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FS441

S/F Food; vegetables, fruits

Final report: Assistance to canned food factories

C/F Romania

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ABSTRACT

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In fulfillment of UNIDO Contract 72/26, FMC undertook a study and made recommendations concerning an industrial development project for the rehabilitation of the canned food factories, Zagna Vadeni and 11 Junei, Dej.

The project took into account all the factors that lead to a complete agro-industrial development program including: plant design; location of plant sites to protect them from future flood damage; survey and analysis of salvageable materials from the existing plants for inclusion in new facilities; product markets; production factors affecting raw material supplies; and overall economic feasibility.

As a result of this study and after consideration of alternatives, an agro-industrial system was recommended.

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INTRODUCTION

INTRODUCTION

Agro-industrial development entails the vertical integration of the complete food production process from the field to the final consumer. To establish such a system three main steps are followed:

1. To develop and research markets, both local and international. These markets will differ and be limited by factors such as purchasing power, acceptance of product, distances of production and distribution, and climatic conditions.

2. The second problem that faces a new agro-industrial development system is the supply of adequate raw material. A modern up-to-date system needs a steady flow of high quality raw material at convenient prices. The individual cooperative production of small farmers in most areas is not the proper source of raw material for an agro-industrial complex.

3. Agro-industrial raw material production and marketing therefore becomes an integral part of food processing in this developing complex.

In general, the planners of the modern agro-industrial combine must essentially be market minded and must thoroughly investigate and analyze the existing and future market demands, both domestically and on world markets, to ascertain which products should be produced to meet this demand. They must then assess which of the products in demand are likely to be the most possible to produce, then investigate the possibility of the large-scale industrial production of the raw materials required for the products in demand. Planners then select the optimum size processing plants which will allow the complete utilization of the raw material to be taken from production to the appropriate markets. The principal criteria for establishing an agro-industrial combine is that it shall provide an acceptable rate of return on the investment required.

In developing a program for the rehabilitation of the canned fruit factories "Zagna Vadeni" and "11 Junei" in Romania, three approaches could be used.

The direction taken will depend upon the level of investment the Organization is willing to consider.

Plan 1. Minimum investment is needed to rehabilitate portions of the line that are completely non-automated. Automated or semi-automated sections would be added to have complete semi-automatic processing lines.

Plan 2. On the second level of investment, all equipment in working condition will be salvaged and moved to a new site. Lines will be reconstructed using this equipment plus new equipment that would be integrated into the lines to form semi-automated high capacity lines. In this plan, supporting technologies of civil engineering will be used to determine a suitable site for the new processing facility to integrate as much as possible with existing production areas and distribution channels.

Plan 3. This plan will involve the complete establishment of an agro-industrial development complex. In this case, supporting technologies of marketing, industrial agricultural production, civil engineering and processing lines will be integrated. The sites will be chosen in conjunction with production areas that have been dictated by the suitability of producing items required by the marketing research conducted.

It is the consensus of the study team that the general parameters for success are favorable no matter which Plan is chosen.

Floods such as occurred in 1970 are of highly infrequent occurrence ("once in one hundred years"), thus are not a primary threat to the plant investment; however, there are some flood related and ancillary factors that favor plant movement as an alternative. However, as discussed above, the selection of alternatives rests with the Organization.

Economic analyses of each Plan and investment required will provide the informational base upon which the Organization can make a decision.

Market studies have indicated directions that, when followed, should provide for a logical and healthy growth as required in Plan III or for relatively static but still successful operations as described in Plans I and II.

The physical parameters–climate, soil and water–are within certain recognized limits, capable of supporting the technologies required for Plan I, II or III.

The existing technological base is well founded and thus able to proceed with Plan I and II or to adopt the new procedures required for Plan III.

Finally, the social parameters, personnel aptitude and attitude, can provide a source of capable management and labor (as long as it is efficiently used) that could bring about any scale of successful agro-industrial development.

OBSERVATIONS

GENERAL OBSERVATIONS

Agriculture is a major sector of Romania's economy, employing over 50 percent of the labor force and contributing about 24 percent of the national income in 1970. Compared with the 12 percent in the industrial growth of the 1960's, the 3 percent gain in agriculture has been modest. Nonetheless, growth in Romanian agriculture has been faster than the average for Eastern European countries. The 1971-75 Five Year Plan calls for a 5.0-5.5 percent growth rate in farm output. In 1968, agriculture received 16 percent of investment: in the 1971-75 Five Year Plan period, it will receive 22 percent of investment.

Historically, Romania has been considered the bread-basket of Europe; today, it could become the supermarket of the area. The range of climate and soils is one of the most diverse in Eastern Europe, and the growing season one of the longest. Annual precipitation averages about 585 mm in the fertile southern plains, and dips below 500 mm in mountainous regions of Moldavia along the Romanian-Soviet border. Recurrent droughts cause considerable yearly fluctuations in crop output. Total land area is approximately 23.8 million hectares, of which 44 percent is arable. The mountainous regions of Transylvania which occupy roughly one-half of the country could be important for pasturage and fruit production.

The two areas being studied are geographically apart and technically different. The plains around the towns of Zagna and Vadeni are very well suited for intensive industrial production of vegetables, while the hilly region around the city of Dej make it very suitable for the production of high quality fruits and some vegetables.

Even though these are major differences, the two plants share quite a few problems:

- the present site of the two processing plants at Zagna Vadeni and Dej are in the flood plains of rivers;
- the sites are too small for new construction without removal of present structures;
- the present structures are in poor condition for the present purposes and if rehabilitated would still be old and generally inadequate;

- the access to the plants is difficult.

In analyzing the possibilities of solving some of the above problems, it was noticed that the rainfall in Dej and run-off patterns in both sites are highly unpredictable because of the geographical positions, especially in relation to the Carpathian Mountains and the prevailing air-mass movements. The flood records show almost annual minor floods and some major floods (like the one in 1970) that have happened at fifty to one hundred year intervals and against which total protection would not be possible.

The construction of dykes for total plant protection would not only interfere with access and egress, but the cost would easily balance the cost involved in establishing the plants at new sites. While it might be possible to protect the plants by local dykes and the basin flood control program, there can be no certainty that they would not be flooded on occasion. Thus it appears that the physical and economic possibilities for river flood control programs, as related to the present problem of plant location, are not pertinent. Therefore, it seems that a study for flood control is not indicated as a necessary part of this immediate project, but could be one of long-range planning for conservation of the river systems of Romania.

ZAGNA VADENI

AGRICULTURAL PRODUCTION

The following section contains the observations of the team agronomist after on-site surveys and discussions with various technical personnel from the area and the Central at Braila and Bucharest. First, the general discussion of the production area will present observations referring to the overall situation of crop, climatic and edaphic factors, and general problem areas. Secondly, specific observations referring to the production of the individual crops will be discussed.

The major crops produced in the area surrounding the processing plant are, of course, those that are needed to supply the plant with the raw material necessary for the type of finished product produced by the plant. The vegetable crops that are produced in larger quantities are tomatoes, peas, green beans, bell peppers (green and red), and cucumbers for pickling. Other vegetables produced in the area are onions, carrots, okra, squash (zuchini), eggplant and potatoes. These latter vegetables, along with some agronomic crops (rice, dried beans), are used in smaller quantities in a mixed end product. Fruits, produced in lesser quantities due to disease ("apoplexy") and climatic problems, are apricots, peaches (freestone), cherries and grapes. A list of trial plantings is presented in the Appendix. Much of the raw material for fruit processing is imported from other districts.

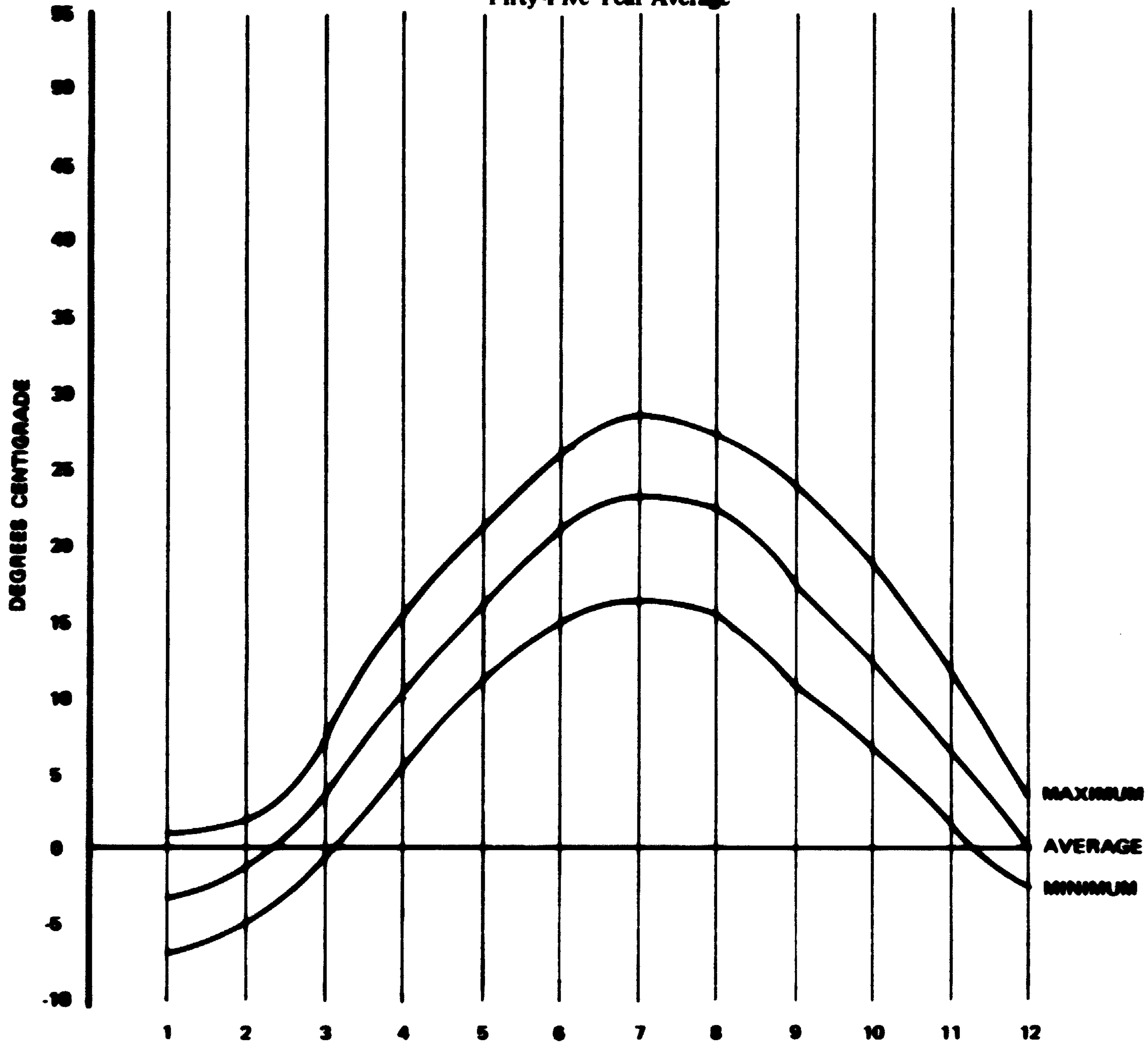
Presently most of the raw material (60-80 percent) is supplied by the State Farm "Dunarea" with the remainder supplied by cooperatives and some land managed directly by the cannery. Present plans call for the cannery to control increased production facilities, up to 8,000 hectares of land, with new irrigation developments.

The general conditions of the production areas are low elevation, heavy alluvial soils, with a high water table (see Appendix) and characterized by a subsurface (18-20 cm) compacted layer. The major climatic patterns are primarily continental with a maritime influence from the Black Sea (Köppen-Gieger classification Cfa, see climatic data for Galati, figure 1 and 2, and Appendix). Annual rainfall is 600 to 700 mm with the driest period occurring from July to September.

Cultural techniques can be classified as semi-mechanized, with heavy tillage and general cultivation carried out through the use of medium-sized ("Universal 400,"

Figure 1
GALATI

Monthly Maximum, Minimum, Average Temperature
Fifty-Five Year Average*

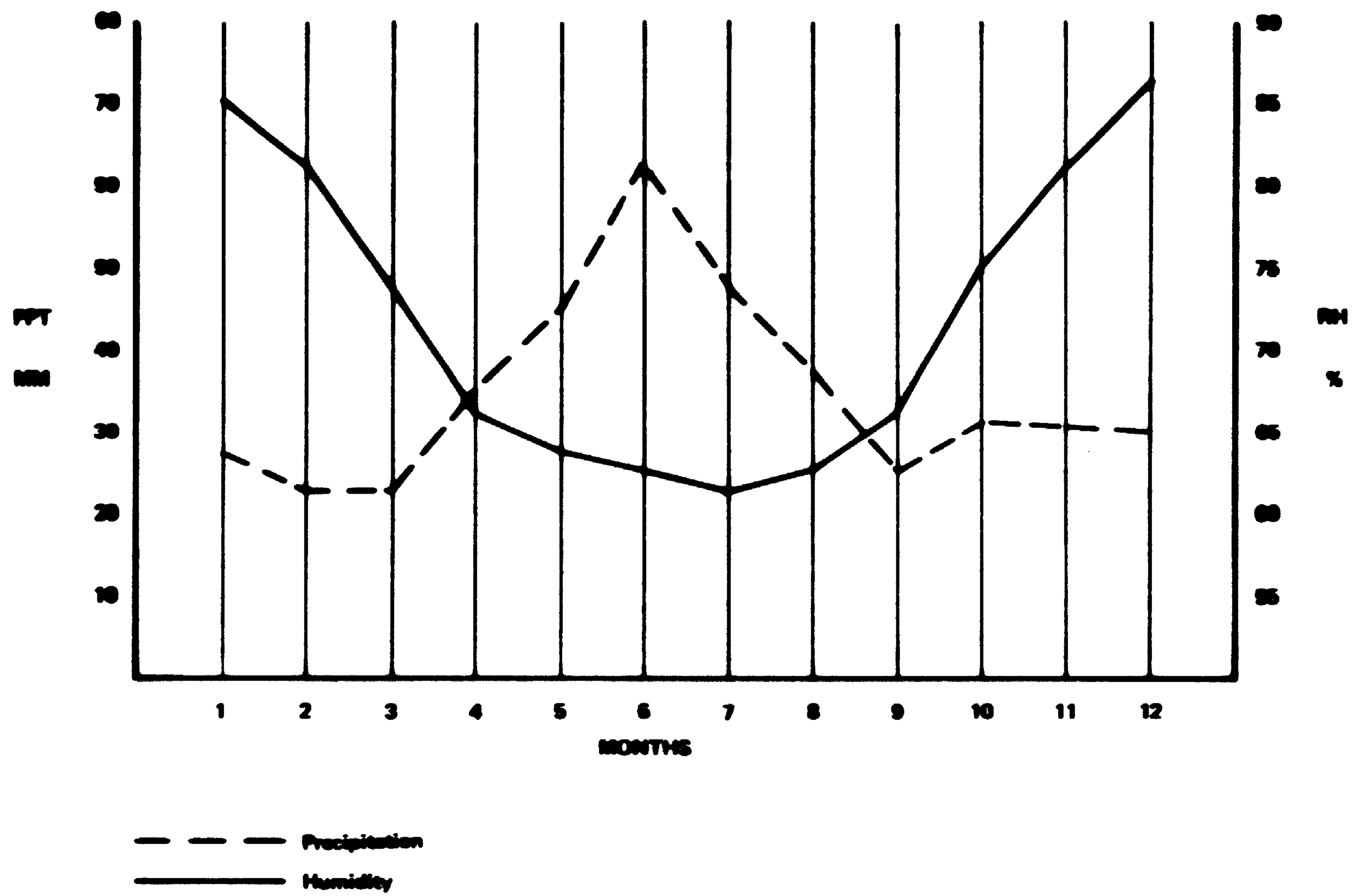


* Courtesy of Institute of Meteorology and Hydrology

Figure 2

GALATI

Monthly Precipitation and Average Relative Humidity
Fifty-Five Year Average*



* Courtesy of Institute of Meteorology and Hydrology

40-60 HP) wheel and track-type tractors. Close cultivation, harvesting and transplanting (tomatoes) are accomplished by manual methods.

Presently, the major production problems of this area are poor drainage and high water table due to the low elevation, although the soil is basically highly productive (see Appendix for soil analyses). The present solution is to abandon these lands to lower income forage crops and shift the production of vegetables and fruit to higher lands. This shift has resulted in problems of damage during transport of the raw materials as the handling methods from field to processing plant are not suited to the longer distances over rough roads.

The final general problem is one of quality control. The quality of raw products for the cannery is not regulated sufficiently to provide for a first quality finished product.

TOMATOES

Varieties

The earliest variety used is a Romanian variety, Arges 1, a general purpose variety of indeterminate growth and small (two locules) round fruit. Midseason varieties are Ace, Campbell 1327, VF-145 B7, VF-145 B8, and Heinz 1370. Late season varieties used are Floradel and Rutgers. The varieties Roma and Red Top are grown for the production of pear shaped tomatoes.

The VF-145 types have produced the highest soluble solids of the round-fruited varieties, reaching 4.5 to 5 percent soluble solids.

Planting

The tomato production season, in the field, is approximately from April 15 to October 1, with earlier plantings in the greenhouse, hot beds or cold frames for starting of transplants. (Greenhouse production was omitted from this report as it is concerned with fresh market production and not processing.) Some direct seeding is carried out with the later season, determinate varieties (VF-145 and Heinz varieties).

Planting is on slightly raised (10-12 cm) beds approximately 1.6 m center to center. The rows are single or double (25-35 cm apart).

Fertilization

Exact fertilizer rates of application were not available, however soil analysis (see Appendix) indicates low P_2O_5 and K_2O content and tendency to high sodium, reflecting the drainage problems.

Fertilization is usually carried out by a broadcast application of a complete (N-P-K) analysis fertilizer prior to planting with one to three nitrogen topdressings at various stages of growth (18-20 cm height, first bloom and one month prior to harvest). A starter fertilizer may be used with transplanting.

Weed Control–Cultivation

Some chemical weed control with the chemical diphenamid, preplant, is used as well as treflan before transplanting. Primary weed control and close cultivation is done manually (hoe) with interrow cultivation carried out with the use of tractor drawn implements (sweeps, knives, etc.).

Irrigation

Irrigation is generally carried out by the use of sprinklers with some surface (furrow) irrigation. Irrigation is employed in most of the vegetables for processing and is applied to supplement natural rainfall (see figure 2). Therefore, no rigid irrigation schedule exists and many of the systems are of small capacity (total area covered) but of high application rate (greater than 15 mm per hour).

Disease, Pest and Pathogenic Conditions

Alternaria solani is perhaps the major disease affecting tomatoes but other diseases known to occur are: *Phytophthora infestans, Septoria lycopersici, Corynebacterium michiganense, Pseudomonas tomato, Xanthomonas vesicatoria, Pyrenochaeta lycopersici, Cladosporium fulvum, Pyrenochaeta terrestris,* Stolbur virus, *Verticillium alboatrum* and *Fusarium oxysporum.*

Control measures applied against foliar diseases are Fine (2 percent), Artecid (2 percent) and Dithane (2 percent). These measures are generally adequate against foliar fungi (*Alternaria, Phytophthora, Septoria, Cladosporum*) but do not give as good control against the bacterial diseases. The VF varieties exhibited typical resistance to *Verticillium* and*Fusarium.*

The major insect pests are *Leptinotarsa decemlineata* and various Noctuidae larvae. These insects are adequately controlled by organophosphate sprays.

Harvest

Average yields are about 40 metric tons per hectare. Harvesting is done by hand—the laborers pick into small field containers which are emptied into field trailers. The trailers (about 12 metric ton capacity) transport the tomatoes to the cannery (average of 35 kilometers distance, 30 percent of which is on unimproved roads). The tomatoes are reloaded at the factory into metal bins (approximately 1 X .7 X .7 meters with drop bottom). These bins are used to elevate the tomatoes into the flume at the processing plant. Approximately 30 percent of the tomatoes received at the cannery are unusable and an average cost for one kilogram of tomatoes is 60 Bani, although a higher price is paid for early tomatoes and a lower price is paid for late tomatoes. The price is fixed by government order in a preseason contract. A reject clause is included in the contract.

Presently, 50 percent (3000 metric tons) of the tomatoes used by the plant at Zagna Vadeni are supplied by State Farm "Dunarea", with the remainder from cooperatives and processor controlled lands. The harvest season is approximately 75 days, from July 15 to October 1.

PEAS

Varieties

Varieties of peas used in the Braila area are Pilot, D'Anouse, Fine Green, Delicious and Gullivert. The variety Pilot is an early (60 day) and wrinkled-seeded variety. Gullivert is a small-seeded pea with high quality for canning. Delicious is a medium to late season variety (76 days) with large seeds. These and the other varieties are of growth and pea size that do not lend themselves well to mechanical harvesting or uniform quality.

Planting

Planting is done on the flat, using seed drills such as those used for wheat. The attempt is made to reach a viable population of from 600,000 to 1,000,000 plants per acre and thus the seeding rate is adjusted according to the number of seeds per kilogram and germination percentage of the seed. The production season is from mid or late March (15-25) until mid or late June. Staggering of harvest is done by planting varieties of different maturity lengths, in a relatively short period of time.

Fertilization

Exact fertilizer rates were not available but approximate rates are 100 kilograms N per hectare, 60 kilograms P_2O_5 per hectare and 50 kilograms K_2O per hectare. Sample soil analyses are presented in the Appendix and indicate low P_2O_5 and K_2O content.

Weed Control–Cultivation

The most common chemical weed control method is trifluralin (2-3.5 kg per hectare) applied with low volume, low pressure boom sprayers and incorporated with a harrow.

Pre-emergence application of contact herbicides (DNBP) are also used.

General weeds in this area are members of the Chenopodium, Amaranthus, Polygonum, Brassica and grass species and can be effectively controlled by the above mentioned materials if properly applied and incorporated. However, in some fields complete weed control was not achieved.

Cultivation after emergence is not practiced extensively. Soil condition indicated that deep tillage prior to planting was not practiced. This may have been due to the generally high water table.

Irrigation

Irrigation for peas is generally not practiced except during occasional droughts. Rainfall patterns indicate that irrigation is not usually necessary.

Disease, Pest and Pathogenic Conditions

Diseases known to occur in this area are *Mycosphaerella pinodes, Ascochyta pisi, Ascochyta pinodella, Peronospora pisi* and *Erysiphe polygoni.* No major problems were reported with regard to these diseases.

Harvest

Harvest is carried out by cutting in the field with a swather, loading the cut vines onto wagons and transporting to stationary viners where the peas are shelled. The shelled peas are then transported to the processing plant. Average distance from the field to the viner is about 15-20 kilometers and from the viner to the plant is about 3-5 kilometers. Average yields are about 2.0 to 3.0 metric tons per hectare. Harvesting is carried out at a tenderometer reading in excess of 160 as it is felt that a higher starch content in canned peas is desired by the market.

Forty percent of the peas used by the cannery at Zagna Vadeni are from the State Farm "Dunarea."

GREEN BEANS

Varieties

Green bean varieties grown for canning are Harvester, D'Arovit and Preludi. These varieties are bush type and used for their production of cylindrical, straight (15 cm X 1 cm) and well-colored pods, although the largest sized pods are used for cut beans. Harvester is produced in the greatest area and is usually the earliest maturing. The production season for these varieties is from April 15 to July 15.

Planting

Planting is conducted on flat culture or slightly raised (6-8 cm) beds with one or two seed lines 12 cm apart in rows 35-60 cm apart. Seeding rates are adjusted according to seed size and germination percentage in order to obtain 20 to 30 plants per meter of row. Since the beans are harvested by hand and multiple pickings are carried out, little attention is paid to a precise planting schedule.

Fertilization

Fertilizer practices are similar to those for peas.

Weed Control–Cultivation

Chemical weed control (when used) is with trifluralin and DNBP. As with peas, these materials give good control of Chenopodium, Amaranthus and Echinochoa species when well applied and/or incorporated. However Brassica species and *Hibiscus trionum* are resistant to trifluralin alone.

Cultivation between the rows is by standard tractor drawn implements (sweeps and knives) and is generally satisfactory although not precise.

Irrigation

Irrigation is not a standard practice as natural precipitation occurs throughout the production season (see figure 2).

Disease, Pest and Pathogenic Conditions

Bean diseases known to occur in this area are *Xanthomonas phaseoli, Fusarium solani* sp. *phaseoli, Pseudomonas phaselicola* and *Rhizoctonia solani*.

No field measures are generally taken against these diseases.

Harvest

Harvest is by hand and usually three pickings are carried out. Average yields are from 5 to 8 tons per hectare with the beans graded into various sizes at the processing plant. The harvest season is approximately June 10 to July 15. The beans are picked into field containers which are loaded onto trailers and then transported to the cannery. Average transport distance is 30 kilometers.

MISCELLANEOUS CROPS

Peppers

Pepper varieties in use are of the red and green bell pepper types. These varieties are used by the processing plant for mixing with other products, canning whole or stuffed with meat and rice and then canned.

Peppers are transplanted or direct seeded in the flat or on slightly raised (6-8 cm) beds in rows 50 cm apart. The pepper production season is from April 15 to October 1.

General cultural techniques are similar to tomatoes.

Major insect and disease pests of peppers are *Chloridea obsoleta, Gryllotalpa gryllotalpa, Myrodes persicae, Tetranychus onticae, Limax agrestis, Leveillula taurica, Fusarium* and *Verticillium* Spp.

Cucumbers

The major cucumber variety is Cornishon du Paris which produces the largest percent of the most desired size fruit (6-9 cm). The production season is late April to early July and average yields are 15 tons per hectare with four to five pickings. Production is on raised beds, similar to tomatoes, 1.5 to 1.6 meters wide with single seed lines and about three to four plants per meter.

Major insect and disease pests are *Cerosipha gossypii, Tetranychus urticae, Doralis fabae, Limax agrestis, Phytomyza atricornes, Erysiphe cicoracearum, Sphaerotheca fuliginea, Colletotricum lagenarium, Fusarium* Spp. and *Pseudoperonospora cubensis.*

Other Vegetables and Fruits

Other crops grown in the area and used in some quantity by the plant are onions, potatoes, carrots, strawberries, apricots, plums, grapes, walnuts, peaches and quinces. The vegetable crops (including strawberries) are grown in rows on slightly raised beds again much like tomatoes. Precise yield and production data is not available although the area is suited to the production of these crops. The tree crops are not produced on extensive areas, much of the supply coming from small plantings. Cherry supplies are largely imported from other areas. Test plantings of apricots and peaches have been somewhat successful, although disease problems (apoplexy of apricots—cause unknown) and low winter temperatures (see figure 1) have slowed the progress of such trials.

Meats

The meat supply for the off season canning of pork and beef canned alone, and for mixtures with vegetables (pork and beans), is from locally slaughtered animals in small quantities.

Agronomic Crops

The source of these crops (rice, dried beans) is purchases from the surrounding state farms and cooperatives.

PROCESSING PLANT

This plant consists of two main sections, each section having its own building. Both sections use one common power supply, and also a common area for the storage of finished material.

The plant started on a very small scale twenty years ago and in 1952 production was approximately 100 tons of tomato paste. Since then the plant has been added to many times. Today it processes not only tomato paste and juice in the tomato section, but it also packs many types of vegetables in both cans and glass jars.

None of the lines are completely mechanized, and most of them are not mechanized at all. The tomato paste and juice lines are more complete than the other lines. But even these lines have nothing workable to handle the raw product and the finished canned product is handled entirely by hand.

Each line will be described separately, commenting on different pieces of equipment.

TOMATO LINES

Tomato Paste

Tito Manzini, Installed 1950. This is an old Italian bowl system to make tomato paste and pack it in wooden barrels. The line is complete from dumping, chopping, pulping, finishing, holding tank, six bowls, one condenser, through three vacuum pumps.

This is a very old line and cannot be moved. It has been patched and repaired many times. Left in its present location it can be used, but it very badly needs a complete overhaul job. Most of the vacuum pans are eaten out around the product discharge valves and all three vacuum pumps are in a poor condition. The pulpers and finishers require all new screens, bearings and paddles. The holding tank could never be moved due to the fact it is flush mounted and cemented in the floor. All six vacuum pans are installed on a mezzanine floor and cemented in place. The filling operation is completely manual underneath this mezzanine floor; the pans are gravity drained directly into the barrels. The line capacity is 2,725 kilos of water evaporated per hour.

Tito Manzini, Installed 1963. This line is complete from dumping, inspection, chopping, heating, pulping, finishing, holding, evaporating, through filling into 1/10 liter cans. The first part of this line, dumping and inspection and chopping, could be used if left in its present location; however, all parts are badly worn and rusted. The double effect evaporator consists of one vertical column and has a capacity of 4,500 kilos of water evaporated per hour. It seems to be in very good condition. The first effect is stacked directly over the second effect. As the raw juice enters the first effect, it is heated by vapors from the second effect. Circulation is by thermo-syphon. Product is discharged into the second effect and heating is accomplished by steam into swept surface heating coils. Finished product is pulled off after the main circulation pump and the paste is packed directly into barrels. There were three Manzini horizontal, piston-type fillers for 1/10 liter cans that were purchased with this unit.

Rossi Catelli, Purchased 1969. This is a complete line from dumping, inspection, chopping, heating, pulping, finishing, holding, evaporating, through filling.

After the chopper, there is a shell and tube heat exchanger. This heat exchanger is in excellent condition, however, it will only handle eight tons of tomatoes per hour. Following the heat exchanger is a pulper and two finishers. The pulper is 58.5 cm in diameter and 100 cm long. It has a 1 cm screen. This product discharges into two finishers, each 35 cm in diameter and 68.5 cm long with a .020 screen. After the pulpers, juice is held in several stainless steel tanks, 760 liters capacity.

The juice is then fed into a double effect, Heinz-type Rossi Catelli double effect evaporator, one vertical column, the first effect being directly over the second effect. The circulating pump is powered by a steam turbine. Vapors from the second effect are pulled off and heat the incoming juice in a shell and tube heat exchanger for the first effect. Steam from the turbine heats the product going into the second effect, also a shell and tube. Product is removed at the main circulation pump through a 5 cm Moyno PD pump and passed through two Rossi Catelli swept surface heat exchangers to bring the product to filling temperature. Filling is by two Rossi Catelli air operated tomato paste fillers, one for 5 kilo cans, the other for 1/2 kilo cans. (Change parts for one kilo cans are available.)

When filling tomato paste into 1/10 liter cans, the product from the Rossi Catelli evaporator is pumped to an older shell and the tube Tito Manzini heat exchanger where the temperature is raised to filling temperature and filled into 1/10 liter cans by three horizontal, piston type, Tito Manzini fillers. These three fillers, plus the shell and tube after heat exchanger, were purchased in 1963, at the same time as the Tito Manzini double effect evaporator. Since the purchase of the new Rossi Catelli line, all tomato paste that is put into cans comes from the Rossi Catelli evaporator. There are five seamers in the tomato paste section:

- Two double Gloria B Italian seamers, purchased in 1963.
- One double Gloria B Italian seamer for the 1/2 kilo can, purchased in 1969.
- One Russian seamer (Mpoamaw), brand new, never used, purchased this year for seaming one kilo cans. This seamer is good for speeds up to 80 cans per minute. The seaming chucks are similar in design to an Angelus; however, they have a very poor system for adjusting the rolls and the lid feed mechanism is of very poor design.
- One Nina No. 52 Single Head for seaming the 5 kilo can that is in excellent condition, purchased new in 1969.

All of these seamers can be reused for tomato paste, with the exception of the two Gloria B Double Head seamers that were purchased in 1963.

Cooling

For cooling the 5 kilo cans, there is a cooler built in Romania in 1969 and copied from the old Chisholm-Ryder type cooler. At the present time, all 5 kilo cans are being hand cooled outside with a hose.

All other can sizes are cooled in a Bertucci draper cooler. This cooler is 1.73 m wide and 1.20 m long. The draper is made up of stainless steel slats, 5 cm wide, attached to heavy duty extended pitch roller chain on both sides.

Tomato Juice

This is a completely separate line that will handle an input of approximately 8 tons per hour. The line is made up of a standard Tito Manzini dump and inspection table. It has the standard Manzini chopper mounted as an integral part of the table at its discharge end.

Juice then passes through a swept surface Manzini heat exchanger and into a small holding tank. It is then pumped through one of two small type screw extractors, very similar to the FMC No. 35. One is a Bertucci, and the other a Manzini. After these small screw extractors, the juice is pumped into one of three small 175 liters holding tanks, where the juice is pulled by vacuum into a deaerator (no manufacturer's name). From this deaerator, juice passes through either an APV heat exchanger or a DeLaval, then to a holding tank, which is elevated and feeds a bottle filler by gravity. Ahead of the bottle filler and capper is a bottle washer built by Graham Enock Ltd. under license from Crown, Cork and Seal. The bottles leave the washer and are automatically fed to a filler and capper. This is a seventeen valve filler and has a seven station capper. This unit is also built by Graham Enock Ltd. under license from Crown, Cork and Seal. From this filler-capper, the bottles are hand fed into a large draper sterilizer/cooler.

FRUIT AND VEGETABLE CANNING PLANT

Green Peas

The green pea line actually begins about a mile from the plant with a stationary viner. Here, the peas are collected in aluminum dish pans and trucked to the plant.

At the plant, the peas are hand dumped into one of two large stainless steel bins containing recirculated water. The bins are V-bottom and pitched. They are approximately 1.80 m wide and 5.5 m long inside. Peas are flumed out one end of this tank through a 9 cm pipe and into a collecting basin from which they are pumped up approximately 6.1 m to a rotating water separator which discharges the peas into a reel type hull separator. The reel, or drum type separator, is one meter in diameter and 3 m long. Peas to be processed fall through and pods are discharged out the end.

Good peas are collected in the bottom pan and flumed to a six size rotating reel type sizer, similar to the IMC pea sizer. Directly under each sizing section is a collecting bin for each of the six sizes. Peas are discharged from one of these bins and into a flume running the length of the sizer. Peas are transferred from the end of this flume by means of a hydraulic elevator into another rotating water separator located at the infeed of the blancher. The blanchers are quite old and not center tube type. The shells have rusted through in several places. From the blanchers, the peas are discharged into a water bath cooler, then onto a shaker type water separator and particle remover. Good peas are discharged onto the inspection belt and the water and particles are discharged into a small drum cleaning screen. Water is recycled into the cooler, hulls and particles are discharged into a box. Up to this point there are two identical lines.

One of these inspection belts is 60 cm wide and 4.6 m long. This belt discharges into a gooseneck elevator which elevates the peas approximately 4.6 m from the floor level and discharges them into a holding bin which is in the form of a double hopper. From one side of this double hopper, peas are fed into an IMC fifteen valve filler/briner which is connected to an IMC 550HCM seamer, purchased in 1963 (serial number 329). From the seamer canned peas are transported on a table top chain, 5.5 m long, from which they are hand packed into retort baskets.

From the other side of the double hopper mentioned in the preceding paragraph, which feeds the IMC pea filler/briner, excess peas are returned to the floor level by means of a 20 cm diameter pipe where they are collected in dishpans, later to be hand packed into cans or jars. Blanched peas from the other identical line are discharged from the inspection belt into dishpans which are stored on the floor, later to be hand packed into cans or glass jars.

Besides the filler/briner combination, there are three other hand pack lines from which peas and other products can be hand packed into cans. The three hand pack tables for cans that are used for peas and other products are approximately 7 m long. There is a 18 cm table top chain running the length of the table and extending beyond the table on the discharge end, into the feed mechanism of three different seamers. One of the lines is set up for 1/2 kilo cans, the other two lines are set up for one kilo cans. On the tables, 15 cm below the level of the table top chain and on both sides of it, is a stainless steel shelf, 30 cm wide, upon which is placed dishpans full of peas. Cans are hand packed from these dishpans and placed on the table top chain. Just prior to the cans entering the seamer, they are brined manually with a rubber hose. Excess brine runs on the floor. After seaming, the cans are discharged onto a flat, steel plate approximately 92 cm square. From this plate, the cans are hand placed into one or more retort baskets. The three seamers that are used are:

Lubeca seamer, 1/2 kilo can size, 128 cans per minute speed, purchased in 1966.

Russian Mpaomaw seamer, 1 kilo can size, 90 cans per minute speed, purchased in 1971.

IMC 252 seamer (serial number 437), 120 cans per minute speed, purchased in 1967.

Green Beans

Green beans are received from the field in wooden boxes. The boxes are fabricated from extremely lightweight wood and measure 40 cm wide, 60 cm long and 32 cm deep. Beans are hand fed into a bank of fifteen bar graders. These fifteen bar graders discharge directly into fifteen snippers. The snippers are arranged in three banks of four and one bank of three, each group discharging onto a take-away conveyor, which in turn discharges into another bar-type grader, one grader per bank of machines. These last four graders discharge into large, aluminum dishpans, which are stacked in piles in the immediate area.

This primary operation takes place in a covered area, approximately 250 m from the main canning plant. From this area, the dishpans are trucked to the main plant as required.

If peas are not being packed then green beans are blanched in the pea blanchers. They are fed into the blancher by means of an auxiliary gooseneck elevator. If peas are being processed at the time green beans are received, the green beans are blanched in open steam jacketed kettles. In either case, after blanching they are immediately put back into dishpans. In the case of cut string beans, there are two green bean cutters which are Romanian copies of the Urschel machines. So far, this plant does not pack any French-cut or bias-cut beans. These cutters are mounted directly over the gooseneck elevators which discharge into the blanchers. There are no nubbin separators or sizers used on the line. After blanching, the beans are stored in dishpans. These dishpans are hand carried to the hand pack canning tables, both glass and cans. If the beans are to be packed in cans, they are canned on the same table, in the same way as peas. If they are canned in glass jars, the arrangement of the hand pack tables is slightly different. The tables for hand packing jars are approximately the same length as those for hand packing cans. However, instead of having one straight table top chain running down the center of the table, there is an endless merry-go-round type table top chain that turns corners. This chain runs back and forth across the top of the table. This chain is always kept full of empty jars. As the hand packers require jars for hand filling, they are removed from this chain, filled with product, and returned to the same chain. As filled jars pass the discharge end of the table, they are lifted from this chain by hand and placed on the infeed of the capping machine. Another person standing along this infeed belt to the capper brines the jars with a rubber hose or tin cup as they pass by Here, again, all excess brine merely runs on the floor.

Due to the fact that in Romania all jar caps are of the compression-type pry-off lids, the cappers are very simple. Most of them are hand operated. In operation a lid is placed on top of the jar, transferred under the compression chuck. The operator merely pulls down the handle which clinches the lid to the jar. There are two motorized units, but with the exception of the motor, the capper is a very simple affair. After capping, the jars are manually placed in retort baskets.

Along one wall of this main canning room, there are ten steam jacketed tilting-type steam kettles. These are approximately 285 liter size kettles. These kettles are used for many things: blanching many special products, including beans; preparing special tomato sauces which are added to different packs of green peas, green beans, peppers, etc., instead of brine; lye peeling of certain products; whole peeling of certain products, such as tomatoes.

Cook Room

Cooking for all products is done in vertical retorts. In the main canning room, there are seventeen retorts all arranged in line controlled from overhead by an operator in a control room. At one time, these retorts were very well controlled. However, due to poor maintenance, they no longer operate automatically. All temperatures are recorded automatically, but length of cooking and cooling is done manually.

All retorts are 1.67 m deep and will take a 91.5 cm diameter basket.

All baskets are 91.5 cm in diameter. However, they have two different heights: one is 66 cm high, and the other is 91.5 cm high. All cooling is done in the retort. All retort baskets are hand trucked from the seamers to the retorts and, again, from the retorts to a holding area. In this holding area, retort baskets containing different types of product are marked. They are transferred by mark by means of a forklift from this holding area to different parts of the warehouse depending, of course, on the product. Upon arrival to its designated area, the baskets are manually unpacked and all cans are hand stacked in piles 3 m wide, 9 m long and 3 m high.

With the exception of bean snippers, blanchers, seamers, and forklifts, the entire operation is manual. There is not one conveyor belt, or even a cart to transport the dishpans from one location to the other. Even the moving of the filled retort basket is completely manual, with the exception that the mover does have three wheels. In the case of labeling, this also is mostly done by hand. There is one labeler, but the quality of labels and the labeling machine itself is poor.

Cherries

Both sweet and sour cherries are received in small wooden field boxes. These are dumped by hand on two semi-automatic stemmers. Cherries discharge over the end of the stemmer and into a rotating drum sizer. Under the sizer, the different sizes are collected in dishpans. These dishpans are moved manually to the hand packing tables in the jam room to be hand packed into glass jars or cans. Cherries are not pitted. The cans or jars are lidded or seamed after syruping and hand placed in retort baskets.

This cherry and jam department is isolated from the rest of the cannery, although it is in the same building. There are five steam jacketed, tilt-type open kettles for the cooking of different jams and also for the preparation of different syrups. They also have five retorts. These retorts are the same diameter as the seventeen in the main cannery. They will accommodate a 91.5 cm diameter retort basket. However, they are not as deep; they will only take one basket, 91.5 cm by 91.5 cm.

After retorting, the baskets are handled in much the same manner as they are in the main cannery.

Cherry Jam

When preparing cherry jam from both sweet and sour cherries, the incoming fruit arrives the same as when packing whole cherries with pits. The cherries are first passed over the destemmer, then the sizer. Cherries are carried to two locally built cherry pitters in dishpans, hand fed into these pitters, and discharged on the backside into other dishpans. Pitted cherries in dishpans are then carried to hand pitting tables, where they are completely reworked due to the extremely poor pitting job of the cherry pitters.

After all pits have been removed from the cherries, be they sweet or sour, they are transferred by dishpan to one or more of the open top steam jacketed, tilting-type kettles where sugar and a small amount of pectin is added, and the jam is cooked down at atmosphere. After cooking, the cherries are dumped into push-type stainless steel gondola cars and hand packed into glass jars by tin cups at one of the hand pack canning tables. In the case of the sweet cherries, the pH is adjusted just prior to transfer from the kettles to the gondola cars.

After filling into glass jars, the cans are hand capped, hand placed in retort baskets and heated in the retorts. However, this is an atmospheric operation. After removal from the retorts, they are transferred by hand to a special enclosed portion of the warehouse where they are hand stacked.

Boilers

There are four boilers installed at this plant, two of which are quite small, producing 5 metric tons per hour each. There is one other boiler which produces 8.4 metric tons per hour.

These four boilers give a total capacity of 23.4 metric tons per hour of steam.

CIVIL ENGINEERING

GENERAL FACTORS

The processing plant Zagna Vadeni is located in an area bounded on the north by the Siretul River, on the east by the Dunarea, and on the west and south by the Braila-Galati Road. The plant site itself is located in the center of the old production area which supplied the raw product. Production is currently moving away from the present plant site toward Traian, due to soil drainage problems. One side of the triangle bounding the site is composed of the railroad line, another side is the access road leading to the plant which dead-ends at the plant itself, and the third side is composed of low and boggy area. In addition, the present structures are in poor condition. There are six buildings housing various components of the processing plant which makes for a spread-out, non-consolidated processing area.

The present location of the Zagna Vadeni plant places it on the flood plain of both the Siretul and Dunarea Rivers. Due to the location of the Carpathian Mountains in relation to the headwaters of the Siretul River flooding problems would seem to be annual. Rainfall and runoff patterns for the area are highly unpredictable and records show almost annual flooding, some minor, some major, such as the 1970 flood (see Appendix Isohyet maps). Against the latter, total protection would not be feasible in this particular site. Any attempt to establish dykes for plant protection would first of all interfere with transportation into the plant. The land surrounding the plant site in Zagna Vadeni is extremely marshy and construction costs would be such that they would easily exceed the cost involved in establishing at a new site. The area in which the plant stands is already saturated and it takes only moderate additional amounts of water to cause damage. Studies are currently being undertaken by local experts to determine an appropriate new site for the plant facilities. Discussion of this will be presented in the Recommendations Section.

UTILITIES

Adequate supply of electric power is extremely important to a processing facility, and observation indicates that utility problems for this area are minimal. The Romanian integrated transmission system seems more than adequate to cover most possible outages.

The supply of fuel oil appears adequate.

WATER

The water used in the condensers at the plant is drawn from the river. Potable water is drawn from local wells. Discharge waste water is run out of the plant back into the fields.

The quantity of water available appears more than adequate and the quality after normal treatment is quite satisfactory (see Appendix).

At present, sewage treatment facilities are unavailable.

DRAINAGE AND SOIL STRUCTURE

The area surrounding the processing plant is poorly drained as indicated by the presence of standing water around the area. Any attempt at expansion or modification at the present site would be difficult in that the soil is extremely unstable as a result of this poor drainage and loading capacity may be low.

BUILDING MATERIALS

Construction prices in Romania are fixed by the Government, and there are no private contractors. Under the Romanian system, cost figures for each operation are fixed and it is the responsibility of the "force account" manager to make sure the work is done at the cost indicated. The cost of completed structures with all utility and mechanical connections without processing machinery are estimated at 1,200 lei per square meter.

Structures are adequate but less refined in finish. The pre-fab pre-stress method is utilized for construction.

LABOR

Observation by local experts indicate that labor availability is becoming a problem due to the current location of the plant. It is necessary for workers to ride a train approximately 30 kilometers to reach the plant site which is isolated from population centers and general transportation. In addition, health conditions due to the standing water and marshy condition of the surrounding area may be called into question. Evidently there has been a decline in labor availability over the past years.

TRANSPORTATION

Raw product is transported into the plant on trucks over a poorly surfaced road leading from the production areas. This road is the only way in and out of the plant which means that during high season it becomes extremely crowded with loaded and unloaded trucks attempting to use the same narrow road. In addition, the road into the plant crosses the railroad. This causes delay when the trucks must wait for passage of trains either on the way to the plant or when returning to the field.

The processed product is moved out of the plant to the railroad spur and on to the main line which provides for extremely good outward movement of product.

11 JUNEI

AGRICULTURAL PRODUCTION

The following section contains the observations of the team agronomist after on-site surveys and discussions with various technical personnel from the area and the Central at Cluj. First the general discussion of the production area will present observations referring to the overall situation of crop, climatic and edaphic factors and general problem areas. Secondly, specific observations referring to the production of the individual crops will be discussed.

The crops produced in the Dej area for processing at the 11 Junei plant are strawberries, cherries (sweet and Morello), apricots, peaches (75 percent clingstone, 25 percent freestone), plums, pears, apples, wild berries (raspberries), green beans, cucumbers (pickling), tomatoes, bell peppers, carrots and miscellaneous vegetables for mixtures.

The processing plant is located in the city of Dej, near a branch of the Somesul River in Transylvania.

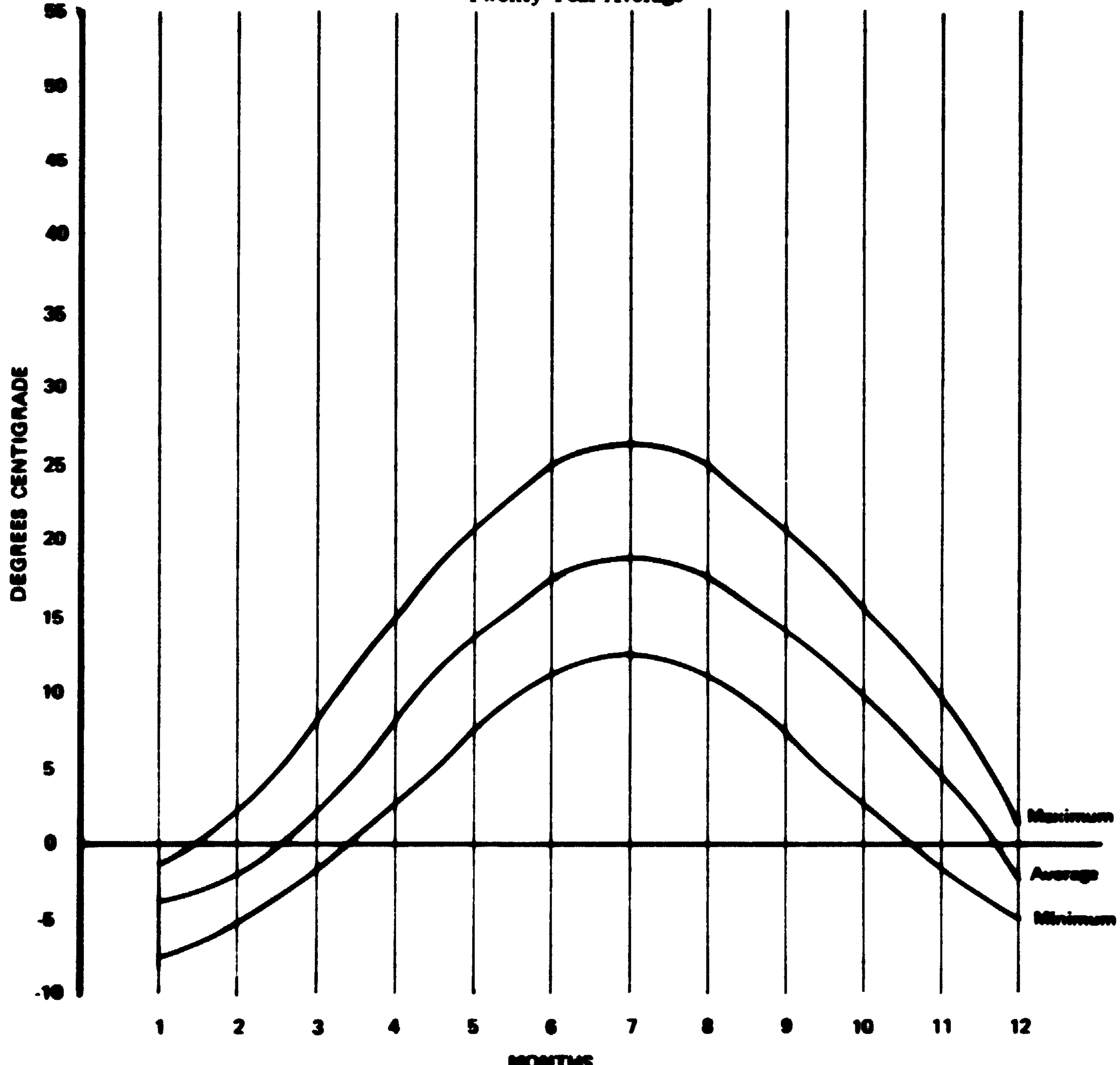
The production areas are in the aluvial fans and foothills of the Lapusulvi range of the Carpathian Mountains. The climate is strongly continental with some alpine influence (Köppen-Geiger classification Dfa). The last spring frost is May 20 and the first fall frost is September 15 (see Figure 3). Annual precipitation is about 800 mm with the heaviest occurring in the spring and summer (April through August, see Figure 4).

Soils are mountain alluvium of a sandy clay loam type. Depth of the A horizon varies from shallow (25-30 cm) in the foothills to deeper in the alluvial fans. Much of the terrain is rolling hills with some rather flat open spaces. Most of the cultivation is shallow, done with light draft (20-30 cm) plows and approximately 40 HP tractors.

Raw material supplies for the cannery often come from isolated "backyard" trees within a 60 kilometer radius, harvest being done by traveling crews. There are, however, some large orchard plantings that belong to state farms in the area.

Figure 3
DEJ

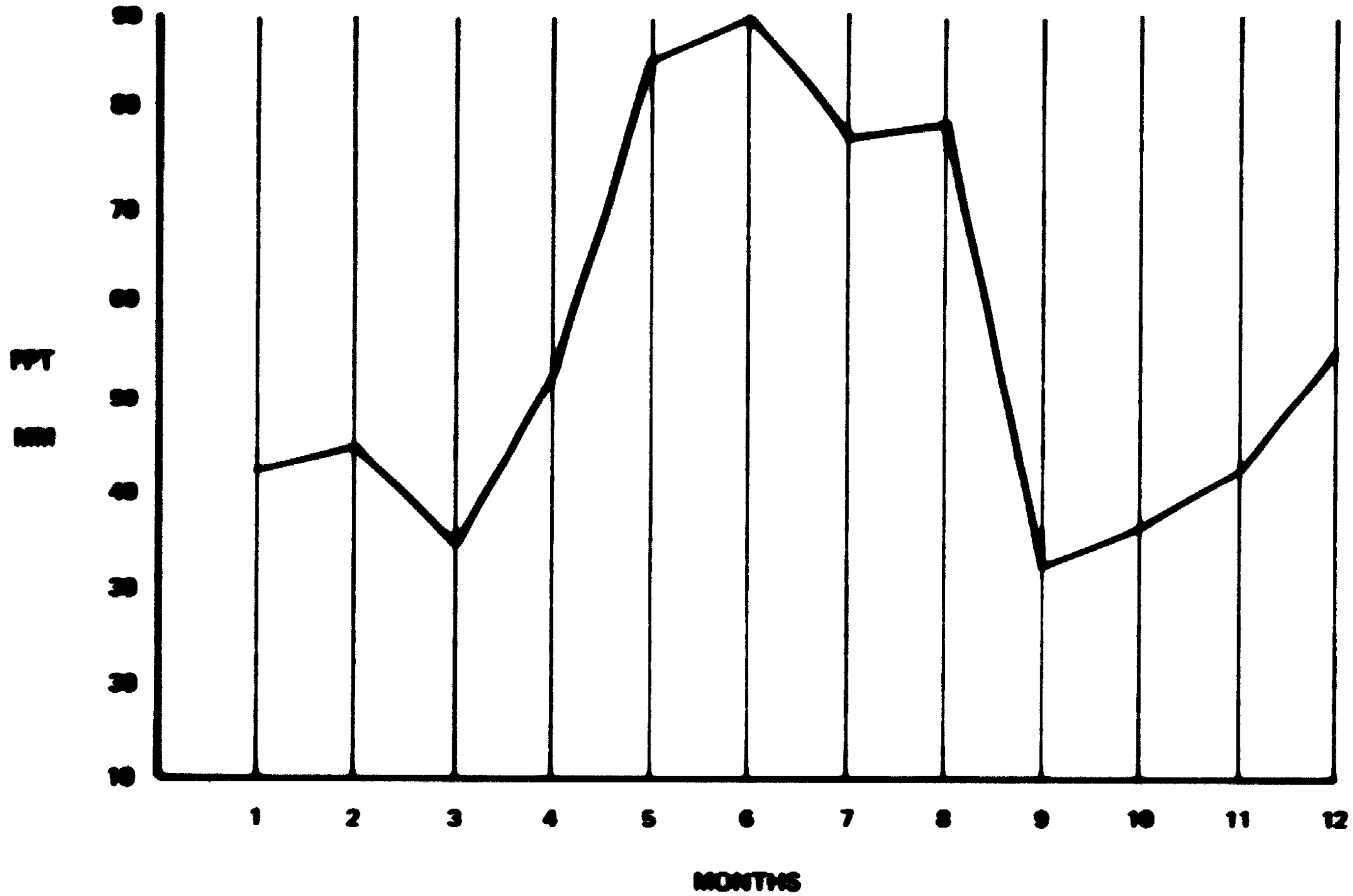
Monthly Maximum, Minimum, Average Temperature
Twenty Year Average*



* Courtesy of Institute of Meteorology and Hydrology

Figure 4
DEJ

Monthly Precipitation
Twenty Year Average*



* Courtesy of Institute of Meteorology and Hydrology

In addition to the existing supplies of fruit, it is felt that the cannery could support 800 hectares of vegetables and 200 hectares are planned to be developed by the cannery and are to be under its direct control. The lack of sufficient labor is a limiting factor in the expansion of this area.

Presently the philosophy of the cannery is to produce a limited amount of high quality product, particularly cherries and green beans.

The present major hindrances to raw material production as observed by the team agronomist is the lack of uniform quality and supply as caused by the scattered, individual sources, the lack of adequate raw material handling systems, and the lack of sufficient labor (although this can more correctly be considered a problem of efficient labor use).

FRUIT

Table 1 is a list of the fruit varieties found in the Dej area. There is little detail available with regard to the cultivation of these trees as most are in small plots and any cultural techniques applied are not uniform or significant. Also, no general propagation program is in use. Sample soil analysis of a fruit producing area indicates low P_2O_5 and K_2O content and tendency to high salt accumulation (see Appendix).

Table 1

Fruit Varieties Grown in Dej Area

Fruit Type	Variety	Yield/Tree	Trees/Hectare (Calculated)	Season
Cherries	Hedelfingen Germersdorfer	20-25 kg	200	June 20 - July 10
Apricots	Best of Hungary	10 kg	250	July 1 - July 15
Peaches	Hale Elberta	10-15 kg	400	July 20 - September 15
Plum	Vinete Romanesti	15 kg	200-250	August 15 - September 15
Pear	Cure	20-25 kg (Alternate Bearing)	200	August 15 - September 15
Apples	Gustav Durabel Jonathan Sovari Nobil	15-30 kg	150	September 15 - October 10

Major pests are San Jose scale (*Aspidiotus perniciosus*) of apples and pears and codling moth (*Carpocapsa pomonella*). These insects are treated with dormant sprays or organic phosphates although no particular schedule is followed.

Precise information on disease and plant protection was not available due to the scattered nature of the production plots.

(In addition, difficulties with peaches and apricots are encountered due to the low winter temperatures and early frosts and therefore the plant often obtains these from other, warmer areas [80-100 km away].)

Obviously, fruit obtained in such a way is not of uniform quality and much sorting must be done to provide a uniform raw product.

Due to the rolling terrain and scattered nature of the plantings, total harvest mechanization does not appear feasible. Some limited mechanization may be possible, such as limb shakers mounted on small tractors and hand carried catch frames. Powered picking and pruning platforms might also be used.

GREEN BEANS

Varieties

Varieties grown for canning are bush type and used for their production of cylindrical, straight (15 cm by 1 cm) and well colored pods. The largest sized pods are used for cut beans. The varieties are Favorite, Processor and Harvester. The production season for these varieties is June 20 to July 5, although interest was expressed in growing two crops per season and this appears possible.

Planting

Planting is conducted primarily on flat culture with one or two seed lines 12 cm apart in rows 37-60 cm apart. Seeding rates are adjusted according to seed size and germination percentage in order to obtain twenty to thirty plants per meter of row. No scheduling system is used other than planting the earliest variety (Harvester) first.

Fertilization

Fertilizer practices are similar to those used for peas, with approximately 100 kilograms N per hectare, 60 kilograms P_2O_5 per hectare, and 50 kilograms K_2O per hectare applied broadcast preplant. Soil analysis indicates that these applications would be adequate when applied to the new lands with the exception of requiring 10-20 kilograms more P_2O_5 per hectare. Liming to correct high sodium problems may also be necessary (see Appendix).

Weed Control–Cultivation

Chemical weed control (when used) is with trifluralin and DNBP (or Aratit). These materials give good control of Chenopodium, Amaranthus and Echinochloa species when well applied. Brassica and Hibiscus species are resistant to trifluralin alone.

Cultivation between the rows is by standard tractor-drawn implements (sweeps and knives) with interplant cultivation done by hand (hoe).

Irrigation

Irrigation is not used.

Disease, Pest and Pathogenic Conditions

Bean diseases known to occur in this area are *Xanthomonas phaeseoli*, *Fusarium* Spp, *Pseudomonas phaeselicola* and *Rhizoctonia solani*. No field measures are used against these diseases.

Harvest

Harvest is by hand, and usually three pickings are carried out. Average yields are from 5 to 8 tons per hectare with the beans graded into various sizes at the processing plants. Harvest season is approximately June 25 to July 15. The beans are picked into field boxes which are then transported to the cannery. Average transport distance is 25 kilometers.

STRAWBERRIES

Varieties

Varieties used are Madam Moutout and Senga-Sengana. The plants are inspected for virus infection. These varieties are used for their flavor, color and sugar content in producing jam.

Planting

Strawberries are planted in rows with the goal of achieving a population of 60,000 plants per hectare. Planting is done every year.

Cultural Practices

Little information was available on such cultural practices as fertilization, weed control, cultivation and irrigation. The yield estimates (5-8 tons per hectare) indicate good fertilizer and water management practices.

Disease, Pest and Pathogenic Conditions

Major disease problems are viral in nature, such as aster yellow, leaf roll and multiplier. An inspection system exists but is not fully utilized. Other soil, foliar and fruit diseases, such as *Verticillium, Phytophthora, Mycosphaerella, Sphaerotheca, Botrytis, Rhizopus* and *Rhizoctonia* can cause difficulties at times.

Harvest

Harvest is by hand into small field boxes which are transported (15-20 km) to the cannery. The harvest season is from June 15 to June 30.

CUCUMBERS

Varieties

The main cucumber variety grown for pickling is Cornichon du Paris. The size most commonly produced (80 percent) is 6-9 cm. The maximum acceptable size is 12 cm and the minimum size is 3 cm.

Planting

Field culture is similar to tomatoes. Cucumbers are grown on slightly raised (6-7 cm) beds at 1.5 to 1.6 m center to center spacing. There are approximately three to four plants per meter. Planting is done about May 1 and harvest begins about July 10.

Fertilizer

Preplant, broadcast fertilizer is common, however, precise fertilization rates were not available. Soil samples were taken and recommendations based on these are made later in the report.

Weed Control

Chemical weed control is not widely practiced.

Irrigation

Large-scale irrigation systems are not used. The primary method is furrow irrigation to supplement rainfall.

Disease, Pest and Pathogenic Conditions

The primary insect and disease pests of cucumbers are: *Cerosipha gossypii, Tetranychus urticae, Doratis fabae, Limax agrestis, Phytomyze atricoinis, Erysiphe cichorasearum, Sphaerotheca fuliginea, Colletotrichum lagenarium, Fusarium* Spp., *Pseudoperonospora cubensis*. Control methods are organophosphate, dithiocarbamate and heavy metal sprays and dusts.

Harvest

Harvest is by hand; usually four to five pickings are made with an average yield of 15 tons per hectare. The cucumbers are picked into field boxes which are taken to the cannery.

MISCELLANEOUS CROPS

Other crops used for a small volume of products, such as tomatoes, peppers, spinach, carrots and wild berries, are grown in small, market garden plots or harvested from volunteer, wild plants and no major cultural effort is devoted to them with the exception of tomatoes. In this case, the cannery source is second quality and late harvests from the greenhouse and staked fresh market crops.

PROCESSING PLANT

This is a much smaller plant than the one at Zagna Vadeni. It is strictly a fruit and vegetable canning plant, canning mostly green beans, cherries, apricots and peaches (unpeeled), currants, jams, many kinds of fruit concentrates, and cucumbers.

There is also a soft drink line which is in a separate part of the cannery. This soft drink line bottles only cola and has nothing to do with the canning facility.

This plant was also under water during the flood of 1970. However, the flood only lasted about two days, and after the mud was cleaned from the plant it was right back in operation.

GREEN BEANS

Green beans are received at the plant in wooden field boxes measuring 40 cm X 60 cm X 32 cm.

Green beans are hand fed into six bar graders. These six bar graders discharge into six bean snippers, which in turn discharge onto six inspection belts. After inspection, the belts discharge into six more bar graders. The beans are then collected into dishpans and stored in a convenient area until blanching.

Two blanchers are fed by two gooseneck elevators into which the green beans are hand dumped. From the blanchers, the beans are discharged into a rotating water cooler, which discharges into dishpans. The beans are distributed in dishpans along two hand pack, merry-go-round type canning tables. Empty one kilo cans are received by means of a long gravity can run from an elevated mezzanine floor.

The cans are hand packed with green beans and placed on this endless merry-go-round chain in the center of the table. At the discharge end, they are manually removed from the chain and placed on the infeed conveyor of the seamer where they are also brined by hand. There are two German Lubeca seamers, 1 kilo can size, operating at 130 cans per minute. Cans from the seamer discharge onto a stationary steel plate, where they are hand packed into retort baskets.

Cook Room

Along the back wall of the cannery fifteen vertical retorts have been installed, all in one line. These retorts will accommodate a round basket, 91.5 cm in diameter and 94 cm high. The retorts are completely hand operated and handle only one basket each. They have a pressure gauge, a globe valve for steam entering and a valve for incoming water. Cooking is timed with a wrist watch.

SWEET CHERRIES

Due to the fact that there is a large pack of sweet cherries, there is a special preparation line for this fruit. Sweet cherries are hand dumped onto five hand operated stemmers. These five stemmers discharge into one common gooseneck elevator which moves the cherries into a four size drum-type sizer. The four sizes discharge under the drum-type sizer into four separate gooseneck elevators.

These are not used as elevators but are inverted; the inverted buckets full of cherries pass upsidedown through a hot water blanch tank. After blanching, they are discharged into dishpans that are then placed along a hand pack, merry-go-round type canning table. Here the cherries are hand packed into glass jars and placed on the merry-go-round table top chain. At the end of the table, the jars are placed on a short section of table top chain which runs underneath a tank with four discharge pipes all in line. As the jars pass under the pipes, they are filled with syrup. Any excess syrup runs over and down the jars on the outside and into a tank with a pump that returns the unused syrup to the overhead tank. Extra syrup is added to the top tank with a bucket. After syruping, lids are placed on the jars and they move into a semi-automatic capper. Jars are then placed in retort baskets by hand.

SOUR CHERRIES

Sour cherries are hand dumped onto two semi-automatic hand operated stemmers. (All stemmers mentioned in this report are identical.) Cherries discharging from this hand operated stemmer enter a three size drum sizer, where they are caught in dishpans.

These dishpans full of cherries are carried to one of the hand pack, merry-go-round filling tables. Cherries are hand packed into cans, syruped, capped and hand placed into retort baskets. All whole canned sour cherries are canned with pits.

Cherry jam is made by first hand dumping the cherries onto the cherry stemmers and then through a sizer. After the sizer, cherries are caught in dishpans and hand dumped into one of two cherry pitters. Pitted cherries are discharged out the back of the machine and carried to a hand inspection table where they are repitted. After all pits have been removed, the cherries are hand dumped into steam jacketed, tilting open-top kettles and sugar is added. After the cherry solution has cooked down it is dumped into open gondola cars, hand filled into glass containers, hand capped, and manually placed into retort baskets.

FRUIT CONCENTRATE LINE

In a room adjoining the main cannery, there are fifteen steam jacketed, tilting, open-top stainless steel kettles. Many types of fruit and vegetables are cooked in these kettles, one such product being peaches and apricots. After cooking, the product is hand dumped into gondola cars which are then pushed to two paddle finishers. Here, the product is removed by buckets and hand dumped into these finishers. Product is pumped from these finishers to one of three Italian vacuum pans where it is concentrated, then pumped into one of two horizontal piston fillers. Concentrates are packed in glass jars or large cans, both of which are hand packed into retort baskets.

BOILERS

There are two small boilers, each with a capacity of 5 metric tons of steam per hour. They were originally wood burning and have been converted to fuel oil. It is recommended that these be replaced.

CIVIL ENGINEERING

GENERAL FACTORS

The 11 Junei processing plant is located south and west of the junction of the Somesul Min and Somesul Max. The plant site is within the city of Dej, bounded on one side by the River Somesul, on the second side by the access road, and on the third side by houses. The plant's location in the center of the village of Dej makes access extremely difficult.

The buildings comprising the processing facility are generally in poor condition and show signs of age and wear. Even if rehabilitated, they would still have many drawbacks in terms of raw material delivery.

FLOOD PROTECTION

The current site of the plant is just two kilometers southeast of the confluence of the Somesul Min and the Somesul Max. As was noted in the general observation earlier, rainfall and runoff patterns are highly unpredictable in this area due to the position of the Carpathian Mountains in relation to the prevailing air mass movements. Records show almost annual minor floods and some major floods (such as that of 1970, see Appendix). With a record like this it is difficult to envision any type of plan that would provide total, economical production against flooding especially for a rare flood such as occurred in 1970 for this particular site. An attempt to establish a dyke or dyking system to protect this particular plant would be most difficult because:

- With the present location there is no guarantee that complete dyke protection against such infrequent, excessive floods is possible.
- Such dyking would interfere with access and egress.
- The cost would approach the cost involved in moving to a new site.
- Current plans for flood control and protection in the area indicate that a dyking system should run directly through the current plant site.

Studies are currently being completed by local experts to determine an appropriate new site and engineering plans for the plant facilities. Discussion of this will be presented in the Recommendations Section.

UTILITIES

To carry out successful processing operations, adequate supplies of electric power is extremely important. Observation indicates that the whole area is well traversed by transmission lines and therefore electric power for operation should be no problem. In addition, the Romanian integrated transmission system seems more than adequate to cover most possible outages.

Supply of fuel oil appears adequate and communications, such as telephones, are available.

WATER

Water for the processing plant is currently drawn from the city system. Discharge waste water is run out of the plant into the river. The location in relationship to the river provides easy access to a large supply of water.

As shown in the analysis in the Appendix, water quality appears satisfactory.

At the present time, sewage treatment facilities are not available for the Dej plant.

DRAINAGE AND SOIL STRUCTURE

The processing plant is located on alluvial soil at the edge of the Somesul River. Drainage does not seem to be a problem. In 1970 flooding in this area passed extremely quickly. Loading capacity seems to be adequate.

BUILDING MATERIALS

Construction prices in Romania are fixed by the Government, and there are no private contractors. Under the Romanian system, cost figures for each operation are fixed and it is the responsibility of the "force account" manager to make sure the work is done at the cost indicated. The cost of completed structures with all utility and mechanical connections without processing machinery are estimated at 1,200 lei per square meter.

Structures are adequate but less refined in finish. The pre-fab pre-stress method is utilized for construction.

LABOR

Observation indicates that the labor supply is static. While labor availability is not currently a problem, it may become one should plant capacity be expanded without mechanization of the operations. A further discussion of this is provided in the Recommendations Section.

TRANSPORTATION

Raw product is transported into the plant by trucks over a poorly surfaced road leading from the production areas through town. This road goes past one side of the plant. It is necessary for the drivers to make an extremely sharp turn in order to enter the staging area. This reduces the speed of access and egress from the staging area.

The space within the plant site used for unloading of trucks is extremely small and confined, causing problems with product flow. The processed product is moved out of the plant by truck to the nearby railroad station.

MARKET ANALYSIS

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INTRODUCTION

This section will examine the structure of world import demand for selected processed vegetables and fruits. The section is divided into two parts:

1. Canned Vegetable Products (green beans, green peas, and various tomato products).

2. Canned Fruit Products (cherries, fruit cocktail, peaches, pears, and pineapple).

Note that although pineapple is a tropical fruit, it is an ingredient in fruit cocktail, a product which can be produced by non-tropical countries.

It is the objective of this portion of the report to show the structure of world import demand for canned or processed vegetables and fruits, describing which countries import which products, in what quantities, and how imports varied over the last few years. Actually, the world structure of import demand for the products studied is relatively simple. In Europe, and indeed in the world as a whole, the United Kingdom and West Germany dominate the import market for most products. These are affluent countries with large populations (see Table 2).

Table 2

Populations of Selected Countries in 1970

Country	Population (in millions)
France	51
Italy	53
Japan	100
Netherlands	13
Spain	32
United Kingdom	55
United States	201
West Germany	60

In many of the tables it will be noticed that the Netherlands is a large importer of canned goods. However, it is also a large *exporter* so that the final demand is much smaller.

For most of the vegetable and fruit products under consideration, the major importing countries are the United Kingdom and West Germany (Tables 3, 4, and 5).

Table 3

United Kingdom Market Size for Canned Vegetables in 1971

Product	£ mn at r.s.p.
Processed Peas	17
Garden Peas	13
Tomatoes	10
Green Beans*	6

* Includes string and runner beans, butter beans, and broad beans.

Source: Retail Business, The Economist Intelligence Unit, May 1972, Number 171.

Table 4

United Kingdom Production of Canned Vegetables in 1970

Product	Net Can Content (1,000 tons)
Broad Beans	11.3
Beans (Runner & French)	17.8
Beans (Butter in Brine)	11.9
Peas (Processed)	182.5
Peas (Garden)	104.5

Source: Retail Business, The Economist Intelligence Unit, May 1972, Number 171.

Among the canned vegetable products for which the total import markets appear to be expanding are:

Table 5

Imports of Canned Vegetables by Type in 1970

Product	Volume (Net Can Content—1000 Tons)	Value (£ Millions)
Beans	8.0	0.8
Peas	0.9	0.1
Tomato Purees	62.8	7.2
Tomatoes	93.5	8.9

Source: Retail Business, The Economist Intelligence Unit, May 1972, Number 171.

- green beans
- green peas
- tomatoes (at least in recent years)
- tomato paste
- tomato pulp and puree (still a very small market)

The imports of tomato concentrates increased moderately in the final year for which data was available (1970). The imports of tomato juice appear to be constant or possibly declining.

Among the canned fruit products, imports are increasing for fruit cocktail and pineapple. Markets are constant for cherries, peaches and pears.

VEGETABLE PRODUCTS

Green Peas and Beans

Both the United Kingdom and West Germany pack canned peas; West Germany also packs green beans. The major importing countries of canned green beans are shown in Table 6. It can be seen that the imports of the United Kingdom fluctuate around a static level while the imports of West Germany, quantitatively much larger, fluctuate erratically about an apparently growing trend.

Table 6

Canned Green Beans–Imports of Selected Countries
(1,000 cases, equivalent 24/303's–24 lbs, approx. 11 kg)

Country	1962	1963	1964	1965	1966	1967	1968	1969	1970
United Kingdom[1]	532.0	1053.0	887.0	690.0	858.0	989.0	799.0	814.0	750.0
West Germany[2]	.....	.....	.....	3099.4	4076.0	2274.2	3698.2	5142.0	5972.6

1 Source: The Almanac

2 Sum of imports into West Germany from B.L.E.U., Canada, France and the Netherlands.
Source: USDA/Foreign Agricultural Service, September 1971.
NOTE: B.L.E.U. refers to the Belgium-Luxembourg Economic Union.

Major importing countries of canned green peas are shown in Table 7. The United States, as well as the United Kingdom and West Germany, is a major importer of canned peas. The imports of the United Kingdom are relatively small and fluctuate around a level trend. The United States imports are larger than the United Kingdom's, but much smaller than West Germany's. The United States' imports, despite a dip in one year, appear to be growing rapidly during the years of the data. West German imports are by far the largest of the three, completely dominating the total. West German imports appear to have fluctuated for a time but appear to be growing rapidly during the last few years.

Table 7

Canned Green Peas–Imports of Selected Countries
(1,000 cases, equivalent 24/303's–24 lbs, approx. 11 kg)

Country	1962	1963	1964	1965	1966	1967	1968	1969	1970
United States[1]	.....	.....	.....	162.4	154.7	239.9	294.0	449.6	508.1
United Kingdom[2]	64.0	143.0	89.0	237.0	65.0	95.0	80.0	79.0	91.0
West Germany[3]	.....	.....	.....	4060.0	3910.7	3553.8	4557.1	5959.0	6747.3

1 Year beginning June 1 of year shown.
Source: USDA/Foreign Agricultural Service

2 Source: The Almanac

3 Sum of West German Imports from B.L.E.U., France and the Netherlands.
Source: USDA/Foreign Agricultural Service.

As an aid for understanding the trade flows of these two products in Western Europe, Figures 5 and 6 and Tables 8 and 9 are included. The figures show schematically the trade flows between European countries. Because the data are incomplete, not all quantities traded are shown. However, it is clear from these figures that for both products West Germany is a major importer, drawing from B.L.E.U., France, the Netherlands, and Canada (for green or waxed beans). Tables 8 and 9 show the export sources of the West German imports. Again because of insufficient data, the actual size of West German imports may be larger. Since the sources did not show total West German imports, the figures were compiled by looking at breakdowns of the export figures of various countries and seeing the amounts exported to West Germany by these countries.

Table 8

Canned Green Beans—Exports to West Germany from Selected Countries

Imports into West Germany (1,000 cases, equivalent 24/303's—24 lbs, approx. 11 kg)						
Country	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**
Canada	1,059.8	896.9	543.7	894.6	707.5	922.1
B.L.E.U.	431.1	245.4	358.7	535.9	1,280.0	1,605.8
France	1,138.7	2,077.8	494.5	862.8	1,379.2	1,571.9
Netherlands	469.8	855.9	877.3	1,404.9	1,775.3	1,872.8
Total	**3,099.4**	**4,076.0**	**2,274.2**	**3,698.2**	**5,142.0**	**5,972.6**

Share of Annual Market						
Country	**1965**	**1966**	**1967**	**1968**	**1968**	**1970**
Canada	34%	22%	24%	24%	14%	15%
B.L.E.U.	14%	6%	16%	14%	25%	27%
France	37%	51%	22%	23%	27%	26%
Netherlands	15%	21%	39%	38%	35%	31%

Total Volume Index (Volume in 1965 = 100)						
	1965	**1966**	**1967**	**1968**	**1969**	**1970**
Total Index	100	132	73	119	166	193

Source: USDA/Foreign Agricultural Service, September 1971.

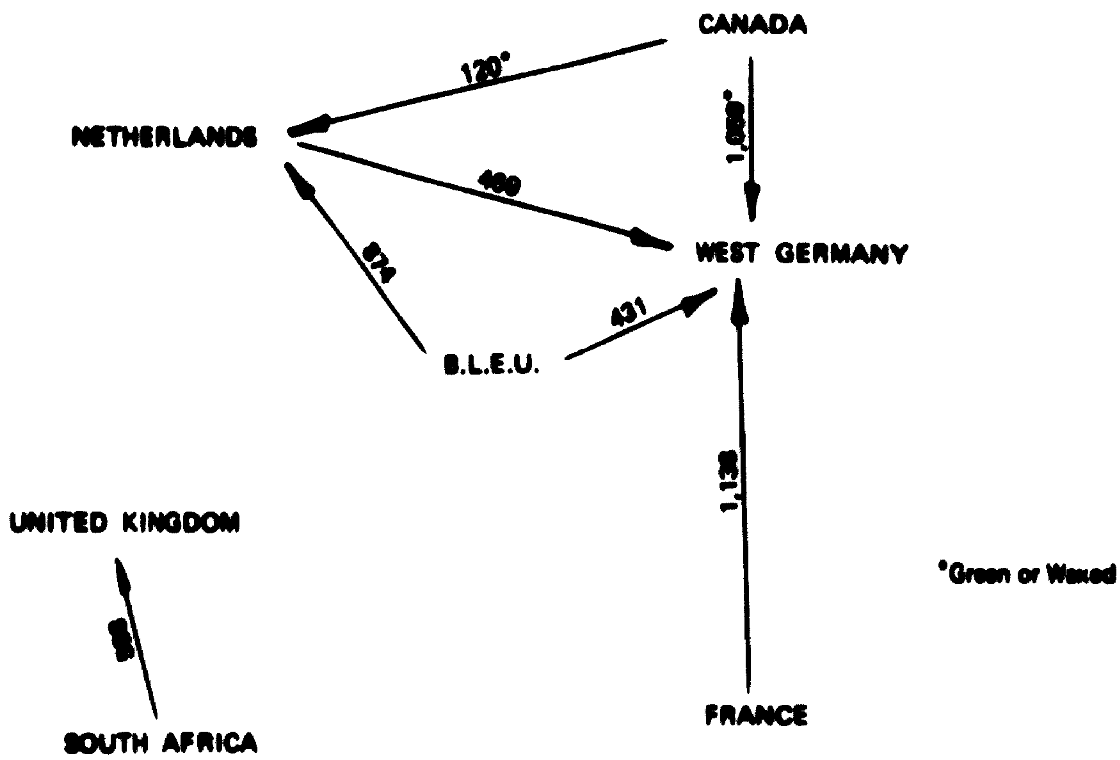

Figure 5. Green Beans (Canned), 1965
Units: 1,000 cases, equivalent
24/303's–24 lbs, approx. 11 kg

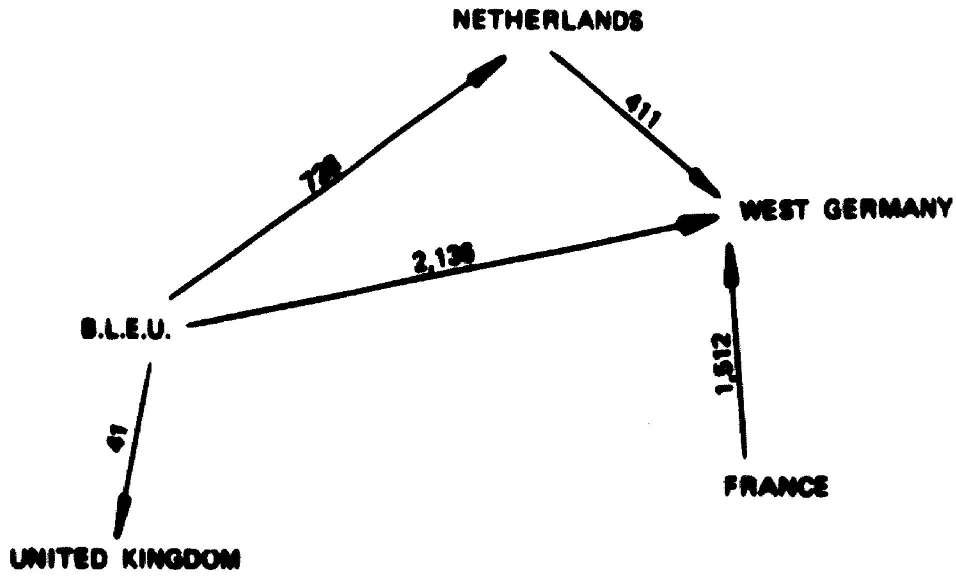

Figure 6. Green Peas (Canned), 1965
Units: 1,000 cases, equivalent
24/303's–24 lbs, approx. 11 kg

Table 9

Canned Green Peas–Exports to West Germany from Selected Countries

Exports to West Germany (1,000 cases, equivalent 24/303's–24 lbs, approx. 11 kg)						
Country	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**
B.L.E.U.	2,136.9	1,453.7	1,526.8	1,826.3	2,478.3	2,497.6
France	1,512.0	2,271.9	1,777.6	2,139.3	2,997.2	3,885.5
Netherlands	411.1	185.1	249.4	591.5	483.5	364.2
Total	**4,060.0**	**3,910.7**	**3,553.8**	**4,557.1**	**5,959.0**	**6,747.3**

Shares of Annual Market						
	1965	**1966**	**1967**	**1968**	**1969**	**1970**
B.L.E.U.	53%	37%	43%	40%	42%	37%
France	37%	58%	50%	47%	50%	58%
Netherlands	10%	5%	7%	13%	8%	56%

Total Volume Index (Volume in 1965 = 100)						
	1965	**1966**	**1967**	**1968**	**1969**	**1970**
Total Index	100	96	88	112	147	166

Source: USDA/Foreign Agricultural Service, Fruit and Vegetable Division, Commodity Analysis Branch, September 1971, "Fresh and Processed Vegetables: Production and Trade Statistics."

Tables 3, 4 and 5 show that in the United Kingdom the market size in money terms is far larger for canned peas than for canned green beans. The import volumes on the other hand were far larger for canned green beans than for canned peas. The explanation must be that domestic production supplies a larger (money value) proportion of domestic consumption in the case of canned peas than in the case of canned green beans.

This can be seen primarily because, as shown in Table 10, the price per pound (.4 kg) is higher for canned beans than for canned peas. Thus, the market in terms of volume for canned beans is even smaller relative to canned peas than it is in terms of value. Table 11 shows that domestic production of canned peas in the United Kingdom is large enough to suggest the plausibility of such an interpretation.

Table 10

United Kingdom Average Prices in 1970

Product	New Pence Per Pound (.4 kg)
Canned Peas	5.97
Canned Beans	6.30
Tomatoes (canned or bottled)	7.91

Table 11

Canned Vegetable Packs in Specified Countries by Commodity (1,000 cases, equivalent 24/303's–24 lbs, approx. 11 kg)

Country & Item	1965	1966	1967	1968	1969	1970
GREEN BEANS						
Canada	1,363	1,528	1,813	1,952	1,461	1,870
South Africa	849	463	992	762	430	574
United States	41,024	36,564	48,150	47,136	42,481	43,189
Total	**43,236**	**38,555**	**50,955**	**49,850**	**44,372**	**45,633**
GREEN PEAS						
Australia[1]	1,332	1,271	1,020	1 265	1,625	.....
Canada	5,742	4,502	4,008	6,521	4,370	3,891
South Africa	1,067	949	1,453	1,521	953	1,042
United Kingdom	6,888	8,335	8,447	6,375	7,905	9,753
United States	37,585	31,856	37,692	36,231	32,071	28,697
Total Last Four	**51,282**	**45,642**	**51,600**	**50,648**	**45,299**	**43,383**
Total All Five	**52,614**	**46,913**	**52,620**	**51,913**	**46,924**	.....

Source: USDA/Foreign Agricultural Service, September 1971.
The Almanac, 1971.

1 Year beginning in July of year shown.

Table 12 shows that in the United Kingdom quick frozen peas are taking an increasing share of the pea market and that "market and other types" are losing out. Canned garden peas are also losing out and canned processed peas have a constant or barely increasing share.

Table 12

United Kingdom Pea Consumption by Type of Processing
(in percents)

	1963	1964	1965	1966	1967	1968	1969	1970	1971
Quick Frozen	26	28	29	30	33	34	34	34	34
Canned Garden	23	21	20	20	19	18	18	18	19
Canned Processed	25	25	25	25	25	25	25	26	26
Market and Other Types	26	26	26	25	23	23	23	22	21

Source: Fruit Trades Journal, August 11, 1972, p. 14.

Tomato Products

Processed tomatoes are traded in a variety of different forms: canned tomatoes, tomato juice, tomato paste, tomato puree, tomato sauce, tomato pulp, and tomato concentrate. It should be noted that the United Kingdom imports its entire supply of tomatoes though some reprocessing may occur.

Imports of canned tomatoes are shown in Table 13. According to the Almanac, the United Kingdom and United States shares of imports of canned tomatoes have fallen from 48 percent and 38 percent respectively in 1962 to 45 percent and 28 percent in 1970. The volume of these imports rose greatly over the last half of the nine year period.

Table 14 shows the imports of tomato juice, which were dominated by the United Kingdom with 79 percent of the imports in both 1962 and 1970. Volume remained approximately constant with a slight tendency to decline possibly hidden in the year to year fluctuations.

Table 15 shows imports of tomato paste, which were dominated by the United Kingdom and the United States. These two countries had, respectively, 59 percent and 21 percent shares in 1962 and 42 percent and 27 percent shares in 1970. Volume expanded greatly during the nine year period, especially in the first seven years, falling a bit in the last two years to a level in 1970 which still was 94 percent higher than in 1962. Some of the Almanac figures for tomato paste also include imports of tomato puree and tomato sauce.

Table 13

Canned Tomato Imports by Country

Canned Tomato Imports
(1,000 cases, equivalent 24/303's–24 lbs, approx. 11 kg)

Country	1962	1963	1964	1965	1966	1967	1968	1969	1970
Canada	415	544	1,027	1,386	1,129	1,431	979	1,637	2,039
Netherlands	540	605	567	700	747	746	869	1,127	984
Switzerland	917	1,150	1,053	1,212	1,367	1,678	1,793	1,954	2,229
United Kingdom	6,700	6,723	7,430	6,171	6,376	7,416	8,262	8,719	8,727
United States	5,348	4,081	3,395	3,651	4,306	5,571	5,827	4,590	5,356
Total	**13,920**	**13,103**	**13,472**	**13,120**	**13,925**	**16,842**	**17,730**	**18,027**	**19,335**

Shares of Annual Imports

Country	1962	1970
Canada	3%	11%
Netherlands	4%	5%
Switzerland	7%	12%
United Kingdom	48%	45%
United States	38%	28%

Total Import Volume Index
(Volume in 1965 = 100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970
Index	106	100	103	100	106	128	135	137	147

Source: The Almanac, 1971.

Table 14

Tomato Juice Imports by Country

Tomato Juice Imports
(1,000 cases, equivalent 24/303's–24 lbs, approx. 11 kg)

Country	1962	1963	1964	1965	1966	1967	1968	1969	1970
Canada	296	499	755	409	334	253	223	48	290
France	28	27	40	9	21	38	62	64	63
United Kingdom	1,243	1,011	1,315	1,442	1,426	1,269	1,735	1,218	1,298
Total	**1,567**	**1,537**	**2,110**	**1,860**	**1,781**	**1,560**	**2,020**	**1,330**	**1,651**

Shares of Annual Imports

Country	1962	1970
Canada	19%	18%
France	2%	4%
United Kingdom	79%	79%

Total Import Volume Index
(Volume in 1965 = 100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970
Index	84	83	113	100	96	84	109	72	89

Source: The Almanac, 1971.

Table 15

Tomato Paste Imports by Country

Tomato Paste Imports
(1,000 cases, equivalent 24/303's–24 lbs, approx. 11 kg)

Country	1962	1963	1964	1965	1966	1967	1968	1969	1970
Canada	972	1,456	846	1,665	1,984	2,329	2,212	2,433	1,808
France[1]	502	1,707	1,332	959	372	1,044	1,129	2,696	2,544
United Kingdom[1]	4,249	4,790	4,059	4,949	6,018	5,467	6,116	4 873	5,861
United States[2]	1,487	771	549	1,013	2,085	6,465	6,652	3,644	3,808
Total	**7,210**	**8,724**	**6,786**	**8,586**	**10,459**	**15,305**	**16,109**	**13,646**	**14,021**

Table 15 continued: Tomato Paste Imports by Country

Shares of Annual Imports

Country	1962	1970
Canada	13%	13%
France	7%	18%
United Kingdom	59%	42%
United States	21%	27%

Total Import Volume Index
(Volume in 1965 = 100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970
Index	84	102	79	100	122	178	188	159	163

Source: The Almanac, 1971.

1 paste and puree

2 paste and sauce

Imports of tomato pulp and puree are shown in Table 16. Imports of tomato pulp and puree by Norway and Sweden were small but expanded greatly Since none of the Almanac data gave figures for West German imports of tomato products, United States Department of Agriculture sources were utilized for exports of tomato concentrates to both West Germany and the United Kingdom. This information was obtained in two steps. First, the combined exports of tomato concentrates from Italy, Portugal and Spain were found to B.L.E.U., France, West Germany, and the United Kingdom (Table 17). It was found that the United Kingdom and West Germany were the major importers. Since the figures for Italy and Portugal were more complete than Spanish and United States data, Table 18 was compiled showing the combined exports of tomato concentrates from Italy and Portugal to West Germany and the United Kingdom. The volume of such exports grew moderately in the final year of the six year period. West Germany and the United Kingdom had import shares of 33 percent and 67 percent in 1965 and 37 percent and 63 percent in 1970, respectively.

The West Germans apparently do not import canned tomatoes in any quantity according to United States Department of Agriculture figures. In recent years, Israel has become an important exporter of juice to the United Kingdom.

Table 16

Tomato Pulp and Puree Imports by Country

Tomato Pulp and Puree Imports
(1,000 cases, equivalent 24/303's–24 lbs, approx. 11 kg)

Country	1962	1963	1964	1965	1966	1967	1968	1969	1970
Norway	147	192	190	209	202	233	200	261	n.a.
Sweden	146	169	144	193	229	278	346	490	570
Total	**293**	**361**	**334**	**402**	**431**	**511**	**546**	**751**	

Shares of Annual Imports

Country	1962	1969
Norway	50%	35%
Sweden	50%	65%

Total Import Volume Index
(Volume in 1965 = 100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970
Index	73	90	83	100	107	127	136	187	...

Source: The Almanac, 1971.

Table 17

Combined Exports of Tomato Concentrate from Italy, Portugal, Spain & the United States[1]

Tomato Concentrate Exports

Country Exported To	1965	1966	1967	1968	1969	1970
B.L.E.U.	23,285	17,574	19,474	21,023	21,218	20,406
France	7,980	1,993	6,183	134	33,163	29,983
West Germany	52,020	42,273	52,153	46,276	56,090	71,634
United Kingdom	105,316	120,691	102,230	121,050	109,004	123,599
Total	**188,601**	**182,531**	**180,040**	**188,483**	**219,475**	**245,622**

Table 17 Continued: Combined Exports of Tomato Concentrate from Italy, Portugal, Spain and the United States

Shares of Annual Imports

Country	1965	1970
B.L.E.U.	12%	8%
France	4%	12%
West Germany	28%	29%
United Kingdom	56%	50%

Total Import Volume Index
(Volume in 1965 = 100)

	1965	1966	1967	1968	1969	1970
Index	100	97	95	100	116	130

Source: USDA/Foreign Agricultural Service

1 Year beginning July 1

Note: Spanish data is missing before 1969. Missing data assumed to be zero.

Table 18

Combined Exports of Tomato Concentrates from Italy and Portugal

Tomato Concentrate Exports
(1,000 lbs, approx. 455 kg)

Country Exported To	1965	1966	1967	1968	1969	1970
West Germany	51,984	42,247	52,082	45,806	54,081	70,845
United Kingdom	105,231	120,643	102,021	120,833	100,347	120,380
Total	**157,215**	**162,890**	**154,103**	**166,639**	**154,428**	**191,225**

Shares of Annual Imports

Country	1965	1970
West Germany	33%	37%
United Kingdom	67%	63%

Total Import Volume Index
(Volume in 1965 = 100)

	1965	1966	1967	1968	1969	1970
Index	100	104	98	106	98	122

FRUIT PRODUCTS

This section is concerned with the import demand for cherries, fruit cocktail, peaches, pears and pineapple. Fruit cocktail is a highly standardized product containing specifically fixed proportions of cherries, grapes, peaches, pears and pineapple.

As was the case with canned vegetables, the import market is dominated by the United Kingdom and West Germany, which together absorb one-half of the canned fruit which enters world trade.

The United Kingdom and West Germany are not self-sufficient in many of the fruit products being considered. Of the products listed above, West Germany packs only cherries. The United Kingdom packs fruit cocktail and extremely small amounts of peaches, cherries and pears. It should be noted that all the pineapple for fruit cocktail packed in the United Kingdom must be imported.

Table 19 lists the major world importers of canned fruit (of all types). The United Kingdom and West Germany have the first and second largest shares, respectively of world imports. Comparing import shares in 1969 with average shares for the years

Table 19

Import of Canned Fruit by Country

Import of Canned Fruit (% of Imports by Weight)

Country	Average 1956-60	1969
United Kingdom	47%	30%
Canada	8%	7%
West Germany	13%	19%
United States	7%	11%
Japan	2%	6%
France	3%	5%
Soviet Union	2%	6%
Total	**82%**	**84%**

Total Volume Index
(Volume in 1965 = 100)

	Average 1956-60	1963	1964	1965	1966	1967	1968	1969
Index	57	87	92	100	104	106	116	118

Source: Fruit: A Review, The Commonwealth Secretariat, p. 180.

1956-60, the share of the United Kingdom has fallen by one-third (from 47 percent to 30 percent) and that of West Germany has risen by one-half (from 13 percent to 19 percent). The United Kingdom and West German combined share has thus declined from 60 percent to 49 percent. Other countries which have increased their shares of imports are the United States, Japan the Soviet Union, and France, and - though much less important Italy and the Scandinavian countries. The total quantity of canned fruit entering international trade is shown by Table 19 to have increased steadily

Tables 20 through 24 show the imports for selected countries of cherries (Table 20), fruit cocktail (Table 21), peaches (Table 22), pears (Table 23), and pineapple (Table 24). Each table shows the volume of imports of each country the percentage share of that country's import volume of the total volume of all the countries shown, the total volume of imports of all countries, and an index of total volume.

Cherries

Table 20 shows that import volume has fluctuated around a level trend. The United States is the leading importer of cherries with Canada and United Kingdom having equal shares. In the past ten years, Canada's share has declined slightly, and the shares of United Kingdom and the United States increased slightly. It will be noticed that, due to rounding, shares may not add up to 100 percent.

Fruit Cocktail

Table 21 shows that imports of fruit cocktail have increased (unsteadily) in the last six years. The last three years are definitely higher than the previous three, but year to year variations are unpredictable. The data show only United Kingdom and Canada as importers with their shares of the market (United Kingdom 65 percent, Canada 36 percent) apparently the same in 1968/69 as in 1963/64.

Peaches

Table 22 shows that imports of peaches are dominated by the United Kingdom and West Germany. The Canadian and United States share of imports has risen slightly and the shares of United Kingdom and West Germany have fallen slightly over the last eight years. The total volume of imports of the six countries listed has been nearly constant.

Table 20

Cherry Imports by Specified Countries

Cherry Imports (1,000 lb. approx. 455 kg)								
Country	**1962/3**	**1963/4**	**1964/5**	**1965/6**	**1966/7**	**1967/8**	**1968/9**	**1969/70**
Canada	8,284.0	6,286.4	8,395.0	6,058.5	7,818.7	6,365.8	8,416.8	6,627.9
United Kingdom	6,256.8	5,861.7	6,816.3	5,324.5	4,851.8	5,965.1	6,876.8	6,545.3
United States	10,044.9	18,108.7	9,348.5	8,014.8	11,552.0	11,339.2	16,589.6	10,509.7
Total	**24,585.7**	**30,256.8**	**24,559.8**	**19,397.8**	**24,222.5**	**23,670.1**	**31,883.2**	**23,682.9**

Shares of Annual Imports

Country	1962/3	1969/70
Canada	34%	28%
United Kingdom	26%	28%
United States	41%	44%

Total Import Volume Index
(Volume in 1965 = 100)

	1962/3	1963/4	1964/5	1965/6	1966/7	1967/8	1968/9	1969/70
Index	127	156	127	100	125	122	164	122

Source: The Almanac, p. 454.

Table 21

Fruit Cocktail Imports by Specified Countries
(Year beginning July 1)

Fruit Cocktail Imports (1,000 cases, equivalent 24/2½'s–45 lbs, approx. 20 kg)						
Country	**1963/4**	**1964/5**	**1965/6**	**1966/7**	**1967/8**	**1968/9**
Canada	899.6	1,051.4	952.6	1,274.1	975.5	1,238.8
United Kingdom	1,571.5	1,322.9	1,237.9	1,635.9	1,663.9	2,205.3
Total	**2,471.1**	**2,374.3**	**2,190.5**	**2,910.0**	**2,639.4**	**3,444.1**

Table 21 Continued: Fruit Cocktail Imports by Specified Countries

Shares of Annual Imports

Country	1963/4	1968/9
Canada	36%	36%
United Kingdom	64%	64%

Total Import Volume Index
(Volume in 1965 = 100)

	1963/4	1964/5	1965/6	1966/7	1967/8	1968/9
Index	113	108	100	133	121	157

Source: Canned Fruit: World Production and Trade Statistics.
USDA/Foreign Agricultural Service, December 1969.

Table 22

Canned Peach Imports by Specified Countries

Canned Peach Imports
(1,000 cases, equivalent 24/2½'s–45 lbs, approx. 20 kg)

Country	1962/3	1963/4	1964/5	1965/6	1966/7	1967/8	1968/9	1969/70
Canada	669.1	761.8	1,106.9	1,125.1	1,507.5	1,527.2	1,633.8	1,401.7
West Germany	3,396.5	3,264.9	3,232.9	4,022.4	3,233.5	3,181.2	3,974.4	3,118.4
Netherlands	349.7	395.3	446.9	511.7	542.1	456.5	440.8	505.4
Sweden	411.1	400.7	463.9	410.2	395.8	368.3	393.2	424.9
United Kingdom	4,672.7	5,526.4	5,042.4	5,258.2	4,383.4	5,065.5	4,814.4	4,958.7
United States	521.7	537.9	511.6	464.6	561.3	396.8	233.5	874.9
Total	**10,020.8**	**10,887.0**	**10,804.6**	**11,792.2**	**10,623.6**	**10,985.5**	**11,490.1**	**11,284.0**

Shares of Annual Imports

Country	1962/3	1969/70
Canada	7%	13%
West Germany	34%	28%
Netherlands	4%	5%
Sweden	4%	4%
United Kingdom	47%	44%
United States	5%	8%

Table 22 Continued: Canned Peach Imports by Specified Countries

Total Import Volume Index (Volume in 1965 = 100)								
	1962/3	**1963/4**	**1964/5**	**1965/6**	**1966/7**	**1967/8**	**1968/9**	**1969/70**
Index	85	92	92	100	90	93	98	96

Table 23

Canned Pear Imports by Specified Countries

Canned Pear Imports (1,000 cases, equivalent 24/2½'s–45 lbs, approx. 20 kg)								
Country	**1962/3**	**1963/4**	**1964/5**	**1965/6**	**1966/7**	**1967/8**	**1968/9**	**1969/70**
United Kingdom	3,119.2	3,222.3	3,329.8	2,976.5	3,228.7	2,841.3	3,286.5	3,200.0
Canada	128.7	168.8	318.3	202.9	295.4	199.2	251.6	116.6
Sweden	88.9	106.2	102.0	129.6	126.5	151.7	165.9	190.5
Total	**3,336.8**	**3,497.3**	**3,750.1**	**3,309.0**	**3,650.6**	**3,192.2**	**3,704.0**	**3,507.1**

Shares of Annual Imports

Country	**1962/3**	**1969/70**
United Kingdom	94%	91%
Canada	4%	3%
Sweden	3%	6%

Total Import Volume Index (Volume in 1965 = 100)								
	1962/3	**1963/4**	**1964/5**	**1965/6**	**1966/7**	**1967/8**	**1968/9**	**1969/70**
Index	101	106	113	100	110	97	112	106

Source: The Almanac, 1971

Table 24

Canned Pineapple Imports by Specified Countries

Canned Pineapple Imports
(1,000 cases, equivalent 24/2½'s–45 lbs, approx. 20 kg)

Country	1962/3	1963/4	1964/5	1965/6	1966/7	1967/8	1968/9	1969/70
B.L.E.U.	349.5	390.7	390.7	367.3	437.4	401.8	377.4	345.4
Canada	1,051.2	1,329.6	1,329.6	1,031.3	1,255.9	1,324.4	1,276.4	1,167.1
Denmark	293.9	212.4	212.4	235.7	246.5	203.0	208.8	258.9
France	651.8	785.9	785.9	932.4	1,138.8	1,078.5	1,023.5	1,300.5
West Germany	3,112.4	2,625.4	2,625.4	3,099.3	2,846.9	3,337.5	2,870.2	3,132.0
Japan	1,141.3	1,373.9	1,373.9	1,787.9	2,503.9	2,322.2	2,537.8	3,118.6
United Kingdom	2,721.5	2,931.3	2,607.7	2,716.0	3,269.0	3,269.6	2,424.0	3,093.3
United States	2,240.3	2,877.5	3,288.5	3,530.1	4,197.6	5,051.9	5,705.4	5,557.4
Total	**11,561.9**	**12,526.7**	**12,614.1**	**13,700.0**	**15,[illegible].0**	**16,[illegible].9**	**16,423.5**	**17,973.2**

Shares of Annual Imports

Country	1962/3	1969/70
B.L.E.U.	3%	2%
Canada	9%	7%
Denmark	3%	2%
France	6%	7%
West Germany	27%	18%
Japan	10%	17%
United Kingdom	24%	17%
United States	19%	31%

Total Import Volume Index
(Volume in 1965 = 100)

	1962/3	1963/4	1964/5	1965/6	1966/7	1967/8	1968/9	1969/70
Index	84	92	92	100	116	124	120	131

Source: The Almanac, 1971.

Pears

Table 23 shows that pear imports have been almost constant in total volume over the last eight years and that an overwhelming share has gone to the United Kingdom.

Pineapple

Table 24 shows that pineapple imports have tended to rise greatly over the last eight years, and that the largest share now goes to the United States (31 percent), with nearly equal shares (17 percent, 17 percent, 18 percent) going to Japan, the United Kingdom, and West Germany, respectively. Eight years ago the largest share had gone to West Germany (27 percent), followed by the United Kingdom (24 percent), the United States (19 percent), and Japan (10 percent). Since the total volume is increasing, even a diminishing share of imports may represent increased volume. The increased shares of the United States and Japanese imports thus represent even greater increases in total volume.

Any exports of processed pineapples would have to be imported pineapples.

Conclusions

Tables 20 through 24 show that the trends of total volumes are increasing unmistakeably for fruit cocktail and pineapple. Total imports of cherries, peaches and pears have been about constant.

Large percentage increases in import shares have occurred for individual countries with particular fruits. Thus, in canned peaches, with a roughly constant total level of imports, there were large increases from 1962/63 to 1969/70 in the shares of Canada (from 7 percent to 13 percent) and the United States (from 5 percent to 8 percent in 1962/63). The Swedish share of pear imports rose from 3 percent to 6 percent in 1969/70. In pineapple trade there were increases in the shares of Japan (from 10 percent to 17 percent) and the United States (from 19 percent to 31 percent) from 1962/63 to 1969/70. These changes in the shares of individual countries may be more important for pineapples, since in that fruit the total market is also expanding. However, since pineapple can only be grown in the tropics, exports of processed pineapple would not be economically feasible unless pineapple could be imported on favorable terms.

The Appendix contains selected fruit pack data by commodity and country.

In general, fruit producers are those countries with warmer climates: Italy and Spain in Western Europe; Bulgaria, Romania and Hungary in Eastern Europe; Australia; Canada; New Zealand; South Africa; the United States; and various tropical countries including Kenya, Malaysia and the Philippines.

SUMMARY AND CONCLUSIONS

The total market analysis consists of an assessment of current and projected supply and demand conditions. This division between "current" and "future" can be considered as a static analysis or as a dynamic analysis.

The particular market for a crop or product cannot be labeled as poor or good without reference to a specific producer's conditions. Markets can, however, be defined as expanding, static or declining. Even taking this into consideration should a surplus exist in a particular crop at any moment, the market in this crop might be considered as a "good" market for a low-cost producer while it would obviously be a poor market for a high-cost producer. The low-cost producer under surplus supply conditions might be able to make a substantial profit selling all production at a low price, while the high cost producer could sell only at a loss. As long as the producer is able to sell his product at a profit, the market must be considered as "good."

The existence of a static or declining market indicates that production and processing emphasis should probably not be placed on those products. Greater emphasis naturally should be placed on those with expanding market potential, as long as the producer can make a profit at the current price and at projected prices. Among the vegetable products considered in this analysis for which total import markets appear to be expanding are:

- Green Beans
- Green Peas
- Tomatoes
- Tomato Paste
- Tomato Pulp and Puree (generally very small market)

In Western Europe, the major importing country for canned green beans and peas is West Germany and the major importer of canned tomatoes and tomato products is the United Kingdom.

For fruit products, expanding markets appear to exist for canned fruit cocktail and for pineapple. Markets for cherries, peaches and pears appear to be constant. The discussion of the pineapple market and availability of canned pineapple products was included due to the fact that the canned fruit cocktail market is expanding. Canned fruit cocktail is based on a formula which involves specific percentages of peaches, pears, pineapples, cherries, and grapes. All of these, except pineapple, are available in Romania. Since the market for cherries, peaches and pears is constant, production of canned fruit cocktail could provide an alternative method for export of these fruit products. In this connection it should be noted that the United Kingdom is a producer of fruit cocktail, but grows no pineapple itself. The United Kingdom imports and reprocesses pineapples for inclusion in its fruit cocktail pack. In addition to being the producer of fruit cocktail, the United Kingdom is also an importer of this product. Total consumption of this product is also on the increase throughout Europe.

It should be re-emphasized that a market analysis must also make reference to the economic feasibility of producing and marketing a product. Included at the end of the report is a section containing an economic feasibility analysis for each of the products to be produced by the processing plants Zagna Vadeni and 11 Junei, Dej. Utilizing this feasibility approach, costs and revenues are determined for the current market situation and then the cost and revenue factors are varied plus or minus 50 percent to determine the most sensitive items, i.e., those that most directly affect the profitability of the operation.

A static market analysis is then an economic determination: whether the producer can make a profit on the sale of a particular product under current conditions.

The dynamic market analysis determines whether this profit can be expected to be maintained into the future. In a dynamic analysis it is necessary to determine supply and demand trends. If production in the future can be expected to exceed future demand levels then prices can be expected to decline. The relevant market analysis under this situation is a determination of whether the future depressed price levels can still offer the producer a substantial return on investments. If profits remain high, then the market in both static and dynamic analyses can be considered a good risk for this specific producer. (Of course, if prices can be expected to rise, then the situation would prove to be more favorable to the producer.)

Assessing the economic profitability both statically and dynamically is the basis of the market analysis. Utilizing the information available in the Economic Analysis section of the report and taking into consideration additional factors, recommendations are presented in the Conclusions section concerning particular marketing objectives.

From the marketing point of view, emphasis should be placed on production of canned green beans, particularly a premium pack, green peas, pickles, whole tomatoes, tomato paste and some other types of tomato specialty designed to suit a particular end market. In the area of fruits, emphasis should be placed on development of a fruit salad or fruit cocktail pack. Less emphasis should be placed on peaches, pears, plums, apricots, and apples, and the quality and consistency of supply of the cherry pack should be enhanced. On-site observation of the market indicates that Romanian jams, especially strawberry, are well received and that improvement in quantity or quality would be well accepted.

RECOMMENDATIONS

INTRODUCTION

In the rehabilitation, modernization and rejuvenation of the processing plants Zagna Vadeni and 11 Junei, three major directions could be followed. Keeping in mind the objective of the program, that is the adjustment of export quantities to satisfy certain markets and improve quality to that of international acceptable standards, three plans with three levels of investment will be offered. In this way economic evaluations derived from the complete study would direct a recommendation to the optimum mix in light of economic returns, technical feasibility and returns that are not directly quantifiable such as improvement of conditions of labor and consideration of a model system for national agro-industrial development.

The three plans would be:

PLAN I. Low level of investment. Lines will not be moved, all existing equipment will operate in the same capacity as at the present, and where the operation is completely manual, it will be semi-automated.

PLAN II. Meaium level of investment. All equipment in working condition will be moved to a new site, where it will be integrated with other equipment to form a complete semi-automated line.

PLAN III. High level of investment. Completely new automatic lines will be installed at the most favorable site in the area.

ZAGNA VADENI

PLAN I

AGRICULTURE

In keeping with the goals of this Plan, particularly making minor adjustments in production methods to upgrade the quality of the raw product while minimizing the capital investments, no major changes are recommended in agricultural technology.

However, some improvements should be made in raw product handling and in disease control as well as in soil and water management. Particularly, transportation and handling equipment should be improved, disease control programs should be developed and adhered to, fertilizer practices should be closely watched through soil and tissue analysis, greater use of soil amendments should be made and drainage and irrigation systems to lower salt accumulations should be investigated.

Better coordination between the plant and field operations is necessary to avoid delays in processing the raw product. Finally, stricter adherence to quality standards is necessary to provide a suitable quality finished product, particularly for export marketing.

For specific recommendations applying to improvements in various agrotechniques, the reader is referred to the sections under specific crop recommendations in Plan III.

PROCESSING

After the flood of 1970, the plant was cleaned out and was back in limited production six weeks later. For the 1972 season, management expected to produce at full capacity.

TOMATO PASTE LINE

The tomatoes are received in 450 kg bottom-drop bulk bins. This system seems to be very inefficient and causes a large portion of the incoming tomatoes to be lost or broken, which will cause the increase in mold count since the fruit is damaged from rough handling, and is often left at the plant for a period of time before processing.

The system can be improved by installing a fixed bin (450 kg) dumper or a bulk hydro-receiver for 5 ton trailers. On the receiving dock an automatic bulk bin handling system would be installed to automatically handle and dump incoming bins. The system will also unstack incoming full bins and stack the empty outgoing ones to be removed by the fork lifts. A 1.20 m X 1.50 m loose fruit belt with variable speed accumulates fruit between dump cycles. This will result in a striking reduction in labor used, since one fork lift operation with one fork lift could feed the full bins after dumping. In addition, the system would provide a smooth, efficient base for operation of the rest of the lines.

(If the tomatoes were to be received in bulk 5 ton trailers, a bulk hydro-receiver should be installed. This consists of a tank alongside of which the trailers are brought and dumped. The tank is equipped with a special pump to circulate the water and move the tomatoes forward toward the exit end.)

At the exit end of both systems, the tomatoes are carried into the plant via a series of flumes and live roll elevators. The latter are equipped with high pressure water jets to wash off dirt and residue from the fruit. The slow rotation of the rollers on the elevators is directly transmitted to the tomato to insure full exposure of product surface for effective washing. The flume system would be designed to divert the fruit to the three existing lines according to their capacities.

The three existing preparation lines, which are composed of culling, chopping, pulping, and finishing, are adequate and not much should be added.

From the finishers of the Tito Mancini line installed in 1963 and the Rossi Catelli line installed in 1969, large surge tanks of 7.6 kiloliter capacity would be installed ahead of the evaporators to keep the lines running constantly, and avoid the present practice of turning the receiving part of the line on and off, according to the capacity and operation of the evaporators.

From the evaporators the paste is directed to the fillers. The present filling equipment, even though in only moderately good condition, seems adequate for the present production. In Plan I the bulk barrel filling program, a simple materials handling system, would be installed to fill the barrels. Two people could handle the filling and closing of the bulk filled paste.

Cooling of small size cans is presently well handled on the Bertucci draper cooler, which is in good condition. However, this draper cooler has no air blower on the discharge end to remove water that collects in the top of the can. To solve this water problem, which results in many rusted ends, an adjustable plenum tube will be mounted on the discharge end.

At the present time, there is no equipment to cool the larger size cans of tomato paste. This definitely reduces the quality of the product, causing darkened color and burned flavor. A continuous cooler is therefore recommended to handle the 5 kg cans efficiently and economically.

VEGETABLE LINE (PEAS AND GREEN BEANS)

Peas are dumped into one of two large, stainless steel bins containing recirculating water. The peas are then flumed to the sizer, then to the blanchers. This part of the system seems quite adequate for the present capacity.

Green beans are received in field boxes, and hand fed into a bank of fifteen snippers and graders. This primary operation takes place in a covered shed, approximately 300 meters from the main canning plant. From this area, they are carried in dishpans and trucked to the main plant.

It is recommended that the receiving area of the main plant should be extended to allow the moving of these snippers and graders to the beginning of the line. The present method of snipping and grading the beans away from the beginning of the line causes undue labor, expense, and congestion of personnel.

The beans are then elevated and blanched through the same blancher as the peas. Although these blanchers are not center tubed blanchers and are in fairly poor condition, they seem to be doing an adequate job for the present production.

The one filler-briner-seamer combination on one of the pea lines needs a complete overhaul. However, this piece of equipment is in basically good condition.

The other combined pea and bean line could be improved from what it is now. In either case, after blanching, the peas or beans are immediately put back into dishpans. These dishpans are carried by hand to a packing table where girls fill them into cans or glass jars going around an endless conveyor.

A series of table top conveyor graders would be installed to carry the produce from the blancher and distribute it onto the filling tables. At the present time, all cans coming out of the seamers are filled into the retort baskets by hand. This is a very time consuming operation, and is also very demanding on the person doing the work.

A set of semi-automatic basket filling machines should be installed behind every seamer. These are relatively simple machines and could operate on baskets the same size as the present retorts.

All cooking is done in vertical retorts. In the main canning room there are seventeen retorts, all arranged in line, and controlled from overhead by an operator in a control room. However, due to poor maintenance, these retorts no longer operate automatically. All temperatures are recorded, but length of cooking and cooling is timed manually. It is essential to install complete control systems for these retorts since this is the most important area to insure the quality and safety of the product coming out of the cannery.

The plant has no warehousing or materials handling equipment whatsoever. Movement of cans from processing area to warehouse, stacking right cans, unstacking, labeling, casing and case sealing are all done by hand.

A semi-automatic single line would be installed to handle either of the two can sizes that come into the warehouse.

PLAN II

AGRICULTURE

In keeping with the goals of this Plan, particularly making minor adjustments in production methods to upgrade the quality of the raw product while minimizing the capital investments, no major changes are recommended in agricultural technology.

However, some improvements should be made in raw product handling and in disease control as well as in soil and water management. Particularly, transportation and handling equipment should be improved, disease control programs should be developed and adhered to, fertilizer practices should be closely watched through soil and tissue analysis, greater use of soil amendments should be made and drainage and irrigation systems to lower salt accumulations should be investigated.

Better coordination between the plant and field operations is necessary to avoid delays in processing the raw product. Finally, stricter adherence to quality standards is necessary to provide a suitable quality finished product, particularly for export marketing.

For specific recommendations applying to improvements in various agrotechniques, the reader is referred to the sections under specific crop recommendations in Plan III.

PROCESSING

All equipment in the present Zagna Vadeni cannery, regardless of condition, will be overhauled and moved to a new location. In rebuilding the new lines, new equipment will be integrated with old equipment to form a complete semi-automatic line. The capacity of the plant will not be changed, since some of the old equipment moved to the new location would be a limiting factor; nevertheless, the operation will be made more efficient.

The most important consideration regarding Plan II will be that the complete plant will probably be out of production for a season. This means not only loss of revenue, but also removing product presence from the market for an entire season. The total effects of these actions must be considered by planners. Plan II is offered only as an alternative for consideration and its adoption is not recommended.

TOMATO PASTE

The Tito Manzini bowl system presently used for making tomato paste and packing it in bulk barrels with 10 percent salt should not be moved. The system is outmoded, the equipment is in poor condition, and the resulting product is not in demand on international markets.

The new Tito Manzini and the Rossi Catelli lines are in very good condition and can be moved to a new location. The equipment can be reinstalled with a new plant design which will include all the extra equipment included in Plan I to provide an efficient economical line.

The capacity will not increase, but the operation will be more efficient and utilize less labor.

VEGETABLE LINES (PEAS AND GREEN BEANS)

The existing equipment in the pea and the bean lines is in only mediocre condition, but could be moved if such a decision is made. Using the existing equipment the lines will be redesigned to provide for a continuous handling system which would reduce labor and make the operation more efficient and economical.

Peas

The first part of the pea line, which is the receiving tank, should not be moved. The design of this tank is such that the peas will not discharge by themselves, and it requires three men along each side of the tank with wooden boards to manually remove the peas to the discharge pipe.

Under Plan II, at the receiving station a box dumper will be installed to receive stacks of boxes coming from the field, unstack them, empty them, and restack the empty boxes at the end of the line. The shelled peas are then carried over a conveyor to a green peas dry cleaner, which eliminates much of the trash and loose dirt left on the peas after the vining operation. From the dry cleaner, the peas go to a washer which does the final cleaning on the peas. From there, the peas can be flumed to the present water separator and the reel type separator. The peas are then flumed to the existing reel type sizer. Peas then go to the existing 15 valve filler briner, which is connected to the seamer. Even though this equipment was purchased over ten years ago, after being overhauled it could do a good job.

Green Beans

The receiving section of the green bean line should also be redesigned to include a box dumper which would feed the snippers, which in turn would be followed by the bean graders. A separate line would be set up for running the beans through the existing bean cutters. The beans should then be channeled to a gooseneck elevator for blanching through the existing blanchers.

The blanched cooled beans are then directed to a semi-automatic hand pack filler for filling. Following the filler, a briner would be installed to add brine to the can before closing.

From the briner, the cans would move into the existing seamers.

Semi-automatic retort basket fillers and baskets would be added as described in Plan I. Also, retort control devices and material handling equipment in the storage areas would be provided and installed as described in Plan I.

CIVIL ENGINEERING

GENERAL COMMENTS

The plant should be located close to the production area so as to minimize field to plant transportation. The following specific requirements will need to be met.

UTILITIES

Constraints on the location due to the supply of utilities such as electric power and fuel oil are minimal since electric power transmission in the area under consideration is excellent and fuel oil can be transported easily as long as good roads are available.

WATER

The availability of a constant and adequate supply of good quality water is vitally important to the function of a processing plant. Water availability in the area under consideration seems more than adequate and water quality appears good.

FLOOD PROTECTION

The most important consideration in the location of the processing plant is establishment at a site with adequate protection from flooding. This would mean that the plant should not be affected by the annual minor floods that occur and that insofar as possible, it would be protected from any major floods.

The area under consideration for the transfer of the Zagna Vadeni plant is south of Braila between Braila and Traian. The land in this area is a bluff, which should provide more than adequate protection from flooding. This would also move the plant away from the confluence of the two rivers and out of the marshy area.

SOIL STRUCTURE AND DRAINAGE

Land in the area being considered for the new site is deep, uniform in quality and appears to be stable. Unlike the present location, the site under consideration does not have standing water.

As discussed in greater detail in the Agricultural Section of Plan III, the production area around the plant site at Zagna Vadeni is poorly drained, and for this reason has caused production problems. In the opinion of the team engineer and team agronomist, it may be possible to modify drainage to rectify this situation and thereby save this land for the use of vegetable production instead of converting it to salt-tolerant lower-profit crops. Methods for achieving such drainage should be evaluated.

Soil in the area surrounding the site under consideration for relocation of the plant appears of good quality for production.

TRANSPORTATION

The area under consideration for the relocation of the processing plant is served by the Galati-Braila Road which is in excellent condition, and is also bounded on one side by a rail line. It therefore seems possible that a tie-in could be made to the processing plant area finally selected. Transportation of raw product to the factory should be much more convenient because of the better road and transport of the finished product from the factory should not be adversely affected because of the proximity of the rail line.

LABOR

Relocation of the plant between Braila and Traian (yet close to Braila) would provide for better location in terms of labor availability since both Braila and Traian, as well as other towns in the vicinity, could provide a good labor pool. Transportation to the plant should be more easily available which would also have a good effect on labor availability.

It is further suggested that time and motion studies would be helpful to the full operation.

CONSTRUCTION

The present site is both too small to allow for construction of modernized facilities alongside of existing structures, and it is not feasible from the point of view of flood control. Therefore, under Plan II consideration is given to construction of a new building at a new site. Observation indicates that while some aspects of moving may be difficult, it should be possible. While road conditions out of the plant to the main road are not the best, they should prove adequate.

It is projected that one season's production will be lost due to the move. The actual building can be constructed in advance of the move and prepared for reception of the processing equipment. However, due to weather and the complexity of installing a new line at the new site, it is more than likely that one season's operation will be lost.

Construction in Romania is carried out by the Government and prices for construction are fixed. It is the responsibility of the Government Manager to be sure that work is done at the cost indicated. Completed structures with all utilities and mechanical connections, but without processing machinery, are estimated at 1,200 lei per square meter. The pre-fab, pre-stressed method of construction has been adopted and it is felt that workable structures can be provided.

One opportunity provided by the move of the Zagna Vadeni plant is the possibility of relocating all process functions in one main building thereby eliminating problems in materials and process flow.

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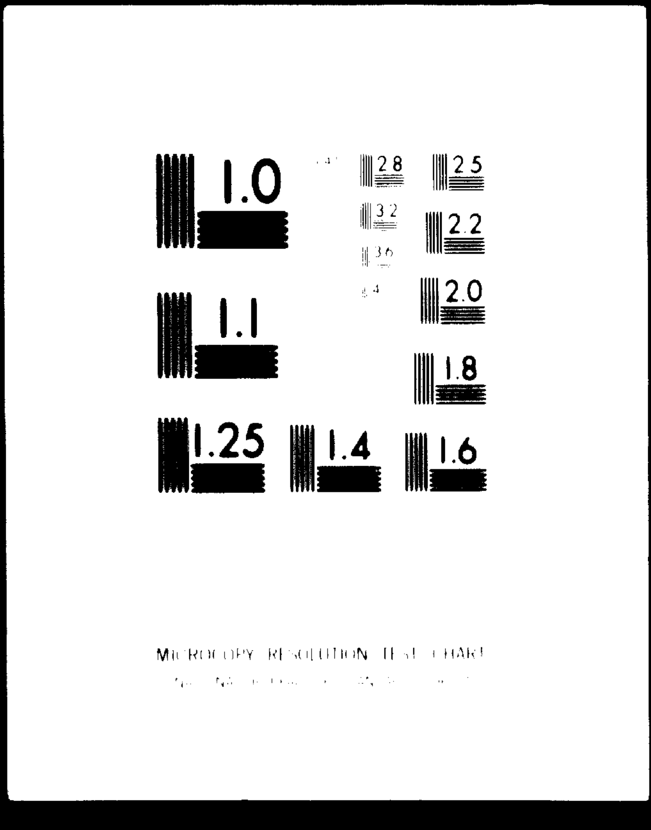

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PLAN III

AGRICULTURE

GENERAL RECOMMENDATIONS

There should be no major impediments to the large-scale production of vegetables with limited production of fruits and some meats. Although the humid, fluctuating continental climate will produce problems not experienced in some other production areas, the problems can be anticipated and corrected.

It is agreed that the plant could be moved, perhaps within a 40 kilometer radius, in a direction southwest from Braila in the direction of Traian and other production areas. However, the existing production area, that enclosed by the rough triangle formed by the Dunarea (Danube), Siretul (Siret), and the Braila-Galati Road, should not be abandoned before further evaluation of the possibilities of drainage systems.

If a drainage and pumping installation could be feasibly developed, a subsurface irrigation system could be utilized. Thus, with the water table sufficiently controlled, the existing production area would be well suited for the large-scale production and mechanization of vegetables for processing.

This industrialization would, however, require a large infusion of machinery and the concomitant technology to adapt the mechanization systems to local conditions as well as provide a coordinated supply of raw material for a modern processing plant built to the indicated specifications as discussed in Plan III.

Then attention must be given to new production techniques, new varieties, new drainage and irrigation systems, disease control methods and new handling systems from field to plant. The following recommendations are gauged to supplying such a modern processing plant, for no major changes in production techniques need be made for Plan I or II (with the exception of the drainage system and improved post-harvest handling techniques).

The primary crops of interest would be tomatoes, peas and green beans; however, some other vegetables such as cucumbers, peppers, eggplant, onions, carrots and spinach could be considered as well as some deciduous fruits (peaches, apricots), agronomic crops (beans, rice) and meat in order to provide complete utilization of the plant.

TOMATOES

Varieties

Important characteristics for processing tomato varieties to be produced for mechanical harvest at Zagna Vadeni are as follows:

- Fruit able to stand the rigors of mechanical harvesting.
- Plant growth characteristically small and determinate.
- Fruit set heavy and occurring during a relatively short period of time.
- Plants resistant to local disease.
- Small stem scar and easy separation.
- No excessive fruit shattering or cracking.
- Ripe fruit remains in good conditions for a reasonable length of time.

Following is a list of the varieties recommended for trials at Zagna Vadeni.

Campbell 28. For market and processing use; medium early maturity (128 days); medium, oblate, smooth and firm fruit; compact, determinate vine with good cover; resistance or tolerance to fusarium wilt; early mechanical harvest type with some crack resistance.

NCX 315. For processing; medium early maturity (128 days); medium-small, globe, smooth, firm fruit of uniform deep red color; compact, determinate vine; resistant to fusarium and verticillium wilt; mechanical harvest type.

Centennial. For processing; medium maturity (130 days); medium, deep globe fruit with uniform ripening; determinate vine; tolerance or resistance to verticillium and fusarium wilt; crack resistant, mechanical harvest type for humid areas.

Heinz 1370. For market and processing use; medium maturity (133 days); medium-small, globe, firm fruit; determinate vine with good cover, tolerant to fusarium wilt; crack resistant, mechanical harvest type for humid areas.

Mars. For market and processing use; medium-early maturity (128 days); fruit small, oblate to round, tendency to nipple slightly; crack resistant; resistant to VF wilts and gray leaf spot; plant is small, low growing, determinate and compact.

Potomac (VF). For processing; early maturity (120 days); fruit elongated, small, uniform color; resistant to gray leaf spot, verticillium and fusarium wilts and cracking. Humid area adaption.

Merit (VF). For processing; medium-early maturity (125 days); fruit globe-shaped with uniform color, small core; small to medium vine with concentrated setting, jointless character; resistant to verticillium, fusarium and cracking; humid area adaption.

Red Rock (VF). For processing; medium maturity (128-130 days); fruit globe to deep globe; medium size vine, determinate with jointless character; tolerance to gray leaf spot and resistance to verticillium and fusarium wilts and cracking.

Napoli. For processing; medium-early to medium ripening (125-128 days); fruit small, plum shaped, firm; vine semi-determinate; tolerant to major diseases.

Heinz 6201 (1548). For processing; early maturity (120-123 days); deep oblate fruit, uniform ripening; small, determinate vines; tolerance to fusarium wilt and cracking; bred for humid area production.

VF 145 7879. For processing; medium maturity (130 days); fruit round, deep globe, green shoulder; resistant or tolerant to verticillium (race 1) and fusarium wilt; most widely used processing tomato in California; has exhibited some limited crack resistance.

Chico III. For processing; adapted to wide range of growing conditions; medium-early maturity (125 days); medium-small, pear shaped, firm fruit; compact, determinate, exposed crown; resistance or tolerance to fusarium wilt and stemphylium.

NCX 317. Closely related to NCX 315. Uniform color with round fruit and concentrated set; small core with deep red color; fruit shape globe, thick walls; resistance to verticillium and fusarium wilts; adapted primarily to western United States.

NCX 316. Similar to NCX 315 and 317 but with greater crack resistance; high degree of success in humid areas.

VF 100. Early maturity (125 days); deep globe; uniform ripening; determinate; resistance or tolerance for verticillium and fusarium; mechanical harvest, compact habit.

New Yorker. Early maturity (120 days); medium, deep oblate to globe fruit; determinate, good cover; resistance or tolerance to verticillium wilt; Fireball type with better cover; difficulty with mechanical harvest; used for earliness.

Nova. Early maturity (120 days); pear shaped type; adapted to humid area; exhibits tolerance to verticillium and fusarium wilts. New release.

Land Preparation

Fields should be of regular shape so that the machinery has room to operate and turns can be made easily. Long rows are preferred as less is lost in turning. Uniform soil type is preferred so that the tomatoes ripen evenly. Tomatoes cannot tolerate wet soils, so good internal drainage and a low water table are essential.

Leveling is necessary in order that depth of planting, cultivation, and fertilizer placement can be controlled. A smooth, flat, firmly formed seedbed helps insure more uniform planting, emergence and growth. It also contributes to more accurate placement of fertilizer and weed control chemicals. Perhaps most important is the fact that a rough seedbed causes harvest delay since more soil and clods are picked up by the harvester due to the deeper cut required. Therefore, plowing, discing and landplaning must be done with care to provide soil with good tilth.

Land preparation for the tomato crop should begin as early as possible in the preceding fall. Organic matter from crops previously planted on the area can be incorporated into the soil by discing two or three times. The plow should be adjusted so that it will properly cover the crop residue and turn over a uniform furrow slice with a minimum of large air pockets. A fully mounted three point hitch rollover plow, sometimes called a two-way plow, is recommended for this operation. This type of implement eliminates dead furrows and leaves a smoother, more uniform field surface and a better seedbed condition.

After plowing, discing may be required to facilitate proper listing. The beds will pass through the winter in this rough condition. All operations described up to this point should be completed before fall rains so as to facilitate developing good seedbed conditions and avoid soil compaction. Beds of 152 cm, center to center, should be listed up in the fall as shown in Figure 7.

In the spring if weeds develop before planting time, they may be controlled by cultivation. These cultivations should be only deep enough to destroy the weeds and not so deep as to turn up new soil from within the bed that will bring new weed seed to the surface to germinate. Chemicals such as Paraquat or weed oil may also be used for this preplant weed control.

Planting

Planting for processing tomatoes necessarily involves the development of a sequential harvest program since all production must be carefully developed to assure a steady daily flow of fruit to the cannery. A sample schedule is presented in Figure 8. Studies and experience emphasize the effectiveness of scheduling plantings to achieve programmed sequential harvest flow.

Planting should begin when the soil temperature at a depth of 5 cm reads 13 degrees C or more between 11 a.m. and 12 noon for three consecutive days.

Plant Population

Efficient harvesting of tomatoes requires a uniform and concentrated fruit set and ripening period. Plant population is one of several factors used to control fruit set and ripening. High plant population promotes uniform fruit set, permitting the quick early set of only the first several flower clusters on the plant. This small amount of fruit per plant is offset by having a large number of plants per hectare.

Bed spacing is a factor to consider in plant population. It is recommended that spacing of 152 cm be used because these are more adaptable to twin row plantings, which need a wider area for vine occupancy.

Two rows of seed are planted per bed. The rows are 30 to 36 cm apart and centered on the bed.

Direct seeding can be done by planting in solid lines and thinning or by precision planting.

Figure 7

Furrow Profiles

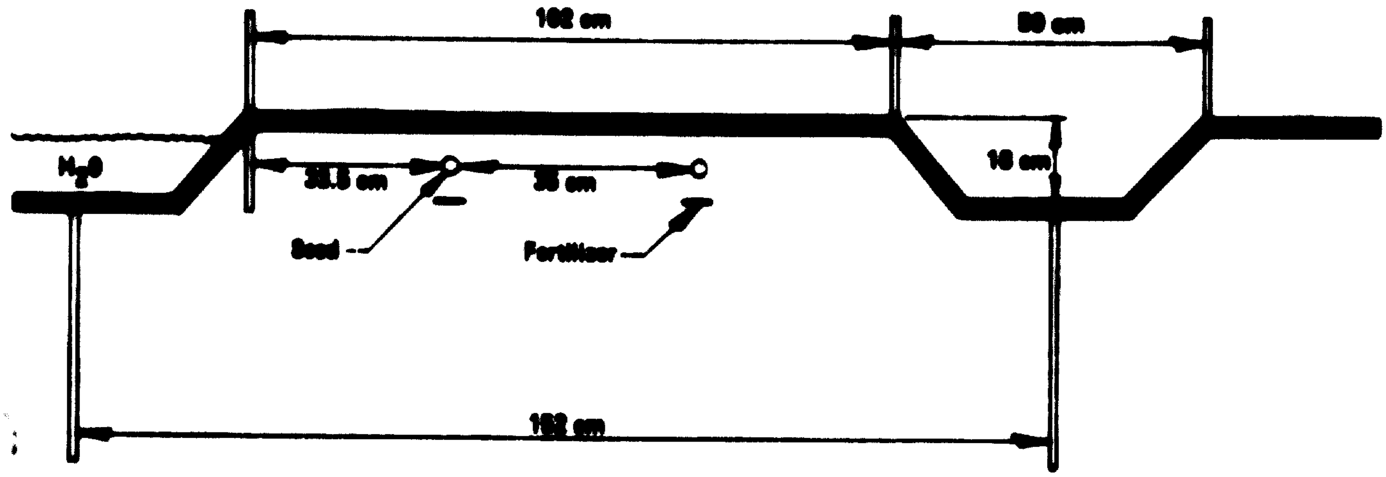


Illustration 1. Single Furrow Tomato Bed Profile—Precision Shaped

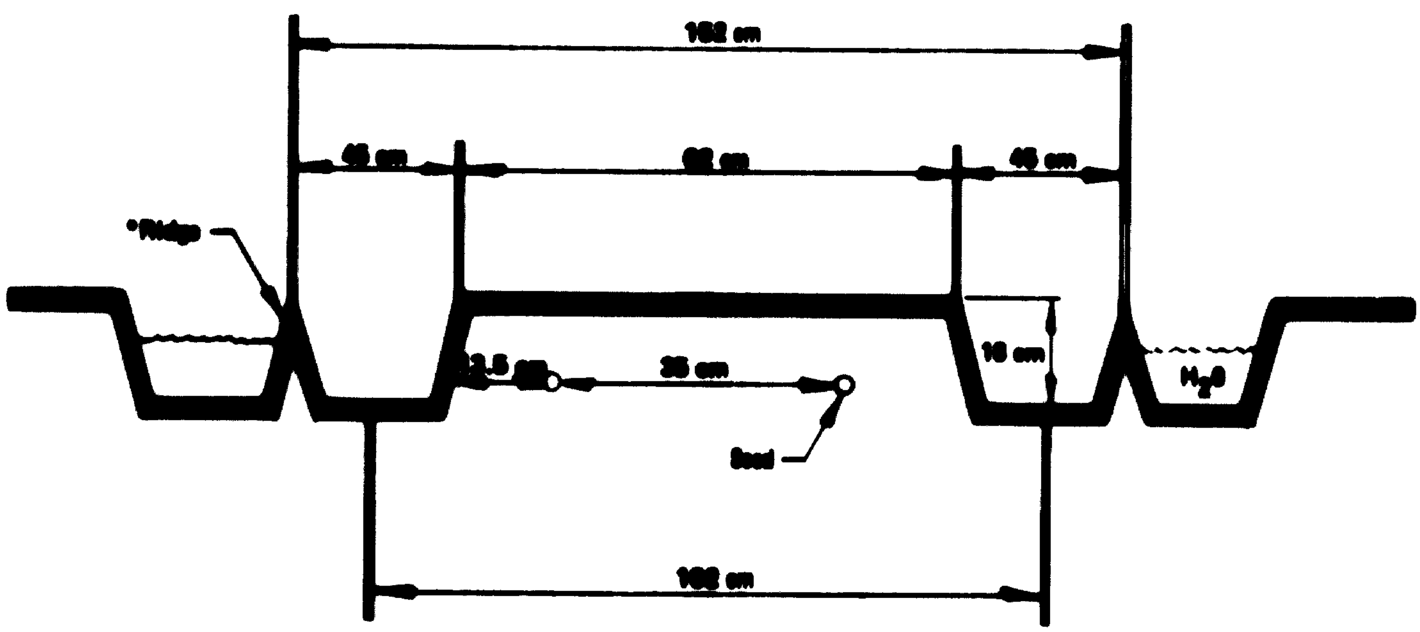
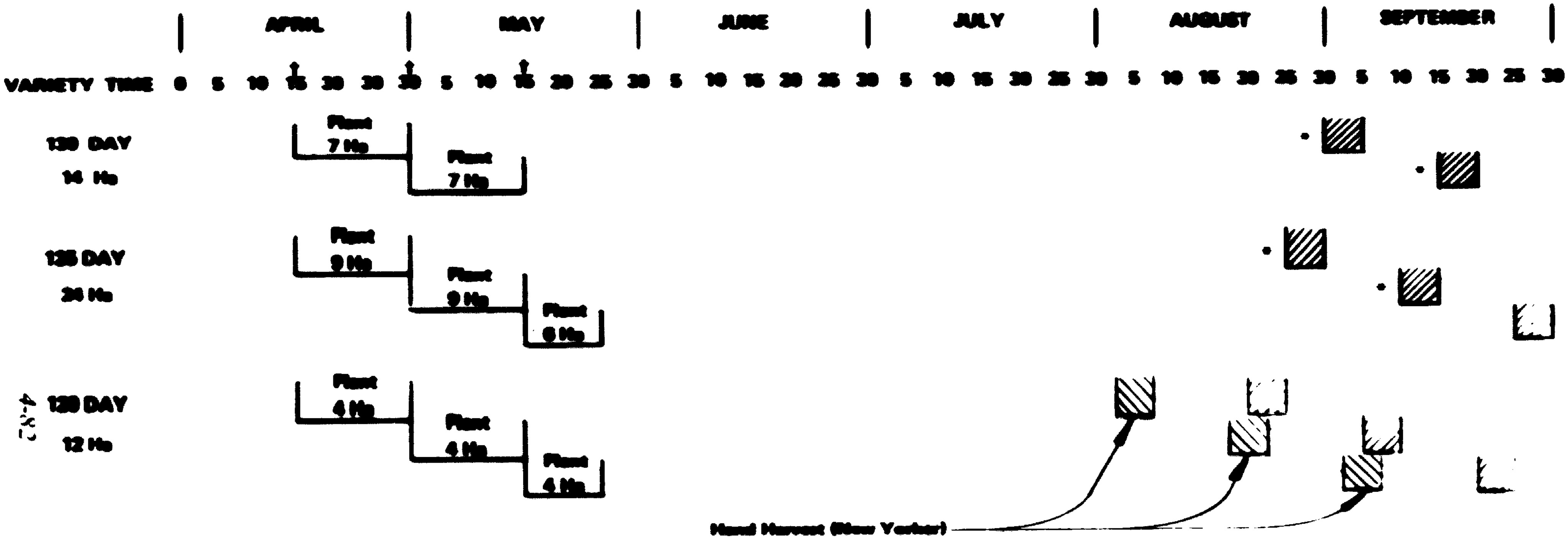


Illustration 2. Double Furrow Tomato Bed Profile—Precision Shaped

* Note: After emergence, the center ridge is split and the soil moved to the sides of the bed.

Figure 8

Sample Tomato Planting and Harvest Schedule for One Machine



130 DAY VARIETIES

(7) HEINZ 1370
(6) CENTENNIAL
(7) CHICO GRANDE
(6) VF EARLY CASTLEMECH

125 DAY VARIETIES

(2) VF 100
(2) NCX 316 (VF 316, VF 100)
(4) NCX 315 (VF 315)
(2) CHICO III (TAMU CHICO)
(3) NCX 317 (VF 317)
(3) CAMPBELL 28

(1) = Early
(7) = Late

120 DAY VARIETIES

(1) NEW YORKER**

* Requires 20 hour harvest day.
** Not well suited for mechanical harvest. One hand harvest prior to machine harvest suggested.
† Plant by this date or when plants show first true leaf.

Planting with a precision planter should be carried out dropping three to five seeds per clump, 25 to 30 cm in the row and with double rows 35 cm apart.

Trials of single row plantings of three to five seeds per clump, 15 to 23 cm in the row and 137 cm center to center could be carried out as well.

Thinning should be done when the plants are small, yet firmly rooted in the soil. This is usually when the plants are 8 to 12 cm high or at the two to four true leaf stage.

This early thinning results in less shock to the plants and a faster recovery of the plants and gives an earlier harvest and more uniformity between plants at maturity. It is not necessary to thin to single plants.

With precision planting, the size of stand (number of plants emerging) is extremely critical as a full stand is required for maximum yield. Soil crusting is a major factor in reducing the size of the stand, particularly in heavier soils.

In the United States, the problem of soil crusts is dealt with in a number of ways. Two of the more popular mechanical methods are:

- **Solid set sprinkler irrigation**. If enough equipment is available, a complete set can be left in the field until the stand is established. Light, frequent irrigation time to correspond with the emergence of the crop will usually insure a stand.

- **Rolling**. If the crust is light, a roller can be used to break it and allow the seedlings to emerge.

Non-mechanical methods of preventing the formation of a crust are:

- Petroleum mulch.
- Petroleum coke.
- Vermiculite sand.
- Phosphoric acid.

Transplanting becomes expensive with the high plant populations required for mechanical harvesting but can be done on single rows, placing hardened plants 10 to

15 cm tall 15 to 23 cm apart in the row or on double rows 25 to 30 cm apart in the row. A high phosphorus liquid starter solution should also be used in the transplant water.

Fertilization

The kind of fertilizer and rates of applications, of course, will depend on the soil type and its inherent fertility characteristics, amount of rainfall, soil leaching characteristics, previous crop history and amount of crop residues in the soil. A program of tissue testing is recommended and a listing of various suggested nutrient levels is presented in Table 25.

The use of a starter fertilizer is very important, especially for tomatoes planted early in cold soil. The phosphorus requirement of tomato seedlings is high, so to assure fast early growth, a band of fertilizer high in phosphorus must be placed directly under the seedling at a depth of about 5 to 7.5 cm below the seed. This permits early contact of the plant with the fertilizer.

Table 25

Critical and Safe Nutrient Levels for Tomato Tissue*

NITRATE NITROGEN (Dry Matter Basis)	
Safe Level	greater than 5,000 ppm
Deficiency Range	less than 2,000 ppm
PHOSPHATE PHOSPHORUS (Dry Matter Basis)	
Safe Level	greater than 3,000 ppm
Deficiency Range	less than 1,500 ppm
POTASSIUM (Dry Matter Basis)	
Safe Level	greater than 3.0 percent
Deficiency Range	less than 1.50 percent

Sampling of First Matured Leaf Down From Tip of Plant During Early Bloom

Stage of Plant**	NO_3N	Percent K	P
Early bloom	8,000	3	as above
Fruit 1 inch diameter	6,000	2	
First color	2,000	1	

* Western Fertilizer Handbook, third edition.

** Tyler, R. California tomato grower.

Either liquid or dry fertilizer equipment should be used to accurately place the fertilizer at a precision depth and alignment under the seed with a minimum of soil disturbance as shown in Figure 7.

Because the first root of the seedling goes straight down, the placement should not be more than one cm to either side, otherwise, the root will miss the fertilizer. During cold early spring planting, a critical time loss can be experienced while secondary roots are developing to contact the fertilizer if it has been placed outside the zone of primary root penetration.

Place sidedress fertilizer as close as possible to the tomato plants without injuring the roots. Where furrow irrigation is used, the fertilizer should be placed at about the same depth or slightly below the bottom of the irrigation furrow. Where sprinkler irrigation or rainfall will be used to make the fertilizer available to the plant, shallower placement is satisfactory.

Late application of nitrogen should be avoided as this frequently stimulates excessive late season vegetative growth and causes non-uniform ripening.

Lime and Fertilizer

Lime To give a pH of 6.0 to 6.8 and maintain a good calcium/sodium ratio (see Appendix, Soil Analyses).

Fertilizer Below are listed minimum and maximum rates. Adjust according to needs of particular piece of ground being cultivated. According to the soil samples, lower N and higher P_2O_5 and K_2O would be recommended.

All soils:	N kg/ha	P_2O_5 kg/ha	K_2O kg/ha
	50-200	100-300	100-300

Application Broadcast one-half to three-quarters before plowing or drill in deeply following plowing. Apply remainder in bands 5 cm deep and 8 to 10 cm from row.

Sidedress Determine which varieties may require additional nitrogen on sandy soils or badly leached soils. An application of 100 kg of nitrogen per hectare may be desirable at first fruit set.

Weed Control

Weed control is the most serious problem in tomato production. There are several herbicides that are registered for use on direct-seeded tomatoes and these are presented in the Appendix.

Chemical weed control on tomatoes is widely practiced and good results are obtained when:

1. Perennial weeds are controlled during non-crop periods of the year.

2. Proper rate of application for materials is used for the particular soil type.

3. Precision placement incorporation of the materials is practiced.

Incorporation of herbicides may be accomplished by discing or, more efficiently, by a tilther at planting. Certain oil based herbicides may be sprayed on the field, pre-emergence.

Tilthers used for application and incorporation have given more consistent weed control than disc incorporation, and this is the preferred method.

Cultivation

Cultivation is required to assist the chemical weed control program. The first cultivation can be a simultaneous operation with the fertilizer sidedressing. A second cultivation is frequently used and occasionally a third is used. This third cultivation, when possible, is usually restricted to the furrow and bed shoulders. Occasionally, because of rapid plant growth and untimely rains, only one cultivation is possible.

Sled-mounted cultivators with self-steering systems are more precise and will do a closer job of cultivating than tractor-mounted cultivators. However, more careful land preparation and good precision bed shaping are essential when using self-steering cultivators.

Irrigation

During the seedling growth and early flowering and fruit set, a high level of soil moisture must be maintained to obtain maximum yields. Moisture stress at any time through the fourth or fifth cluster set will decrease yields. After this, a decreased moisture is required to maintain the plant. This will slow the plant vegetative growth, but still permit proper fruit development and ripening.

Careful land leveling and land preparation are, of course, essential to achieve uniform irrigation of a field.

Low spots which puddle and receive excessive water or high spots which receive inadequate water, of course, will lower crop yields.

Two bed profiles are commonly used for tomatoes. Furrow type depends on the method of irrigation to be used. These bed profiles are pictured in Figure 7.

The single furrow bed is used where sprinkler irrigation is employed to germinate the seed and start plant growth.

As can be seen in Figure 7 the seed is about 33.5 cm from the edge of the furrow With this type of bed profile, using furrow irrigation to germinate the seed would require an excessive long period of time for the water to soak across the bed to the seed zone.

Where furrow irrigation is planned, this problem is overcome through use of the double furrow bed profile as shown in Figure 7 in the second illustration. It will also be noted in this illustration that the irrigation furrow is about 13.5 cm from the seed. This facilitates more rapid moisture saturation of the seed zone.

During the first cultivation after the plants have emerged, the soil forming the ridge separating the two furrows is divided and this soil is added to the two adjoining beds, thus forming a single furrow bed profile as in the first illustration.

Disease, Pest and Pathogenic Conditions

It is expected that the following diseases, pests and pathogenic conditions will be important in tomato production at Zagna Vadeni.

Diseases

Bacterial speck caused by *Pseudomonas tomato*

Bacterial spot caused by *Xanthomonas vesicatoria*

Damping off caused by *Rhizoctonia solani* and *Pythium* Spp.

Early blight caused by *Alternaria solani*

Anthracnose caused by *Colletotrichum phomoides*

Late blight caused by *Phytophthora infestans*

Leaf mold caused by *Cladosporium fulvum*

Septoria leaf spot caused by *Septoria lycopersici*

Stolbur, probably caused by a mycoplasm

Verticillium wilt caused by *Verticillium alboatrum*

***Orobranche* Sp.**

Pests

Aphids, various species

Colorado beetle, *Leptinotarsa decemlineata*

White flies, various *Aleyrodidae* Spp.

Pathogenic Conditions

Blossom end rot, dry set and puffiness, caused by lack of water.

Herbicide and crusting injury to young seedlings.

Potassium deficiency on VF varieties appearing after heavy fruit set.

Growth cracks.

Control

Diseases. To control the major foliar problems *Phytophthora, Alternaria, Septoria, Colletotrichum* and *Cladosporium* – the following spray program is recommended.

1. Beginning seven days after full emergence, treat every ten days with Zineb 75% W.P. at 2.24 kg per hectare for the first twenty-eight days.

2. For the remainder of the season or until *Phytophthora infestans* is seen in the crop treat with Maneb 80% W.P. at 1.7 kg per hectare or 1.2 kg per hectare Maneb 80% W.P., dithane M-45 80% W.P. or Manzate 200 80% W.P. PLUS 1.12 kg per hectare Dyrene 50% W.P. The spray interval must be determined from the climatic information. The *maximum* spray interval will be ten days.

3. After *Phytophthora* is seen, probably in the second half of August, treat with a copper spray, copper oxychloride or basic copper sulphate, to apply 3 to 5 kg metallic copper per hectare. The spray interval will be determined from the climate and the maximum interval will be ten days. It may be recommended also, depending on the disease conditions, to include Maneb with this spray (1.7 kg per hectare 50% W.P.).

(A spreader sticker should be used with all these sprays. Whenever Maneb is listed, use a formulation of Maneb plus zinc sulphate.)

Regarding the method of application, it is absolutely essential to have good ground spray machinery available. Machinery selected should cover the entire crop efficiently in two days.

The continued use of clean, treated seed in clump plantings, good field sanitation and a three year rotation period is also recommended. These precautions should help to control the incidence of *Pseudomonas, Xanthomonas*, damping off pathogens, Stolbur, double virus streak and *Verticillium*. Particular attention needs to be given to the disposal of tomato plant residue after harvest. Deep plowing or removal and burning are recommended; in no event should residue be left at the surface of the field because it is in such material that many pathogens survive.

Pests. The recommendations for the control of Colorado beetle, aphids and white flies are to spray with carbaryl or an organophosphate insecticide.

The insecticide spray recommended can be mixed with the recommended fungicides and a combination treatment applied. But *do not wait* to spray Colorado beetle until the next fungicide spray is due. Colorado beetle can be devastating during the first six weeks of tomato plant growth unless it is watched carefully and treated promptly.

Pathogenic Conditions. Take great care in land preparation and early irrigations to allow maximum root penetration and development. Subsequently during fruit setting and enlargement, it is necessary to be sure that the roots continuously have an adequate supply of water so that an internal water stress does not develop in the plants. These precautions will essentially eliminate blossom end rot and dry set problems.

If a shortage of irrigation water is anticipated, bear in mind that the round fruit varieties suffer much less from blossom end rot than long fruited varieties. However, there is no substitute for adequate water.

Care should be taken to apply only the recommended preplant herbicide concentrations and crusting must be avoided. These precautions will help avoid the occurrence of herbicide injury and will prevent delay of the crop and uneven ripening of plants.

Harvest

Harvesting processing varieties is a mechanized operation. If planting blocks are held to the proper size and planned according to the sequential scheduling advised earlier in this report, the number of difficulties encountered at harvest time should be reduced greatly.

Mechanical harvesting should begin when the field is 65 to 70 percent ripe. By the time peak harvest is reached, then the field will be 80 to 90 percent ripe. This reduces the loss in yield due to overripe product. Waiting until the field is totally ripe would mean that by peak harvest time a sizeable portion of the crop would have become overripe. A sampling procedure to establish tomato maturity is presented in Table 26.

The success of mechanical harvesting is naturally dependent on the selection of proper varieties and the implementation of suitable cultural practices that will together produce a crop adapted to machine harvest.

Table 26

Sampling Procedure for Establishing Tomato Maturity

1. When ripe fruit begin to appear:

   a. Choose sample area (1 meter of row per 10 hectares).
   b. Count all fruit from sample area and sort into ripe, green and rot categories.
   c. Determine percentage of each category.
   d. Plot on chart as presented below.

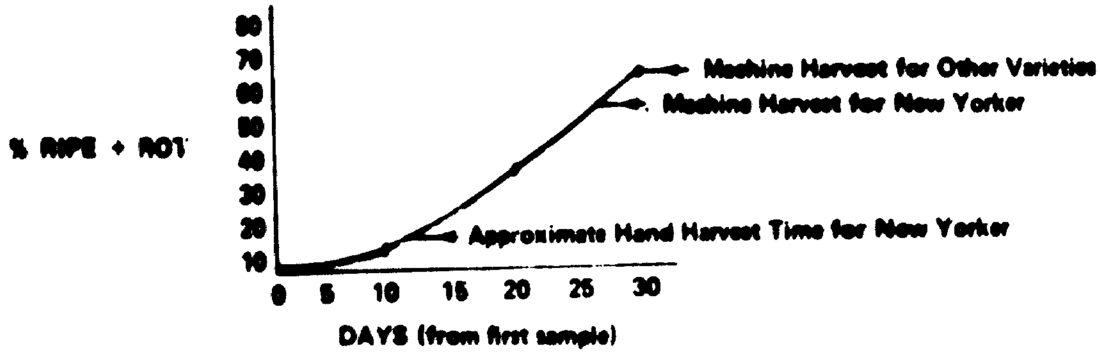
2. Repeat steps "a" through "d" above once per week (using different sample area).

3. When percent ripe plus rot reaches 50, sample once every two days.

4. When percent ripe plus rot reaches 65, begin harvest (except New Yorker).

   a. Hand harvest New Yorker variety at 15 percent ripe plus rot.
   b. Machine harvest New Yorker (following hand harvest) at 55 percent ripe plus rot.
   c. Rate of ripening (slope of graph plot) gives indicator of required harvest speed.

SAMPLE PLOT OF TOMATO RIPENING RATE



The machine cuts the plants off just below ground level, elevates them into the machine where the fruit is shaken free of the vines. The vines are discarded and the fruit is conveyed along a grading table where workers sort the fruit. Then the fruit is discharged into a trailer which is pulled along side the harvester. The trailer is then used to transport the fruit directly to the processing plant.

This innovation in handling tomatoes by bulk loading directly into trailers or trucks eliminates the need for bins and the handling associated with them.

Tomatoes have been bulk loaded up to 1.2 meters deep with good success. The trucks or trailers are hauled directly to the cannery where they are dumped into water flumes.

Equipment Recommendations

The following is a list of recommended equipment for 500 hectares:

2	100+ HP wheel tractor
1	80+ HP wheel tractor
3	Two-way, five-bottom plows
2	Subsoil chisel
1	Landplane
3	Bed shaping device capable of forming and shaping beds, incorporating herbicides, fertilizing, cultivating and planting in one or more operations.
2	Air row crop sprayers
2	Heavy-duty wheel controlled offset discs
2	Ring rollers (cultipacker)
10	Tomato harvesters
2	High pressure washer for tomato harvester
15	Bulk trailers (12 ton capacity)
12	40HP wheel tractors
1	Harrow (peg tooth or spring, 7 meters)

PEAS

The basis for pea production at Zagna Vadeni is good and only slight modifications need be made to insure full mechanization.

Varieties

The desired characteristics of pea varieties for canning at Zagna Vadeni are:

- Clear or colorless skin.
- Good starch retention.
- Majority of peas with diameter 6 to 9.5 mm.
- Concentrated pod set.
- Upright growth habit.
- Adapted to humid production areas.
- Suitable range of maturation times.

The varieties presently in use are suitable for present demands, however, for further field mechanization and the production of a greater amount of high quality peas, the following varieties are recommended for trial evaluation.

Wasatch. 64 days to harvest. Requires 1400 heat units (see Appendix, "Predicting Maturity by Heat Unit Method"); large seeded, medium-early, some wilt resistance.

Sieve Size*:	1	2	3	4	5	6	7
Percent:	2	5	12	22	22	26	11

Perfection 3040. 69 days to harvest. Requires 1610 heat units (see Appendix); Early Perfection canner, wilt resistant, root rot tolerant, wrinkled seeds.

Sieve Size:	1	2	3	4	5	6	7
Percent:	1	4	11	24	32	24	4

* Sieve Size 1-7 corresponds approximately to diameters of .72, .76, .80, .84, .88, .92, and .96 cm respectively.

Perfection WR-112. 71 days to harvest. Requires 1680 heat units (see Appendix); late season, wilt resistant, root rot tolerant, wrinkled seeds.

Sieve Size:	1	2	3	4	5	6	7
Percent:	2	5	12	33	34	13	--

Pride. 65 days to harvest. Requires 1400-1500 heat units (see Appendix); vine 66 cm, medium dark; pod 8-25 cm, blunt, straight, light green; seed medium-large sized, wrinkled; wilt resistant.

Dot. 58 days to harvest. Requires 1200-1300 heat units (see Appendix); vine 75 cm; pod 5.5 cm; seed dimpled, small.

Famous. 67 days to harvest. Requires 1500-1600 heat units (see Appendix); vine 65 cm, medium dark, fairly heavy; pod 8.75 cm, light, blunt, double; seed medium sized, wrinkled; wilt resistant.

Target. 61 days to harvest. Requires 1300-1400 heat units (see Appendix); vine 65 cm; pod 8.75 cm, blunt with high percentage of doubles; seed small, wrinkled; wilt resistant.

Alaska WR. 58 days to harvest. Requires 1200-1300 heat units (see Appendix); vine 75 cm; pod 5.5 cm, straight, blunt; seed round and smooth, pale green color.

Star. 58 days to harvest. Requires 1200-1300 heat units (see Appendix); vine 75 cm; pod 5 cm, high percentage of doubles; seed smooth.

Land Preparation

Fall discing and landplaning in two directions are recommended. Soil should be dry when these operations are performed to prevent unnecessary compaction. These operations should be performed in addition to plowing, to produce a more uniform seedbed and to fully incorporate the fertilizer.

In the spring, a second discing to incorporate nitrogen applications is recommended. The practice of mounting a spray boom on the front of the disc and towing a spray trailer for application and incorporation of trifluralin results in better weed control if the depth and speed of the disc is controlled. This practice prevents volatilization and photodecomposition of the herbicide.

Following the disc with a roller or drag may be necessary to further prepare the seed bed.

Planting

The general planting methods employed are good although planting machinery with more uniform depth control and band placement of fertilizer should be employed. Higher plant populations have been found to increase yields in some cases.

A general rule of thumb indicates the slender and more indeterminate vine types like Alaska should have a heavier planting rate of 25.24 plants per meter (fertility and moisture being adequate) while the heavier vine Perfection types should be planted at a rate of 16.40 to 22.96 plants per meter.

Table 27 is computed for a standard 17.5 cm (7 inch) drill showing *pounds per acre** to be planted to establish a stand of either 25.24 plants per meter (8 plants per foot), 22.96 plants per meter (7 plants per foot), 19.44 plants per meter (6 plants per foot), or 16.40 plants per meter (5 plants per foot) based upon seed count and germinable seeds per pound (seed count per pound as well as germination percentage is indicated on each shipment of seeds to aid in calculation of seeding rates).

It is recommended that the degree day method of predicting harvest maturity and scheduling planting should be used at Zagna Vadeni as this will provide a more even flow of uniform, high quality raw material into the cannery. This method is discussed in the Appendix. An example of this method is presented as follows:

Planting Schedule

1. 30 degree days will be added each day at harvest time for the sample area. (Determined by empirical calculations for the sample area using the following formulae:

$$\text{Daily Mean Temperature (DM) (degrees F)} = \frac{\text{Daily Maximum Temperature (degrees F)} - \text{Daily Minimum Temperature}}{2}$$

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* To Convert: plant per foot to plant per meter: multiply by 3.28
pounds per acre to kilograms per hectare: multiply by 1.12
inches to centimeters: multiply by 2.54
seeds per acre to seeds per hectare: multiply by 2.47
seeds per pound to seeds per kilogram: multiply by 2.20

Table 27

Pounds of Seed Planted in 7 Inch Rows to Establish:

Average Seeds Per Pound	8 Plants/Foot Germination Percentage				7 Plants/Foot Germination Percentage				6 Plants/Foot Germination Percentage				5 Plants/Foot Germination Percentage				Average Seeds Per Pound
	100	95	90	85	100	95	90	85	100	95	90	85	100	95	90	85	
1600	373	381	414	439	327	344	363	384	280	295	311	329	233	246	259	275	1600
1700	351	370	390	415	307	323	342	362	263	277	293	310	220	231	244	258	1700
1800	332	350	369	390	290	306	323	342	249	262	276	293	207	218	230	244	1800
1900	313	331	349	370	265	290	306	324	236	248	262	277	196	207	218	231	1900
2000	299	314	332	351	261	275	290	307	224	236	249	263	187	196	207	220	2000
2100	284	299	316	334	249	262	276	293	213	225	237	251	178	187	197	209	2100
2200	271	286	302	319	238	250	264	279	204	214	226	240	170	179	189	200	2200
2300	260	273	288	305	227	239	252	267	195	205	216	229	162	171	180	191	2300
2400	247	262	276	293	218	229	242	251	186	196	207	220	156	164	173	183	2400
2500	239	251	267	281	209	220	232	246	179	189	199	211	149	157	166	176	2500
2600	230	242	255	270	201	212	223	236	172	181	191	202	144	151	160	169	2600
2700	221	233	246	260	193	204	215	228	166	175	184	195	138	146	154	163	2700
2800	213	225	237	251	187	196	207	220	160	168	178	188	133	140	148	157	2800
2900	206	217	229	242	180	190	200	212	154	163	172	182	129	136	143	151	2900
3000	199	210	221	234	174	183	194	205	149	157	166	176	124	131	138	146	3000
Approximate Viable Seeds Per Acre	597,384				522,711				448,038				373,365				

Degree Days = DM - 40 degrees F) *

2. If harvester and/or cannery capacity is 5 hectares per day, plant 5 hectares and wait until 30 degree days have elapsed to plant the next 5 hectares. Repeat until total area is planted.

Harvest Prediction

1. The variety Pride requires 1,400 degree days to reach a tenderometer reading of 100.

2. From local past records converted to degree days, 1,400 degrees days are elapsed from the period April 15 to June 20 and harvest will probably begin on June 20.

3. From seasonal records a cumulative total of degree days is kept and the June 20 harvest date is modified accordingly.

Fertilization

Approximate fertilizer rates should be 40-60 kilograms N per hectare, 60-80 kilograms P_2O_5 per hectare, and 50-80 kilograms K_2O per hectare. However, it is recommended that a split application procedure be adopted, whereby 1/2 to 2/3 of the phosphorus and potassium be applied in the fall and the remainder, plus all of the nitrogen application, be made as precision placed bands at planting. Liming to correct the calcium/sodium ratio would be beneficial (see Soil Analyses Appendix).

Irrigation

Although the precipitation patterns (see Figure 2) indicate that irrigation would not be necessary, trials should be conducted with supplemental overhead irrigation (particularly in periods of drought) to determine whether the increased yields could pay for the investment. Drainage to decrease salt content is also recommended.

Weed Control

The materials presently in use are generally satisfactory However, in addition to trifluralin preplant applications (by disc incorporation), topical application of DNBP

* To convert degrees C to degrees F: degrees C + 17.98 x 1.8 = degrees F

may be necessary for the control of Brassica species. A newly developed material, IGRAN, or 2,4-DB, may provide more effective selective weed control and trials with these materials should be conducted.

Cultivation

None should be necessary with adequate chemical weed control.

Disease, Pest and Pathogenic Conditions

The continued use of disease-free, treated seed, careful field sanitation and a three to six year crop rotation will insure that *Ascochyta* and *Peronospora* and other diseases do not become serious problems in pea production.

The pea aphid (*Acynthosiphon onobrachis*) can be controlled with parathion applications and carbaryl can be used for outbreaks of lepidopterous pests.

Harvest

Since the varieties recommended have various maturation dates and it is critical to harvest peas at the precise moment of optimum maturity to insure uniform high quality for export (tenderometer reading of 100), a planting and harvesting scheme becomes extremely important. Harvest delays of one or two days can produce a product of greatly decreased quality. Therefore, the adoption of a planting and harvesting scheme based on the heat unit method (see Appendix) is recommended.

Also for the expanded requirements of Plan III, a more efficient system of harvesting and hauling is needed, which necessitates the use of mobile viners.

Equipment List for 1500 Hectares

3 3 meter seed drills with adjustable depth control and separate fertilizer placement.

3 5 meter wheel controlled offset discs with spray boom, tank and pump.

2	3 meter pea windrowers
10	Pull-type mobile viners
4	Subsoil chisels
2	Harrows (spike tooth or spring, 7 meters)
6	2-way plows (5-bottom)
2	12 by 9 meter landplanes
4	85 HP tractors
2	65 HP tractors

GREEN BEANS

Varieties

Green bean varieties grown at Zagna Vadeni should meet the following requirements:

- Dark green pod color.
- Meaty or fleshy pods free of strings or fibers.
- Slow seed development.
- Straight pods, round in cross-section.
- Concentrated pod set, uniform maturity (bush type).
- High placement of pods.
- Adapted to humid production area.

The varieties recommended for trial are:

Bush Blue Lake 274. 58 days. Plants are bush type with pod characteristics of the Blue Lake pole bean; plants are 30 to 57 cm high and vigorous; pods are 15 cm by 0.8 cm, round, straight and of high quality; tolerant to common bean mosaic and to N.Y. 15 strain.

Niagara 773. 59 days. An outstanding new bush variety especially well suited for mechanical harvesting. Bush is 50 to 60 cm in height, very vigorous; plants are dark green in color; pods 15 to 16.5 cm long by .95 cm wide; pods medium dark green and fleshy with extremely slow seed development; seeds white, about 1,300 per pound; resistant to common and N.Y. 15 strains of bean virus 1. Primarily a canning and freezing variety with very high yield potential and slow seed development. There is some indication that nitrogen requirements are not as high as for most other varieties. A Niagara introduction.

Slimgreen. 60 days. For market and processing use. Plants are bush type, tall and erect with concentrated set; pods are 13.75 to 15 cm by .95 cm, straight, smooth and slender with a round cross section and medium dark green in color; seeds are white. Resistant to common bean mosaic.

Sprite. 54 days. For market and processing use. Plants are bush type, 40 to 45 cm high, vigorous and heavily productive, erect; pods are 12 to 13.75 cm, slim, long, straight and medium green in color, nearly round; seeds are off-white. Resistant to common bean mosaic. Should be harvested at proper edible stage. Harvest when 80 percent or more is No. 4 sieve for processing.

Gallatin 50. 53 days. A Tendercrop type for processing, and for home garden use. Plants are 40 to 45 cm high, vigorous, erect and medium green in color, with the pods held high on the plant; pods are 12 to 13.75 by .93 cm, quite straight, smooth, and round to creaseback; medium dark green in color, they are good quality; seed develops slowly, ivory white. Resistant to mosaic, N.Y. 15 virus and pod mottle.

Early Gallatin. 57 days. A white seeded variety in the large sieve class suitable for canning and freezing; styles, cut and French; plant habit is erect, slightly spreading under weight of pods; pod set is concentrated and heavy and located in center and top of plant; length of No. 4 sieve is about 11.25 to 11.88 cm; pod shape is round to slightly compressed in the No. 4 sieve; external color is medium to medium dark green; pod walls are thin; seed growth and pod development are slow. Resistant to common and N.Y. 15 strain of bean virus 1.

White Seeded Tendercrop. 57 days. (GB13) Plant is 45 to 52 cm tall, upright growth, very productive; pods are 15 by .93 cm, round and slightly creaseback;

smooth, meaty, dark green with slow seed development, slightly slimmer than Tendercop; seed is white. Jointly released by the New York A.E.S. and USDA. Very similar to Tendercrop in all characteristics except for the white seed.

Picker. 54 days. Plant is about 43.5 to 50 cm; pods straight and smooth; white seeded. Resistant to common and N.Y. 15 strain of bean virus 1. Designed for machine harvest.

Land Preparation

Land preparation similar to that for tomatoes and peas should be employed for green beans.

Production of green beans on slightly raised beds and employing furrow irrigation to supplement natural rainfall is used in many areas of the world to provide high quality green beans due to the lessened amount of disease on the pods. The raised beds (6-10 cm) should be formed in the fall on 75 cm center to center spacing.

Planting

Planting should be done with an accurate, calibrated and reliable planter, equipped with band fertilizer placement attachments. The 25.24 plants per meter (8 plants per foot)* population is recommended for the 75 cm row spacing at Zagna Vadeni. Table 28 is a planting chart to help in calculating seeding rates.

Planting, particularly for mechanical harvest, must be strictly planned, for it is critical that a steady supply of uniform quality green beans move to the processing plant. Thus it is recommended that a heat unit system as recommended for pea production be developed for green beans so that planting and harvest dates can be accurately planned.

Fertilization

Fertilizer rates should be the same as for peas. Green beans are particularly sensitive to salt accumulation and care should be taken to correct the problem in soils used for beans. However, a split application is recommended whereby 1/2 to 2/3 of the phosphorus and potassium be applied broadcast in the fall or spring prior to

* See RECOMMENDATIONS–PEAS–Planting for conversion chart.

Table 28

Seeding Rates for Snap Beans*†

The pounds of snap bean seed/acre required to obtain six plants/foot in rows 3' apart as determined by the average number of seed/pound and % germination

Average Number Seeds/Pound	Percent Germination									Average Number Seeds/Pound	Percent Germination								
	100	95	90	85	80	75	70	65	60		100	95	90	85	80	75	70	65	60
1000	87	92	97	102	109	116	124	134	145	1440	60	64	67	71	75	81	87	93	101
1020	85	90	95	100	107	114	122	132	142	1460	60	63	66	70	75	80	85	92	99
1040	84	89	93	98	105	112	119	130	140	1480	59	62	65	69	74	78	84	91	98
1060	82	87	92	97	103	110	117	127	137	1500	58	61	64	68	73	78	82	90	97
1080	81	85	90	95	101	107	115	124	134	1520	57	60	64	67	71	76	82	89	96
1100	79	84	88	93	99	105	113	122	132	1540	57	60	63	67	70	75	81	87	94
1120	78	82	87	92	97	104	111	120	130	1560	56	59	62	66	70	74	79	86	93
1140	76	81	85	90	96	102	109	117	127	1580	55	58	61	65	69	73	78	85	92
1160	75	79	84	89	94	100	107	115	125	1600	54	57	60	64	68	73	78	84	91
1180	74	78	82	87	92	98	105	113	123	1620	54	57	60	63	67	71	76	82	90
1200	73	76	81	85	91	97	104	112	121	1640	53	56	59	62	66	71	76	82	89
1220	71	75	79	84	90	95	102	110	119	1660	52	55	58	62	66	70	75	81	88
1240	70	74	78	82	88	93	100	108	117	1680	52	54	58	61	65	69	74	79	87
1260	69	73	76	81	87	92	98	106	115	1700	51	54	57	60	64	68	73	79	85
1280	68	71	75	81	85	91	97	105	113	1720	51	53	57	60	63	67	73	78	84
1300	67	70	75	79	84	90	96	103	112	1740	50	53	56	59	62	67	71	76	84
1320	66	69	74	78	82	88	94	101	110	1760	49	52	55	58	62	66	71	76	82
1340	65	68	73	76	81	87	93	99	108	1780	49	52	54	58	61	65	70	75	82
1360	64	67	71	75	81	85	92	98	107	1800	48	51	54	57	60	65	69	75	82
1380	63	66	70	74	79	84	91	97	105	1820	48	51	53	57	60	64	68	74	79
1400	62	65	69	73	78	82	89	96	104	1840	47	50	52	56	59	63	68	73	79
1420	61	65	68	73	76	82	88	94	102										

* William Hollis, Department of Horticulture, University of Maryland; Hort. Research, Mimeo 13, January 1958, Revised November 1963.

† For seeding rates giving 7 plants/foot multiply above rates by 1.17; for 8 plants/foot multiply by 1.34; for 9 plants/foot multiply by 1.51.
For 38" rows multiply above rates by 0.94; for 30" rows multiply by 1.2

To convert: see PEAS–Planting

planting, the remainder of phosphorus and potassium be applied, along with 2/3 of the nitrogen, in a band 5 cm below and 10 to 12 cm to the side of the seed at planting, and the remainder of the nitrogen applied about midway during the growing season as a sidedressing.

Weed Control

Preplant weed control of annual grasses can be obtained with trifluralin or EPTC suitably incorporated, as discussed for pea production A post-plant, pre-emergence spray of DNBP or Chloro-IPC can also be used, particularly if Hibiscus, Solanaceae Lactuca and Sunchus species become problematic. Other herbicides recommended for trial are IGRAN (Ciba-Geigy), KERB (Rohm and Haas) and LASSO (Monsanto).

Cultivation

Mechanical and manual cultivation will undoubtedly be necessary in the near future, particularly if resistant weeds become a problem.

Irrigation

Although no extensive irrigation is practiced now, it is recommended that surface (or subsurface) irrigation trials be developed. Supplemental irrigation will insure higher, more uniform and more concentrated yields while surface (or subsurface) irrigation can reduce the amount of bean diseases, particularly Anthracnose and bacterial blight.

Disease, Pest and Pathogenic Conditions

The continued use of disease-free seed, careful field sanitation and a three year rotation should insure that neither *Xanthomonas* nor *Pseudomonas* will become severe problems. These measures will also help reduce the chance of damage from *Fusarium*.

Harvest

It is important that the harvest be orderly and well planned to insure a uniform product flow to the cannery. This is particularly important when mechanical harvest (as recommended) is developed so that proper utilization of the machinery can be realized. Data for development of a heat unit system should be collected and a system developed. A useful method for determining stage of maturity for harvest is the ratio of percentage of small pods (sieve size* 4 and under) to large pods (sieve size* 5 and 6).

The most common ratios used for determining the proper harvest stage are 70:30 (70 percent of pods sieve size 4 and under and 30 percent of pods sieve size 5 and 6), 65:35 and 60:40.

Equipment List for 1100 Hectares

4 4-row, adjustable spacing bean planters, trail type with fertilizer equipment.

3 5 meter offset discs, wheel controlled with sprayboom, tank and pump.

12 2-row (75 cm) green bean combines.

3 Subsoil chisels.

2 Harrows (spike tooth or spring).

5 2-way plows (5-bottom).

2 12 by 9 meter landplanes.

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Sieve Size	Thickness	
	Round Pods	Flat Pods
1	less than 5.74 mm	
2	5.74 mm but not 7.34 mm	less than 5.74
3	7.34 mm but not 8.33 mm	5.74 mm but not 7.34 mm
4	8.33 mm but not 9.25 mm	7.34 mm but not 8.33 mm
5	9.25 mm but not 10.69 mm	8.33 mm but not 9.25 mm
6	10.69 mm or more	9.25 mm or more

4 Cultivation units (4-row) for mechanical cultivation.

2 65 HP tractors

3 85 HP tractors

MISCELLANEOUS PRODUCTS

Peppers

The basic technology used for tomatoes should also be applied to pepper culture with the exception that peppers should be grown on one meter beds (1 m center to center) in two seed lines, 36 cm apart. No useable harvester exists for harvesting the bell-type peppers so these must be harvested by hand. Trials using the green bean harvester for harvesting paprika peppers (dried, powder) on 75 cm single rows have shown considerable success.

Cucumbers

The technology in use for cucumbers is generally good; however, for mechanical harvest, high populations (197,600 to 247,000 plants per hectare) are necessary. Pickling varieties (SMR 58, Pioneer, Piccadilly, Pixie, Chipper, Early Pik) adapted to mechanical harvest in the United States have not been received well in Europe as the pickles produced are of too large a size (14-15 cm by 6 cm).

Miscellaneous Vegetables

The other vegetables produced (onions, carrots, okra, spinach, potatoes and eggplant) could be mechanized when the quantity required by the processing plant reaches a significant amount. Presently, with the demand being for mixed specialty products, the need for large-scale mechanization does not seem great.

Agronomic Crops

Since it is recommended that large-scale mechanization be developed for the three major vegetable crops, it appears logical that the requirements for agronomic crops be met by outside purchase from state farms specializing in these crops and producing on lower value land.

Meat

Meat requirements would also be more logically obtained from outside sources as chilled carcasses.

Fruits

It is possible that the development of deciduous fruit orchards could be feasible in the Zagna Vadeni area. But since these fruits (particularly peaches and apricots) could, at times, conflict with the major industries of peas, beans, and tomatoes, they should not be considered as a major product.

PROCESSING PLANT

TOMATO PASTE AND TOMATO JUICE PROCESSING LINES

Description

A line to process ten tons per hour of tomatoes for the production of tomato paste, and five tons of tomatoes for tomato juice, has been designed in such a manner to allow common receiving and preparation prior to the specialized unit operations for each product. This integration of portions of the lines reduces the capital investment as compared to installing two completely separate lines. The line is designed to allow the future addition of a bulk storage system for reprocessing tomato products off season.

Reception

The tomatoes are received in the processing plant in bulk trailers with the capacity of approximately five tons. The trailers pull up on a low platform along-side a bulk hydro-receiving tank. The trailer is elevated on the side opposite the tank, and the tomato load is dumped into the water. Raising the side of the trailers gives the opportunity to regulate the rate at which the tomatoes are fed into the tank. The hydro-receiving method cushions the fall of the product and prevents breaking the tomatoes. The tank is equipped with a circulating pump that moves the product toward the exit end to a belt elevator. The movement of the water around the tomatoes in the tank also helps loosen any dirt on the fruit.

The tomatoes are carried in a flume system to the beginning of the line.

Washing

The washing is done in a flood-type washer, which gives maximum washing efficiency due to its adjustable flood-type spray nozzles, coupled with silt and refuse removal filter screens to insure clean washing, gentle product handling and sanitary operations. A goose-neck type discharge elevator provides direct discharge of washed product to the following operation. A single stage impeller type pump is used to circulate the water. Fresh water from the intake is used for the final sprayer and water from the front of the washer is discharged as sewage.

Sorting

The clean fruit is brought to a sorting station where cull fruit is removed from the incoming tomatoes by means of a Roto-Sort. This machine assists in the sorting by presenting the tomatoes to the operators in rows on the reel rotating before them. This permits a removal of culls by a flick of the finger. No two operators inspect the same tomato and accordingly responsibility is divided equally among all operators. This results in improved sorting accuracy, increased output per operator, and reduced floor space.

Preparation

The tomatoes coming from the Roto-Sort grading station are dropped into a tomato chopper designed to receive all the tomatoes and to chop them into small pieces, preparatory to unit operations. The whole tomatoes are dumped directly into the feed hopper and fed into a rotating screw. The product is conveyed forward by the screw and forced through the openings of the sheer plate. A rotating cutter connected to the screw shaft cuts the tomatoes in small pieces as they are extruded through the discharge end of the sheer plate. The chopped product is then discharged into a hot break tank which is usually installed below the chopper. This allows the chopped tomatoes to be heated almost instantaneously to 92 degrees C.

This operation is called hot break, and inactivates the pectic enzymes which if allowed to react would destroy the natural pectins of the tomato and accordingly reduce the viscosity of the final product.

In the case of tomatoes going to juice production, the temperature of the hot break tank is decreased to 60 degrees C in order to reduce the loss of Vitamin C in the juice. After the hot break tank, the product is then diverted either toward a paste line or a juice line.

TOMATO PASTE

Presterilization and Flashing

The product is delivered from the hot break tank by means of positive displacement pump to a sterilizing pre-heater. Here, the chopped tomato pulp is heated to approximately 117 degrees C in a steam jacketed tubular type heat exchanger to destroy thermophilic bacteria and presterilize the pulp. Automatic controls are provided to maintain a constant sterilizing temperature. From this pre-heater the product is discharged into a flash tank at atmospheric pressure. This return to atmospheric pressure flashes off vapor sufficient to drop product temperature below 100 degrees C; this allows part of the water to be removed from the product and accordingly reduces the load on the evaporators. It also allows a better separation of pulp from skins and seeds in the pulpers and the finishers.

Pulping

The pulper has rotary paddles which move the product from feed end to discharge, driving the pulp through perforations in the screens surrounding the paddles. The seeds and peel are retained by the screens and discharged from the end of the machine while the pulp is discharged through a bottom opening and into the finisher which is located immediately below the pulper.

The finisher operates in the same manner as the pulper, but with finer screens to remove smaller particles of pomace which are discharged from the end of the machine. The product then passes through the screen discharges on the bottom of the finisher to a holding tank prior to evaporation.

The holding tank provides surge capacity prior to the evaporators. The capacity of the tank is 3,000 gallons or more than one hour line production.

Concentration

The tomato juice is brought to a final concentration of 32 percent solids in a double effect backwards flow, recirculating, induced circulation evaporator. This assures the highest efficiency and the best quality for a hot break tomato paste. The evaporator is fed approximately 8,200 kilograms per hour of tomato juice, and removes approximately 6,600 kilograms of water per hour, to produce over 1,500 kilograms of paste an hour.

Sterilization

The paste coming out of the evaporator is run through a scraped surface heat exchanger for final sterilization before filling and closing.

Canning

The can filler is a six nozzle piston type unit with a filler bowl to receive product from the scraped surface heat exchanger. Rotation of the filler bowl in combination with a stationary plow plate tends to drive the product into the cylinders on the piston ground stroke to assure uniform filling and accuracy. The filler has a no-can-no-fill provision to avoid product spillage if cans are not in place to receive the product during the filling cycle.

The filled cans are discharged from the filler and smoothly transferred to a modified straight line feed to the can closing machine. A chute in the can closing machine holds a supply of lids for the top end of the cans. The lids are automatically marked with the code number to identify the product by date or other classification and then placed in the can body. A double seam is then formed between the can lid and the body by the closing machine. Ends do not rotate in the seam forming operation thus minimizing the tendency to spill.

The filled closed cans then proceed to the pasturizer-cooler-dryer. This is a complete unit made up of three sections. The first section is a sterilizing section in which steam is directed toward the top of the can, and therefore sterilizes the inner surface of the can lid and the product in contact with it. The second and main section of the machine is to spray cold water on the surface of the can which upon evaporation provides a cooling effect to the paste, and therefore preserves the good color of the product. The third section is a blower-dryer combination at the discharge end, which has two individual air passages. The first passage removes excess water from the top of the can and the second passage provides for the drying of the can, and accordingly prevents rusting during storage.

Due to the low capacity of this line, it is recommended that labeling, casing and case sealing be done manually.

TOMATO JUICE

Extraction

The juice is extracted on a super extractor employing the screw principle to press the juice from the tomatoes. The juice is pressed out by means of a revolving screw surrounded by a close fitting screen through which the juice is strained. The machine has a nickel silver screen, and all sheet metal parts and all other contact parts are of stainless steel.

Deaeration

The main feature of the deaerator is to maintain high quality, natural color and flavor which is imperative for a high quality product. It also helps preserve Vitamin C which would be oxidized and lost if the juice is not deaerated.

The unit is completely automatic which assures dependable flash control at all times. The rate of flow is regulated by the modulating valve, activated by a float mechanism and stainless steel float in the product pool; accordingly, it is impossible to flood the deaerator.

The machine is essentially a vacuum chamber formed by: the deaerator cover; a product flow system (including an inlet tee, modulating valve, inlet pipe, elbow and spray assembly); a vacuum system employing a steam jet or mechanical pump; and the dual control system.

Sterilization

The deaerated juice is then pumped through a plate heat exchanger for final sterilization before filling. The plate heat exchanger is comprised of a plate rack containing a predetermined number of corrugated heat transfer plates. The number and size of the plates are determined by the flow rate, physical properties of the product to be treated, temperature progressions and heating duty. Joining plates are spaced by gaskets which form a narrow uninterrupted space through which the liquids flow. The configuration is such that intermixing is impossible from plate to plate. The corrugations in the plates create a liquid turbulence which assures rapid heat transfer and also avoids the formation of any heat and insulating films. The same plate heat exchanger can be used to bring the product to sterilizing temperature, then to filling temperatures before it is filled in the cans.

Canning

The juice is filled into the cans by means of a juice filler which is designed to fill practically any light, free flowing liquid into a container without spillage and waste.

All working parts are entirely enclosed, protecting them in wash down operations. This also protects parts from any product spillage.

In operation, cans are indexed under each valve on the individual lift beds which raise the containers until they come into contact with the valve seal plates. As the container contacts the valve, a movable valve body rises and opens the valve. The liquid flows by gravity into the container. As the container fills, the excess liquid enters the vent tube until it reaches the level of the product in the filler bowl. As the can lift lowers, the valve seat is closed. The product in the vent tube drains rapidly into the can, bringing it up to the predetermined head space. Valve dripping is practically eliminated, and accuracy assured since filler bowl level is closely controlled automatically.

From the filler the cans will pass to a seamer for closing. The filled, closed cans then move to the pasturizer-cooler-dryer.

The dry containers leave the coolers and move to a special can labeller, where the paper labels are put on and glued. These labellers apply complete labels on any style can. From the labellers the cans go to a non-shock caser which puts the cans in specially designed cartons. From this point, the cases are channeled to a case sealer which applies the glue, then compresses and discharges the sealed shipping case.

GREEN BEAN AND PEA LINE

The market demands are greater for young tender peas. The quality grades are also affected by the maturity as pointed out in the grading section. Therefore, it is important for the processors to receive peas of tender maturity. One instrument for determining maturity of peas is the tenderometer machine. It measures the tenderness of shelled peas by shearing them through a set of steel grids. The lower the reading on this machine, the more tender the pea. The food value is the same for tender and mature peas, the difference is that the selling price is higher for tender peas. In view of the higher price, the first step the processor must take is to insure that raw material meets this quality.

As in the case of peas, the first step in processing beans must be a supply of first grade green beans. A large percentage of the scoring points for grading has to do with character. Good character is partially defined as green beans that are very young and tender, full fleshed and not fibrous, seeds in early stages of maturity and having no more than 5 percent with tough strings.

Reception–Green Beans

At the cannery, the green beans are dumped into the feed hopper and carried up an inclined elevator to a cluster breaker. In the cluster breaker, any beans which are joined together by the stems are separated into single beans. Beans then pass through an air cleaner which removes leaves and light debris.

After air cleaning, the beans pass over a shaker screen which allows heavier foreign material to pass through the screen and be removed. The beans then go into a washer and discharge into an oscillating type conveyor which delivers the beans to three horizontal bar size graders. These graders size the beans according to the thickness of the bean into two sizes. This preliminary sizing allows the snippers to be adjusted according to bean size and reduces the amount of waste.

Preparation–Green Beans

The beans, after being snipped, are put over an inspection belt so that any beans which have passed through the snippers without being snipped can be snipped by hand and any pieces of bean ends can be removed. After inspection, the beans then discharge to two bean cutters. In these cutters, the beans can be cut to any desired length such as 2 cm, 3 cm, or 4 cm. The beans then discharge into two shaker type nubbin separators. In these machines, any pieces of beans which are shorter than the required cut length are removed. Thus, there will be two grades of beans, one graded according to the cut length desired, and the cheaper grade which contains miscellaneous lengths of beans. The beans discharge from the nubbin grader into galvanized hopper trucks containing water. Each hopper truck holds approximately 230 kilos of beans plus water. The trucks are wheeled over to the hydraulic elevator where they are dumped onto a shaker-separator which feeds the hydraulic elevator. Thus, one grade of bean is fed at a time so that the two grades are kept separate.

The process from this point on is the same as for peas, described in the following paragraphs.

Reception—Peas

Peas are harvested and shelled and are brought to the canning plant in lug boxes. It is essential that the time lag between the actual harvesting of the peas and the arrival at the cannery be reduced within six hours. The longer the time between harvesting and canning, the tougher the peas will be.

Preparation—Peas

Peas are dumped into the feed hopper of the bucket type elevator which delivers the peas to an air cleaner. In the air cleaner, any leaves or light debris are removed. The peas then pass over a pod and stick eliminator which takes out any pods remaining in the peas.

The next unit in the line is the froth flotation cleaner. The flotation separator works on the principle of difference in wettability of peas compared with that of nightshade berries, thistle heads, weed seeds, etc., in a frothy mixture of small air bubbles, water, a colorless and tasteless light mineral oil and a special soap of high detergent power. The nightshade berries and the other weed seeds and fragments, also pea hulls because of difference in wettability compared with that of the whole peas, collect many small bubbles of air from the frothy mixture and thereby become lighter than the peas and float; the peas sink.

Sizing

After passing through the flotation cleaner, the peas pass over a separating unit. In the separating unit, the peas are given a rinse to remove oil emulsion which may be adhering to them. Peas are then put through a washer which is equipped with a riffle section for removing stones and heavy debris. After washing, the peas are taken by means of a bucket elevator to the size grader. In the size grader, the peas are separated into five sizes. From the sizer, the peas are flumed to holding tanks where the various sizes are kept separate until they are ready to be run through the line. Only one size at a time is processed.

Blanching

The peas are conveyed by means of a hydraulic elevator to the blancher where they are given a hot water blanch. Blanching of peas has several purposes. One of the most important is that of cleaning the surface of the peas by softening and dissolving the dried coating of vine juice. This is the juice from the pods and leaves that wets the peas during vining. It may contain considerable imbedded dust and other debris, and if too long a time elapses between vining and canning, it may develop considerable bacteria. Blanching also tends to remove a slight raw taste and odor characteristic of shelled peas that have stood for some time. It removes the air and other gases entrapped or dissolved in the pea tissues and unless removed will lower the vacuum in the cans. Another objective of blanching is to swell and soften peas so that a more uniform fill of the cans and more uniform texture of the canned product is attained. After blanching, the peas pass through a separator screen where they are washed and cooled.

Grading

At certain times of the season, there may be a large number of lower grade peas of a higher specific gravity and it will be necessary to remove these peas in the quality grader. At other times, the peas may be of all uniform tenderness and quality grading is not required. In the quality grader, the peas are separated according to specific gravity in a salt solution.

After separating, the peas return to the line where they are put over an inspection belt. In this inspection belt, any foreign material which has not been removed previously can be picked out visually and any off-color or off-grade peas removed. Peas then are carried by means of a stainless steel bucket elevator to either of two fillers. Two filling and processing lines are included, one line for 73 X 113 mm cans and the other for 99 X 115 mm cans. A flexi-filler is used for filling either peas or beans into the cans. After filling, the cans pass through a briner where hot brine is added and then the cans are immediately double seamed. The cans are carried by means of an elevator up to the feed valve of the continuous pressure cooker.

Cooking

Continuous pressure cookers are required as by this means, absolute uniformity of processing is insured and because of the agitated cook, it is possible to process the product in a much shorter time than in retorts. In addition, the high temperature short time cook improves the quality of the product as well as insuring complete uniformity.

Cooling

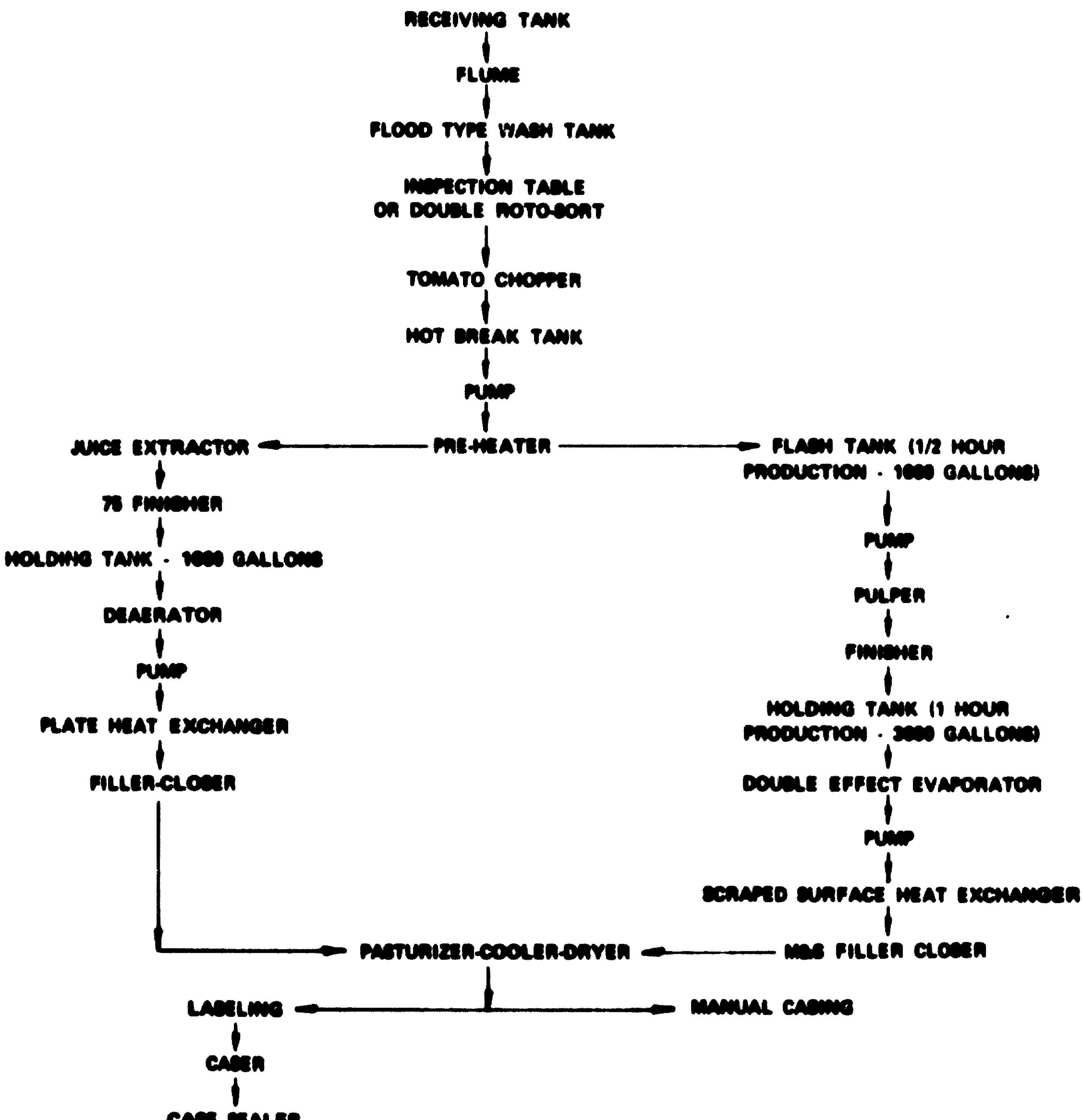
After cooking, the cans go into the pressure cooler. In the pressure cooler, air pressure is maintained so that the can will not be subjected to an instantaneous change of pressure from the cooker to atmosphere. After a short pressure cool, the cans then pass into an open continuous cooler where the remainder of the cooling is done.

Casing

After cooling, the cans are ready for packing into the shipping containers. A separate case packer is employed for each line. The cardboard cases may be either stapled or glued and this operation is carried out manually.

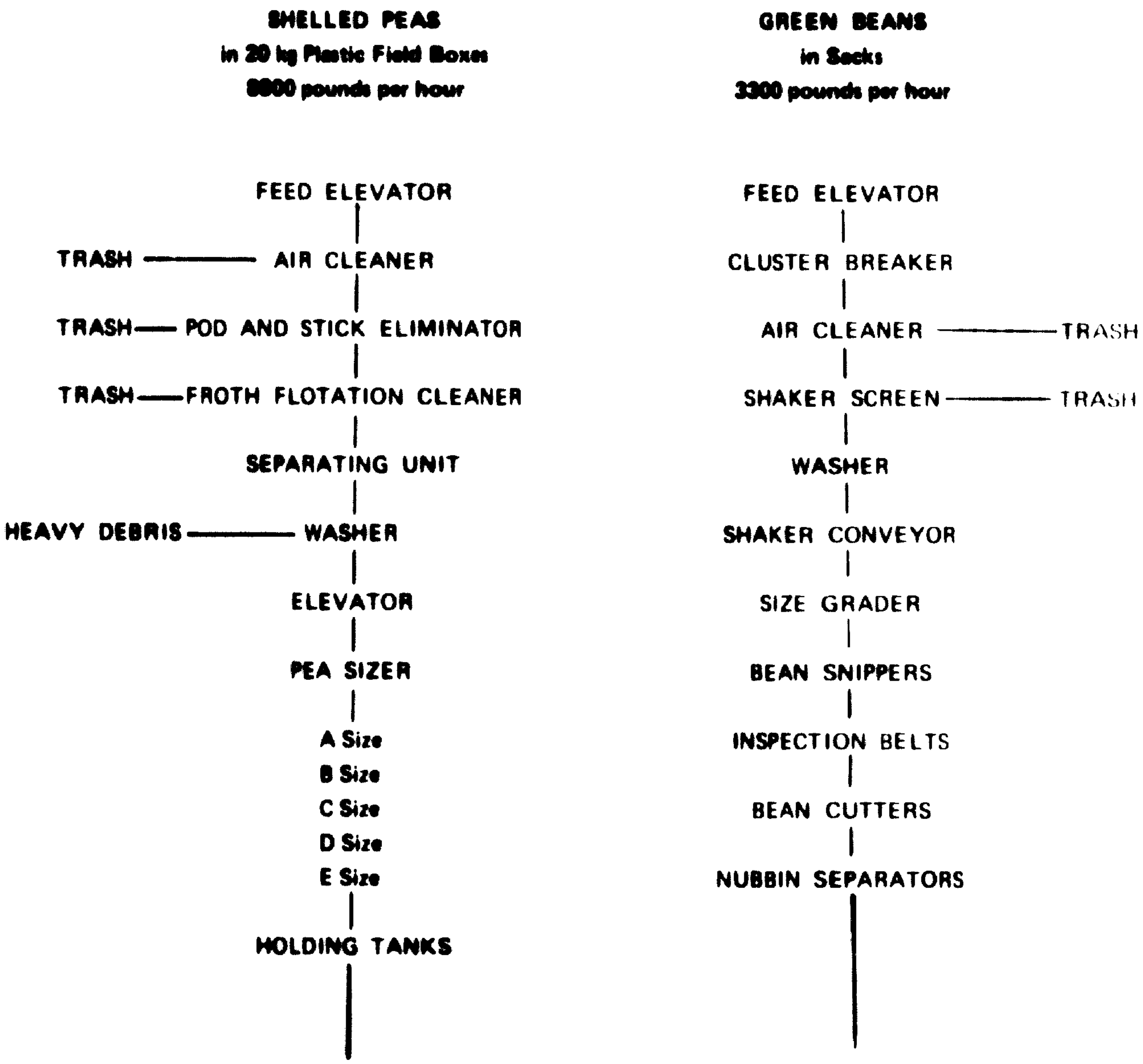
FLOW DIAGRAM

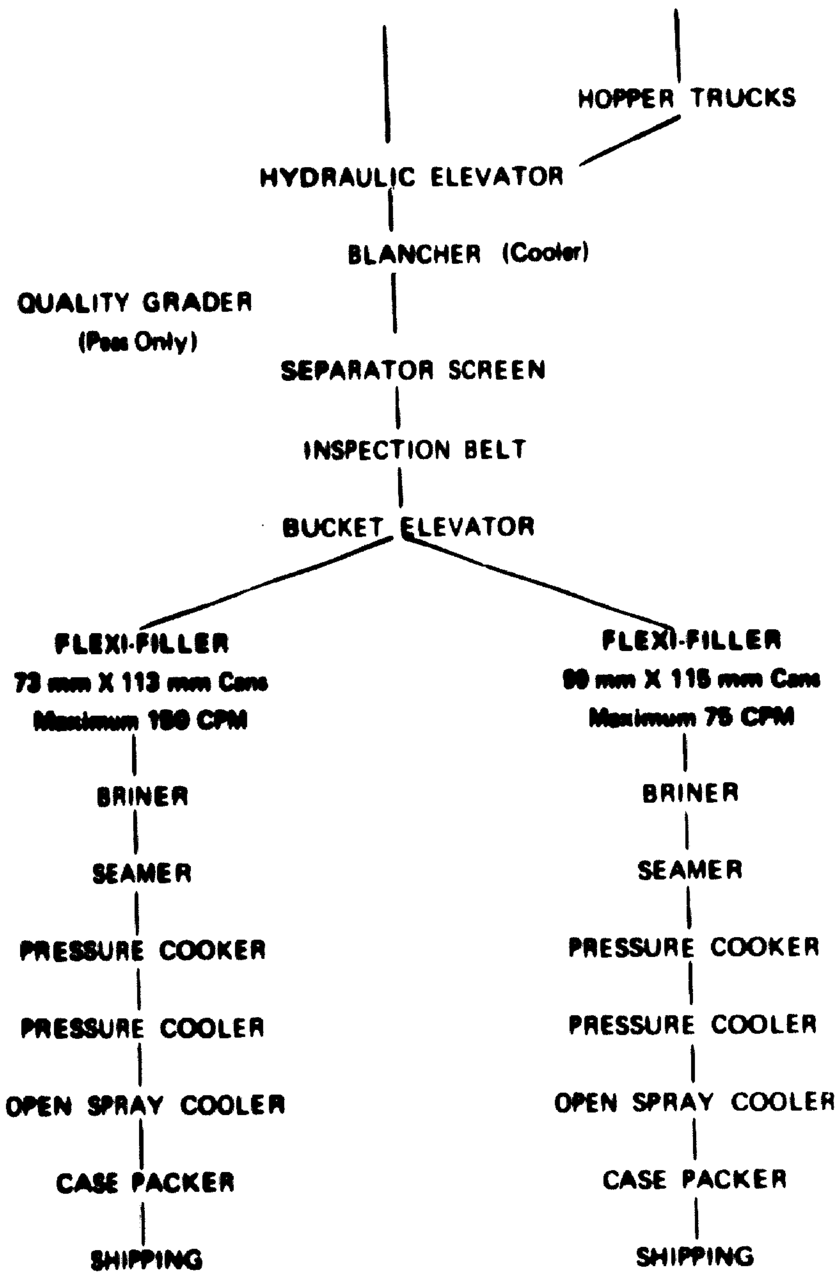
Tomato Paste and Juice Line



PROCESS FLOW DIAGRAM

GREEN BEAN AND PEA LINE




HOPPER TRUCKS
HYDRAULIC ELEVATOR
BLANCHER (Cooler)
QUALITY GRADER
(Peas Only)
SEPARATOR SCREEN
INSPECTION BELT
BUCKET ELEVATOR
FLEXI-FILLER
73 mm X 113 mm Cans
Maximum 150 CPM
BRINER
SEAMER
PRESSURE COOKER
PRESSURE COOLER
OPEN SPRAY COOLER
CASE PACKER
SHIPPING
FLEXI-FILLER
99 mm X 115 mm Cans
Maximum 75 CPM
BRINER
SEAMER
PRESSURE COOKER
PRESSURE COOLER
OPEN SPRAY COOLER
CASE PACKER
SHIPPING

MACHINERY LIST

TOMATO PASTE PROCESSING LINE (10 TPH)

Quantity	Description
1	Receiving Tank
1	Flood Type Washer
1	Roller Elevator
1	Inspection Table
1	Chopper
1	Hot Break Tank
1	Pre-heater/Sterilizer
1	Flash Tank
1	Pulper Super 100
1	Finisher Super 100
1	Holding Tank 3000 Gallons
1	Evaporator
1	Sterilizer
1	Filler
1	Seamer
1	Cooler

4	Positive Displacement Pumps
1	Can Handling System
1 Lot	Piping
1 Lot	Spare Parts
1 Lot	Motor Starters
1 Lot	Tools

TOMATO JUICE LINE (5 TPH)

Quantity	Description
1	Holding Tank
1	Deaerator
1	Finisher
1	Plate Heat Exchanger
1	Juice Filler
1	Seamer
1	Labeler
1	Caser
1	Seamer

GREEN BEAN AND PEA LINE

Quantity	Description
1	Dump Elevator
1	Cluster Breaker
1	Air Cleaner and Shaker
1	Shaker Screen
1	Washer
1	Conveyor
3	Sizers
1	Conveyor
1	Conveyor
1	Conveyor
1	Conveyor
1	Conveyor
1	Oscillating Conveyor
4	Snippers and Picking Tables
2	Conveyors
2	Cutters
2	Nubbin Separators
	Hopper Trucks
1	Air Cleaner

1	Pod and Stick Eliminator
1	Froth Flotation Cleaner
4	Separating Units
1	Elevator
1	Washer
1	Elevator
1	Sizer
1	Hydraulic Elevator
1	Supply Tank
1	Separating Unit
1	Blancher
1	Quality Grader
1	Inspection Belt
1	Conveyor
1	Flexi-Filler
1	Flexi-Filler
	Briners
2	Seamers
2	Elevators
1	Cooker
1	Pressure Cooler

1	Open Cooler
1	Cooker
1	Pressure Cooler
1	Open Cooler
2	Case Packers
1	Air Compressor
4	Empty Can Systems
2	Tanks
	Pumps

ENGINEERING CALCULATIONS

TOMATO PASTE AND JUICE

Basic Data

A. Input Raw Product 15 metric tons per hour

B. Feed Solids 6%

C. Output Solids

1. Tomato Paste 32% Solids

2. Tomato Juice 6% Solids

D. Process Loss 7%

E. Filling

1. Tomato Paste: 73% 5 kg can 4 kg content
   27% 1 kg can 0.750 kg content

2. Tomato Juice: 100% 1 kg can 0.750 kg content

Production Estimates

A. Length of Season 60 Days

B. Hourly Net Feed

15,000 kgs - (15,000 x 0.07) = 13,950 kgs/hr. 6% T.S.

C. Output by Products

1. Tomato Paste: 2,050 kgs/hr 32%

2. **Tomato Juice**: 1,680 kgs/hr 6%

D. **Canning Data**

1. **Tomato Paste** 32%

   5 kg can = 4 kgs of tomato paste

   1 kg can = 0.750 kg of tomato paste

2. **Tomato Juice** 6%

   0.780 kg of tomato juice per 1 kg can

E. **Unit Production**

1. **Tomato Paste**:

   5 kg can maximum capacity: 2050 ÷ 4 = 572 CPH
   = 10 CPM

   1 kg can maximum capacity: 2050 ÷ 0.750 = 2735 CPH
   = 46 CPM

2. **Tomato Juice**:

   1 kg can maximum capacity: 1680 ÷ 0.750 = 2240 CPH
   = 38 CPM

F. **Casing Data**

1. 5 kg cans, 6 cans per case:

   572 ÷ 6 = 95 cases per hour

2. 1 kg cans, 24 cans per case:

   46 ÷ 24 = 2 cases per minute
   = 120 cases per hour

G. **Season Production**

60 days total including cleanup average operation per day = 22 hours

Total net operating hours = 1320 hours

1. Tomato Paste 32%

   5 kg cans 73%

   1320 x .73 x 572 = 551,180 5-kg cans per season
   = 21,865 cases @ 6 cans per case

   1 kg cans 27%

   1320 x .27 x 2735 = 974,754 1-kg cans per season
   = 40,615 cases @ 24 cans per case

2. Tomato Juice:

   1 kg cans 100%

   1320 x 2240 = 2,956,800 1-kg cans per season
   = 123,200 cases @ 24 cans per case

H. **Personnel Requirements**

32 People plus Maintenance, Boiler Room, and Yard Personnel

I. **Utility Requirements**

1. Steam 35,000 lbs per hour @ 25 and 100 psig

2. Water 2,500 GPM water at 85 degrees F. Should install cooling tower.

3. Electric 450 KWH.

GREEN BEAN AND PEA LINE

Basic Data

A. Input Raw Product

1. Peas 4 metric tons per hour

2. Green Beans 1.5 metric tons per hour

B. Process Loss, both products 10%

C. Filling

1. Peas 32%: 73 X 113 mm - 500 grams
   69%: 99 X 115 mm - 1 kg

Production Estimates

A. Length of Season

1. Peas 30 days

2. Green Beans 60 days

B. Unit Production

Maximum capacity is on peas:

73 X 113 mm, 500 grams = 8650 cans per hour
= 145 cans per minute

99 X 115 mm, 1 kg = 4350 cans per hour
= 73 cans per minute

C. Casing Data

1. 500 gram cans–48 per case

2. 1 kg cans–24 per case

D. **Season Production**

1. **Peas** 30 days total
   22 hours per day
   660 operating hours per season

   500 gram cans 32%:

   660 X 8650 X .32 = 1,826,880 cans per season
   = 38,000 cases per season

   1 kg cans 68%:

   660 X 4350 X .68 = 1,943,280 cans per season
   = 81,000 cases per season

2. **Green Beans** 60 days total
   22 hours per day
   1320 operating hours per season

   500 gram cans 32%:

   1320 X 3230 X .32 = 1,364,352 cans per season
   = 28,500 cases per season

   1 kg cans 68%:

   1320 X 1640 X .68 = 1,472,064 cans per season
   = 61,500 cases per season

E. **Personnel Requirements** 32 people

F. **Utility Requirements**

1. **Water** 115 GPM
2. **Steam** 3500 pounds per hour
3. **Electricity** 115 KWH

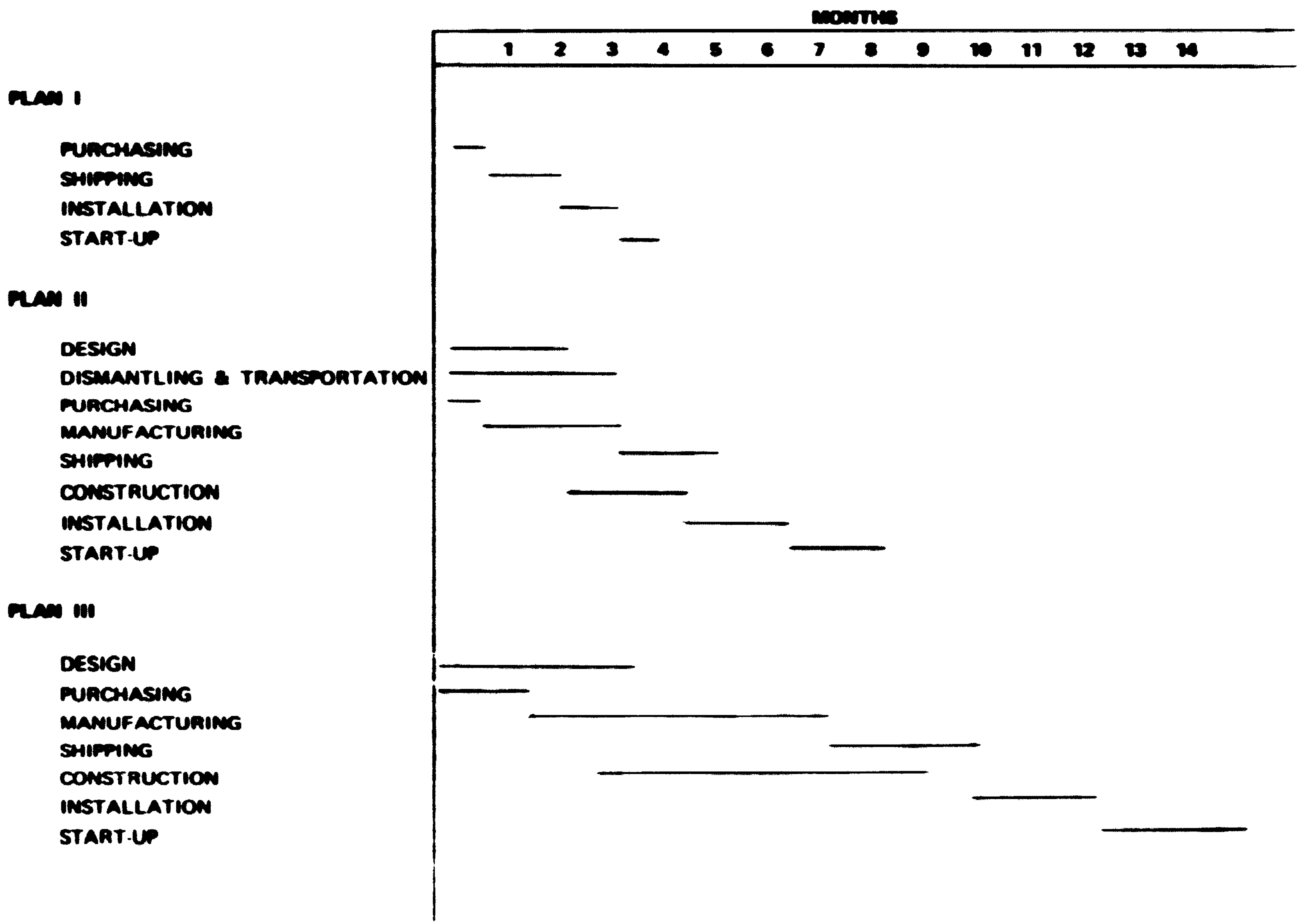
CIVIL ENGINEERING

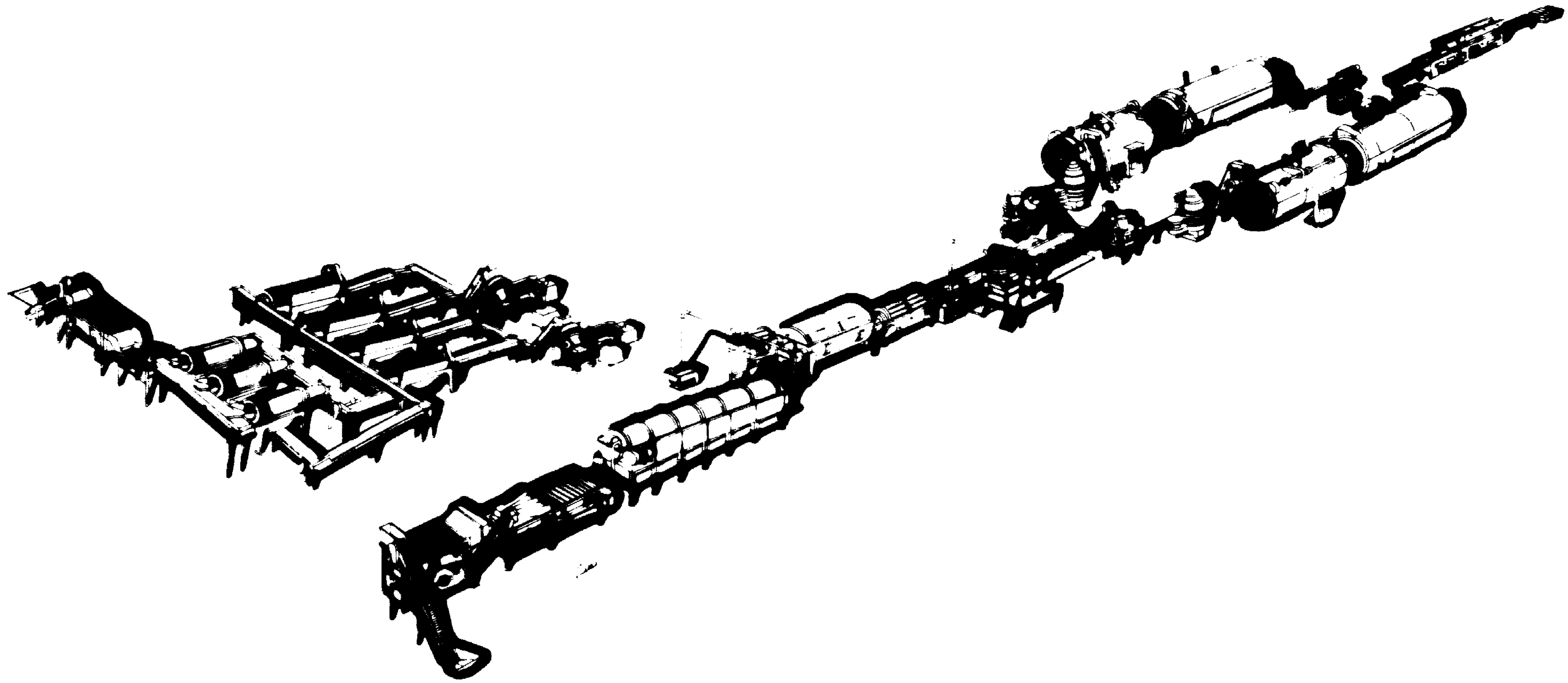
Discussion of matters relating to relocation of the processing facility is provided in Plan II.

In addition, it is recommended that the new facility for Plan III be designed and engineered following the design and engineering of the processing lines. In this manner, the physical site will be more appropriately and efficiently planned in relation to function.

This will also reduce modification to either the lines or the plant to a minimum, thereby reducing construction and set-up costs.

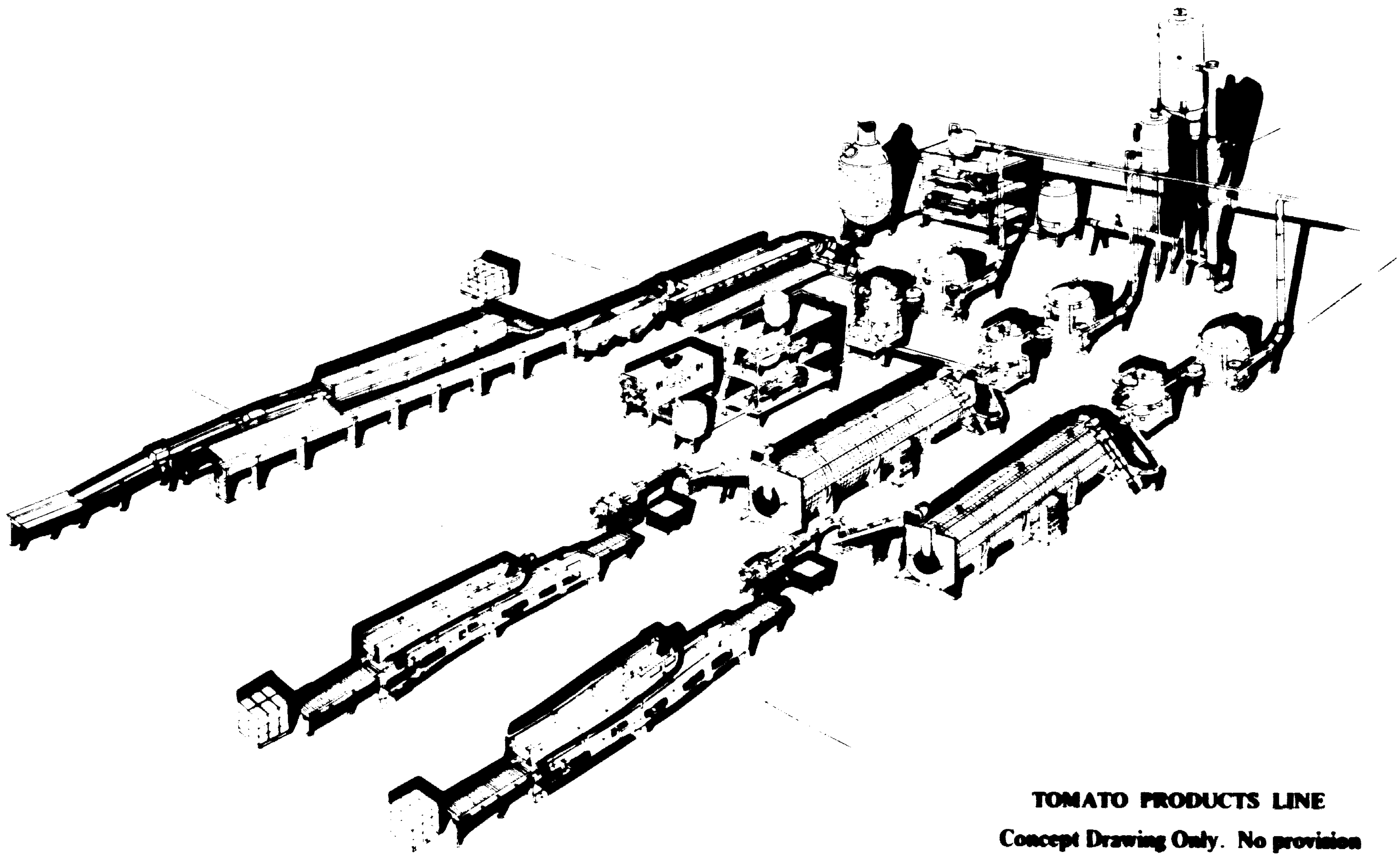
TIME SCHEDULE–ZAGNA VADENI





GREEN BEAN & PEA LINE

Concept Drawing Only. No provision made for integration of lines.



TOMATO PRODUCTS LINE

Concept Drawing Only. No provision made for integration of lines.

II JUNEI

PLAN I

AGRICULTURE

In keeping with the goals of this Plan, particularly making minor adjustments in production methods to upgrade the quality of the raw product while minimizing the capital investments, no major changes are recommended in agricultural technology.

However, some improvements should be made in raw product handling and in disease control as well as in soil and water management. Particularly, transportation and handling equipment should be improved, disease control programs should be developed and adhered to, fertilizer practices should be closely watched through soil and tissue analysis, greater disc of soil amendments should be made and drainage and irrigation systems to lower salt accumulations should be investigated.

Better coordination between the plant and field operations is necessary to avoid delays in processing the raw product. Finally, stricter adherence to quality standards is necessary to provide a suitable quality finished product, particularly for export marketing.

For specific recommendations applying to improvements in various agrotechniques, the reader is referred to the sections under specific crop recommendations in Plan III.

PROCESSING

The plant at Dej is small but was reconditioned after the flood, which only lasted two days. Accordingly, it is in better condition and more efficient than the plant at Zagna Vadeni.

The plant site is very much limited and cannot be expanded since it sits on the river bank and is surrounded on all other sides by buildings.

In order to protect the whole city of Dej from future floods, plans have been made to build a control dyke on the bank of the river. This dyke will pass through the present cannery site. Therefore, no plans will be made for rejuvenation of the plant at the present site.

Plans II and III for 11 Junei, Dej, will involve relocating the cannery in an industrial park approximately 22 kilometers from the present site.

PLAN II

AGRICULTURE

In keeping with the goals of this Plan, particularly making minor adjustments in production methods to upgrade the quality of the raw product while minimizing the capital investments, no major changes are recommended in agricultural technology.

However, some improvements should be made in raw product handling and in disease control as well as in soil and water management. Particularly, transportation and handling equipment should be improved, disease control programs should be developed and adhered to, fertilizer practices should be closely watched through soil and tissue analysis, greater use of soil amendments should be made and drainage and irrigation systems to lower salt accumulations should be investigated.

Better coordination between the plant and field operations is necessary to avoid delays in processing the raw product. Finally, stricter adherence to quality standards is necessary to provide a suitable quality finished product, particularly for export marketing.

For specific recommendations applying to improvements in various agrotechniques, the reader is referred to the sections under specific crop recommendations in Plan III.

PROCESSING

At the Dej plant the emphasis is on production of fruits and jams. There is also a moderate production of pickled cucumbers and a small output of canned green beans.

Most of the equipment in the Dej cannery is in fair condition, and accordingly under Plan II could be moved to a new site.

GREEN BEANS

The green bean line can be retained almost intact. An automatic box dumper would be installed at the receiving station to facilitate product handling and reduce labor at this point. The graders, snippers, elevators and blanchers would be moved as they are. A hand pack filler and briner, similar to that proposed in Plan II for Zagna Vadeni, would be installed for filling and brining before seaming.

CANNED FRUITS

The fruit preparation lines are completely manual, and little can be done to improve them since the individual pieces of equipment, such as the cherry stemmers and pitters, apple peelers, and peach peelers and pitters, would not fit in the continuous line. Accordingly, it is advisable to leave this equipment as is and redesign the process flow to minimize the amount of labor required.

Many improvements could be introduced in the present fruit canning line. The present cherry blancher should not be moved to a new location, since in the opinion of the team food technologist, it is not necessary in the processing of cherries.

A hand pack filler and a pre-vacuumizing syruper would be installed on the filling line to handle any type fruit that is being canned. The pre-vacuumizing syruper would pre-vacuumize and add syrup to fruits in cans. The syruper follows the filler and precedes the steam flow closer.

The seamers presently used in Dej are in working condition and they could be overhauled and reused. A complete system of semi-automatic retort basket loaders would be installed.

Retorts at the Dej plant are completely manual with no controls whatsoever. This is completely unacceptable in a cannery. Therefore, a full set of controls and recorders would be installed on the present retorts.

JAM

The equipment for producing jam is completely manual and operates on a batch basis. It would be impossible to introduce separate pieces of equipment to automate the operation. Accordingly, it should either be left as is or a complete new line should be introduced. The recommended new line is described in Plan III for 11 Junei, Dej.

CUCUMBER PICKLES

At the present time the only equipment for processing pickles is a very old steam blancher and a home made cucumber sizer. It is felt that these would not be worth moving or integrating into a new line, and therefore the installation of a completely new line is strongly recommended.

WAREHOUSING

Since the present facility has no warehousing or material handling equipment for finished products, a complete line would be provided and installed to handle all outcoming products.

CIVIL ENGINEERING

GENERAL FACTORS

A new location for the Dej plant has already been selected by the Projects Group in the Ministry of Agriculture and rather detailed plans have been prepared concerning not only site but buildings.

It is not therefore the object of the team engineer to discuss such planning in great detail; however, certain general comments should be made which might be of value for consideration.

The site so far selected will be near to the city on high ground in an industrial park.

UTILITIES

Since the proposed location is within an industrial park and electricity is already plentifully available within the area, it is presumed that the availability of utilities will be more than adequate at the new site.

WATER

Water will continue to be drawn from municipal sources and should be readily available. A problem may arise, however, with the growth of the city and the growth of the processing plant. For this reason, it is recommended that consideration be given to alternative sources of water for the processing plant so as not to overload demand on the municipal system.

In addition, consideration should also be given to appropriate sewage treatment and disposal for the volume of water that will be discharged from the plant.

FLOOD PROTECTION

The improvement in altitude above the river should have a definite positive effect, providing protection from annual floods and probably from major, infrequent flooding.

SOIL AND DRAINAGE

Both drainage and loading at the proposed new site seemed adequate and the soil conditions throughout the Dej area seem more stable than those at Zagna Vadeni.

TRANSPORTATION

The new site is located near the city of Dej but not in the congested area as was the old site. For this reason the relocation should have a very positive effect on transportation of the goods into the plant. The location should be such that trucks can move easily in and out of the staging area. The staging area itself should be large enough to accommodate the high season flow of trucks and positive forward progression to avoid any unnecessary time wasted due to cramped staging area. This in turn should have a good effect on product flow within the plant.

Because the new site is located at an industrial park, it is presumed that some provision will be made for railway transport for finished product coming out of the plant. This would save time compared to the present operation which requires loading the product onto trucks for transfer to the rail station and thence to railway cars.

LABOR

As observed earlier, the labor situation is static and will not be drastically heightened by the relocation of the plant to another site within the Dej area. The team engineer therefore concurs with the recommendation of the processing specialist that consideration be given to maximizing labor efficiency through automation.

It is further suggested that time and motion studies would be helpful to the full operation.

CONSTRUCTION

The present site is both too small to allow for construction of modernized facilities alongside of existing structures, and it is not feasible from the point of view of flood control. Therefore, under Plan II consideration is given to construction of a new building at a new site. Observation indicates that while some aspects of moving may be difficult, it should be possible.

It is projected that one season's production will be lost due to the move. The actual building can be constructed in advance of the move and prepared for reception of the processing equipment. However, due to weather and the complexity of installing a new line at the new site, it is more than likely that one season's operation will be lost.

Construction in Romania is carried out by the Government and prices for construction are fixed. It is the responsibility of the Government Manager to be sure that work is done at the cost indicated. Completed structures with all utilities and mechanical connections, but without processing machinery are estimated at 1,200 lei per square meter. The pre-fab, pre-stressed method of construction has been adopted and it is felt that workable structures can be provided.

Since the size of the structure required depends on the quantity and placement of processing machinery, it appears that the structure currently planned for 11 Junei may be too large if United States machinery is to be used. A reduction in building size would naturally reduce the cost.

PLAN III

AGRICULTURE

GENERAL RECOMMENDATIONS

It is recognized that the relocation of this plant is almost inevitable due to the direction of earthwork construction. The proposed new location has no effect on the agronomic considerations with the exception that it allows for better planning in the receiving area which should thereby reduce the inefficiencies and long unloading time that contribute to raw product deterioration.

The philosophy of a plant in this area should be one of low volume and high quality, the reasons for this being that the terrain and short season prohibit the use of high capacity machinery and large-scale production techniques which are necessary for the supply of a high volume processing plant.

This does not, however, preclude the development of a modern, efficient plant as described in Plan III. In fact, Plan III is recommended and the following recommendations pertain to the agrotechnique necessary to supply such a high quality (but relatively low volume) plant.

Although total mechanization is excluded as unfeasible, minimum mechanization and labor aids should be utilized to increase the efficiency and decrease the work load of the individual worker.

The following crops discussed in specific sections are those that have been determined to be the most profitable and those that have the greatest export market potential. It is recommended that these crops be developed in single plantings by the state farms in the Dej area. Certain crops have been de-emphasized due to problems in production or lack of market. The crops to be discussed are cherries, strawberries, miscellaneous fruits, green beans and cucumbers for pickling.

CHERRIES

Varieties

Current varieties should continue to be used; however, new varieties as well as new rootstock should be evaluated, particularly with regard to higher yields of higher quality fruit, extending the season, winter hardiness, resistance to cracking in rainy weather and maintaining the same characteristics as desired by the market.

Table 29 is a list of cherry varieties and rootstocks recommended for trial in the Dej area.

Table 29

Cherry Varieties Recommended for Trial in Dej Area

Variety	Average Ripening (N.Y.)	Fruit Color	Average Fruit Width	Flesh Firmness	Skin Cracking	Winter Hardiness
Sour Cherry						
Montmorency	July 21	medium red	2 cm	semi-firm	none	hardy
Montearly	July 14	medium red	2 cm	semi-firm	none	hardy
North Star	July 28	very dark red	2 cm	soft	none	very hardy
Sweet Cherry						
Windsor	July 16	dark red	2 cm	firm	little	hardy
Star King	July 7	nearly black	2.4 cm	firm	little	hardy
Hardy Giant						
Lamida	July 11	nearly black	2.5 cm	firm	little	hardy
Sam	July 6	black	2 cm	very firm	little	moderately hardy
Ulster	July 14	nearly black	2-2.4 cm	firm	little	medium hardy
Root Stock						
Mahaleb (Prunus mahaleb)						
Mazzard (Prunus Avium)						
American Mazzard is preferred						

Planting

Prior to setting the trees, the soil should be well prepared by plowing and discing, particularly in strips where the trees are to be placed. At this time, lime should be added if necessary to correct to a pH of 6.5.

Also, organic matter and fertilizer should be used to establish a base of 50 kilograms P_2O_5 and 175 kilograms K_2O per hectare.

Planting should be done in the spring with 1-1.5 m, one-year old trees. The trees should be placed with the point of budding 5 cm below ground level. Trees should be planted immediately or covered in moist soil.

Plant population for sweet cherries should be from 90 to 120 trees per hectare (10.5 m X 10.5 m, or 9 m X 9 m) depending upon the pruning system and vigor of the trees (trees on Mazzard rootstock may require the lower density).

Pollenizers will be necessary for sweet cherries and compatibility of varieties should be evaluated before plantings are made. A minimum arrangement for pollenizers should be every third tree in every third row. Provision should also be made for bees.

Plant population for sour cherries should be from 120 to 185 trees per hectare (10.5 m X 10.5 m, 7.5 m X 10.5 m, 7.5 m X 7.5 m, or 7.2 m X 7.2 m), again depending upon pruning system and vigor.

Fertilization

Fertilization would not be needed in the first growing season as long as a terminal growth of 30-35 cm is made annually.

Nitrogen should be applied two to three weeks before bud break at 3-5 kilograms per tree. Application of 10-12 tons of barnyard manure should also be made.

Annual requirements for a mature orchard are 60 kilograms N, 35 kilograms P_2O_5 and 175 kilograms K_2O per hectare. A suitable application would be about 50 to 80 kilograms of each nutrient per hectare for a five-year old orchard.

Weed Control

Chemical weed control is recommended, particularly for under-tree application. Herbicide recommendations are shown in Table 30.

Table 30

Herbicide Recommendations—Cherries

Weeds Controlled	Herbicide	Rate/Hectare	Time of Application
Sour Cherries Most annual broadleaved weeds and grasses	Simazine	2 -4 kg A.I.*	Prior to weed emergence: 1 application/year
Sweet Cherries Most annual broadleaved weeds and grasses	Simazine	1.6-4 kg A.I.	Late fall or early spring
Trials with MSMA and dichlobenol are also recommended.			

* A.I. = Active Ingredients

Cultivation

Interrow cultivation (shallow discing) will be necessary, particularly if herbicides are used only under the trees. Also, cover crops such as clover or rye should be used in areas with low organic matter content.

Pruning

Pruning of cherry trees at planting should be the same as for pears and apples. The aim is to encourage a central or modified leader type of tree in which the tree is continuous from the ground line to the terminal. This means that most of the side branches should be removed leaving only two or three well spaced laterals along the trunk.

Pruning during the next three or four years should be designed to keep the terminal whorls thinned to one leader.

This central leader is removed at a height of 1.5 to 1.6 m at five to six years of age, and the main lateral limbs headed to strong outward growing limbs so as to spread the tree and thus prevent excessive heights.

Irrigation

Irrigation trials should be carried out to determine benefits from supplemental irrigation. In the rolling terrain hand move sprinklers or solid set buried systems will be necessary. Benefits from over-tree sprinklers can also be obtained through frost protection and this should also be evaluated.

Disease, Pest and Pathogenic Conditions

For San Jose scale control dormant oil sprays with carbophenothion should be used. For pre- and post-harvest fruit decays (*Rhyzopus* and *Botrytis*), applications of Botran and/or Captan should be used.

Soil samples should be taken and analyzed for nematodes. If a population of harmful nematodes is found, fumigation with DD is recommended.

It is strongly recommended that a virus control program be initiated and all new plantings be done with virus-free stock.

Harvest

Mechanical harvesting of both sweet and sour cherries has been accomplished, although difficulties have been encountered with sweet cherries. It is recommended that mechanical harvesting be evaluated for cherries in the Dej area. It is doubtful that large-scale mechanization would be successful due to the uneven terrain, however trials with small limb shakers and hand carried catch frames should be carried out to determine the feasibility of mechanical harvest.

Hydraulic picking and pruning platforms should also be evaluated.

Harvesting of cherries should begin when the pull force (force to separate the fruit from the branch) is at a minimum (350-450 grams).

STRAWBERRIES

Varieties

Varieties for production in the Dej area for use in the 11 Junei processing plant should have the following characteristics:

- Late bloom to avoid spring frost.
- Resistant or tolerant to virus, root and crown diseases.
- Varying maturity dates to extend picking and processing season.
- Fruit adapted to processing (canning and preserving).
- High yield.
- Self fruitful.
- Adapted to matted row planting.

Varieties recommended for trial are:

Marshall. Berry shape round-conic to conic; crimson in color, with good red internal color; midseason (late June) harvest; runners freely; must use certified virus-free stock; foliage susceptible to leaf spots.

Northwest. Berry shape long blunt conic; good red berry color throughout; low acid; late season harvest; blooms and ripens one week after Marshall; susceptible to red-stele and root rots but somewhat virus resistant.

Siletz. Berry shape is blunt-conic; color is dark red with good internal red color; winter hardy; red-stele resistant and somewhat resistant to virus.

Puget Beauty. Berry shape medium-large to large, mostly long-conic; requires frequent picking; high quality but lower yields; blooms later than Marshall but ripens at same time.

Midway. Berry shape medium-long conic; fruit bright red; early season; good flower.

Catskill. Berry shape roundish-wedge and somewhat irregular; berries large, bright medium red, firm; midseason.

Fairland. Berry shape wedge-conic to blunt wedge-conic; berries large; resistant to red stele.

Earlidawn. Berry shape short-conic; berries uniform, firm and large; bright red.

Midland. Somewhat like Earlidawn but a few days later; tendency to lower yield thus requires careful handling.

Pocahontas. Berry shape large and blunt-conic; skin bright medium red with red internal flesh; tendency to high acid; midseason.

Everbearing Varieties. The following varieties have been found to produce berries over the whole season but commercial application has not been extensive. They are included in this listing for limited trials.

- Superfection
- Streamliner
- Red Rich
- Mastodon

Planting

The matted row production system is recommended for the Dej area as it is felt to provide the highest yield of fruit suitable for processing relative to lower production costs.

The plants should be placed on slightly raised (6-7 cm) beds, 90 cm to 1 meter apart center to center. The plants should be placed 45 to 75 cm apart in the row. Runners (stolons) should be spaced 15 to 30 cm apart. When the row is filled with plants to a width of 30 to 40 cm, all addition runners should be cut off (see Figure 9).

This system should require 14,000 to 20,000 plants per hectare for planting but obviously the system will produce a much higher effective population.

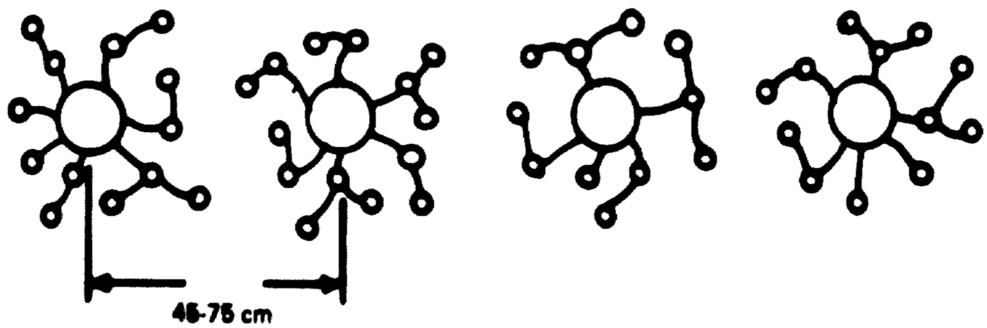


Figure 9

The best soils for strawberries are deep, well drained, loam soils and heavy clay soil should be avoided. Also, a suitable amount of organic matter should be developed prior to planting. Thus for the Dej area, 10-15 tons per hectare of barnyard manure or equivalent green manure should be applied in the fall prior to planting.

Strawberries should be planted in early spring, however it has been found that June planting is possible if dormant plants are dug in the winter, bundled in polyethylene lined crates and stored at -1 degree C. Plants should be placed with the crown just above the surface of the soil with the roots fanned well out. It is probable that mechanical aids will not be useful in the Dej area and the plants must be laid by hand in grooves made in the top of the beds.

Fertilization

With the manuring application previously mentioned, nitrogen should be applied at a rate of 30-50 kilograms per hectare of N, 1/2 applied in the spring as growth starts and the remainder applied in the fall. For other nutrients, 50-60 kilograms per hectare of P_2O_5 and K_2O should be applied in the early spring (see Appendix).

Weed Control

The recommended chemical weed control material is diphenamid at 4-6 kilograms active ingredient per hectare applied after plants are well established. Other chemicals recommended for trial are Sesone, DNBP, 2,4-D, Chloroxuron and DCPA.

Mechanical and manual cultivations will still be necessary not only for weed control but also for plant maintenance, keeping the runners trimmed to the proper length.

Cultivation

Mulching, such as plastic or straw, has been used in many areas for cold protection, weed control, higher yields and improved quality berries. The major advantage for the Dej area would be for cold protection and trials using 5-8 cm of a coarse hay or straw mulch should be conducted to evaluate the benefits obtained from such a system.

Renewal will be necessary as the matted row system should be kept for two years (the most profitable period). Therefore, following harvest the rows should be narrowed to a 15-20 cm strip of plants in the center. Fertilization and mechanical cultivation should also be done at this time. Renovation is most efficiently done with a PTO driven rotary tiller.

With the matted row system, most of the fruit produced the following year is from the runner plants. These plants are larger and more developed if all of the blossoms are removed from the parent plants soon after setting. This is generally desirable.

Irrigation

Some form of irrigation for supplemental water application will most likely be necessary in the Dej area.

Many factors point to the use of sprinklers as the best system.

The rolling terrain and lack of thick topsoil prohibit leveling for surface irrigation and added benefits of cold protection from sprinkler systems point to the need for sprinkler irrigation trials.

Disease, Pest and Pathogenic Conditions

It is imperative that a rigorous plant inspection and certification system be developed and adhered to. The only method of obtaining consistent high yields of good quality fruit is by using certified disease-free plants. It will probably be necessary for one of the state farms in the area to set up a certified nursery to supply plants for surrounding production.

Foliar disease control programs, utilizing chemical applications, will also be necessary for control of foliar and fruit rots (*Botrytis*, etc.).

Fumigation has been found beneficial in many strawberry production areas and trials are recommended.

Harvest

Although some prototype mechanical harvesters for processing strawberries exist, all commercial harvesting is still done by hand.

Therefore, the harvesting method recommneded is to hand pick the berries into shallow (12-15 cm) flats holding about 6 kilograms. These flats should be able to be stacked one on top of the other. The flats should then be stacked on trailers and taken to the processing plant to be hand dumped.

GREEN BEANS

Two types of green bean culture are feasible in the Dej area. The first is bush beans for hand or machine harvest as discussed for Zagna Vadeni. Mechanical harvest is possible in the flatter alluvial areas if sufficiently large planting blocks can be developed.

The second method is the production of pole beans (beans grown on trellises like fresh market tomatoes). This method is of course more labor intensive and costly, but per unit yields are much higher and the production of straight "pencil" type beans for premium quality canning is insured. The following discussion is limited to the production of pole beans. For a discussion of the production of bush beans, see the Recommendations made for Zagna Vadeni.

Varieties

The varieties recommended for pole bean production at Dej are as follows:

Stringless Blue Lake. 66 days to harvest; pod size 15 cm X .7 cm, round and straight, dark green in color with pure white seed; resistant to common bean mosaic.

Stringless Blue Lake Prince Pak. 62 days to harvest; similar to Blue Lake but with more concentrated season, earlier.

Kentucky Wonder Rust Resistant. 67 days to harvest; 17 cm X 1.2 cm size, round oval pod; medium green color, buff seed color; resistant to some races of rust.

Romano. 70 days to harvest; 15 cm X 1.8 cm; pod broad and flat, medium green color; "Italian style" bean not of typical shape for green beans but has special market.

Planting

Planting of pole beans should be done before the stakes are put out. The beans should be planted on raised beds or flat in rows one meter apart center to center. The plants should be thinned to plants 18-25 cm apart in the row.

Soil preparation and preplant fertilization is the same as for bush beans.

Fertilization

Total amounts of fertilizer should be the same as for bush beans; however, the nitrogen applications should be spread out to three to four applications per season. General application rates should be 20-40 kilograms N per hectare, and 30-50 kilograms each of P_2O_5 and K_2O.

Weed Control

Chemical weed control materials (trifluralin) are the same as for bush beans.

Cultivation

The only difference between the cultivation of pole beans and bush beans is that pole beans must have support structures constructed. This can be done using the methods presently adapted to tomatoes grown on stakes in Romania. The stakes for pole beans, however, should be two meters high.

Irrigation

Supplemental irrigation for pole beans is even more necessary than for bush beans. Surface irrigation maintains the highest quality (least diseased pods) product but there is probable difficulty in arranging land leveling for surface irrigation at Dej. For this reason other methods of irrigation should be evaluated.

Disease, Pest and Pathogenic Conditions

The methods for disease and pest control are the same as for bush beans; however, equipment used for application must differ.

Harvest

Harvest is by hand, however hand picking of pole beans is less laborious than for bush beans and harvest crews are smaller as there is less total amount obtained at each picking. A greater number of total pickings is required.

CUCUMBERS

Varieties

It is doubtful that varieties developed in the United States, particularly those developed for mechanical harvesting, will provide a profitable export market for the 11 Junei processing plant since United States varieties produce most of their fruit in a size range (9-15 cm) that is undesirable for the European market.

The following varieties are listed only for their probable good yield performance in the Dej area.

- Early Pik
- Hybrid F_1 Pioneer
- Hybrid F_1 Alice
- Piccadilly
- Northrup King 2995
- Dixie 23

Planting

For hand harvest, planting should be done with one row on single beds 76 cm apart, center to center, or with two rows, 52 cm apart on 1.5 m beds. In either case, plants should be spaced 38 to 45 cm apart in the row. This should produce a plant population of 33,000 to 37,000 plants per hectare.

For mechanical harvest, a plant population of 197,600 to 247,000 plants per hectare is used. This is obtained by planting double rows 31 cm apart in beds one meter center to center. Plants are spaced 8-10 cm apart.

Depth of planting is about 2-4 cm.

Planting schedules should be based on harvest capacity (availability of labor).

Fertilization

Fertilizer requirements (along with 10-12 tons manure) are 40-50 kilograms N, 40-60 kilograms P_2O_5 and 30-40 kilograms K_2O per hectare. Most of this material (except N) should be applied preplant with the nitrogen spaced in three different applications over the season (for hand harvest only).

Weed Control

Trifluralin at .5 to 1 kilogram active ingredient per hectare is the recommended chemical weed control, although trials with chloramiben ester, DCPA, CDEC, DNBP and benesulide are also recommended.

Mechanical and manual weed control will still be necessary to control resistant weeds.

Cultivation

Cultivation using a tractor for weed control and soil aeration will be necessary during the season.

Irrigation

Supplemental irrigation trials to evaluate yield and quality benefits are recommended.

A general irrigation scheme, based on minimum rainfall, is presented as follows:

Planting	Apply up to 10 mm if soil is dry
Planting-Blossoming	Apply up to 25 mm every seven days.
Blossom through Harvest	Apply 30-40 mm every five days.

This schedule will necessarily have to be modified as rainfall occurs during the season.

Disease, Pest and Pathogenic Conditions

Diseases. The use of disease-free seed, good field sanitation and a two to three year rotation period will greatly reduce the risk of serious disease losses of *Pseudomonas* and *Colletotrichum*. In addition, if *Colletotrichum* threatens to become damaging, a Maneb or dithane spray program will assist in controlling it.

Erysiphe is not usually damaging to production. If early infection occurs, spraying with Morestan will limit further spread. The systemic materials ELCIDE 273 and MILCURB from ICI have achieved excellent control of the disease.

Pests. Most insect or mite pests can be controlled with an organophosphate or sulfur spray or dust if applications are timely.

Harvest

For a once over harvest, the proper time is generally when approximately five cucumbers per 4 meters of a twin row bed have just begun to yellow at the blossom end.

For multiple harvests, harvesting can begin when there is a sufficient amount of fruit of the proper size (i.e., before any fruit have become yellow).

MISCELLANEOUS FRUIT AND VEGETABLES

It is recommended that no change be made in the production of apples, peaches, apricots, pears and plums. The existing production of these products is sufficient to satisfy the present requirements and the wisdom of expanding production and developing highly productive systems is questionable. The reasoning is that for apples, pears and plums, the European export market is extremely limited (see Marketing Section) and for peaches and apricots, the Dej area surrounding the 11 Junei plant has too low a winter temperature and too late a spring frost (see Figure and Appendix) to make the large-scale, mechanized production of these crops worth the risk.

Therefore no change should be made and the existing production should be directed into present channels as it is sufficient to meet present demands and possible new uses such as a canned fruit mix.

Further, no major expansion should be made in the assorted vegetables used for minor, locally consumed products and for flavoring. The present quantity is sufficient and the production costs would be too high for such crops as processing tomatoes (short seasons), peppers, carrots, etc. produced in larger scale.

Finally, it is recommended that crops such as raspberries, blackberries, blueberries, currants, etc., be investigated for larger scale production as they promise to be an easily cultivated crop with a ready market as processed jams.

PROCESSING

CUCUMBER LINE

Cucumbers for pickling should be blocky with a length to width ratio of 2.7:1 to 3.0:1, a relatively small seed cavity, well shaped with little or no tapering at the ends and uniform in color.

Reception

The cucumbers are received in bulk trucks, and unloaded into a flume tank by means of a high pressure water hose.

Preparation

From the flume tank they are elevated onto a roller conveyor where the culls are removed manually and dropped into cull chutes. The sorted cucumbers are then fed to deep trough sizers by means of a line roller feeder, where they are divided into five different sizes: small culls, 60 to 90 mm, 91 to 120 mm, 121 to 140 mm and large culls. The large and small culls are diverted to the cull bin. Each of the three middle sizes is diverted to a salt stock tank in one of three different rows of salt stock tanks. Each tank contains up to 22.5 kiloliters. A brine of 40 degrees salometer (10 percent sodium chloride in water) about 30 cm deep is placed in the bottom of the vat to prevent bruising of the cucumbers as the vat is filled.

Fermentation

After the vat is filled, additional brine at 40 degrees salometer is added to cover the cucumbers; equipment can be furnished to standardize the brine to any desired concentration or this operation can be handled manually. A circular head is then placed in the vat over the cucumbers and is held in place at the ends by iron clamps. The cover is necessary to keep the cucumbers submerged in the brine during the fermentation. As the fermentation advances and water is lost from the cucumbers, salt must be added to maintain the salt in the brine at 40 degrees salometer. This prevents the growth of putrefactive organisms. The concentration should not greatly exceed 40 degrees salometer as this might reduce the activity of the lactic acid organisms responsible for fermentation. During the first week of fermentation it is advisable to add salt to the vat each day. The brine must be circulated from the bottom of the vat to the top until brine is uniform in concentration. The fermentation and curing process normally requires from four to six weeks. During the last three to five weeks, salt is added only as necessary to maintain proper concentration.

When fermentation is completed, the salt concentration of the brine is gradually increased and maintained at about 60 degrees salometer (16 percent). After that time the salt stock cucumbers may be held for an indefinite length of time before packing, or packed immediately.

Packing

When the time comes to pack the salt stock cucumbers, they are flumed out of the vat and washed to remove excess salt. This is done by washing with a hydrobrusher using hot water at about 40 to 50 degrees C. A small amount of calcium chloride, soda alum and turmeric in the wash water improves the texture and color of the pickled cucumber. The pickles are then brought to packing tables where they are packed by hand according to size in glass jars. The jars move to a briner where a packing solution (3 percent vinegar and assorted spices) is added at 95 degrees C and the jars are closed. The jars then move to a labeller to be labelled, to a caser where they are placed in cardboard cases, after which they are taken to a case sealer to close the cases.

Materials Handling

The sealed cases are taken away by a live roller conveyor to a semi-automatic palletizer, after which they are taken to storage by a fork lift.

JAMS AND PRESERVES LINE

The process for preparing jams and preserves and filling it into cans for a production rate of approximately 5 tons per hour is described below in general terms. Conditions for each different type of fruit to be processed would have to be determined by processing technologists dealing with specific batches of raw material

Reception

Fruit coming into the plant for processing into jams and preserves will be received and handled in the same manner as fruit for the canning operation. Techniques are the same as described in that section.

Preparation

A batch is prepared in the jacketed kettles where the product is dumped and heated up to approximately 60 degrees C. If the product needs to be broken up, it is directed to the pulper. The heat before the pulping operation gives a better yield. The product is then pumped into the mixing kettle where sugar, pectin and acid are added in quantities varying according to the jam formula used. Using the motor driven agitator, these ingredients are blended together in the mixing kettle.

Cooking

Heat is added until the correct temperature and cook times are achieved. When cooking is complete, the heated liquid is pumped into one of the two vacuum pans. As soon as the mixing kettle is emptied, preparation of another batch begins.

Refining

The vacuum pumps are started and after the required volume of water has been evaporated (depending on the particular type of jam being produced), samples of product are tested with a refractometer. When solids reach 68 percent, the vacuum is broken, the tank is vented and the batch is pumped into the final formulation tanks. Here the jam is checked for pH and acid added if needed to bring the pH to 3.4 or lower.

The product flows by gravity from the formulation tank into the continuous pasteurizer where the temperature is brought up to 92 degrees C for a very short period of time so as not to affect the product.

Filling

The jam is then inspected. It goes through a conveying system with sight glass and very bright lighting, allowing for the removal of any undesirable product in the jam. The jam is then pumped to the piston filler. The empty cans are fed to the filler through a system of unscrambler and empty can conveyors. Once filled, the cans are seamed and conveyed to a draper cooler to cool the product down to about 37 degrees C.

Cooling

A pressure bar at the infeed of the draper cooler provides a positive smooth transfer of cans from the conveyor onto the draper belt. Water at a temperature of about 23 degrees C is sprayed in a fine mist over the cans. The sprays become heavier as the can travels through the draper cooler. Just before the cans are discharged, they receive a blast of air from the blower. This is for removal of water from the can. The heat (37 degrees C) from the can dries it completely.

Packing

Discharged cans move by conveyor into a labelling machine for application of a label. The final phase in the line is the casing of the cans and the sealing of the cases.

Preserves

The process is the same as for jam except for the fact that the fruit are left whole, save for peaches or pears which are halved. The same ingredients, water, sugar, pectin, and acid, have to be added to the fruit in accordance with certain set formulas. Then the mixture goes to the vacuum pan for a concentration of 68 percent solids and follows all the steps outlined in the preceding flow description.

Container Supply

Cans are presumably delivered to the plant in cartons or boxes. Normally they will be inverted within the case so that the bottoms can be seen in an open carton.

Cases of cans are delivered to the can unscrambler. An operator inverts a case of cans, opens the flaps and allows the cans to slide onto the unscrambler conveyor belt. The empty cans are transferred and singulated onto a narrow table top chain conveyor traveling at a right angle from the unscrambler.

The cans proceed to an inverting section where they are cleaned with a blast of air. After cleaning, each can is again inverted, right side up, and delivered to the infeed conveyor of the filling machine.

Cases which have been emptied at the unscrambling table are placed on a conveyor. They are transported to the packing area where they are refilled with cans of jam.

CHERRY LINE

Cherries are received at the receiving belt where they are manually dumped and undergo a preliminary inspection. The product continues to the cluster breaker where bunches and clusters are broken up and then pass to the waste eliminator.

The cherries receive a pre-rinse wash at the shaker washer. The cherries then drop directly into the hydraulic elevator which transfers them (with less mechanical handling than with other systems) to the two storage and surge tanks. Use of tanks prevents product surges on the line and contributes to a more efficient operation.

The cherries are transferred to a rotary washer by another hydraulic carrier and the product is thoroughly washed and is transferred to shaker screens to eliminate water. The cherries are immediately transferred to the picking conveyor and the badly bruised or cull cherries are removed by hand. These are chopped in a cull container that is placed underneath the cull chute and then conveyed to the waste disposal system.

The product is transferred to a distributing conveyor that carries the cherries to a pitting station. The cherries are hand placed on the cups and automatically stemmed and pitted. The cherries then gently drop to a product take-away conveyor which moves them to a hand pack filler.

While the prepared cherries are being filled, incoming cans are being received at the filling station by the empty can handling system. Product is filled into cans and these are transferred to a pre-vacuumizing system. First the free air is removed by vacuum; on completion of pre-vacuumizing, syrup is added to the container. The cans are immediately transferred to a steam flow sanitary can closing machine.

After the seaming operation, filled cans are transferred to a container cooker/cooler. After the product has been cooked and cooled the containers are transferred to a continuous labeller and then directly to a caser.

The caser requires a manual box maker and an operator to place the empty case on the loading funnel. After the cans are loaded into the case the operator manually places the filled container onto a take-away conveyor. The cases are transferred to the automatic case sealer and compression unit. After cases are hand palletized they are taken to finished product storage area.

COMPACT CANNERY LINE

The compact cannery offers an integrated, low cost, versatile canning facility intended for the small scale production of the assorted fruits produced at the 11 Junei plant, including:

- Peaches
- Plums
- Apricots
- Assorted Small Fruits
- Assorted Vegetables

In addition, consideration should be given to utilizing this line for the production of fruit salad and/or fruit cocktail.

This unique processing facility has been designed to maintain maximum flexibility with a minimum investment–allowing for processing and production of any diverse products without heavy investment in specialized equipment.

The approach used here has been to isolate the basic functions of canning and make provisions in the plant equipment scheme for the various types of products possible in each of the provided canning functions rather than attempt to develop the compact cannery for a specific product, or products, with the associated individual flow charts and descriptions. It is a module design basic cannery which may be subsequently augmented with a series of optional packages for specialty products which may require some additional machinery.

GREEN BEAN LINE

The market demands are greater for young tender green beans. The quality grades are also affected by the maturity as pointed out in the grading section. Therefore, it is important for the processors to receive green beans of tender maturity.

The first step in processing green beans must be a supply of first grade green beans. A large percentage of the scoring points for grading has to do with character. Good character is partially defined as green beans that are very young and tender, full fleshed and not fibrous, seeds in early stages of maturity and having no more than 5 percent with tough strings.

Reception

At the cannery, the green beans are dumped into the feed hopper and carried up an inclined elevator to a washer. The washer is equipped with powerful overhead sprays. After washing the beans are discharged onto a shaker screen which allows heavier foreign material to pass through the screen and be removed.

From the shaker screen the beans are lowered onto an oscillating conveyor equipped with diverters, and feeding six horizontal bar size graders. These units consist of a feed hopper, bar grading cylinder, size graded product discharge chute, and railover spout. The machine's rotating cylinder is composed of a series of fixed baffle bars alternated with movable, diamond shaped grading bars, all constructed of hard surfaced aluminum alloy. The grading bars and baffles are spaced or set to allow the desired size beans to fall between them. During the downward portion of the cylinder rotation, the grading bars are firmly held in set grading position. During the upward portion of the rotation the grading bars are rocked 90 degrees out of position to free any product that may have been wedged between the bars and fixed baffles. The beans then fall to the bottom of the cylinder for regrading. The graders will size the beans into two sizes.

This preliminary sizing allows the snippers to be adjusted according to bean size and reduces the amount of waste. A system of conveyors take the sized beans to the bean snippers which consist of a rotating cylinder composed of slotted snipping pockets and an oscillating knife assembly. The beans are received in the perforated feed of hopper, where they tumble through the throat opening into the snipping cylinder. As the beans tumble through the hopper, foreign material and dirt fall through the perforations and drop into the refuse chute under the hopper. Rotation of the drum, its inclined position that provides gravity and a series of internal baffles combine to guide the beans into the slotted snipping pockets through which the ends of the beans extend and are snipped off by the chevron knives. The bean snips fall into the refuse hopper while the whole beans are tumbled inside the drum until they discharge out of a chute onto a picking table for inspection and further preparation.

The picking table discharges onto a cross belt feeding the elevators, which in turn feed the bean cutters. In the cutters, the beans can be cut to any desired length. In this case the beans will be as much as possible whole, but will not exceed a length of 12 to 13 centimeters. The beans then discharge into two shaker type nubbin separators. Employing a series of oscillating decks, each equipped with a pair of oscillating decks, each equipped with a pair of galvanized screens, the separator produces two product separations simultaneously and continuously Perforations in the screens are of different dimensions, the largest being in the top deck. These perforations are smaller in the other deck, so that the second separation will eliminate only the nubbins. Nubbins pass through the back screen and are discharged through a chute.

The first deck of the separator screens out the cuts of desired length. The other deck screens out the short cuts, or those which are less than the desired length. These are diverted by an underside belt to a separate line which will pack the beans as a lower grade. The beans discharge into an elevator which will take them into a blancher. The two grades of beans are thus kept separate.

Blanching

Blanching is one of the important steps in the successful canning of beans. It shrinks the beans somewhat, and makes them pliable so that the can may be properly filled. Blanching has to be done at a temperature of about 60 degrees C. Holding time at this temperature varies with the maturity and size of the beans, but it should be as short as possible. Immediately after blanching the beans should be thoroughly cooled by sprays of clean cold water. The blancher consists of an outer tank which holds the water. The water is fed into the blancher at the discharge end, counter-current to product flow with beans being washed by fresh water before they leave the blancher. From the blancher the beans pass to a rotary cooler after which they are discharged onto a belt for a last inspection prior to filling.

Filling/Seaming

There are three filling lines, two of which have a vertical pack filler for fancy grade, and the lower grade line has a hand pack filler. The vertical pack filler is unique both in design and in operating principle. Basically it consists of a feed table assembly and a can filling mechanism. The feed table is composed of a rubber belt with molded cleats recessed in the center of a stainless steel table, forming a trough. The filling mechanism incorporates a product transfer hopper, compression pockets, can feeding turrets, a can feed chute, and a can discharge. The pockets on the belt are made to accommodate the volume of beans required to fill a given can size to a proper weight. The pockets compress the beans and mold them into a round mass, slightly less in diameter than the can into which they will be filled. The product is filled horizontally into the can but the can is discharged vertically.

A table top can conveyor takes the can to the briner station. The briner is equipped with worm and disc can feed. Product filled containers are gently and positively timed into the machine and are indexed under the brining valves.

Another table top can conveyor takes the can to the seamer. The cans are then carried by means of an elevator up to the feed valve of the continuous pressure cooker.

Cooking

Continuous cookers are required as by this means, absolute uniformity of processing is insured, and because of the agitated cook it is possible to process the product in a much shorter time than in retorts. In addition the high temperature short time cook improves the quality of the product as well as insuring complete uniformity.

Cooling

After cooking, the cans go into the pressure cooler. In the pressure cooler, air pressure is maintained so that the can will not be subjected to an instantaneous change of pressure from the cooker to atmosphere. After a short pressure cool, the cans then pass into an open continuous cooler where the remainder of the cooling is done.

Labeling

The cans go through a labeler which can be a spot or a wrap-around type of labeler using hot melt glue.

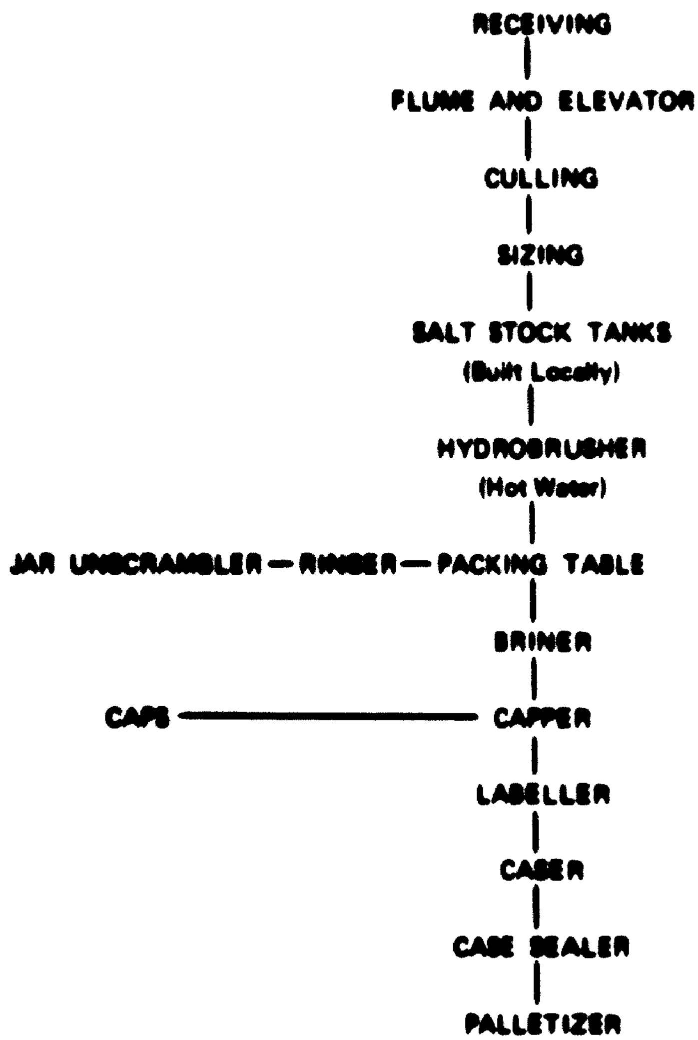
Casing

The cans are now ready for packing into the shipping containers. A separate case packer is employed for each line. The cardboard cases are then sealed by going through a case sealer.

The cases will be palletized manually and taken by lift trucks to the shipping area or to the storage area.

FLOW DIAGRAM

Cucumber Pickling Line



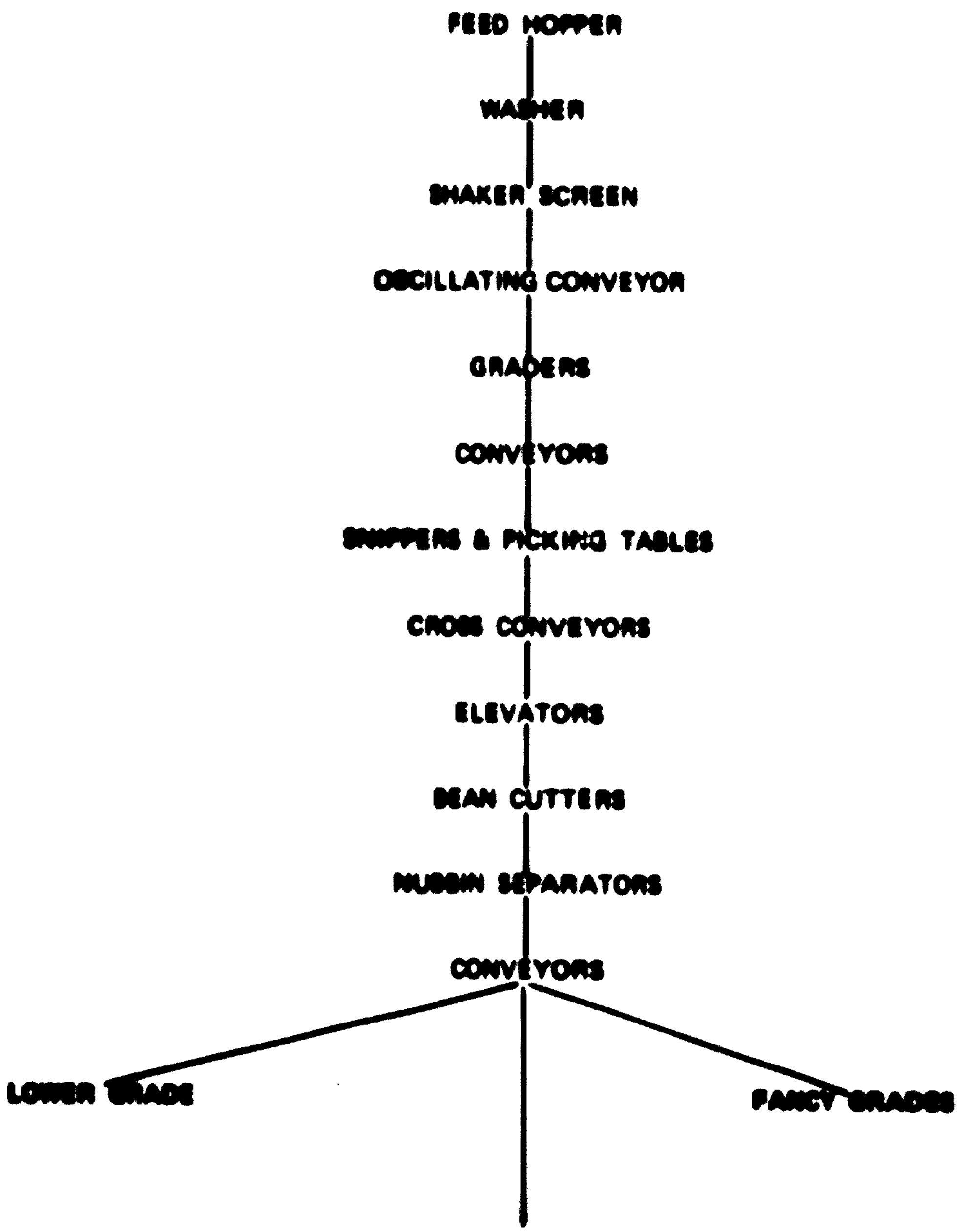
FLOW DIAGRAM

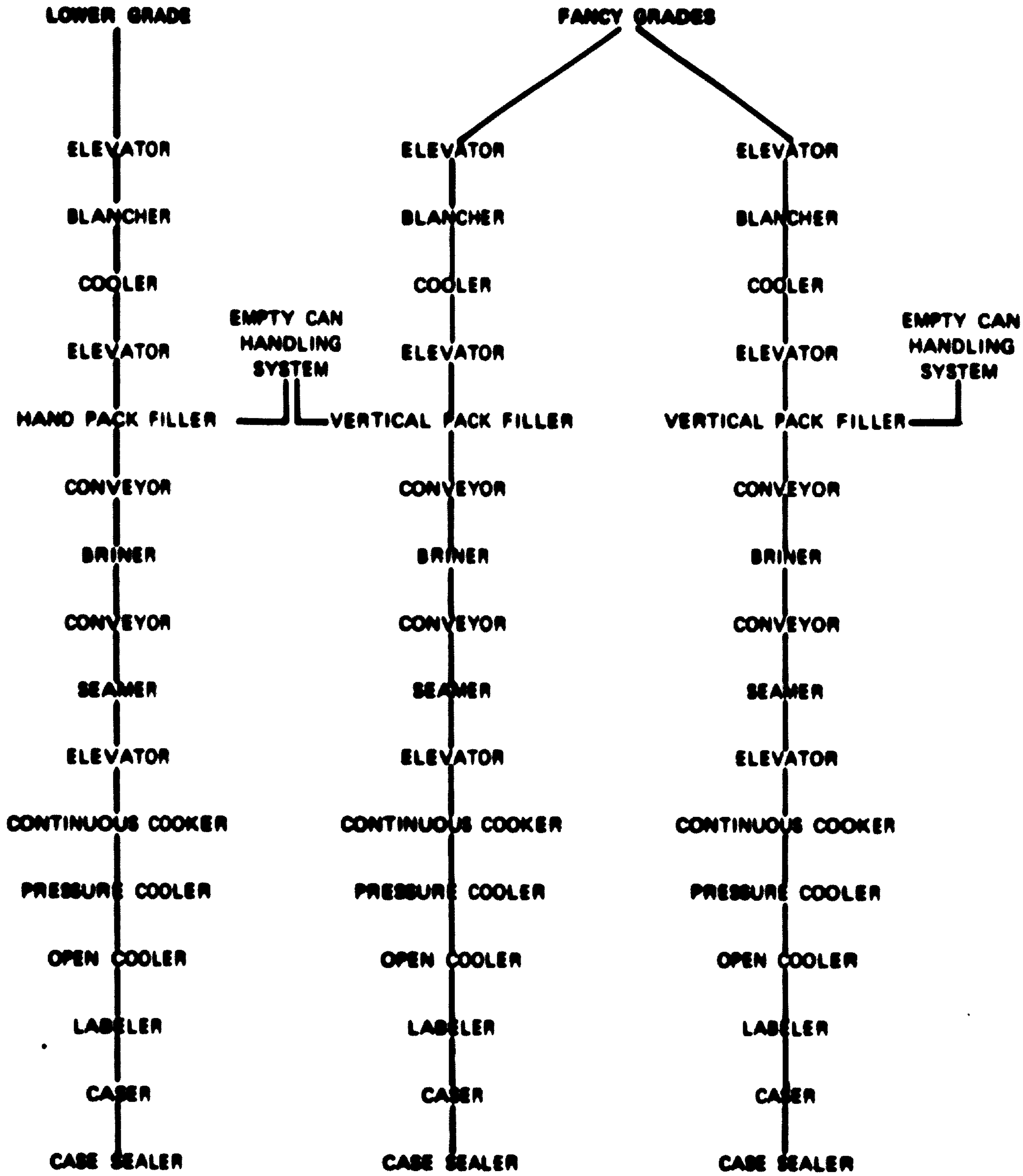
Cherry Line

RECEIVING
|
CLUSTER BREAKER
|
TRASH ELIMINATOR
|
WASHER
|
HYDRAULIC ELEVATOR
|
STORAGE TANK
|
HYDRAULIC ELEVATOR
|
WASHER
|
SHAKER
|
PICKING/INSPECTION CONVEYOR
|
DISTRIBUTION CONVEYOR
|
PITTERS
|
PRODUCT CONVEYOR
|
EMPTY CAN HANDLING SYSTEM ———— FILLER
|
SYRUPER
|
SEAMER
|
CONVEYOR
|
COOKER/COOLER
|
TRANSFER CONVEYOR
|
CASER
|
TRANSFER CONVEYOR
|
CASE SEALER
|
TAKE-AWAY CONVEYOR
|
STORAGE

FLOW DIAGRAM

Green Bean Line




LOWER GRADE
FANCY GRADES
ELEVATOR
BLANCHER
COOLER
ELEVATOR
HAND PACK FILLER
EMPTY CAN HANDLING SYSTEM
VERTICAL PACK FILLER
EMPTY CAN HANDLING SYSTEM
CONVEYOR
BRINER
CONVEYOR
SEAMER
ELEVATOR
CONTINUOUS COOKER
PRESSURE COOLER
OPEN COOLER
LABELER
CASER
CASE SEALER

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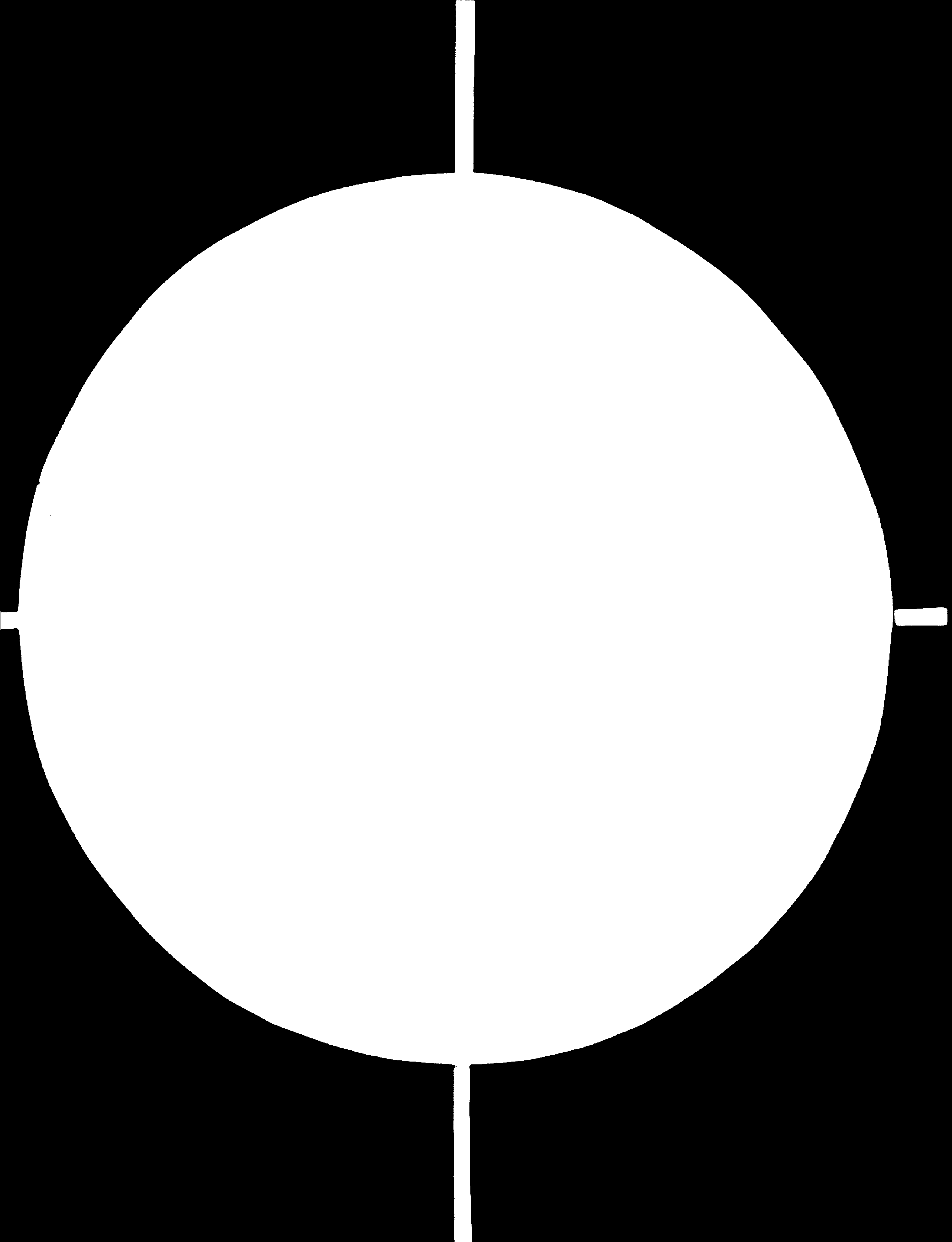

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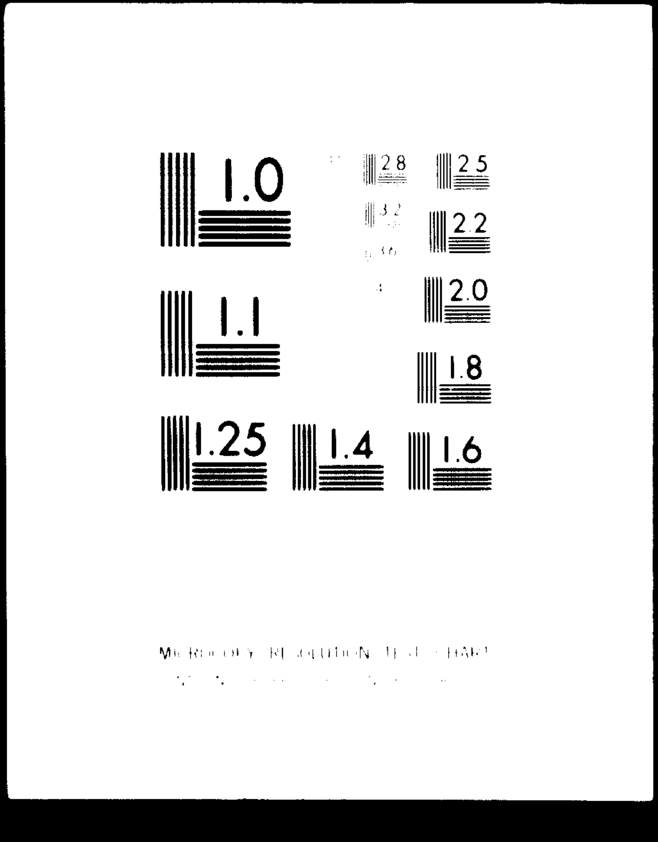

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MACHINERY LIST

CUCUMBER LINE

Quantity	Description
1	Cleated Belt Elevator
1	Live Roller Conveyor
1	Take-away Conveyor
1	Line Roller Feeder
1	Deep Trough Sizer
4	Take-away Conveyors
1	Shaker Screen
1	Hydrobrusher
1	Rotary Bottle Unscrambler
1	Rotary Hand Fed Jar Rinser
1	Packing Table
1	Six-Valve Rotary Briner
1	Labelling Machine
1 Lot	Flat Top Stainless Steel Conveyor Chains
1	Vapor Vacuum Capping Machine
1	Caser

1	Case Sealer
1 Lot	Spare Parts

JAMS AND PRESERVES LINE

Quantity	Description
2	Receiving Kettles
1	Pulper
1	Pump
2	Mixing Kettles
2	Vacuum Pans
2	Pectin Kettles
1	Pump
2	Holding Tanks
1	Continuous Pasteurizer
2	Glass Inspection Conveyors
1	Pump
1	Can Handling System
1	Filler
1	Seamer
1	Draper Cooler
1	Labeler

1	Filled Can Handling System
1	Caser
1	Case Sealer
1	Accumulation Conveyor
1 Set	Laboratory Equipment
1 Lot	Starters, Pipes, Fittings, Valves

CHERRY LINE

Quantity	Description
1	Receiving Belt
1	Cluster Breaker
1	Waste Eliminator
1	Shaker Washer
1	Scott Hydraulic Elevator
2	Storage Tanks
1	Scott Hydraulic Elevator
1	Rotary Washer
1	Scott Shaker
1	Picking Conveyor 24 x 16
1	Distributing Conveyor
2	Pitters

1	Transfer Conveyor
1	Hand Pack Filler
1	Table Top Conveyor
1	Syruper
1	Seamer
1	Table Top Conveyor
2	Sterimatic Cooker/Cooler
1	Table Top Conveyor
1	Caser
1	Conveyor
1	90 degree Curve
1	Accumulator Conveyor
1	Case Sealer
1	Take-Away Conveyor
2	Empty Can Handling Systems
	500 BHP Boiler

COMPACT CANNERY LINE

Quantity	Description
Inspection and Trimming Equipment	
1	Inspection and Trimming Table
1	Washing and Trimming Sink

Preparation

1	Grading and Preparation Table
1	Washing and Cleaning Sink
1	Cutting Table
1	Vegetable Blancher
1	Vegetable and Fruit Peeler-Scalder
2	40 Gallon Kettles, for cooking, mixing and blending
1	50 Gallon Holding and Blending Tank
1	Pulper-Fruit Pitter
1	Filler Mounting Table
1	Filler
1	Syruper-Briner
1	Semi-Automatic Operated Steam Exhauster
1	Stainless Steel Top Table
2	Electric Can Closers

Cooking

2	Miniature Retorts designed for cooking products in either glass or tin containers
1	1/2 Ton Hoist
2 Sets	Laboratory Cooking Equipment

Supporting Equipment

1	Basic Supply Kit
1	Operating Accessories Kit
1 Lot	Electrical Switch Gear for Motors
1	Basic Laboratory Set
1	Label Gluer
1	Air Compressor

Optional Packages

Steam Generation System

1	30 BHP Steam Generator
1	Feed Water Tank and Pump

Piping Set

1 Lot	Required Steam and Water Piping for Basic Compact Cannery Machines

Concentrated Products Unit

1	50 Gallon Vacuum Pan
1	Condensate Pump and Surface Condenser
1	Glass Bottle and Jar Capper

GREEN BEAN LINE

Quantity	Description
1	Feed Hopper With Elevator
1	Washer
1	Shaker Screen
1	Oscillating Conveyor
6	Bar Size Graders
1 Lot	Conveyors
10	Snippers and Picking Table
1 Lot	Cross Conveyors
4	Elevators
4	Bean Cutters
4	Nubbin Separators
2	Cross Conveyors
3	Elevators
3	Blanchers
3	Coolers
3	Inspection Belts
3	Elevators
3	Fillers

3	Table Top Can Conveyors
3	Briners
3	Table Top Can Conveyors
3	Seamers
3	Elevators
3	Continuous Cooker
3	Pressure Cooler
3	Open Cooler
3	Labelers
3	Non-Shock Caser
3	Case Sealers
1 Lot	Empty Case Handling System

ENGINEERING CALCULATIONS

CUCUMBER PICKLING LINE

A. Raw Input: 1900 T, 40 day season

1900 ÷ 40 = 47.5 T per day

10 hr working day

47.5 ÷ 10 = 4.75 TPH = 5TPH

B. Canning Data

1. Whole output in 1/2 kg cans

5000 ÷ .380 = 13160 CPH
= 220 CPM

2. 1 kg cans

5000 ÷ .775 = 6455 CPH
= 110 CPM

JAM LINE

A. Raw Input: 1600 T, 40 day season

1600 ÷ 40 = 40 T per day

8 hr working day

40 ÷ 8 = 5 TPH, 5000 kg/hr

B. Total Output

1. 1/2 kg can

5000 ÷ 0.380 = 13160 CPH
= 220 CPM

2. 1 kg can

5000 ÷ 0.775 = 6452 CPH
= 108 CPM

CHERRY LINE

A. Raw Input: 1250 T, 40 day season

1250 ÷ 40 = 31 T

8 hr working day, 4 TPH

10 percent loss during canning

B. Output Production: 4000 - 400 = 3600 kgs/hr

C. Canning Data

1. Maximum output in 1/2 kg can

3,600,000 ÷ 380 = 9475 CPH = 158 CPM

2. 1 kg can

3,600,000 ÷ 775 = 4645 CPH = 80 CPM

COMPACT CANNERY LINE

Berries

A. Raw Input: 100 T, 45 day season

Season: 40 processing days

$100\ T \div 2500$ kgs/day = 250 kgs/hr

B. Process Losss: Loss due to canning 20 percent

$$\frac{250 \times 20}{100} = 50 \text{ kgs/hr}$$

C. Output Production: 250 - 50 = 200 kgs/hr

D. Canning Data

1. Maximum output in 1/2 kg can

   $200{,}000 \div 380 = 526$ CPH = 9 CPM

2. 1 kg can

   $200{,}000 \div 775 = 258$ CPH = 5 CPM

Apricots

A. Raw Input: 200 T per season, 1-15 July

   Season: 15 processing days

   $200 \div 15 = 13.5$ T per day = 1700 kg/hr

B. Process Loss: Loss due to canning 10 percent

C. Output Production: 1700 - 170 = 1530 kgs/hr

D. Canning Data

1. Whole 60 percent $\frac{1530 \times 60}{100} = 918$ kgs/hr

   Maximum whole apricots 1/2 kg can

   $918{,}000 \div 380 = 2416$ CPH

1 kg can

$$\frac{918{,}000}{775} = 1184 \text{ CPH} = 20 \text{ CPM}$$

2. Halves 40 percent $\frac{1530 \times 40}{100} = 612$ kgs/hr

3. Maximum halves 1/2 kg can

$$\frac{612{,}000}{380} = 1610 \text{ CPH} = 27 \text{ CPM}$$

1 kg can

$$\frac{612{,}000}{775} = 790 \text{ CPH} = 13 \text{ CPM}$$

Plums

A. Raw Input: 500 T per season

Season: 40 processing days

500 T ÷ 40 = 12.5 T per day = 1565 kg/hr

B. Process Loss: Loss due to canning 6 percent

$$\frac{1565\text{K} \times 6}{100} = 94 \text{ kgs}$$

C. Output Production: 1565 - 94 = 1471 kgs/hr

D. Canning Data

1. Whole 60 percent $\frac{1471 \times 60}{100} = 883$ kgs/hr

Maximum whole plums 1/2 kg can

883,000 grms/hr ÷ 380 grms/can = 2325 CPH = 40 CPM

1 kg can

883,000 grms/hr ÷ 775 grms/can = 1140 CPM = 19 CPM

2. Halves 40 percent $\frac{1741 \times 40}{100}$ = 588 kg/hr

3. Maximum halves 1/2 kg can

588,000 grams/hr - 380 grms/can = 1550 CPH = 26 CPM

1 kg can

588,000 grms/hr ÷ 775 grms/can = 760 CPH = 13 CPM

Peaches

A. Raw Input: 300 T per season, 15 July - 31 August

Season: 40 processing days

300 T ÷ 40 days = 7.5 T = 8 T per day = 1 TPH

B. Process Loss: Loss due to canning 40 percent

$\frac{1000 \text{ kg} \times 40}{100}$ = 400 kgs/hr

C. Output Production: 600 kgs/hr

D. Canning Data

1. Slices 60 percent $\frac{600 \times 60}{100}$ = 360 kgs/hr

Maximum peach slices 1/2 kg can

360,000 kg/hr ÷ 380 kg/can = 950 CPH = 16 CPM

1 kg can

360,000 kg/hr ÷ 775 kg/can = 465 CPH = 8 CPM

2. Halves 40 percent $\frac{600 \text{ kg} \times 40}{100}$ = 240 kgs/hr

Maximum peach halves 1 kg can

240,000 kg/hr ÷ 775 kg = 310 CPH = 6 CPM

1/2 kg can 240,000 kg -

240,000 kg ÷ 380 kg/can = 632 CPH = 11 CPM

GREEN BEAN LINE

A. **Raw Input**: 2500 T per season

2500 T ÷ 40 = 62.5 T per day 16 hrs per day = 4 MTPH

B. **Process Loss**: Average loss during canning 35 percent

$\frac{4000 \times 35}{100}$ = 1400 kgs/hr

C. **Output Production**: 4000 - 1400 = 2600 kgs/hr

D. **Canning Data**

1. Maximum output in 1/2 kg cans

2,600,000 ÷ 380 = 6843 CPH = 114 CPM

2. Maximum output in 1 kg cans

2,600,000 ÷ 775 = 3355 CPH = 56 CPM

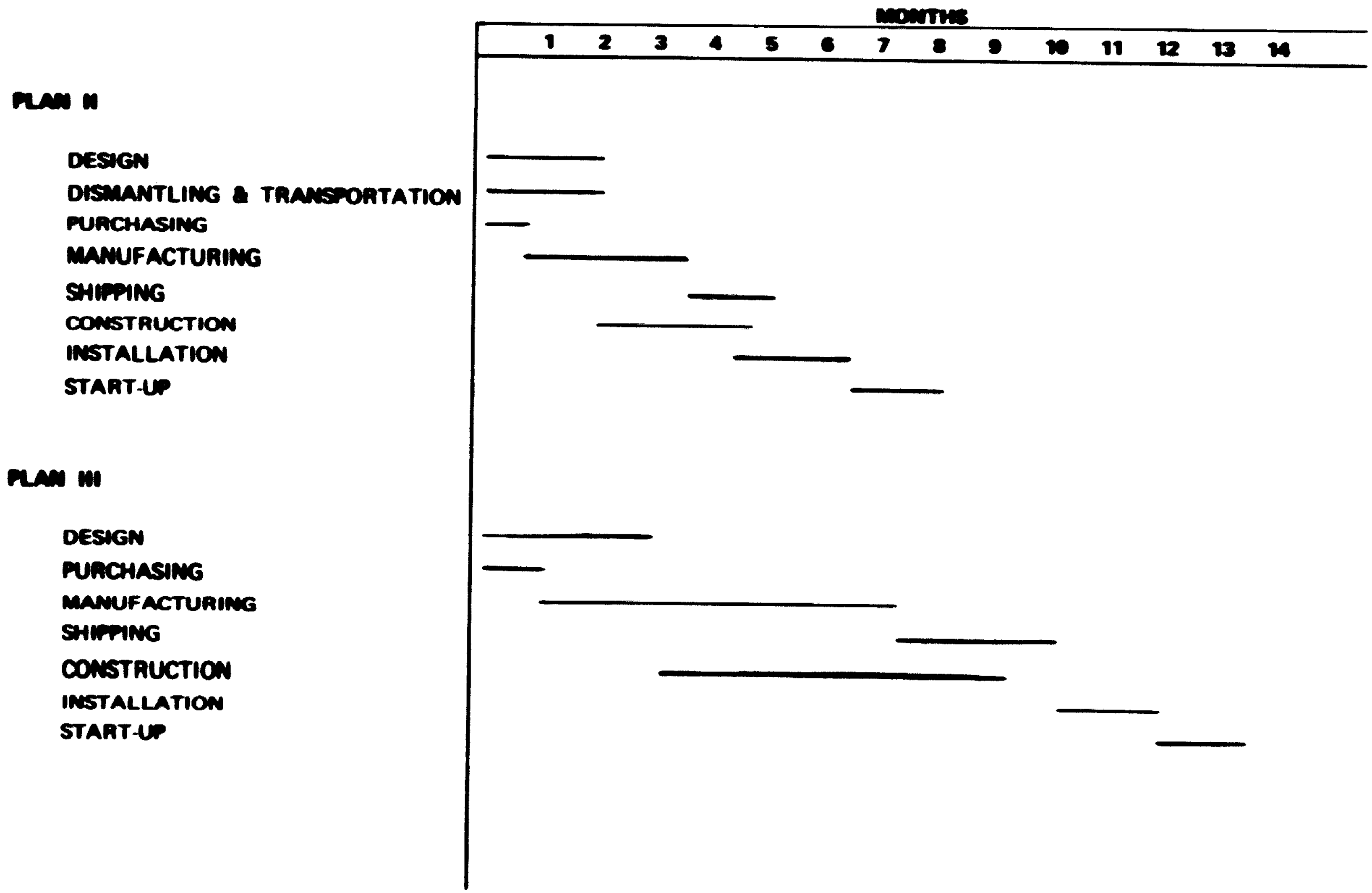
CIVIL ENGINEERING

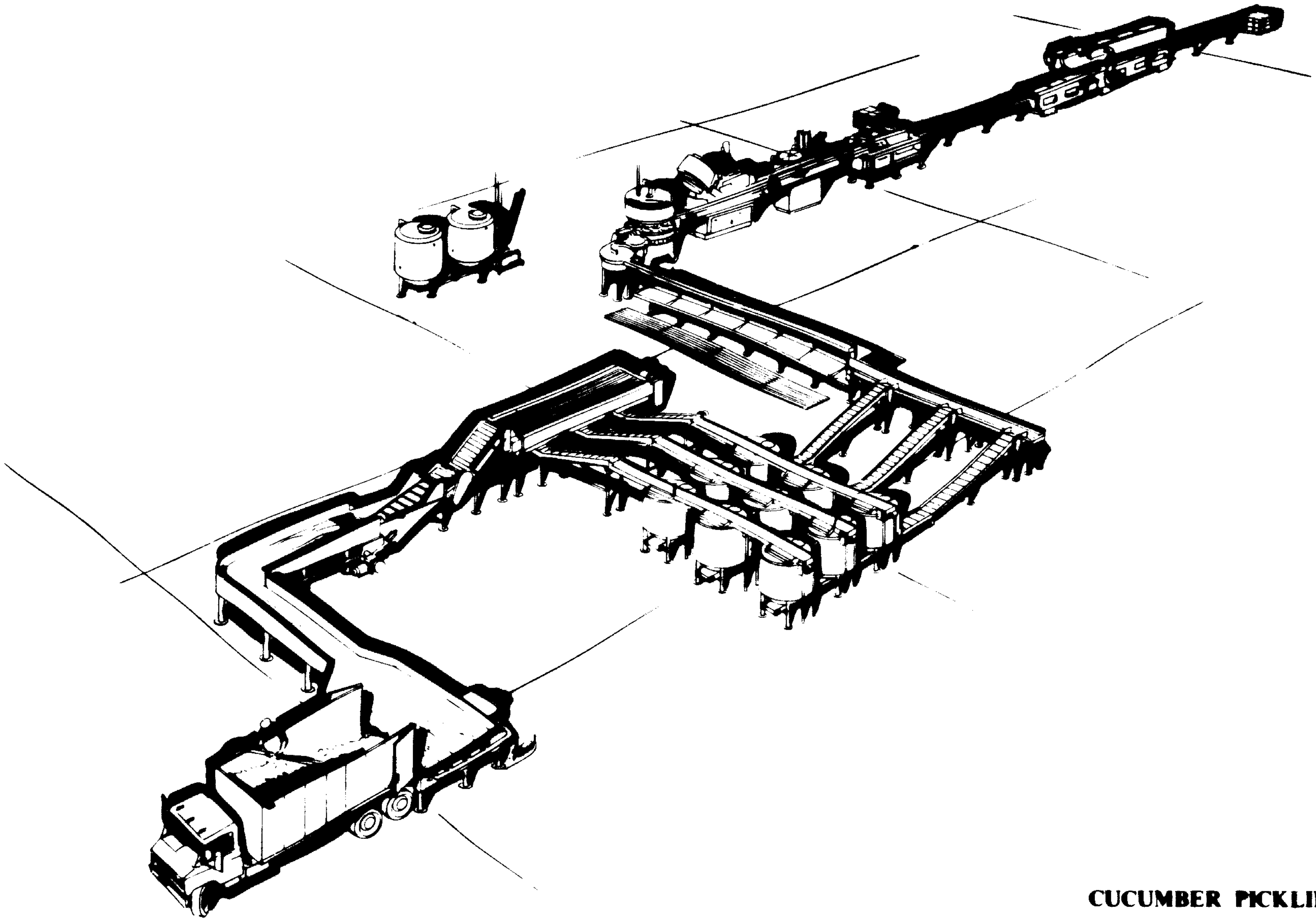
Discussion of matters relating to relocation of the processing facility is provided in Plan II.

In addition, it is recommended that the new facility for Plan III be designed and engineered following the design and engineering of the processing lines. In this manner, the physical site will be more appropriately and efficiently planned in relation to function.

This will also reduce modification to either the lines or the plant to a minimum, thereby reducing construction and set-up costs.

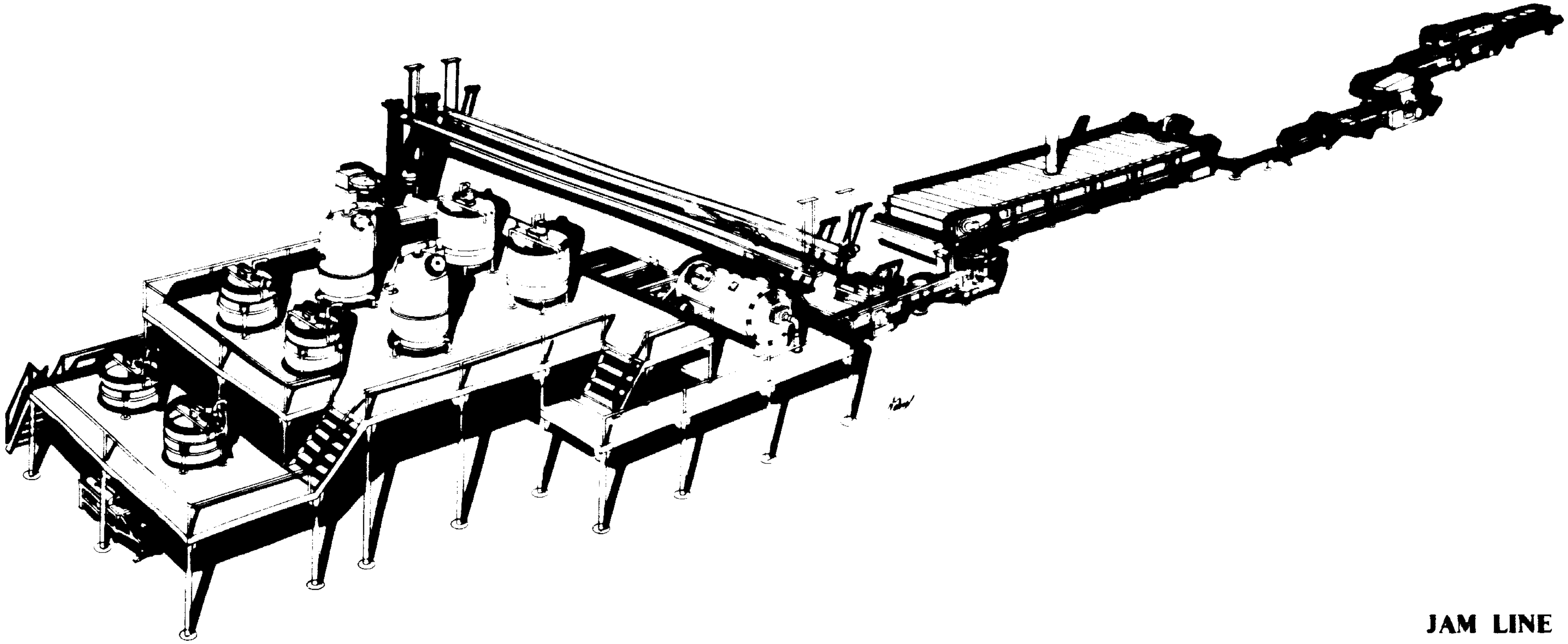
TIME SCHEDULE—11 JUNEI, DEJ





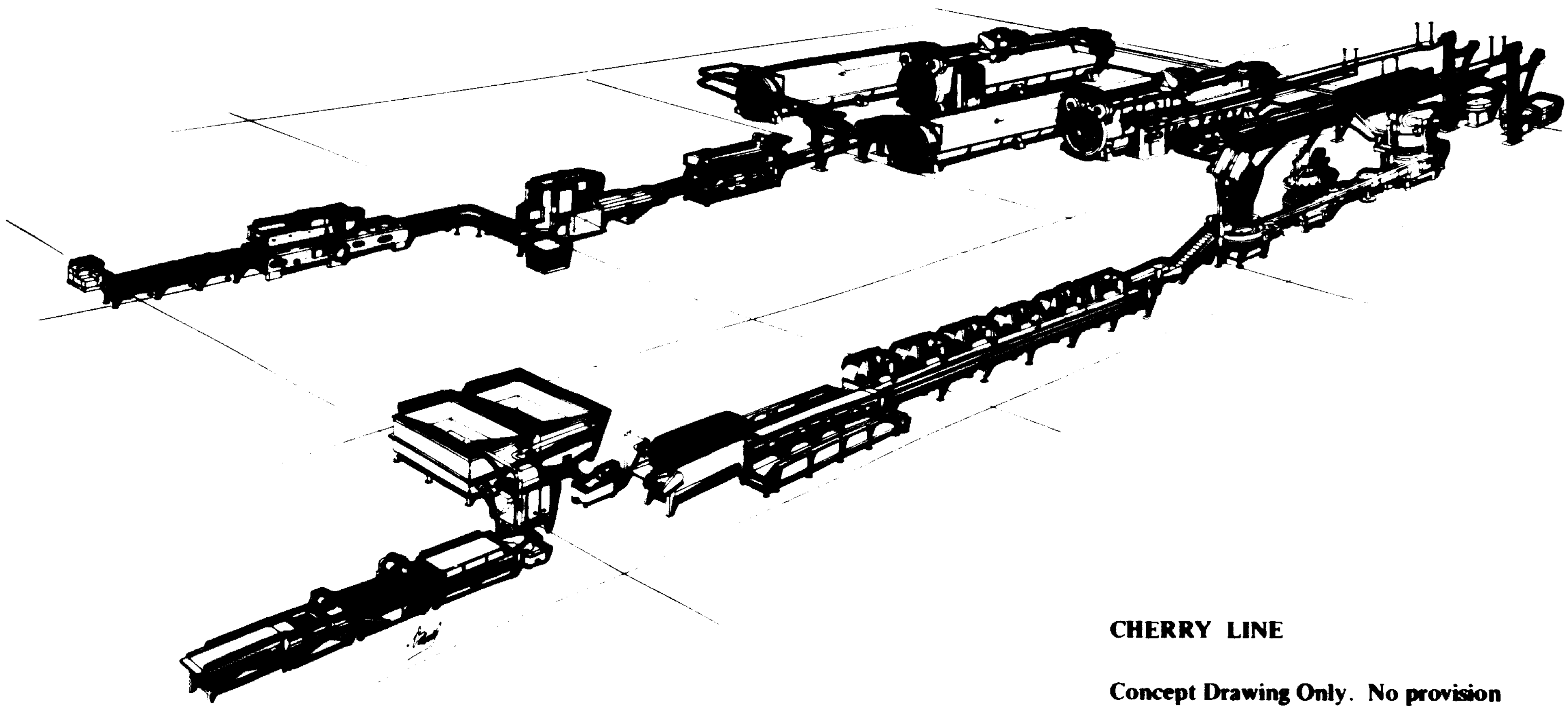
CUCUMBER PICKLING LINE

Concept Drawing Only. No provision made for integration of lines.



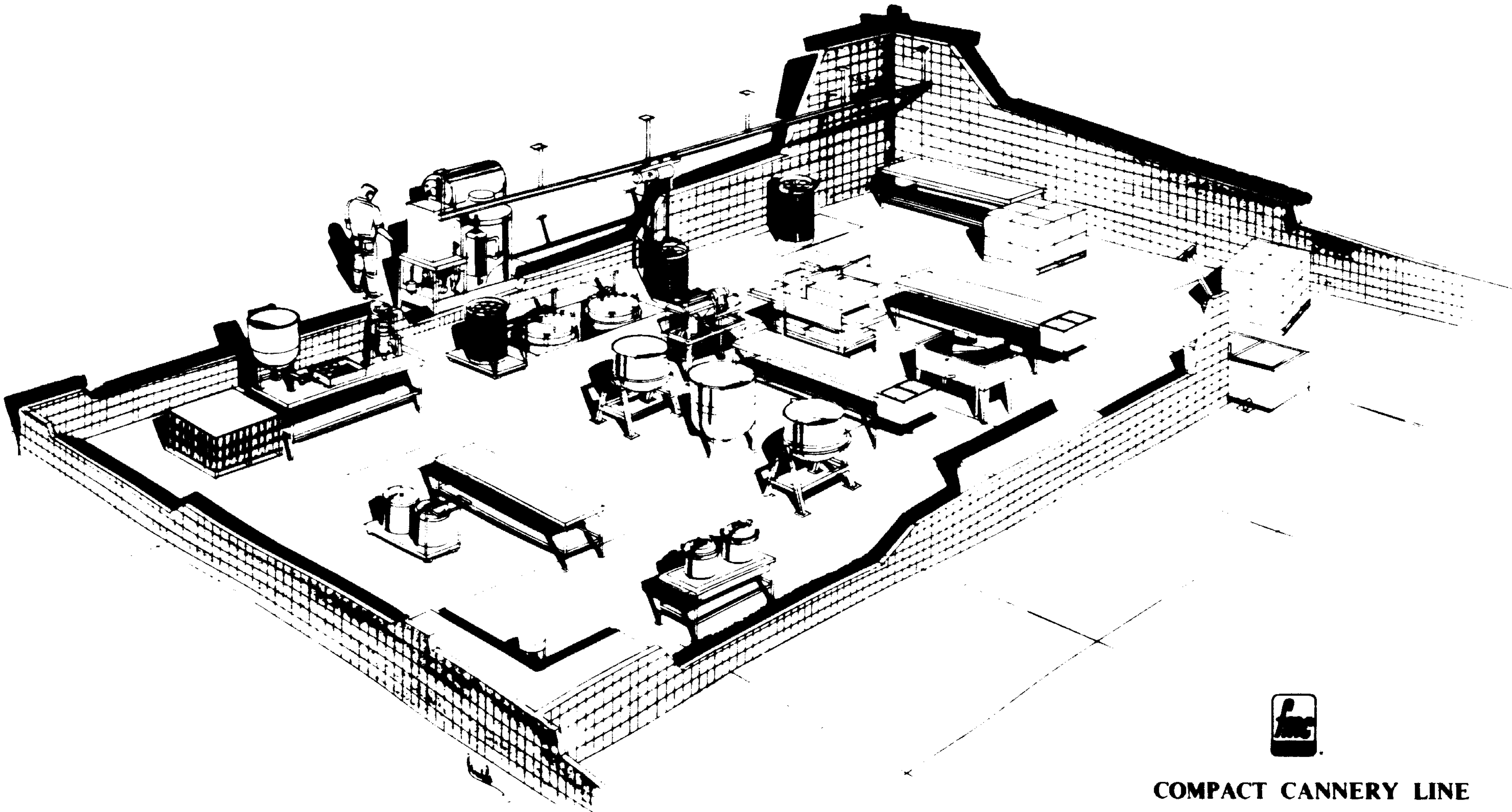
JAM LINE

Concept Drawing Only. No provision made for integration of lines.



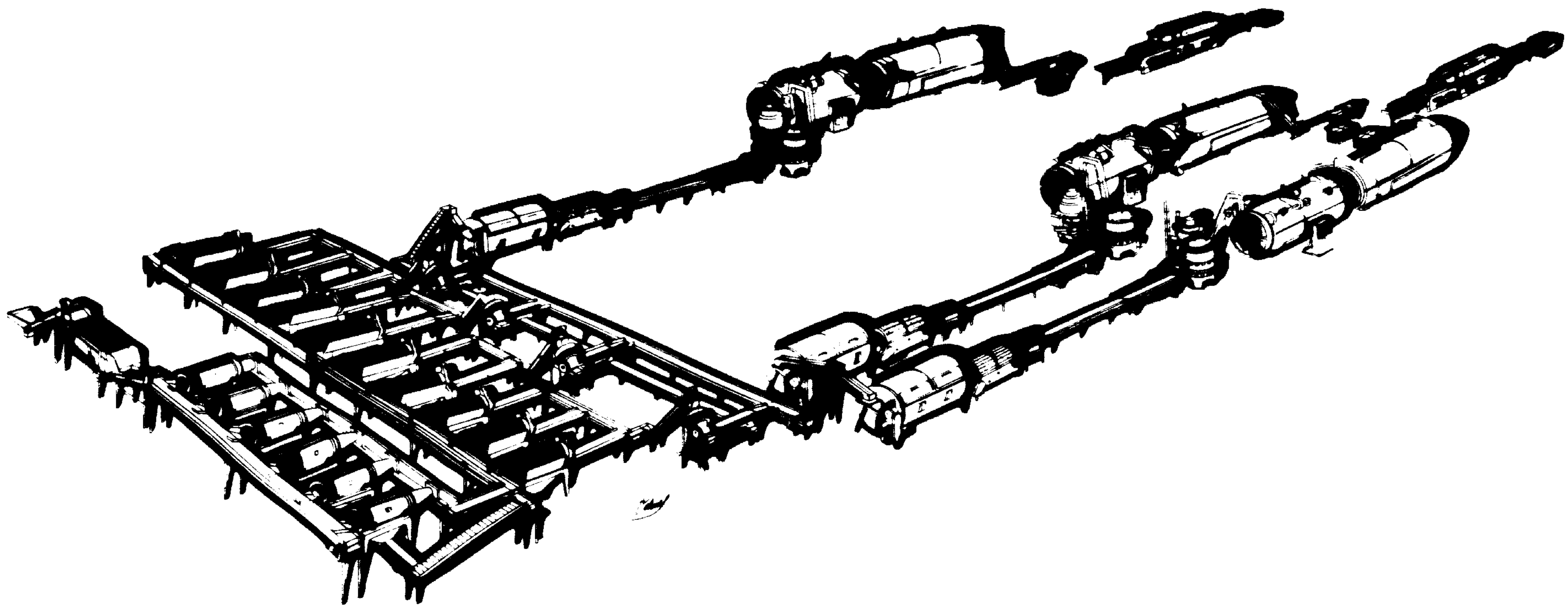
CHERRY LINE

Concept Drawing Only. No provision made for integration of lines.



COMPACT CANNERY LINE

Concept Drawing Only. No provision made for integration of lines.



GREEN BEAN LINE

Concept Drawing Only. No provision made for integration of lines.

ECONOMIC ANALYSIS

INTRODUCTION

The economic analysis is divided into four parts. The first part analyzes the economic feasibility of certain recommendations on improving the current production techniques used at Zagna Vadeni. In the case of the 11 Junei plant, as noted, the plant is in the paths of proposed earthworks and therefore must be moved. It basically determines if the capital investment is justified by the reduction in labor costs.

The second part of the analysis determines the costs involved in moving the Zagna Vadeni and 11 Junei processing plants and compares the benefits and costs of other improvements to these plants.

The third economic analysis investigates the feasibility of constructing new plants and producing products using modern processing technology. In this economic analysis, input costs which have a large effect on profits are identified.

In the final part, the three economic analyses are compared to determine which improvements yield the highest level of economic return.

ZAGNA VADENI

PLAN I

The improvements to the production techniques currently used in Zagna Vadeni do not increase the output of the plant or the quality of the output product. Other factors in the production process limit output and quality. Since the output is not affected, the economic analysis is concerned with potential reduction in costs resulting from these improvements. The economic decision is based on the reduction in costs that might be obtained by substituting capital (new machinery) for labor. If the capital improvements result in a net reduction in costs then the improvement is economically justified. Other considerations, such as improved working conditions, should also enter into the decision on which processes to adopt.

INSTALLATION OF CONVEYOR

The installation of a conveyor will involve an approximate initial investment of 36,000 lei. Depreciation and interest charges on this investment would be 6,120 lei per season. This conveyor would involve a savings of four men per shift. Projected over a season, this labor reduction would mean a savings of 600 man days (assumes three shifts, 50 day season). At a wage rate of 55 lei per day this yields a reduction of the wage bill of 33,000 lei per season. A capital investment cost of 6,120 lei per season therefore results in a cost reduction in labor of 33,000 lei or a net benefit of 26,880 lei. The installation of a conveyor is therefore economically justifiable.

INSTALLATION OF AUTOMATIC BASKET FILLERS

The automatic basket fillers require an initial capital outlay of 832,000 lei. This capital outlay translates to a per season cost of 141,440 lei per season. The savings in labor is estimated at four laborers per shift or 600 man days over the season. This reduction in labor results in a reduction of the wage bill or 33,000 lei. The installation of the automatic basket filler results then in a cost of 141,440 lei per season and a savings of 33,000 lei per season or a net loss of 107,440 lei. This automatic basket filler is then not economically justifiable. However, other considerations, such as the unpleasantness of this filling operation when done manually or possible rising future wages or attributing a real shadow price of labor of greater than 55 lei per day, could justify this expenditure despite the current economic cost of this improvement in the production process.

WAREHOUSE CHANGES

The warehouse changes, the details of which are described elsewhere in this report, would require an initial outlay of 1,360,000 lei. This translates to a per season cost for depreciation and interest charges of 231,200. The labor reduction that would result is estimated at 2,250 man days. At a wage rate of 55 lei per day this results in a wage bill reduction of 123,750 lei per season. On a per season basis, this would result in a net loss of 107,450 lei. If the wage rate rose to 102.75 lei per day then this capital outlay would be economically justifiable.

MOVE BEAN GRADERS AND SNIPPERS

Moving the bean graders and snippers involves only a minor cost outlay. The benefits however are substantial. It is estimated that 2,250 man days will be saved over a season. At a wage rate of 55 lei per day this rearrangement of the production line results in a net cost reduction of 123,750 lei per season. Since costs of this rearrangement are minor, the net benefit of this rearrangement will be 123,750 lei per season and hence is definitely economically justifiable.

REDESIGN FILLER AREA

The redesign of the filler area also requires only a minor cost and results in a considerable savings in manpower. It is estimated that a reduction of 1,500 man days will result per season. At a 55 lei per day wage rate, this redesign would result in a reduction in costs of 82,000 lei per season.

SUMMARY OF PLAN I RECOMMENDATIONS

From this economic analysis, the installation of the conveyor, the moving of the bean graders and snippers, and the redesign of the filler areas are economically justifiable. The automatic basket fillers and the warehouse charges are not justifiable at a wage rate of 55 lei per day. However, other considerations may make such changes desirable. If the wage rate or opportunity cost of labor in the case of the automatic basket fillers increases to 235.7 lei per day or in the case of the warehouse changes to 102.75 lei per day, then these improvements in the production process would be economically justified.

Table 31

Economic Analysis–Plan I

Project	Costs	Benefits	Net
Install Conveyor	36,000 lei or over 10 years = 3,600 lei per season depreciation plus 2520 interest @ 7% charges = 6120 lei per season.	600 man days @ 55 lei per day = 33,000 lei per season.	+ 26,880 lei per season.
Install Automatic Basket Fillers	832,000 lei or over 10 years = 83,200 depreciation plus 58,240 interest @ 7% charges = 141,440 lei per season.	600 man days @ 55 lei per day = 33,000 lei per season.	- 107,440 lei per season.
Warehouse Changes	1,360,000 lei or over 10 years = 136,000 depreciation plus 95,200 interest @ 7% charges = 231,200 lei per season.	2,250 man days @ 55 lei per day = 123,750 lei per season.	- 107,450 lei per season.
Move Bean Graders and Snippers	Minor.	2,250 man days @ 55 lei per day = 123,750 lei per season.	+ 123,750 lei per season.
Redesign Filler Area	Minor.	1,500 man days @ 55 lei per day = 82,000 lei per season.	+ 82,000 lei per season.

ZAGNA VADENI

PLAN II

The analysis of Plan III production involves determining the economic costs of moving the Zagna Vadeni plant and making the economically feasible improvements in the processing line discussed in the section on Plan I. Movement of the Zagna Vadeni plant involves:

- The costs of disassembling the machinery.
- Building a plant at a new site.
- The costs of a lost season of production.

The actual movement of the plant is estimated to require approximately 2,700 man days of unskilled, semi-skilled, and skilled labor. The estimated costs of this labor is 216,000 lei. The cost of a new building is estimated to be 55,000,000 lei. The cost of a season without production is considered to be approximately 26,425,000 lei of profit. This loss is figured on the basis of a 10 percent profit margin from estimated revenue. It considers only direct costs and does not account for any indirect costs that might result in terms of lost market channels or disruption of producer incomes.

Additional costs originate from the improvements in the processing line discussed in Plan I. The total cost of moving this plant is estimated to be 81,461,000 lei.

This cost figure will be used in the final section to determine if it is more economically advantageous to build an entirely new plant with modern processing lines or to move the old plant and lose a season's output.

Table 32

Estimated Cost–Plan II
(All Prices in Leis)

Moving Zagna Vadeni Plant		
(i) Actual Movement of Plant		
2,700 man days @ 80 lei/men day		216,000
(ii) Building, including integral equipment		55,000,000
(iii) Opportunity Cost of one lost season		
Loss of Revenue:		
a. Tomato Paste	60,000,000	
b. Tomato Juice	56,000,000	
c. Whole Unpeeled	125,000,000	
d. Peas	9,250,000	
e. Green Beans	6,000,000	
f. Jams & Preserves	8,000,000	
Actual Cost assuming resources have alternate productive outlets (10% of total revenues)		26,425,000
Improvements Economically Feasible under Plan I		36,000
Total Cost of Plan II		81,461,000
Total Direct Benefits from Machinery Improvements		232,630

ZAGNA VADENI

PLAN III

INTRODUCTION

In this section, the economic feasibility of the investment proposals under Plan III are determined. The procedure used is to estimate production and engineering parameters, assign costs and price figures for inputs and outputs, and then vary these numbers from plus through minus 50 percent to measure the effect on the projected profit margin. This procedure allows a decision-maker to identify those parameters which have a significant effect on profits and hence demand close controls. Also, it permits the decision-maker to use his own judgment on some of the estimated numbers. For instance, if the estimated wage rate used in the economic analysis is considered too high or too low, then a decision-maker need only go to the Sensitivity Table, vary the labor cost, and observe immediately the effect on profits. Similarly, if prices are expected to continue to rise on a certain product, then the effect of this change in prices on profits can be again determined by reference to the Sensitivity Tables. This method of economic analysis then allows much flexibility in that it permits uncertainty in parameter estimates, accounts for dynamic changes in certain costs and prices, and therefore determines the economic feasibility of an operation, not just at one point in time, but over a variety of assumptions on parameter values and over a span of time.

DESCRIPTION OF COSTS ESTIMATES

The specific values for a production process of course vary and are included under the specific economic analysis of the product. The following section defines the cost and value parameters in general terms.

Capital Expenditures

Long Term Capitalization. Capitalization costs in these operations include the initial expenditures for new farm machinery, processing equipment, and buildings. The capitalization costs on the farm machinery and processing equipment are derived from present figures on the price of this equipment. Estimates on installation costs are also included in this cost figure. The capital expenditure on the buildings is estimated to be at a rate of 1,100 lei per square meter. In projecting these costs to a yearly expense, a long term interest rate of 6 percent is used.

Short Term or Working Capital Expenditures. It is assumed that during the operation of this plant certain expenses will need to be met by short term borrowing. This borrowing is necessitated by the gap between the time of cost expenditure and the time when revenues arrive from the sale of the final product. It is estimated that approximately half of the plant's operating costs must be met in this manner. (It should be noted that, even though actual borrowing might not be necessary due to reserves, these reserves have an opportunity costs which must be reflected in the profit calculations). The short term rate of interest assumed on these loans is 8 percent.

Variable or Yearly Costs

Production Costs. These numbers are estimates of the costs incurred during the growing of the crop. They include expenditures on labor, fertilizers, and other chemicals, and seeds.

Harvest Costs. The harvest costs include expenditures on labor and fuel for the farm machinery. The specifics of this operation are described elsewhere in the report.

Labor Costs. The labor costs are estimated by multiplying the manpower requirements by the wage rate for various grades of labor. These are assumed at the following rates:

Skilled Labor:	100 lei/day
Semi-skilled Labor:	75 lei/day
Unskilled Labor:	55 lei/day

Utility Costs. These costs are estimated from the engineering data on the utility requirements of these plants and the cost of these utilities in Romania. These are assumed at the following rates:

Steam Costs:	29.00 lei/ton
Water Costs:	1.09 lei/cubic meter

Electricity Costs:	0.48 lei/kilowatt hour

Supply Costs. Under these costs, expenditures for cans and cartons are estimated. The following costs are assumed:

5 Kg Can:	4.4 lei
1 Kg Can:	1.4 lei
½ Kg Can:	0.8 lei

These numbers include label costs.

Maintenance Costs. Maintenance of the farm machinery and of the processing equipment will be necessary. It is estimated that this will require an expenditure of approximately 5 percent of the initial capitalization costs.

Depreciation Costs. The depreciation schedule assumed is a straight line table with a rate on machinery of 10 percent and on buildings of 2 percent.

Shipping Costs. Shipping costs are based on the rate to England. Other destinations require adjustment of this rate by use of the Sensitivity Tables. It is estimated that the product can be shipped at a rate of 470.4 lei per ton, plus or minus 50 percent.

Sales Revenue. Two estimates are given for the sales revenue. The first one assumes that the product is sold for export and is based on C.I.F., England but does not include tariff rates. Since these rates are subject to change within the EEC and for countries outside the EEC or about to enter, these estimates were kept out of the calculation. To estimate the effect on profits of these tariffs, Sensitivity Tables must be used. For instance, if the projected tariff for a product is expected to be 10 percent, then the profit from the sale of this product should be read under the -10 percent column.

The second estimate on revenues is based on the total product of the processing plant being sold domestically. This revenue figure is not used in the Sensitivity Analysis but is maintained only for reference to that revenue figure obtained from foreign sale.

TOMATO PRODUCTION AND PROCESSING OPERATION

The economic analysis in this section determines the profitability of the tomato operation at current prices and costs and under conditions where cost or prices might be 50 percent higher or lower than these numbers. Table 33 shows the total capitalization costs on the tomato operation. The processing operation requires approximately 2.5 times the initial capital expenditure as does the growing or production operation. This difference reflects the general tendencies of production becoming more capital intensive with the degree of processing. Total capital investment is approximately 38.5 million lei.

Reference to Table 34 shows that this investment results in a profit of 7,678,400 lei without deductions for tariffs. At a tariff rate of 5 percent, for instance, profits would be reduced to 6,323,200 lei and the rate of return on capital would be 16.4 percent. Total foreign exchange earnings would be 25,748,000 per season.

Reference to the Sensitivity Table shows that the tariff rate could increase to 30 percent of the sales price before the operation would become unprofitable. Further reference to the table indicates that an increase in price of tomato products of 10 percent would yield a return of 0.348 lei for every lei of sales revenue. On the cost side, the Sensitivity Table indicates that the cost of supplies (cans and cartons) are a major component in total costs. A reduction in the cost of cans by 20 percent would result in an increase in the profit to sales ratio from .283 to .329. Since can costs in Romania are about 100 percent higher than can costs in the United States, reduction of these can costs might be possible. Any reduction of costs in this area is of course limited by metal costs.

Overall, the tomato operation seems to be highly profitable at current prices and costs. Only a 30 percent fall in prices or a 30 percent tariff would cause losses in the operation. From this analysis, tomato processing appears to be a suitable area for expansion and modernization for Romanian agriculture.

PEA AND GREEN BEAN PRODUCTION AND PROCESSING

The pea and green bean production and processing operation is not nearly as attractive an investment as the tomato production and processing; however, the pea and green bean operation has other features which recommend it. As shown in Table 35, the pea and green bean operation requires an investment of 12.3 million lei for production equipment and 20.2 million lei for the processing operation. This investment yields a modest profit of 1.65 million before any tariffs are deducted. However, these numbers assume sale entirely in the foreign market. Sale domestically means a revenue of 32.2 million lei and a profit of 3,602,280 lei. Furthermore, the major cost of the processing is expenditure on cans. The cost of cans is over half of the total of variable costs of processing as shown in Table 36. Any reduction in this supply cost would yield substantial benefits. As stated previously, judging by United States costs, this reduction does indeed seem possible.

The pea and green bean operation is recommended but with some reservations. Even though the production would result in a total foreign exchange earnings of nearly 32 million lei, the profitability of the operation would be extremely sensitive to any fall in prices. Justification of this investment must be based on need for foreign exchange earnings, domestic sales, and potential of reduced can costs. Reference to Sensitivity Table shows that reduction of can costs by 20 percent would increase the profit to sales ratio from a marginal 0.045 to a more substantial 0.145.

Table 33

Tomato Capitalization Costs—Plan III
(All Prices in Leis)

Production Capitalization	10,173,600
Plant Equipment Capitalization	25,200,000
Buildings	3,119,400
Total Long Term	38,493,000
Working Capital	5,936,850

Table 34

Tomato Production and Processing Variable Costs—Plan III
(All Prices in Leis)

Interest Charges		2,305,800
Production of Raw Input		
Production of Tomatoes		1,368,000
Harvest Cost		1,638,000
Total Production		3,006,000
Processing Variable Costs		
Labor Costs		
Skilled:	6 laborers @ 100 lei/day	
Semiskilled:	3 laborers @ 75 lei/day	
Unskilled:	24 laborers @ 55 lei/day	
Total per hour = 358 lei/hour		322,200
Utility Costs		1,207,800
Supply Costs (cans and cartons)		6,257,700
Maintenance Costs		1,080,000
Depreciation Costs		3,057,300
Shipping Costs		2,188,800
Total Processing Cost		14,113,800
Total Costs		19,425,600
Sales from Foreign Markets		
Tomato Paste:		
1 kg cans = 4,982,000		
5 kg cans = 9,450,000		
Tomato Juice:		
1 kg cans = 12,672,000		27,104,000
If Sold Domestically		31,805,100
Revenues – Costs = Profits (without tariff charges)		7,678,400

Table 35

Peas and Green Beans Capitalization Costs–Plan III
(All Prices in Leis)

Production Capitalization	
Peas	9,326,400
Green Beans	3,018,240
Processing Plant Capitalization	
Processing Equipment	17,640,000
(startup & installation included)	
Buildings	2,599,200
Total Long Term	32,583,840
Working Capital	13,626,600

Table 36

Pea and Green Bean Variable Costs–Plan III
(All Prices in Leis)

Interest Charges		3,044,400
Production of Raw Input		
Pea Production Costs		5,025,120
Pea Harvest Costs		987,360
Green Bean Production Costs		1,411,200
Green Bean Harvest Costs		304,200
Total Production Costs		7,727,880
Processing Variable Costs		
Labor Costs		
Skilled	4 @ 100 lei/day	
Semiskilled	8 @ 75 lei/day	
Unskilled	24 @ 55 lei/day	
Total Labor Costs		348,000
Utility Costs		161,280
Supply Costs (cans and cartons)		11,539,200
Maintenance Costs		1,348,800
Depreciation Costs		2,758,800
Shipping Costs		3,369,240
Total Processing Costs		19,525,320
Total Costs		30,297,600
Sales from Foreign Markets		
Peas		
½ Kg Cans = 3,906,960		
1 Kg Cans = 7,868,880		
Green Beans		
½ Kg Cans = 7,041,600		
1 Kg Cans = 13,133,520		
Total Revenue		31,950,690
If Sold Domestically		32,184,000
Revenue – Cost = Profits (before deductions for tariffs)		**1,663,380**

Table 37

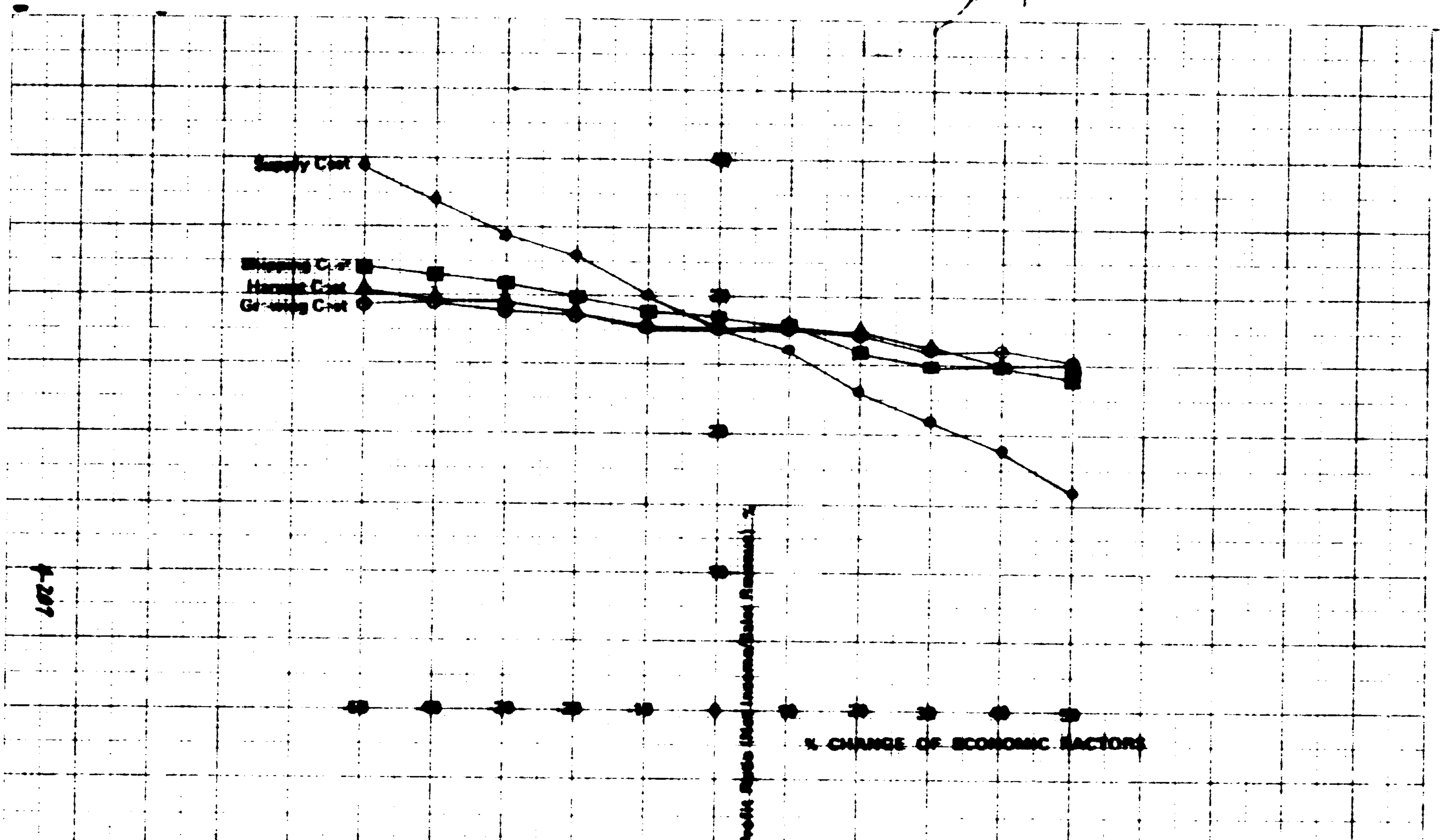
Sensitivity Analysis–Tomato Processing

ECONOMIC FACTORS	PERCENTAGE										
1. Change in Sales Revenue	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	[-0.434]	[-0.195]	[-0.024]	0.104	0.204	0.283	0.348	0.403	0.449	0.488	0.522
2. Change in Supplies Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.399	0.376	0.352	0.329	0.306	0.283	0.260	0.237	0.214	0.191	0.168
3. Change in Depreciation Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.340	0.328	0.317	0.306	0.294	0.283	0.272	0.261	0.249	0.238	0.227
4. Change in Shipping Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.324	0.315	0.307	0.299	0.291	0.283	0.275	0.267	0.259	0.251	0.243
5. Change in Harvest Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.313	0.307	0.301	0.295	0.289	0.283	0.277	0.271	0.265	0.259	0.253
6. Change in Interest Charges		-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0	
PROFIT RATIO		0.310	0.303	0.297	0.290	0.283	0.276	0.270	0.263	0.256	
7. Change in Growing Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.308	0.303	0.298	0.293	0.288	0.283	0.278	0.273	0.268	0.263	0.258
8. Change in Utility Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.305	0.301	0.297	0.292	0.288	0.283	0.279	0.274	0.270	0.265	0.261
9. Change in Maintenance Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.303	0.299	0.295	0.291	0.287	0.283	0.279	0.275	0.271	0.267	0.263
10. Change in Labor Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.289	0.288	0.287	0.286	0.284	0.283	0.282	0.281	0.280	0.278	0.277

Table 38

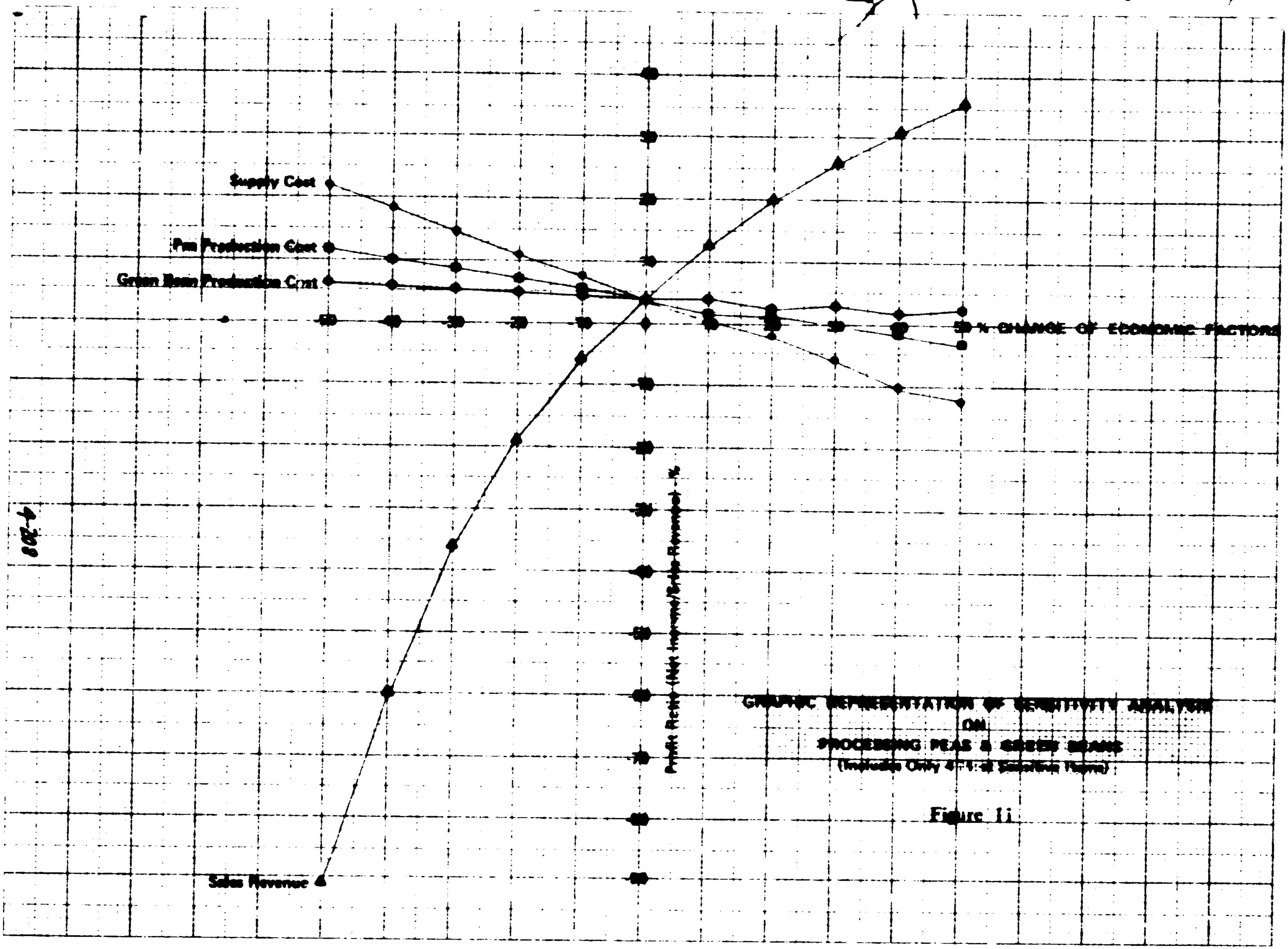
Sensitivity Analysis—Processing Green Beans and Peas

ECONOMIC FACTORS	PERCENTAGE										
1. Change in Sales Revenue	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	[-0.911]	[-0.592]	[-0.365]	[-0.194]	[-0.062]	0.045	0.131	0.204	0.265	0.318	0.363
2. Change in Supplies Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.226	0.190	0.154	0.117	0.081	0.045	0.008	[-0.028]	[-0.065]	[-0.101]	[-0.137]
3. Change in Pea Production Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.124	0.108	0.092	0.076	0.060	0.045	0.029	0.013	[-0.003]	[-0.019]	[-0.035]
4. Change in Shipping Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.098	0.087	0.076	0.066	0.055	0.045	0.034	0.023	0.013	0.002	[-0.009]
5. Change in Depreciation Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.088	0.079	0.071	0.062	0.053	0.045	0.036	0.027	0.018	0.010	0.001
6. Change in Interest Charges		-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0	2.5
PROFIT RATIO		0.074	0.066	0.059	0.052	0.045	0.037	0.030	0.023	0.015	
7. Change in Green Bean Production Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.067	0.062	0.058	0.053	0.049	0.045	0.040	0.036	0.031	0.027	0.022
8. Change in Maintenance Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.066	0.062	0.057	0.053	0.049	0.045	0.040	0.036	0.032	0.028	0.023
9. Change in Pea Harvest Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.060	0.057	0.054	0.051	0.048	0.045	0.041	0.038	0.035	0.032	0.029
10. Change in Processing Labor Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.050	0.049	0.048	0.047	0.046	0.045	0.043	0.042	0.041	0.040	0.039
11. Change in Green Bean Harvesting Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041	0.040
12. Change in Utility Requirements	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.047	0.047	0.046	0.046	0.045	0.045	0.044	0.044	0.043	0.043	0.042



GRAPHIC REPRESENTATION OF SENSITIVITY ANALYSIS
ON
TOMATO PRODUCTION & PROCESSING
(Includes Only 5 Most Sensitive Items)

Figure 10



GRAPHIC REPRESENTATION OF SENSITIVITY ANALYSIS
ON
PROCESSING PEAS & GREEN BEANS
(Includes Only 4:1:al Sensitive Figure)

Figure 11

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PLAN III

INTRODUCTION

In this section, the economic feasibility of the investment proposals under Plan III are determined. The procedure used is to estimate production and engineering parameters, assign costs and price figures for inputs and outputs, and then vary these numbers from plus through minus 50 percent to measure the effect on the projected profit margin. This procedure allows a decision-maker to identify those parameters which have a significant effect on profits and hence demand close controls. Also, it permits the decision-maker to use his own judgment on some of the estimated numbers. For instance, if the estimated wage rate used in the economic analysis is considered too high or too low, then a decision-maker need only go to the Sensitivity Table, vary the labor cost, and observe immediately the effect on profits. Similarly, if prices are expected to continue to rise on a certain product, then the effect of this change in prices on profits can be again determined by reference to the Sensitivity Tables. This method of economic analysis then allows much flexibility in that it permits uncertainty in parameter estimates, accounts for dynamic changes in certain costs and prices, and therefore determines the economic feasibility of an operation, not just at one point in time, but over a variety of assumptions on parameter values and over a span of time.

DESCRIPTION OF COST ESTIMATES

The specific values for a production process of course vary and are included under the specific economic analysis of the product. The following section defines the cost and value parameters in general terms.

Capital Expenditures

Long Term Capitalization. Capitalization costs in these operations include the initial expenditures for new farm machinery, processing equipment, and buildings. The capitalization costs on the farm machinery and processing equipment are derived from present figures on the price of this equipment. Estimates on installation costs are also included in this cost figure. The capital expenditure on the buildings is estimated to be at a rate of 1,100 lei per square meter. In projecting these costs to a yearly expense, a long term interest rate of 6 percent is used.

Short Term or Working Capital Expenditures. It is assumed that during the operation of this plant certain expenses will need to be met by short term borrowing. This borrowing is necessitated by the gap between the time of cost expenditure and the time when revenues arrive from the sale of the final product. It is estimated that approximately half of the plant's operating costs must be met in this manner. (It should be noted that, even though actual borrowing might not be necessary due to reserves, these reserves have an opportunity costs which must be reflected in the profit calculations). The short term rate of interest assumed on these loans is 8 percent.

Variable or Yearly Costs

Production Costs. These numbers are estimates of the costs incurred during the growing of the crop. They include expenditures on labor, fertilizers, and other chemicals, and seeds.

Harvest Costs. The harvest costs include expenditures on labor and fuel for the farm machinery. The specifics of this operation are described elsewhere in the report.

Labor Costs. The labor costs are estimated by multiplying the manpower requirements by the wage rate for various grades of labor. These are assumed at the following rates:

Skilled Labor:	100 lei/day
Semi-skilled Labor:	75 lei/day
Unskilled Labor:	55 lei/day

Utility Costs. These costs are estimated from the engineering data on the utility requirements of these plants and the cost of these utilities in Romania. These are assumed at the following rates:

Steam Costs:	29 lei/ton
Water Costs:	1.09 lei/cubic meter

Electricity Costs:	0.48 lei/kilowatt hour

Supply Costs. Under these costs, expenditures for cans and cartons are estimated. The following costs are assumed:

5 Kg Can:	4.4 lei
1 Kg Can:	1.4 lei
½ Kg Can:	0.8 lei

These numbers include label costs.

Maintenance Costs. Maintenance of the farm machinery and of the processing equipment will be necessary. It is estimated that this will require an expenditure of approximately 5 percent of the initial capitalization costs.

Depreciation Costs. The depreciation schedule assumed is a straight line table with a rate on machinery of 10 percent and on buildings of 2 percent.

Shipping Costs. Shipping costs are based on the rate to England. Other destinations require adjustment of this rate by use of the Sensitivity Tables. It is estimated that the product can be shipped at a rate of 470.4 lei per ton, plus or minus 50 percent.

Sales Revenue. Two estimates are given for the sales revenue. The first one assumes that the product is sold for export and is based on C.I.F., England but does not include tariff rates. Since these rates are subject to change within the EEC and for countries outside the EEC or about to enter, these estimates were kept out of the calculation. To estimate the effect on profits of these tariffs, Sensitivity Tables must be used. For instance, if the projected tariff for a product is expected to be 10 percent, then the profit from the sale of this product should be read under the -10 percent column.

The second estimate on revenues is based on the total product of the processing plant being sold domestically. This revenue figure is not used in the Sensitivity Analysis but is maintained only for reference to that revenue figure obtained from foreign sale.

CUCUMBER PICKLING PRODUCTION AND PROCESSING

In this section, the economic feasibility of a cucumber pickling (production and processing) operation is determined. As shown in Table 39, the initial capital investment for the production of cucumbers is 1,407,320 lei. The capital outlay for the processing plant is 10,161,880 lei. Total initial capitalization, including building costs, is 13,761,800 lei. Return from this investment is a profit of 4,632,576 lei per season before deductions of tariff charges. This represents a return of 34 percent on investment.

Reference to the Sensitivity Table indicates that only if tariff charges rose to 40 percent of selling price would the operation be unprofitable. An increase in the costs of the input factors by 50 percent would not cause losses. For instance, a rise in the cost of cans (supplies) of 50 percent would result in a decline of the profit to sales ratio from 0.333 to 0.199; but this profit level would still be substantial. In fact, a reduction of can cost by 30 percent would yield an increase in the profit sales ratio to 0.414 which would mean that for every one lei of sales a return of .414 lei would be made before tariff expenses. The pickling cucumber operation hence is economically feasible and is recommended.

It is strongly recommended that jars be utilized for the pack instead of cans, as this should favorably affect profitability.

JAM PRODUCTION AND PROCESSING

The economic analysis in this section determines the profitability of a jam production and processing operation. It is based on the costs involved in the production of strawberry jam as considered representative of other fruit jams.

The operation requires an initial capitalization for production of the raw material of 13,504,000 lei. Capitalization for processing plant machinery is estimated at 17,721,600 lei. Total long term capitalization, including building costs, is estimated to be 34,346,400 lei. For this initial investment, a yearly return of 29,807,600 (before tariff charges) is estimated. Since tariff charges vary with the importing country, these profits will be reduced accordingly depending on the country to which the jam is sold. In the EEC, the sugar tariff should cause an additional reduction in profit but not enough to cause a loss.

Reference to the Sensitivity Table for this jam operation indicates that even a reduction in prices of 40 percent (for instance, an effective price decline to tariffs of

40 percent) will not cause losses in this operation. In addition, even a rise in any one of the costs by 50 percent will not reduce profits to zero. The only cost input that has a substantial effect on profits is the price of sugar. A rise in the price of sugar of 50 percent will reduce the profit to sales ratio from 0.436 to 0.324. Therefore, even at this higher sugar price, profits will remain at .324 lei per 1 lei of sales.

The economic analysis therefore indicates that profitability of this plant definitely recommends investment in this operation. The insensitivity of profits to cost variations further supports implementation. Production of a high quality jam should yield Romanian agriculture a high return on capital and approximately 60 million lei in foreign exchange.

CHERRY PRODUCTION AND PROCESSING OPERATION

The economic analysis in this section determines the profitability of the cherry production and processing operation. Reference to Table 43 shows that the cost of establishment of an orchard including farm machinery is approximately 12 million lei. The processing plant for the cherries requires an additional investment of approximately 19 million lei. Total long-term capitalization is then 31 million lei.

The return from this investment is 6,177,664 in profit before tariff deductions and, if the product is sold abroad, 23 million lei in foreign exchange. The profit represents a return on capital investment of 50.4 percent.

Reference to the Sensitivity Table shows that a return of 0.268 lei can be expected from each lei of sales. Only if the tariff is 30 percent of the sales price do losses occur from this operation. Furthermore, any cost might increase by 50 percent without a loss being sustained. Even a rise in shipping cost, either due to an increased cargo rate or shipment to a port more distant than England, would only affect profits slightly as the Sensitivity Table shows.

Since this operation yields a high return on investment and is not particularly sensitive to any particular rise in costs, it is highly recommended at least at current prices.

GREEN BEAN PRODUCTION AND PROCESSING

The economic feasibility of the green bean operation is determined in this section. This operation requires an initial total capital investment of 26 million lei.

Production capitalization is 9 million lei while processing capitalization is 14 million lei. Building costs make up the remainder of the investment.

The return on this investment is estimated to be 19 million lei before deductions for tariff charges. This profit represents a return on investment of 72 percent before this deduction. The effect on the profit to sales ratio caused by any tariff can be determined by reference to the Sensitivity Table. For instance, the table indicates that a tariff of 20 percent would reduce the profit to sales ratio to 0.267. Only if the tariff charge is 50 percent of sales would negative returns result from this operation.

This table also shows that costs could rise as much as 50 percent without losses being sustained. This green bean operation is therefore recommended due to its high return and its resistance to changes in profit due to changes in costs.

Table 39

Cucumber Pickling Capitalization Costs–Plan III
(All Prices in Romanian Lei)

Production Capitalization	1,407,320
Processing Capitalization	10,161,880
Building Costs	3,600,000
Total Long Term	13,761,880
Working Capital	3,439,660

Table 40

Cucumber Pickling Variable Costs–Plan III
(All Prices in Romanian Lei)

Interest Charges		1,185,324
Production of Raw Input		
Production of Cucumbers		462,720
Harvest of Cucumbers		1,078,080
Total Production 1		1,540,800
Processing Variable Costs		
Labor Costs		
Skilled	11 @ 100 lei/day	
Semiskilled	5 @ 75 lei/day	
Unskilled	16 @ 55 lei/day	
Total per hour	358 lei/hour	322,200
Utility Costs		117,760
Supply Costs		3,972,640
Maintenance Costs		578,460
Depreciation Costs		1,228,920
Shipping Costs		1,228,120
Total Processing Costs		7,448,100
Total Costs		10,174,224
Sales		14,806,800
Revenues – Costs = Profits (without tariff charges)		**4,632,576**

Table 41

Jam Capitalization Costs—Plan III
(All Prices in Romanian Lei)

Production Capitalization	13,504,000
Processing Capitalization	17,721,600
Building Capitalization	3,120,000
Total Long Term	34,346,400
Working Capital	17,721,600

Table 42

Jam Variable Costs—Plan III
(All Prices in Romanian Lei)

Interest Charges		3,476,800
Production of Raw Input		
Production Costs		2,358,400
Harvest Costs		1,600,000
Total Production Costs		3,958,400
Processing Variable Cost		
Labor Costs		
Skilled	11 @ 100 lei/day = 1100 lei/day	
Semiskilled	1 @ 75 lei/day = 75 lei/day	
Unskilled	14 @ 55 lei/day = 770 lei/day	
Total per hour	243 lei/hour	486,000
Utility Costs		170,400
Supply Costs		8,448,000
Sugar Costs		15,488,000
Maintenance Costs		1,560,800
Depreciation Costs		3,184,800
Shipping Costs		2,481,600
Total Processing Costs		31,819,600
Total Costs		39,254,800
Sales		69,062,400
Revenue – Costs = Profits		**29,807,600**

Table 43

Cherry Processing Capitalization Costs–Plan III
(All Prices in Romanian Lei)

Production Capitalization (Includes establishment of orchard and equipment)	12,241,920
Processing Plant Capitalization	15,579,520
Building	3,118,720
Total Long-Term	30,940,160
Working Capital	7,227,520

Table 44

Cherry Production Processing Variable Costs–Plan III
(On a Per Season Basis)
(All Prices in Romanian Lei)

Interest Charges		2,433,920
Production of Raw Input		
Production of Cherries		1,009,920
Harvest of Cherries		2,285,440
Total Production		3,295,360
Processing Variable Costs		
Labor Costs:		
Skilled	2 @ 100 lei/day = 200 lei/day	
Semiskilled	4 @ 75 lei/day = 300 lei/day	
Unskilled	26 @ 55 lei/day = 1430 lei/day	
Total per hour	241.2 lei/hour	154,240
Utility Costs		115,840
Supplies Costs		4,942,080
Maintenance Costs		1,391,360
Depreciation Costs		2,844,160
Shipping Costs		1,712,640
Total Processing Costs		11,160,320
Total Costs		16,889,600
Sales		23,067,264
Revenues – Costs = Profits (without tariff charges)		**6,177,664**

Table 45

Green Bean Capitalization Costs—Plan III
(All Prices in Romanian Lei)

Production Capitalization	9,054,720
Processing Capitalization	14,600,000
Building Capitalization	2,600,000
Total Long Term	26,254,720
Working Capital	10,266,911

Table 46

Green Bean Variable Costs—Plan III
(All Prices in Romanian Lei)

Interest Charges		2,396,636
Production of Raw Input		
Production of Green Beans		4,233,600
Harvest of Green Beans		912,600
Total Production Costs		5,146,200
Processing Variable Costs		
Labor Costs		
Skilled	2 @ 100 lei/day = 200 lei/day	
Semiskilled	3 @ 75 lei/day = 225 lei/day	
Unskilled	4 @ 55 lei/day = 1100 lei/day	
Total per hour	190 lei per hour	114,378
Utility Costs		80,640
Supply Costs		10,243,056
Maintenance Costs		1,182,736
Depreciation Costs		2,885,472
Shipping Costs		4,949,548
Total Processing Costs		19,455,830
Total Costs		26,998,666
Sales: Fancy and Lower Grades		46,029,900
Revenues – Costs = Profits (without tariff charges)		**19,031,234**

Table 47

Sensitivity Analysis—Cucumber Pickling Production & Processing

ECONOMIC FACTORS	PERCENTAGE										
1. Change in Sales Revenues	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	[-0.333]	[-0.111]	0.048	0.167	0.259	0.333	0.394	0.444	0.487	0.524	0.556
2. Change in Supplies Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.467	0.441	0.414	0.387	0.360	0.333	0.306	0.280	0.253	0.226	0.199
3. Change in Depreciation Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.375	0.367	0.358	0.350	0.342	0.333	0.325	0.317	0.308	0.300	0.292
4. Change in Shipping Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.375	0.366	0.358	0.350	0.342	0.333	0.325	0.317	0.308	0.300	0.292
5. Change in Harvest Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.370	0.362	0.355	0.348	0.341	0.333	0.326	0.319	0.311	0.304	0.297
6. Change in Interest Charges		-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0	
PROFIT RATIO		0.358	0.352	0.346	0.340	0.333	0.327	0.321	0.314	0.308	
7. Change in Maintenance Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.353	0.349	0.345	0.341	0.337	0.333	0.329	0.325	0.322	0.318	0.314
8. Change in Production Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.349	0.346	0.343	0.340	0.336	0.333	0.330	0.327	0.324	0.321	0.318
9. Change in Labor Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.337	0.336	0.336	0.335	0.334	0.333	0.333	0.332	0.331	0.330	0.329
10. Change in Utility Costs	-50	-40	30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.334	0.334	0.334	0.334	0.333	0.333	0.333	0.333	0.333	0.333	0.333

Table 48

Sensitivity Analysis—Processing Strawberry Jam

ECONOMIC FACTORS	PERCENTAGE										
1. Change in Sales Revenue	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	[-0.128]	0.060	0.194	0.295	0.373	0.436	0.487	0.530	0.566	0.597	0.624
2. Change in Sugar Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.548	0.526	0.503	0.481	0.458	0.436	0.413	0.391	0.369	0.346	0.324
3. Change in Supplies Cost	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.497	0.485	0.473	0.460	0.448	0.436	0.424	0.411	0.399	0.387	0.375
4. Change in Depreciation Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.459	0.454	0.450	0.445	0.440	0.436	0.431	0.427	0.422	0.417	0.413
5. Change in Shipping Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.454	0.450	0.447	0.443	0.439	0.436	0.432	0.429	0.425	0.421	0.418
6. Change in Production Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.453	0.449	0.446	0.443	0.439	0.436	0.432	0.429	0.426	0.422	0.419
7. Change in Interest Charges		-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0	
PROFIT RATIO		0.451	0.447	0.443	0.440	0.436	0.432	0.428	0.425	0.421	
8. Change in Harvest Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.447	0.445	0.443	0.440	0.438	0.436	0.434	0.431	0.429	0.427	0.424
9. Change in Maintenance Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.447	0.445	0.443	0.440	0.438	0.436	0.434	0.431	0.429	0.427	0.425
10. Change in Labor Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.437	0.437	0.437	0.436	0.436	0.436	0.436	0.435	0.435	0.435	0.434
11. Change in Utility Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.437	0.437	0.437	0.436	0.436	0.436	0.436	0.435	0.435	0.435	0.435

Table 49

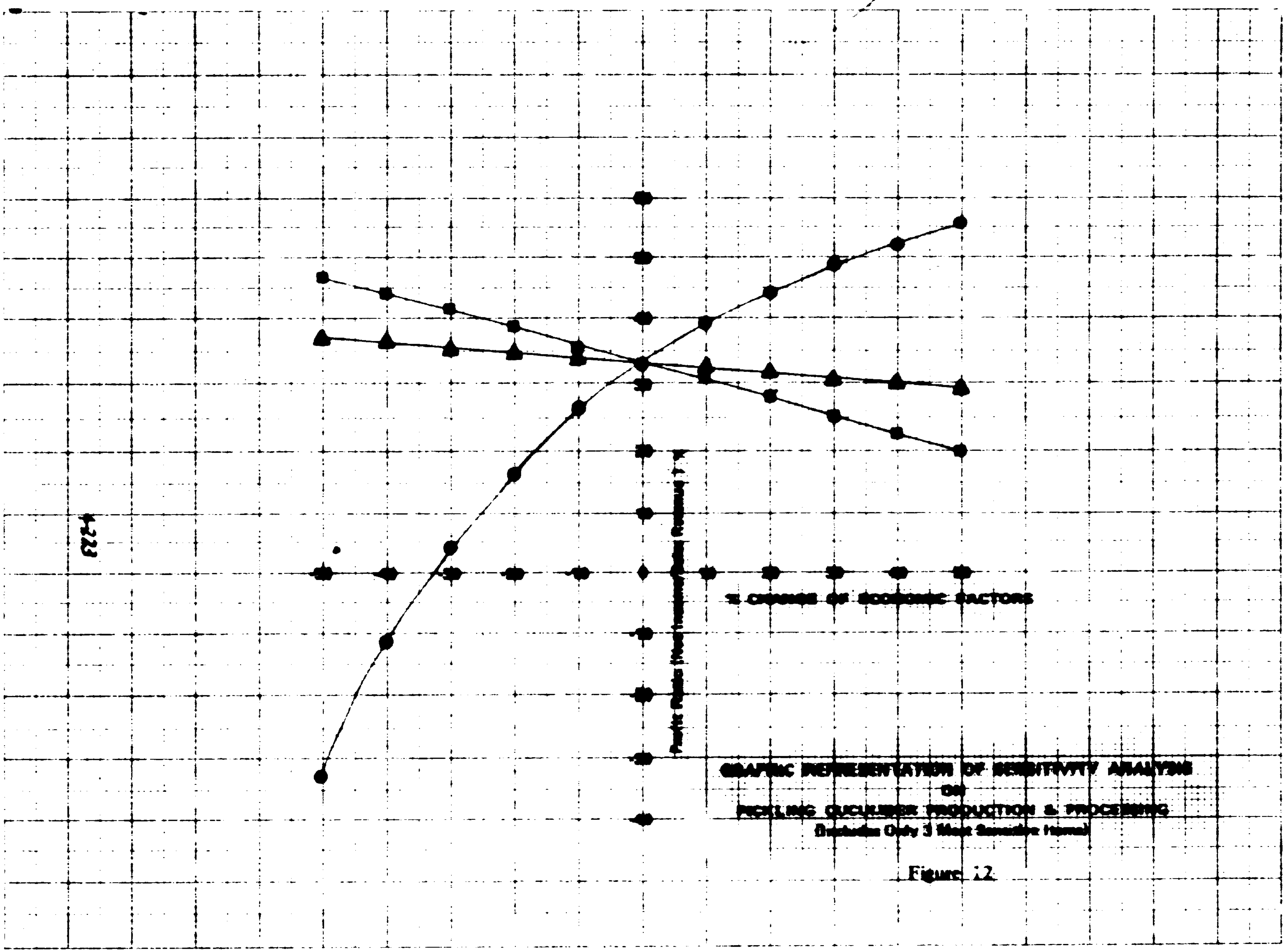
Sensitivity Analysis—Processing Cherries

ECONOMIC FACTORS	PERCENTAGE										
1. Change in Sales Revenue	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	[-0.464]	[-0.220]	[-0.046]	0.085	0.186	0.268	0.334	0.390	0.437	0.477	0.512
2. Change in Supplies Cost	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.375	0.353	0.332	0.311	0.289	0.268	0.246	0.225	0.204	0.182	0.161
3. Change in Depreciation Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.329	0.317	0.305	0.292	0.280	0.268	0.256	0.243	0.231	0.219	0.206
4. Change in Harvest Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.317	0.307	0.298	0.288	0.278	0.268	0.258	0.248	0.238	0.228	0.218
5. Change in Shipping Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.305	0.298	0.290	0.283	0.275	0.268	0.260	0.253	0.246	0.238	0.231
6. Change in Interest Charges		-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0	
PROFIT RATIO		0.301	0.293	0.284	0.276	0.268	0.260	0.251	0.243	0.235	
7. Change in Maintenance Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.298	0.292	0.286	0.280	0.274	0.268	0.262	0.256	0.250	0.244	0.238
8. Change in Production Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.290	0.285	0.281	0.277	0.272	0.268	0.263	0.259	0.255	0.250	0.246
9. Change in Labor Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.271	0.270	0.270	0.269	0.268	0.268	0.267	0.266	0.266	0.265	0.264
10. Change in Utility Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.270	0.270	0.269	0.269	0.268	0.268	0.267	0.267	0.266	0.266	0.265

Table 50

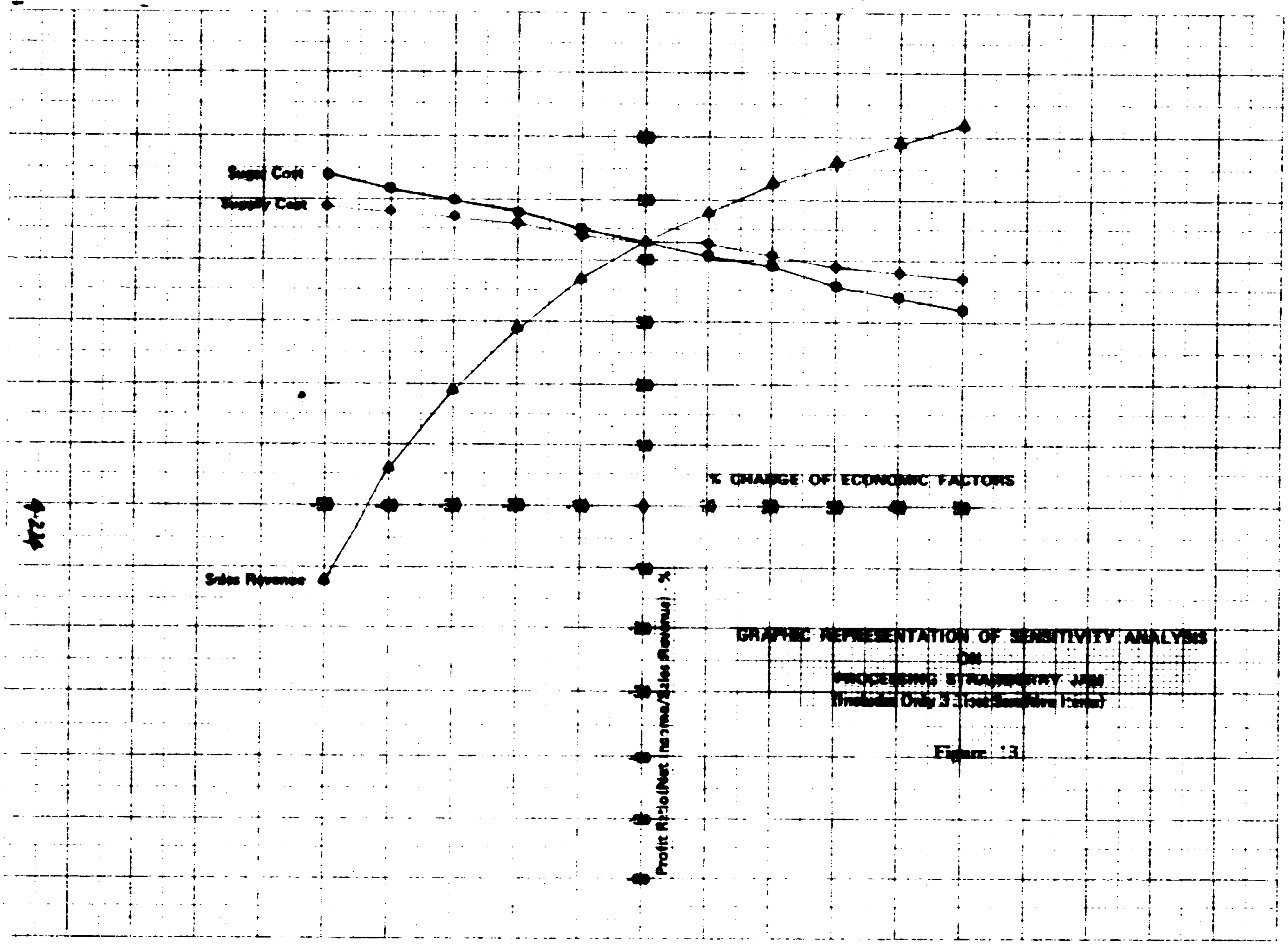
Sensitivity Analysis–Green Bean Production & Processing

ECONOMIC FACTORS	PERCENTAGE										
1. Change in Sales Revenue	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	[-0.173]	0.022	0.162	0.267	0.348	0.413	0.467	0.511	0.549	0.581	0.609
2. Change in Supplies Cost	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.525	0.502	0.480	0.458	0.436	0.413	0.391	0.369	0.347	0.324	0.302
3. Change in Shipping Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.467	0.456	0.446	0.435	0.424	0.413	0.403	0.392	0.381	0.370	0.360
4. Change in Production Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.459	0.450	0.441	0.432	0.423	0.413	0.404	0.395	0.386	0.377	0.367
5. Change in Depreciation Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.445	0.439	0.432	0.426	0.420	0.413	0.407	0.401	0.395	0.388	0.382
6. Change in Interest Charges		-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0	
PROFIT RATIO		0.429	0.425	0.421	0.417	0.413	0.409	0.406	0.402	0.398	
7. Change in Maintenance Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.426	0.424	0.421	0.419	0.416	0.413	0.411	0.408	0.406	0.403	0.401
8. Change in Harvest Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.423	0.421	0.419	0.417	0.415	0.413	0.411	0.409	0.408	0.406	0.404
9. Change in Labor Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.415	0.414	0.414	0.414	0.414	0.413	0.413	0.413	0.413	0.412	0.412
10. Change in Utility Costs	-50	-40	-30	-20	-10	0	10	20	30	40	50
PROFIT RATIO	0.414	0.414	0.414	0.414	0.414	0.413	0.413	0.413	0.413	0.413	0.413



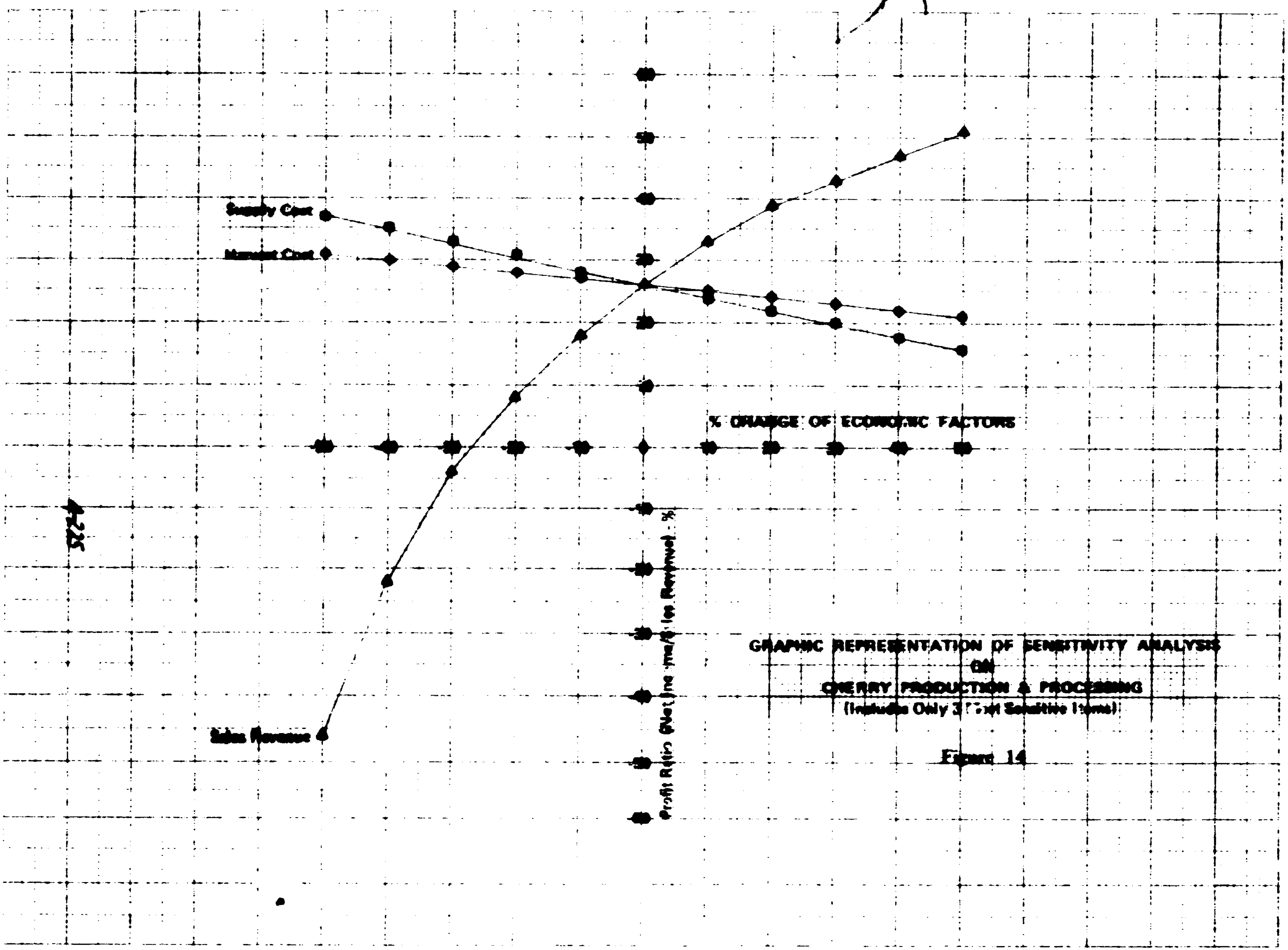
GRAPHIC REPRESENTATION OF SENSITIVITY ANALYSIS
ON
PICKLING CUCUMBER PRODUCTION & PROCESSING
(Includes Only 3 Most Sensitive Items)

Figure 12



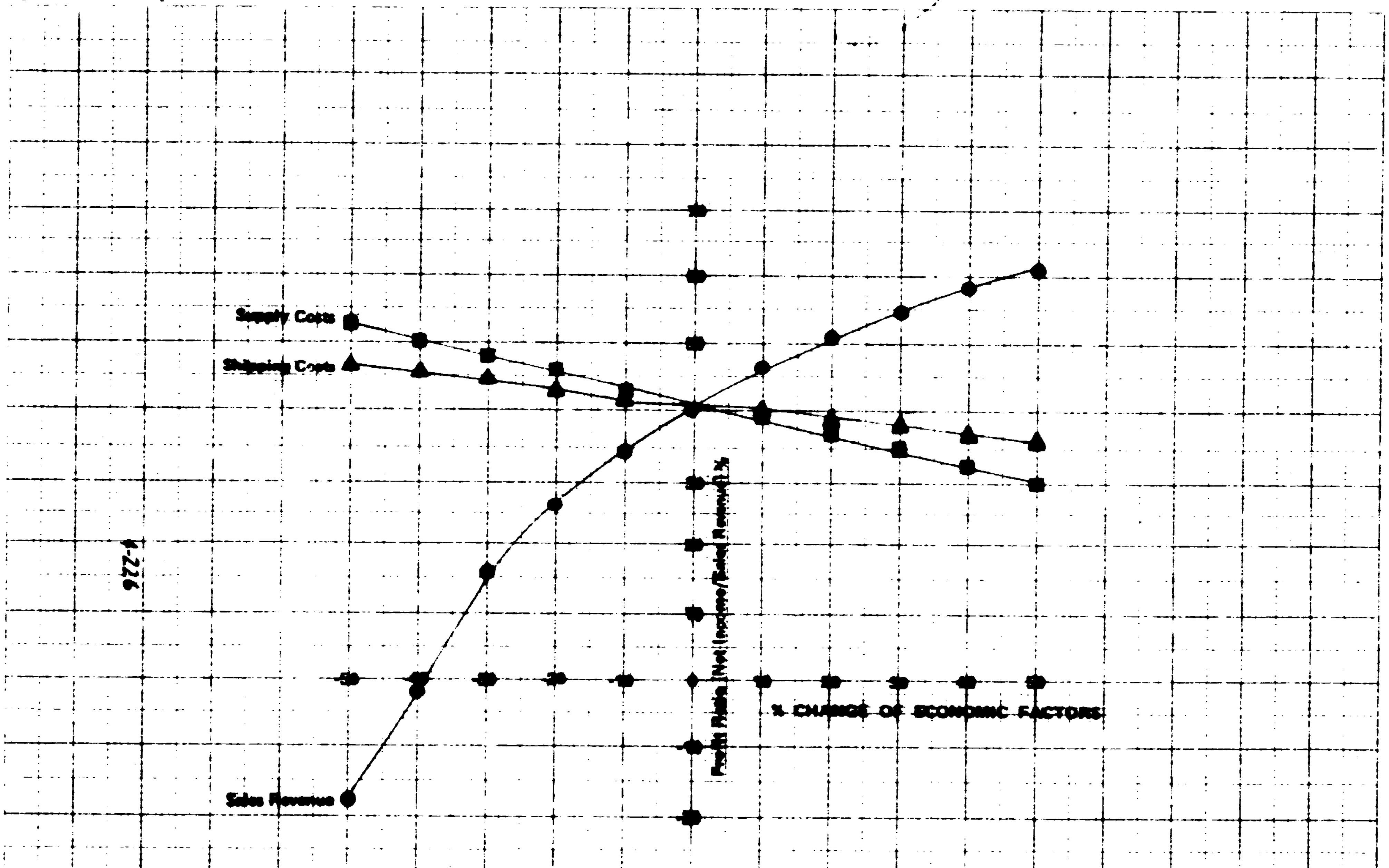
GRAPHIC REPRESENTATION OF SENSITIVITY ANALYSIS
ON
PROCESSING STRAWBERRY JAM
(Including Only 3 Cost-Sensitive Items)

Figure 13



GRAPHIC REPRESENTATION OF SENSITIVITY ANALYSIS
ON
CHERRY PRODUCTION & PROCESSING
(Includes Only 3 Most Sensitive Items)

Figure 14



GRAPHIC REPRESENTATION OF SENSITIVITY ANALYSIS
ON
GREEN BEAN PRODUCTION & PROCESSING
(Includes Only 3 Most Sensitive Items)

Figure 15

SUMMARY

In Tables 51, 52, and 53 the economic analyses of the previous sections are summarized.

Plan I requires for the economically feasible investments a capital outlay of 36,000 lei. The estimated return from this investment in terms of reduction in labor cost is 232,630 lei. This represents a return on investment of 646 percent and therefore can be recommended from an economic point of view. The additional recommendations under Plan I are not economically justifiable and hence must be considered under less easily quantifiable criteria. However, even if these economically unfeasible projects are adopted along with the feasible projects, the total effect will be a net cost of approximately zero. (The returns equal the costs of the improvements.) These recommendations under Plan I have a zero net cost but result in a general modernization of the processing facilities.

As shown in Table 52 the projects under Plan II cannot be justified by economic considerations. If the plant must be moved, a cost of considerable proportions must be absorbed. Part of this cost is loss of profits from the loss of a season's operation. Other less quantifiable costs are the possible loss of established marketing channels. Plan II involves a total capital outlay of 55,252,000 lei, but total initial costs which include the loss of a season's revenue is 81,461,000. Any benefits of Plan II result only from improvements in the processing line are discussed under Plan I.

In Table 53 the recommendations under Plan III are summarized. Plan III's total implementation results in a capital outlay of 175 million lei. This investment results in a return of 70 million lei before tariff deductions or a return of 39 percent. Even with tariff deductions this rate of return should not decline to anything less than 25 percent. These numbers indicate that the investments under Plan III can be retrieved in only four years of operation.

RECOMMENDATIONS

If the capital investment under Plan III cannot be met under current budget constraints, then Plan I should be immediately implemented. The return from labor reductions will be immediate and substantial. If Plan II or Plan III is being considered then Plan III must be recommended. Not only does adoption of this Plan mean a modernization of Romanian agriculture and hence higher quality final products, but it also appears to require a relatively small additional cost when returns are considered compared to Plan II. Plan II requires a cost of approximately 81 million lei. The return is a new plant but with old machinery and hence only a marginally improved production process.

On the other hand, Plan III costs initially 175 million lei, approximately twice the expenditure of Plan II, but results in an entirely modern operation which yields a profit in only four years of operation which meets its initial capitalization. In fact, the additional investment of Plan III over Plan II would be met by only two years of operation of the Plan III plants. If the plants must be moved, then it seems from the estimates of this analysis that new modern plants should be built instead of duplicating the old facility.

Adoption of Plan III over Plan II will require a greater initial investment but will reap high returns over the short-term and even higher returns over the long run in that Romania will be supplying a high quality product to an ever growing, more selective European market.

Table 51

Summary of Plan I
(All Prices in Romanian Lei)

	Capital Outlay	Return/Season
Install Conveyor	36,000	26,880
Move Bean Graders	–	123,750
Redesign Filler Area	–	82,000
	36,000	**232,630**
Return on Investment–**646%**		
If Other Recommendations Are Initiated		
Install Automatic Basket Fillers	832,000	-107,440
Warehouse	1,360,000	-107,450
Total	**2,228,000**	**17,740**
Return on Investment–0.8%		

Table 52

Summary of Plan II
(All Prices in Romanian Lei)

Total Costs	81,461,000
Return Per Season	232,630
Capital Outlays	55,252,000
Return on Outlay	0.42%

Table 53

Summary of Plan III
(All Prices in Romanian Lei)

	Capital Outlay	Return/Season
Green Bean Plant	26,254,720	19,031,234
Pickling Cucumbers	13,761,880	4,632,576
Jam Production	34,346,400	29,807,600
Tomato Production	38,493,000	7,678,400
Peas and Green Beans	32,583,840	1,653,360
Cherry Line	30,940,160	6,177,664
Total Capital	**175,964,520**	**68,980,834**
Average Return Before Tariff Deductions—39%		

CONCLUSÕES

CONCLUSIONS

SUMMARY

In the study for assistance to the canned food factories Zagna Vadeni and 11 Junei in Romania, the approach has been:

- Research the international markets.
- Study the development of the appropriate supply of adequate raw material.
- Integrate the food processing.

In developing and offering a program for rehabilitation three approaches have been used:

- Minimum investment.
- Medium level of investment.
- Higher level of investment.

The concensus of the study team is that the general parameters for success are favorable no matter which plan is chosen. The decision taken will depend upon the level of investment the Organization is willing to consider.

Romania has many of the favorable factors that would make it a leader in agricultural production and agro-industrial business. The two sites at Zagna Vadeni and Dej, each having its different characteristics and yet both being well suited for agricultural production make two excellent models for the development of a vegetable industry in the county of Brailla and fruit industry in the county of Cluj.

Examining the structure of movement of processed food products throughout Europe, one will see that the two major net importers of canned fruits and vegetables are the United Kingdom and West Germany. Among the canned vegetable products for which the total import markets appear to be expanding are green beans, peas, tomatoes and tomato paste. On the canned fruit products, imports are increasing for fruit cocktail and pineapple, while the market is constant for cherries, peaches and pears. It is worthy to note that apart from pineapple, Romania has the capability and capacity for a good production of all above products. As is the case with canned vegetables, the United Kingdom and West Germany together absorb one-half of the canned fruit which enters the world trade. Conclusion: marketing analysis would indicate that emphasis should be placed on production of the premium pack of green beans, peas, pickles, whole tomatoes, tomato paste and some of the tomato specialty items such as tomato soup or spaghetti sauce. In the area of fruits, emphasis should be placed on a fruit cocktail (which is composed of peaches, pears, pineapple, grapes and cherries) or a fruit salad which does not require pineapple. Observations: the market indicates that jams, especially strawberry, will be well received if the quality and quantity is high.

For the supply of adequate raw material for a new agro-industrial development system, the major crops produced in the surrounding area of Zagna Vadeni and Dej are numerous. The vegetable crops that are produced at the present time at Zagna Vadeni are tomatoes, peas, green beans, bell peppers, and cucumbers. A wide variety of other vegetables are also produced in small quantities.

The general conditions of production at Zagna Vadeni are areas of low elevation, with heavy alluvial soils, with a high water table and characterized by a sub-surface compacted layer. The major climatic patterns are primarily continental with a maritime influence from the Black Sea. The annual rainfall is 600 to 700 mm with a dry period from July to September. Cultural techniques are semi-mechanized for heavy tillage and general cultivation, close cultivation, harvesting and transplanting (tomatoes) are accomplished by manual methods. Although the soil is basically highly productive, the major present problem of this area is poor drainage and a high water table.

The processing facility at Zagna Vadeni consists of two main sections, each having its own building, with a common area for the storage of finished material. The plant started as a small tomato paste cannery 20 years ago and since then has been expanded at random many times. None of the lines are completely mechanized, and in many instances the operation is completely manual. There are three lines for tomato paste: an old bowl Tito Manzini system, which is in poor condition and outmoded; a new Tito Manzini line with a double effect evaporator; and a new Rossi Catelli with a backward flow double effect evaporater. The last two lines are in excellent condition but due to limited area are cramped in the building giving a poor layout for the process flow. The only other tomato product line is Tito Manzini tomato juice line. Peas and green beans are handled on a joint line, with different pieces of equipment, and many operations done completely manually. All sterilizing is done in hand operated still retorts. The combined storage area is completely managed by hand.

The crops produced in the Dej area for processing at the 11 Junei facility are strawberries, cherries (sweet and Morello), apricots, peaches (75 percent Clingstone, 25 percent Freestone), plums, pears, apples, wild berries, green beans, cucumbers and small quantities of tomatoes, bell peppers, carrots and other miscellaneous vegetables.

The production areas are in the alluvial fans and foothills of the Lapusulvi range of the Carpathian Mountains. The climate is strongly continental with some alpine influence. Annual precipitation is about 800 mm with the heaviest occurring in the spring and summer. Soils are mountain alluvium of a sandy clay loam type. The terrain is rolling hills with some flat open spaces, and most of the cultivation is shallow, done with light draft plows and small tractors.

Raw material supplies for the cannery comes mostly from isolated "backyard" trees within a 60 km radius with the harvest done manually by travelling crews. However, some large orchards have been planted and are just coming into production.

The processing facility is much smaller than the one at Zagna Vadeni. Most of the fruit operations are done by hand, while there exists a semi-continuous line for the canning of cherries and a semi-continuous line for the canning of green beans. Although there is a fair production of jams and preserves, the complete operation is done manually. All sterilization is done in manually controlled still retorts. All finished product and warehousing is handled manually.

In the rejuvenation plans of the two areas under study, Plan I will involve minor adjustments in production methods to upgrade the quality of the raw product while minimizing the capital investment. No major changes are recommended in agricultural or civil engineering technologies. The processing lines will not be moved, all existing equipment will operate at the same capacity as at the present, and where the operation is completely manual it will be semi-automated.

In Plan II only minor adjustments in production methods to upgrade the quality of the raw product will be applied; some improvements should be made in raw product handling and in disease control as well as in soil and water management. Particularly, transportation and handling equipment should be improved; disease control programs should be developed and adhered to; fertilizer practices should be closely watched through soil and tissue analysis; greater use of soil amendments should be made; and drainage and irrigation systems should be investigated. At the processing facility, all equipment in working condition will be overhauled and moved to a new site, where it will be integrated with other new equipment to form complete semi-automatic lines.

In choosing a new site for the Zagna Vadeni plant, the area under consideration would be south of Brailla between the city of Brailla and the city of Traian. The land in this area is higher which would provide protection from future flooding. Utilities, water and transportation channels seem to be adequate for servicing the plant. In moving the present processing facility to a new site, the opportunity will arise to redesign the process floor in one building thus eliminating the problems in materials and process flow. Nonetheless, it is projected that one season's production would be lost due to the move.

In Plan III for Zagna Vadeni a complete new agro-industrial complex would be erected in a new, suitable location. In this plan, attention is given to new production techniques, new product varieties, new drainage and irrigation systems, disease control methods and new handling systems from field to plant. All recommendations are integrated for supplying a complete modern processing plant, with primary interest for the production of tomatoes, peas and green beans.

In Dej, Plan I, very minor adjustments can be made in the production to upgrade the quality of the raw product. In Plan II, transportation and handling equipment should be improved; disease control programs should be developed and adhered to; and fertilizer practice should be closely watched through soil and tissue analysis. As concerns the moving or new construction of the 11 Junei plant in Plan II or Plan III a new location for the Dej plant has already been selected by the planning section of the project's group of the Minister of Agriculture. It is, therefore, not the object of the team engineer to discuss such planning in great detail. Nevertheless, certain general recommendations are made which might be of value for consideration. For Plan III in the Dej area, the philosophy of the plant operation should be one of low volume and high quality, the reasons for this being that the terrain and the short season prohibit the use of high capacity machinery and large scale production techniques. This does not, however, preclude the development of a modern, efficient plant as described in the Plan. In the complete complex, the crops to be emphasized would be cherries, strawberries, miscellaneous fruit, green beans and cucumbers.

An economic analysis is offered for each of the three Plans and both plants. This analysis, taking into account market and production parameters, isolates the most significant economic factors in production and shows the economic value of each alternative.

Plan II for both plants is rejected as being economically unfeasible. While Plan I exists in reality only for Zagna Vadeni (the decision to move the 11 Junei plant has been made), it is economically feasible and useful where a limited capital investment is desired. Plan III for both plants, although requiring the greatest capital investment, promises the greatest benefits in terms of long-term (and short-term) monetary gains and in terms of non-quantifiable factors such as technical models, worker availability and satisfaction and area income.

CONCLUSIONS

In the low investment Plan I rejuvenation of the system will be very limited due to many limiting factors existing in the present system. Marketing in an international field will be limited by the present products' quality. These products are already oversupplied in high dollar markets. High quality, specific, intensively produced raw material cannot be produced with the present varieties, irrigation systems, cultivation practices, chemical controls, harvesting and transportation methods. Closely controlled quality processed products cannot be produced on much of the equipment already existing. The efficiency of the plants cannot be improved unless continuous lines are introduced.

In the medium investment plan, the cost of dismantling and reinstalling the present equipment will be hard to justify. New equipment introduced and integrated will not greatly improve production, since many of the old machines will be a limiting factor in the new continuous line. The move would be advantaged by redesigning the process flow to improve the efficiency of the operation.

In the final conclusion and recommendation the FMC agricultural programs team would recommend the adoption of Plan III for the rehabilitation of the two areas studied in Romania. As agriculture and food processing develops around the world, such industries should be begun anew Also due to new ideas of agro-industrial development, such a plan, besides its technical and economical advantages, would be a model for the national agro-industrial development and a beginning for the complete rehabilitation of the agricultural sector of Romania.

APPENDIX

CLIMATOLOGICAL DATA

GALATI
55 Year Record*

	January	Feb.	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
Monthly Average Temperature—degrees C	-3.1	-1.1	4.1	10.6	16.5	20.3	22.6	22.0	17.6	11.5	5.2	0.0
Monthly Maximum Temperature—degrees C	0.1	1.9	8.5	16.2	22.2	26.1	28.9	28.5	24.2	17.1	9.5	2.7
Monthly Minimum Temperature—degrees C	-6.5	-5.4	-0.5	5.6	11.2	14.9	16.7	16.1	12.3	7.0	2.3	-3.3
55 Year Maximum	39.0 degrees C—August, 1954											
55 Year Minimum	-28.6 degrees C—February, 1929											
Relative Humidity—Percent	85	81	74	66	64	64	61	62	67	75	82	86
Monthly Average Precipitation—mm	28.5	23.1	23.7	34.9	46.6	62.1	47.7	38.1	26.4	32.6	31.3	31.0
Monthly Maximum Precipitation—mm	155.0	110.3	106.8	103.8	144.8	152.1	174.8	117.9	155.3	208.3	105.4	106.7
Monthly Minimum Precipitation—mm	1.2	..	0.6	3.0	0.5	5.3	0.4	0.6	0.0	0.0	0 1	0.0
Maximum Precipitation in 24 Hours—mm (June 9, 1901)	62.7	59.5	32.0	44.2	59.4	79.5	66.8	69.4	47.0	64.4	32.5	46.8

WINDS

Direction	Percent	Velocity (m/s)
N	25.0	6.3
NE	11.0	4.7
E	6.0	4.2
SE	8.4	4.1
S	11.8	4.9
SW	12.4	5.1
W	3.6	4.0
NW	10.0	6.3
Calm	11.8	

CLIMATOLOGICAL DATA

DEJ

20 and 60 Year Record*

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
20 YEAR RECORD												
Monthly Average Temperature–degrees C	-5.4	-2.7	3.1	9.4	14.3	18.0	19.3	18.4	14.2	8.9	4.3	-1.0
Monthly Maximum Temperature–degrees C	-1.2	1.7	8.9	15.8	20.9	24.6	26.2	25.6	21.9	16.6	8.9	2.2
Monthly Minimum Temperature–degrees C	-8.6	-6.9	-1.6	3.6	8.2	11.8	13.0	12.2	8.0	3.1	0.5	-4.2
20 Year Maximum	37.5 degrees C–August, 1954											
20 Year Minimum	-35.2 degrees C–January, 1963											
60 YEAR RECORD												
Monthly Average Precipitation–mm	41.9	45.1	34.7	52.4	84.1	88.8	76.8	78.2	32.0	37.1	42.3	56.3
Monthly Maximum Precipitation–mm	90.2	100.0	93.8	158.2	174.1	226.1	169.9	154.5	228.5	171.5	112.5	109.1
Monthly Minimum Precipitation–mm	5.0	4.0	1.0	6.3	10.1	27.8	12.4	9.0	--	0.0	--	1.5
Maximum Precipitation in 24 Hours–mm	28.0	27.3	29.0	33.1	47.6	70.0	44.4	60.5	45.0	47.0	30.4	30.2

WINDS

Direction	Percent	Velocity (m/s)
N	13.5	2.1
NE	9.8	2.5
E	1.6	2.4
SE	5.4	2.9
S	4.3	1.9
SW	3.6	1.9
W	2.0	1.8
NW	17.4	2.7
Calm	42.4	

SOIL TYPE AND PEDOLOGICAL OBSERVATIONS

ZAGNA VADENI

The terrain is comprised of alluvial deposits, typified by a layer of yellow silty-clay with some humus, approximately 1.5 meters thick, under which a layer of grayish clay is located, surrounded by a blackish dry solid, whose base is located at a depth from 3.5 to 4.5 meters from the surface of the soil.

It is followed by a layer of gray clay with sandy regions, which has at a depth of 6.5 to 7.5 meters an inclusion of peat approximately one meter thick.

Based on this situation, it is possible to obtain a depth of 1.3 meters with a pressure of 1 kilogram per centimeter with a basic loading.

The depth of 1.3 meters can be obtained due to the presence of plant material at that level.

The water level is on the surface; for this reason, a moist condition is maintained along the entire region.

SOIL ANALYSIS

Explanation of Soil Sample Code

$DV1_a$	Dej area, proposed 200 hectare vegetable production site, northern sector. Topsoil sample (surface 0-15 cm). Presently producing field corn, alfalfa.
$DV1_b$	Dej area, proposed 200 hectare vegetable production site, northern sector. Subsoil sample (15-30 cm).
$DV2_a$	Dej area, proposed 200 hectare vegetable production site, southern sector. Topsoil sample (surface 0-15 cm).
$DV2_b$	Dej area, proposed 200 hectare vegetable production site, southern sector. Subsoil sample (15-30 cm).
$DF1_a$	Dej area, foothill fruit production site. Presently in apples. Topsoil sample (surface 0-15 cm).
$DF1_b$	Dej area, foothill fruit production site. Subsoil sample (15-30 cm).
ZVC_a	Zagna Vadeni vegetable production site. Presently in cucumbers. Topsoil sample (0-15 cm).
ZVC_b	Zagna Vadeni vegetable production site. Subsoil sample (15-30 cm).
ZVT_a	Zagna Vadeni vegetable production site. Presently in tomatoes. Topsoil sample (0-15 cm).
ZVT_b	Zagna Vadeni vegetable production site. Subsoil sample (15-30 cm).

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FIELDS
LAND, WATER,
CLIMATE, ENERGY,
CROPS, LIVESTOCK,
MECHANIZATION

October 11, 1972

FMC Corporation
P. O. Box 1178
San Jose, California 95108

REPORT ON THE RESULTS OF PHYSICAL AND CHEMICAL ANALYSES OF TEN SAMPLES OF SOIL FROM ROMANIA:

One box with 4 samples received July 10, 1972
One box with 6 samples received August 3, 1972

RESULTS OF PHYSICAL ANALYSES

Identifications	Rock Contact Percent	Specific Gravity	Infiltration Rate mm/hour	Infiltration Rate inches/hour
DV1a	0.2	1.143	20	0.79
DV1b	1.1	1.150	15	0.59
DV2a	none	1.139	8	0.31
DV2b	none	1.184	5	0.20
DF1a	3.1	1.072	46	1.81
DF1b	0.9	1.166	40	1.58
ZVCa	none	1.143	20	0.79
ZVCb	none	1.117	20	0.79
ZVTa	none	1.190	14	0.55
ZVTb	none	1.089	71	2.80

Identifications	Saturation	10 CB	30 CB	60 CB	100 CB	NAM
DV1a	57.4	47.5	39.0	33.3	28.5	24.1
DV1b	57.5	48.4	39.0	32.6	27.9	24.9
DV2a	55.1	52.2	41.8	37.2	30.1	17.7
DV2b	60.2	54.3	47.0	39.3	34.0	20.9
DF1a	54.8	43.5	31.7	27.6	23.8	27.2
DF1b	52.9	44.7	32.8	29.5	25.4	23.4
ZVCa	54.1	49.3	39.7	34.9	29.5	19.2
ZVCb	55.4	52.7	42.3	36.3	31.4	19.1
ZVTa	53.5	47.0	40.5	34.5	29.2	18.0
ZVTb	49.0	44.9	38.8	33.8	29.0	14.3

RESULTS OF CHEMICAL ANALYSES

(See The Twining Laboratories, Inc. Examination 88527)

Comments on the Evaluation of Results

The chemical analysis shows that all 10 soils have a slight acid reaction with pH values ranging between 5.9 and 6.7. This is a desirable range for most crops.

The humus content of these soils is very high. The organic matter is well decomposed, resulting in dark colored water extracts.

The nitrate level of most soils is above the desirable level of 25 parts per million. Those soils which are below 25 parts per million show considerable ammonia nitrogen, which will be oxidized to form nitrates.

All soils are very low in available phosphates. Some of the soils are also low in available potash. These plant food deficiencies can be corrected by proper fertilization.

These soils are characterized by a very high sodium content. Fortunately this is offset by a comparatively high calcium and magnesium content, which in most cases results in a favorable calcium/sodium ratio. However, in some of the soils the high sodium has deflocculated the soil structure sufficiently to result in a very slow water infiltration rate.

Some of the soils show excessive concentrations of salt (sodium chloride). The chloride content of a good productive soil should not exceed 200 parts per million. Some crops, such as sugar beets, barley, etc. will tolerate up to 400 parts per million of chlorides. Higher concentrations make the soil unsuitable for agricultural purposes.

These soils are practically free from rocks. The specific gravities are fairly uniform and reflect the presence of considerable humus and possibly a high silt and clay content.

The water holding capacity of these soils is comparatively high, ranging from 49 to 60 percent. The net available moisture in these soils is also comparatively high. With the exception of three soils, the infiltration rate is very low.

Since these soils are high in sodium ions and since they show a slight acid reaction, it would be advisable to continue to treat these soils with lime in order to maintain a favorable calcium/sodium ratio and to improve the infiltration rate.

Soil DV1a and DV1b are low in available phosphates, but are otherwise well supplied with plant food. Soil DV1a contains considerable sodium sulfate, sometimes referred to as white alkali; however, the concentrations are not excessive. It is essential to keep the soil open to prevent further accumulations of sodium salts. Soil DV1b contains an excessive concentration of sodium chloride, which makes it entirely unsuitable for growing crops. The salt content must be reduced to an acceptable level by leaching before crops can be grown on this soil.

Soils DV2a and DV2b are low in available phosphates. The available potash level also is a little lower than desirable. These two soils contain a very high sodium content as compared to the soluble calcium, resulting in a very unfavorable calcium/sodium ratio. This also causes these soils to be very tight, resulting in a very low infiltration rate. The chloride content of these soils is too high for most crops, particularly soil DV2b. An application of lime or gypsum should be helpful to correct the calcium/sodium ratio. This should also help to open up the soil so that the salts can be leached down into the subsoil below the root zone.

Soil DFla contains an excessive amount of chlorides which will interfere with the growth of crops on this soil. Soil DFlb, however, is free from excessive salts and should produce good crops. The sodium appears mostly in the form of sodium sulfate which has a low order of toxicity. This soil is low in available phosphates and available potash. The nitrate level also is lower than desirable, but an ammonia fertilizer apparently has been applied shortly before the sample was taken and will provide the necessary nitrogen requirements. These two soils show a favorable calcium/sodium ratio, which results in a good infiltration rate. This should help to reduce the chloride content of soil DFla by leaching.

Soils ZVCa and ZVCb are almost identical in composition. They are low in available phosphates, but are otherwise well supplied with plant food. They are free from excessive sodium salts; however, the sodium is high enough to reduce the infiltration rate.

Soils ZVTa and ZVTb are low in available phosphates and available potash. They are otherwise well supplied with plant food. The sodium salts are not excessive. These soils should produce good crops. The application of lime or gypsum should help to improve the infiltration rate of soil ZVTa.

The Twining Laboratories, Inc.

2527 Fresno Street Fresno California 268-7021
1507 "G" Street Modesto California 523-0994
Please Address All Mail to P. O. Box 1472, Fresno, California 93716

October 9, 1972

Examination 88527

FOR— Resources International
Rowell Building
Fresno, California 93721.

Identifications:

SAMPLE - SOIL, rec'd. October 3, 1972

MARKED: ROUMANIA PROJECT

Sample No.	pH Value	Humus % by wt.	AVAILABLE PLANT FOOD AND SALTS (1 to 5 Water Extract), parts per million											
			Ammonia Nitrogen (N)	Nitrates (NO_3)	Phosphates (P_2O_5)	Potash (K_2O)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfates (SO_4)	Carbonates (CO_3)	Bicarbonates (HCO_3)	Chlorides (Cl)
DV 1a	6.6	3.02	12.8	31.3	Trace	65	1207	227	485	757	Nil	1989	105
DV 1b	6.6	3.04	6.8	21.4	Trace	65	1132	127	2000	204	Nil	2196	2695
DV 2a	6.7	3.62	12.4	28.3	Trace	35	226	45	700	91	Nil	1232	181
DV 2b	6.7	2.73	12.8	23.5	Trace	20	189	55	860	247	Nil	1025	273

THE TWINING LABORATORIES, INC.

By John P. Burz

The Twining Laboratories, Inc.
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FOR— Resources International
Examination 88527
Page 2
October 9, 1972

Identifications:

SAMPLE – SOIL, rec'd.

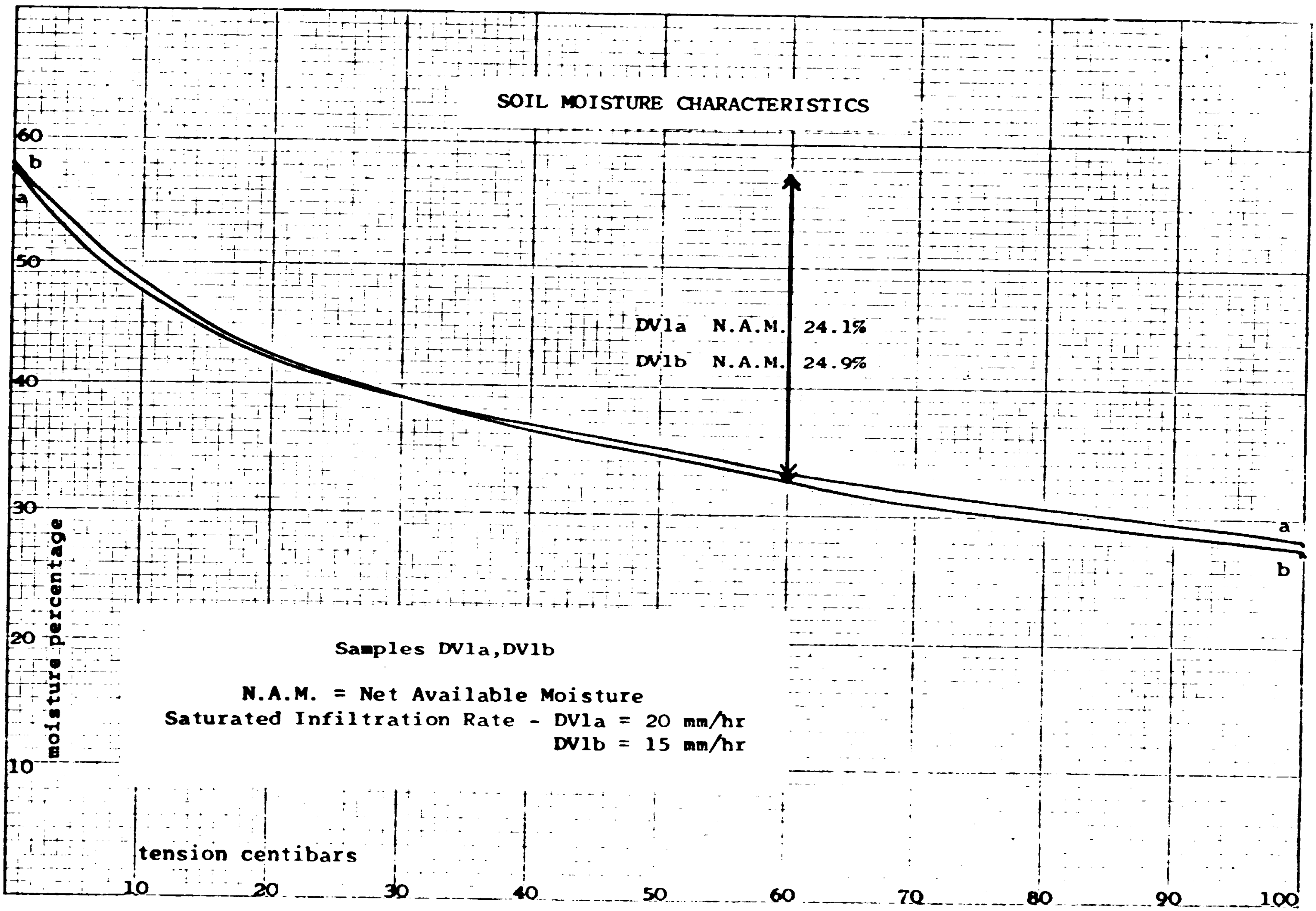
MARKED: ROUMANIA PROJECT

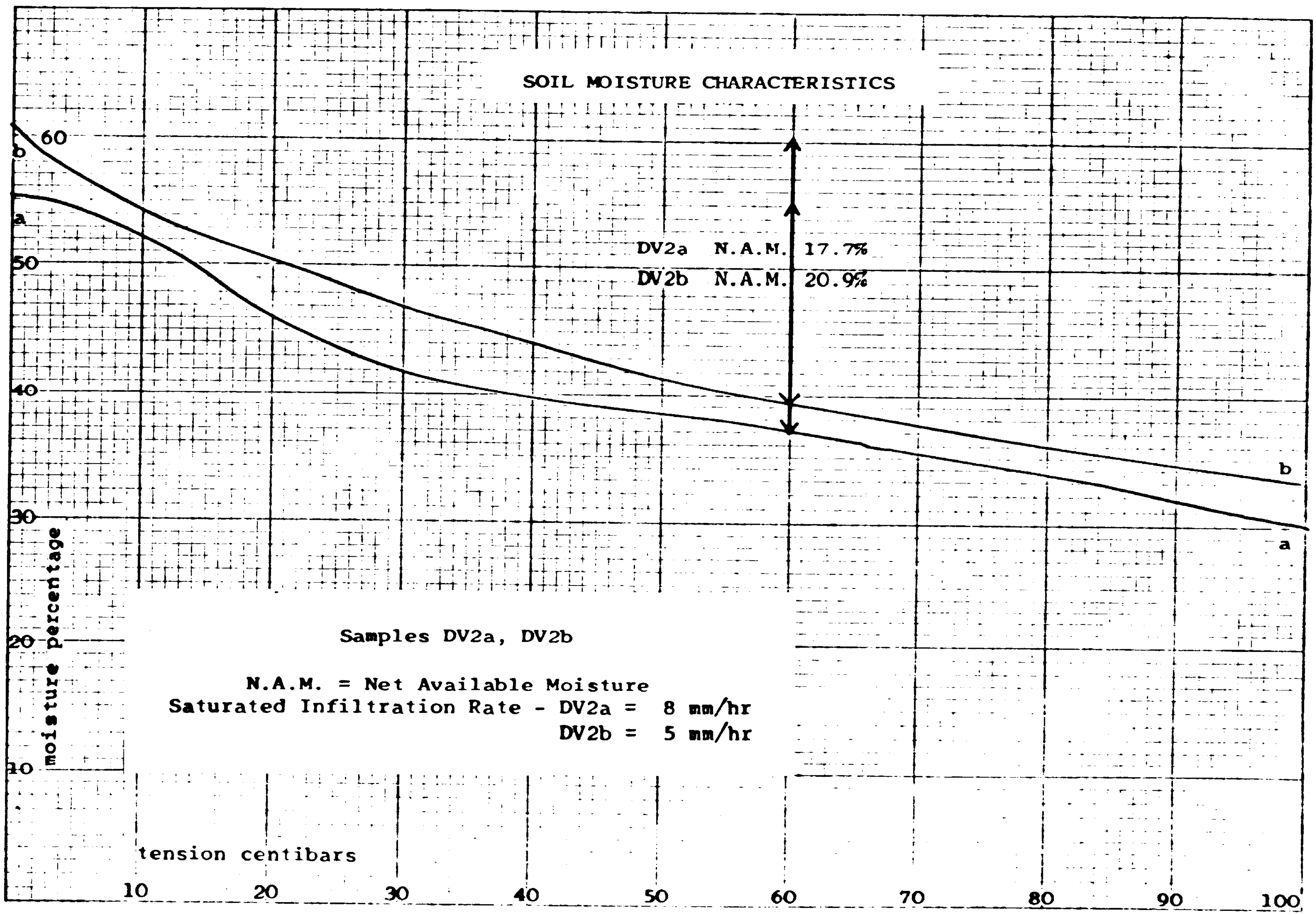
			AVAILABLE PLANT FOOD AND SALTS (1 to 5 Water Extract), parts per million										
Sample No.	pH Value	Humus % by wt.	Ammonia Nitrogen (N)	Nitrates (NO3)	Phosphates (P2O5)	Potash (K2O)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfates (SO4)	Carbonates (CO3)	Bicarbonates (HCO3)	Chlorides (Cl)
DF 1a	6.5	3.60	29.6	12.6	Trace	61	830	281	510	827	Nil	1598	1220
DF 1b	5.9	2.91	28.0	15.7	3.5	32	634	164	350	708	Nil	357	56
ZVCa	6.7	2.54	8.6	34.7	Trace	42	596	64	135	251	Nil	756	70
ZVCb	6.5	2.42	9.6	30.2	Trace	37	453	59	140	156	Nil	695	63
ZVTa	6.6	2.48	7.6	29.3	Trace	22	317	59	130	58	Nil	646	91
ZVTb	6.6	2.13	11.4	24.9	Trace	18	355	50	121	136	Nil	805	70

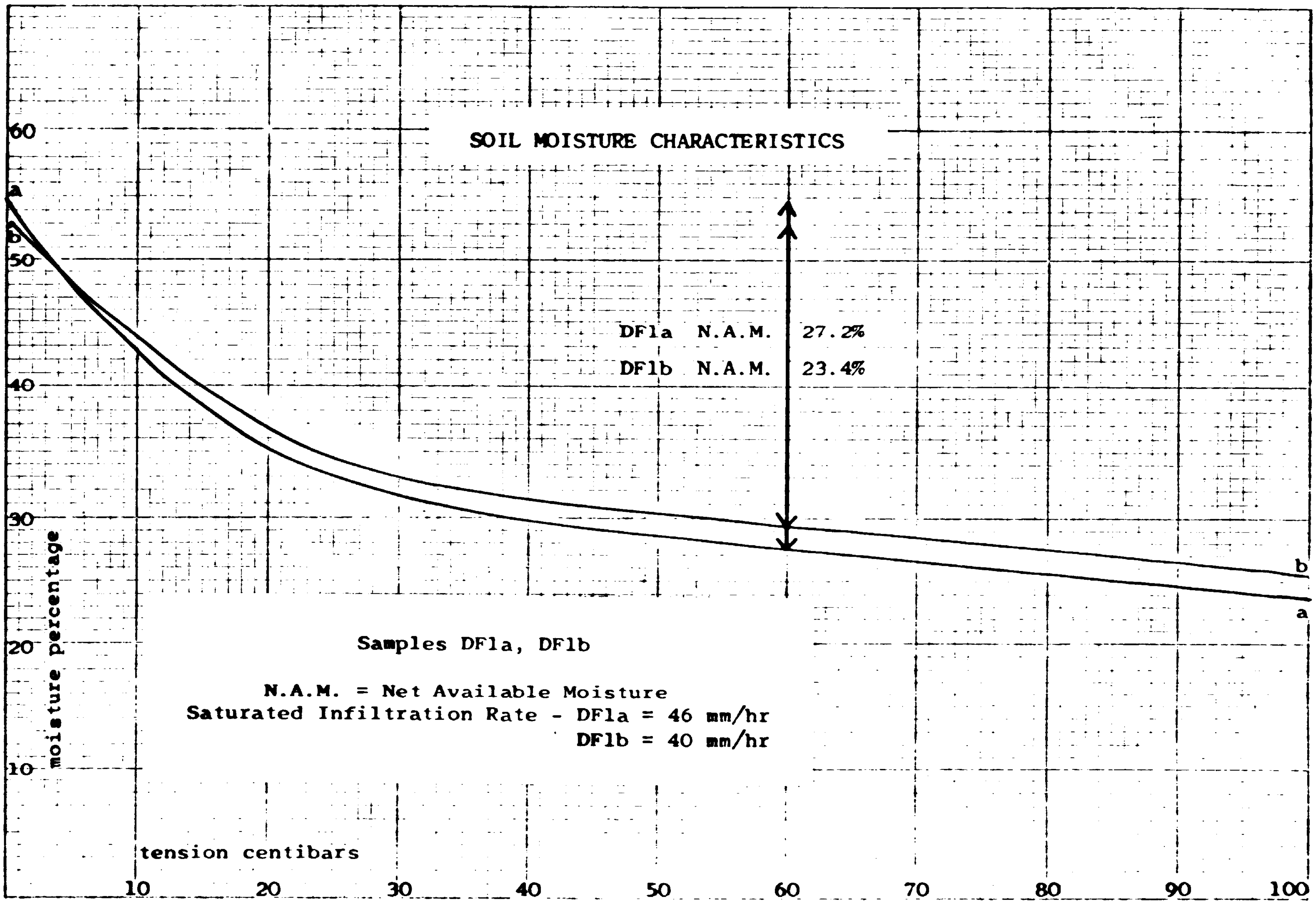
JB/ep
2 cc

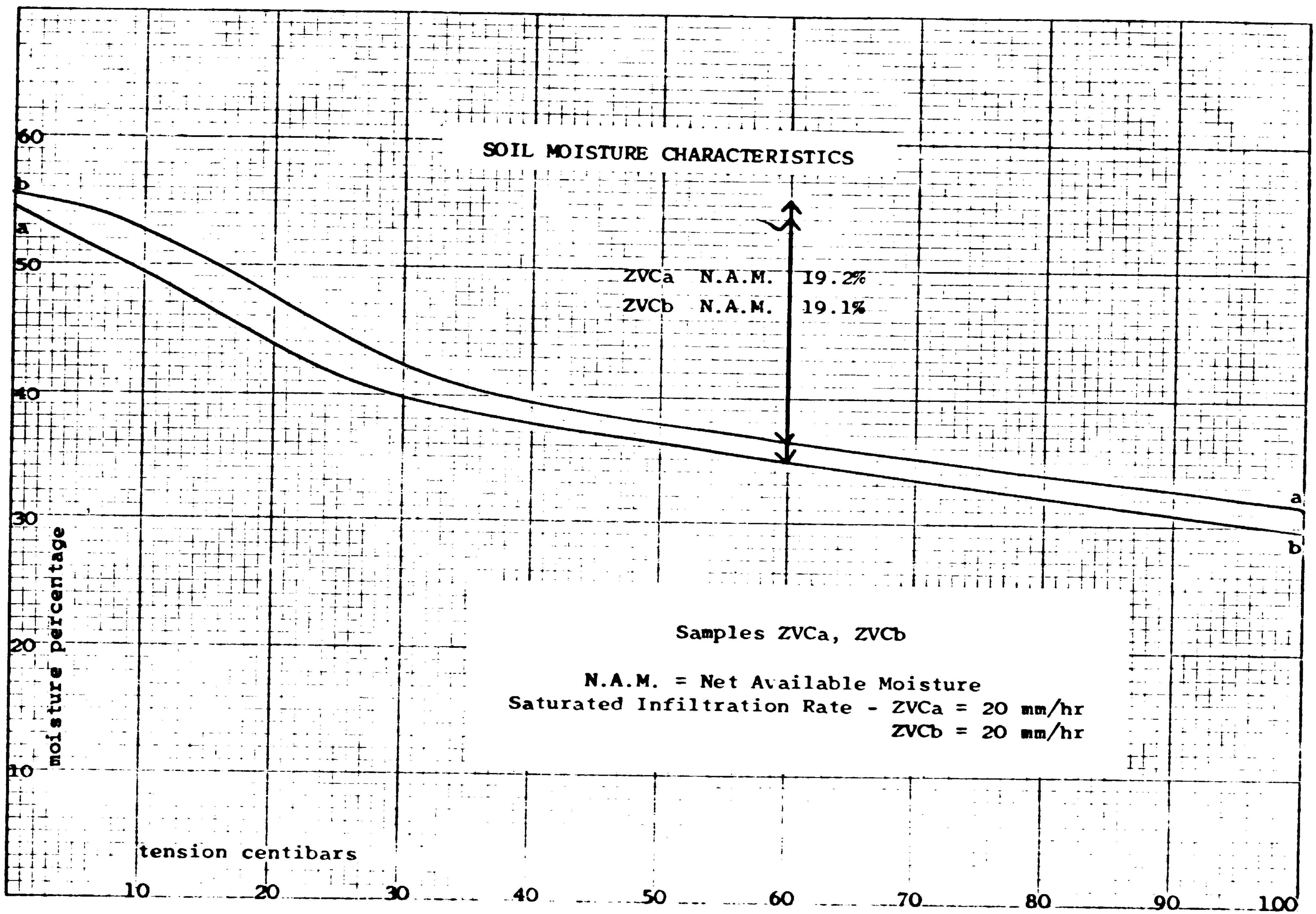
THE TWINING LABORATORIES, INC.

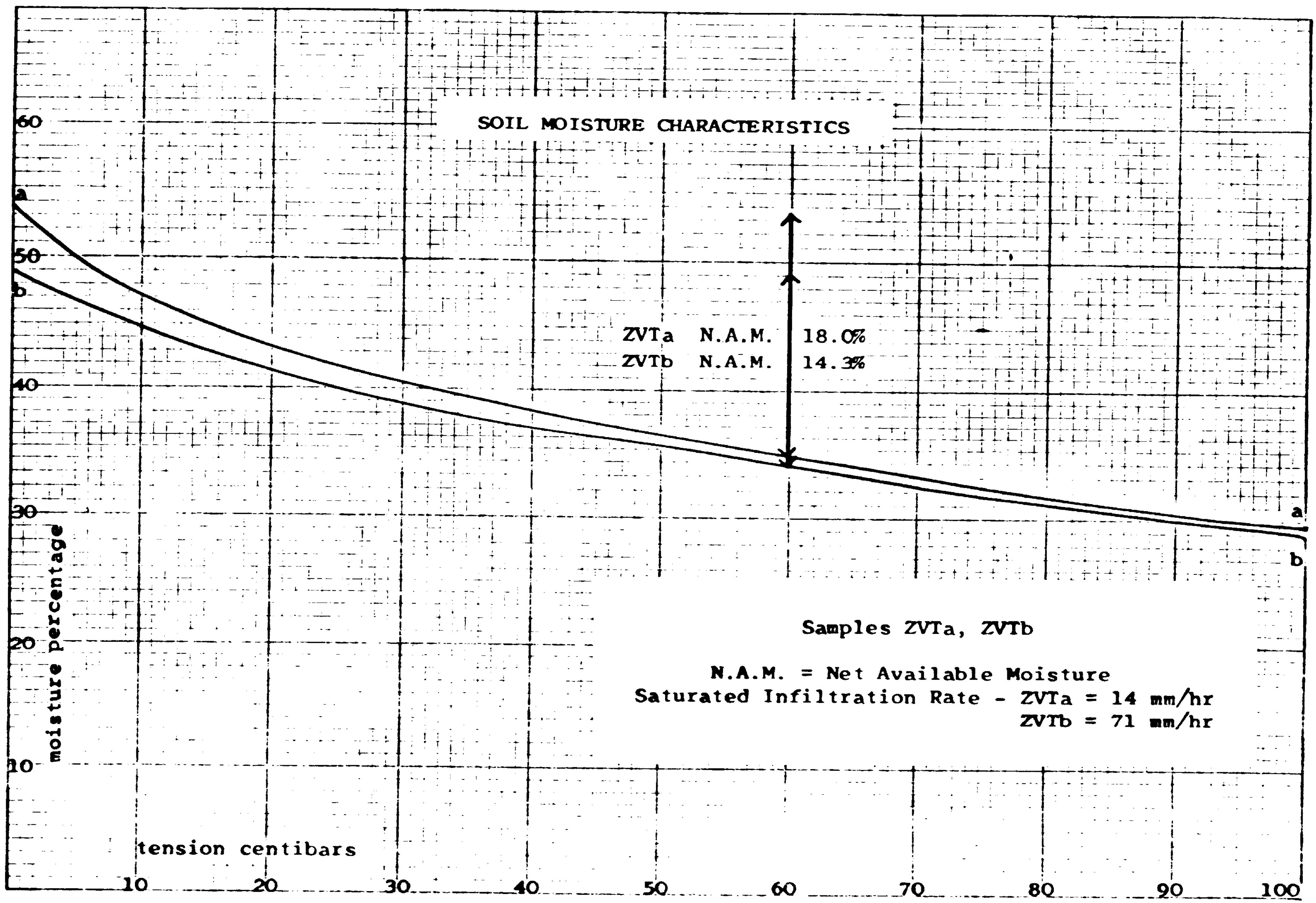
By John P. Barg


SOIL MOISTURE CHARACTERISTICS
DV1a N.A.M. 24.1%
DV1b N.A.M. 24.9%
Samples DV1a,DV1b
N.A.M. = Net Available Moisture
Saturated Infiltration Rate - DV1a = 20 mm/hr
DV1b = 15 mm/hr
moisture percentage
tension centibars
a
b
10
20
30
40
50
60
70
80
90
100


SOIL MOISTURE CHARACTERISTICS
DV2a N.A.M. 17.7%
DV2b N.A.M. 20.9%
Samples DV2a, DV2b
N.A.M. = Net Available Moisture
Saturated Infiltration Rate - DV2a = 8 mm/hr
DV2b = 5 mm/hr
moisture percentage
tension centibars
10
20
30
40
50
60
70
80
90
100
a
b


SOIL MOISTURE CHARACTERISTICS
DF1a N.A.M. 27.2%
DF1b N.A.M. 23.4%
Samples DF1a, DF1b
N.A.M. = Net Available Moisture
Saturated Infiltration Rate - DF1a = 46 mm/hr
DF1b = 40 mm/hr
moisture percentage
tension centibars
60
50
40
30
20
10
10
20
30
40
50
60
70
80
90
100
a
b
b
a


SOIL MOISTURE CHARACTERISTICS
ZVCa N.A.M. 19.2%
ZVCb N.A.M. 19.1%
Samples ZVCa, ZVCb
N.A.M. = Net Available Moisture
Saturated Infiltration Rate - ZVCa = 20 mm/hr
ZVCb = 20 mm/hr
moisture percentage
tension centibars
a
b
10
20
30
40
50
60
70
80
90
100


SOIL MOISTURE CHARACTERISTICS
ZVTa N.A.M. 18.0%
ZVTb N.A.M. 14.3%
Samples ZVTa, ZVTb
N.A.M. = Net Available Moisture
Saturated Infiltration Rate - ZVTa = 14 mm/hr
ZVTb = 71 mm/hr
moisture percentage
tension centibars
60
50
40
30
20
10
a
b
10
20
30
40
50
60
70
80
90
100

PRODUCTION AND TRIALS PAST AND PRESENT

ZAGNA VADENI

NUMBER	CROP TYPE	TOTAL HECTARES PLANTED
1	Tomatoes	27,140
2	Mild Peppers	1,311
3	Peas	3,500
4	Eggplant	320
5	Capsicum	674
6	Pumpkins	227
7	Okra Pods	68
8	Carrots	405
9	Onions	239
10	Cucumbers	255
11	Kapia Peppers (hot, pimento)	91
12	Cabbages	45
13	Cauliflower	6
14	Greens	17
15	Garlic	2
	Total Vegetables	**35,449**
1	Apples	23
2	Pears	29
3	Plums	82
4	Sweet Cherries	57
5	Sour (Morello) Cherries	67
6	Apricots	703
7	Quinces	72
8	Green Apricots	5
9	Green Walnuts	46
10	Grapes	100
	Total Fruit	**1,084**

WATER (SUBSURFACE) ANALYSIS

ZAGNA VADENI

FROM STATION WELL NUMBER 2

CHARACTERISTICS	AT SAMPLING	IN THE LABORATORY
Appearance, color, smell and turbidity	limpid	without odor
Index at 20 degrees C	7.87	– – – – – –
Hydrogen sulfide H_2S mg/l	– – –	– – – – – –
Carbon dioxide CO_2	– – –	– – – – – –
Dissolved oxygen	– – –	– – – – – –

CATIONS	MG/L	M VAL/L	ANIONS	MG/L	M VAL/L
Calcium Ca^{++}	44.0	1.1	Nitrates NO_3^-	– –	– – –
Magnesium Mg^{++}	31	1.28	Nitrites NO_2^{--}	– –	– – –
Sodium Na^+	– –	– –	Sulfates SO_4^{--}	– –	– – –
Potassium K^+	– –	– –	Bicarbonates HCO_3^-	367.2	6.02
Ammonia NH^{++++}	– –	– –	Carbonates CO_3^{--}	missing	
Iron Fe^{+++}	missing	– –	Chlorates Cl^-	60.35	1.7
Manganese Mn^{++}	– –	– –	Phosphates PO_4^{---}	0.012	

FROM STATION WELL NUMBER 3

CHARACTERISTICS	AT SAMPLING	IN THE LABORATORY
Appearance, color, smell and turbidity	limpid	without odor
Index at 20 degrees C	7.72	– – – – – –
Hydrogen sulfide H_2S mg/l	– – –	– – – – – –
Carbon dioxide CO_2 mg/l	– – –	– – – – – –
Dissolved oxygen	– – –	– – – – – –

CATIONS	MG/L	M VAL/L	ANIONS	MG/L	M VAL/L
Calcium Ca^{++}	3.7	0.92	Nitrates NO_3^-	– –	– – –
Magnesium Mg^{++}	30	1.23	Nitrites NO_2^{---}	– –	– – –
Sodium Na^+	– –	– –	Sulfates SO_4^{--}		
Potassium K^+	– –		Bicarbonates HCO_3^-	390	6.4
Ammonia NH^{++++}	– –		Carbonates CO_3^{--}	18	0.6
Iron Fe^{+++}	missing		Chlorates Cl^-	60.3	1.7
Manganese Mn^{++}			Phosphates PO_4^{---}	0.0	

FROM STATION WELL NUMBER 4

CHARACTERISTICS	AT SAMPLING	IN THE LABORATORY
Appearance, color, smell and turbidity	without odor	brown bottles (flasks)
Index at 20 degrees C	7.5	----------
Hydrogen sulfide H_2S mg/l	------	----------
Carbon dioxide CO_2 mg/l	------	----------
Dissolved oxygen mg/l	------	----------

CATIONS	MG/L	M VAL/L	ANIONS	MG/L	M VAL/L
Calcium Ca^{++}	62	1.55	Nitrates NO_3^-	--	---
Magnesium Mg^{++}	7.8	0.32	Nitrites NO_2^{---}	--	---
Sodium Na^+	--	--	Sulfates SO_4^{--}	--	---
Potassium K^+	--	--	Bicarbonates HCO_3^-	297	4.88
Ammonia NH^{++++}	--	--	Carbonates CO_3^{--}	8.4	0.28
Iron Fe^{+++}	0.65	--	Chlorates Cl^-	58.5	1.65
Manganese Mn^{++}	--	--	Phosphates PO_4^{---}	0.0	---

FROM STATION WELL NUMBER 5

CHARACTERISTICS	AT SAMPLING	IN THE LABORATORY
Appearance, color, smell and turbidity	limpid	without odor
Index at 20 degrees C	7.65	-------
Hydrogen sulfide H_2S mg/l	---	-------
Carbon dioxide CO_2 mg/l	---	-------
Dissolved oxygen mg/l	---	-------

CATIONS	MG/L	M VAL/L	ANIONS	MG/L	M VAL/L
Calcium Ca^{++}	40	1.0	Nitrates NO_3^-	--	---
Magnesium Mg^{++}	22.3	0.92	Nitrites NO_2^{---}	--	---
Sodium Na^+	--	--	Sulfates SO_4^{--}	--	---
Potassium K^+	--	--	Bicarbonates HCO_3^-	417	6.82
Ammonia NH^{++++}	--	--	Carbonates CO_3^{--}	missing	
Iron Fe^{+++}	missing	--	Chlorates Cl^-	48.0	1.35
Manganese Mn^{++}	--	--	Phosphates PO_4^{---}	0.0	---

FROM STATION WELL NUMBER 6

CHARACTERISTICS	AT SAMPLING	IN THE LABORATORY
Appearance, color, smell and turbidity	without odor	brown flasks
Index at 20 degrees C	7.85	------
Hydrogen sulfide H_2S mg/l	------	------
Carbon dioxide CO_2 mg/l	------	------
Dissolved oxygen mg/l	------	------

CATIONS	MG/L	M VAL/L	ANIONS	MG/L	M VAL/L
Calcium Ca^{++}	32.4	0.81	Nitrates NO_3^-	--	---
Magnesium Mg^{++}	29.8	1.23	Nitrites NO_2^{---}	--	---
Sodium Na^+	--		Sulfates SO_4^{--}	--	---
Potassium K^+	--		Bicarbonates HCO_3^-	36.3	5.96
Ammonia NH^{++++}	--		Carbonates CO_3^{--}	missing	
Iron Fe^{+++}	--		Chlorates Cl^-	63.8	1.8
Manganese Mn^{++}	--		Phosphates PO_4^{---}	0.01	---

FROM STATION WELL NUMBER 7

CHARACTERISTICS	AT SAMPLING	IN THE LABORATORY
Appearance, color, smell and turbidity	without odor	brown flasks
Index at 20 degrees C	7.75	------
Hydrogen sulfide H_2S mg/l	------	------
Carbon dioxide CO_2 mg/l	------	------
Dissolved oxygen mg/l	------	------

CATIONS	MG/L	M VAL/L	ANIONS	MG/L	M VAL/L
Calcium Ca^{++}	28.7	0.72	Nitrates NO_3^-	--	---
Magnesium Mg^{++}	42.7	1.76	Nitrites NO_2^{---}	--	---
Sodium Na^+	--	--	Sulfates SO_4^{--}	--	---
Potassium K^+	--	--	Bicarbonates HCO_3^-	37.5	6.14
Ammonia NH^{++++}	--	--	Carbonates CO_3^{--}	missing	
Iron Fe^{+++}	0.027	--	Chlorates Cl^-	71.0	2.0
Manganese Mn^{++}	--	--	Phosphates PO_4^{---}	0.01	

Abaterile față de normal ale precipitațiilor căzute în luna mai 1970

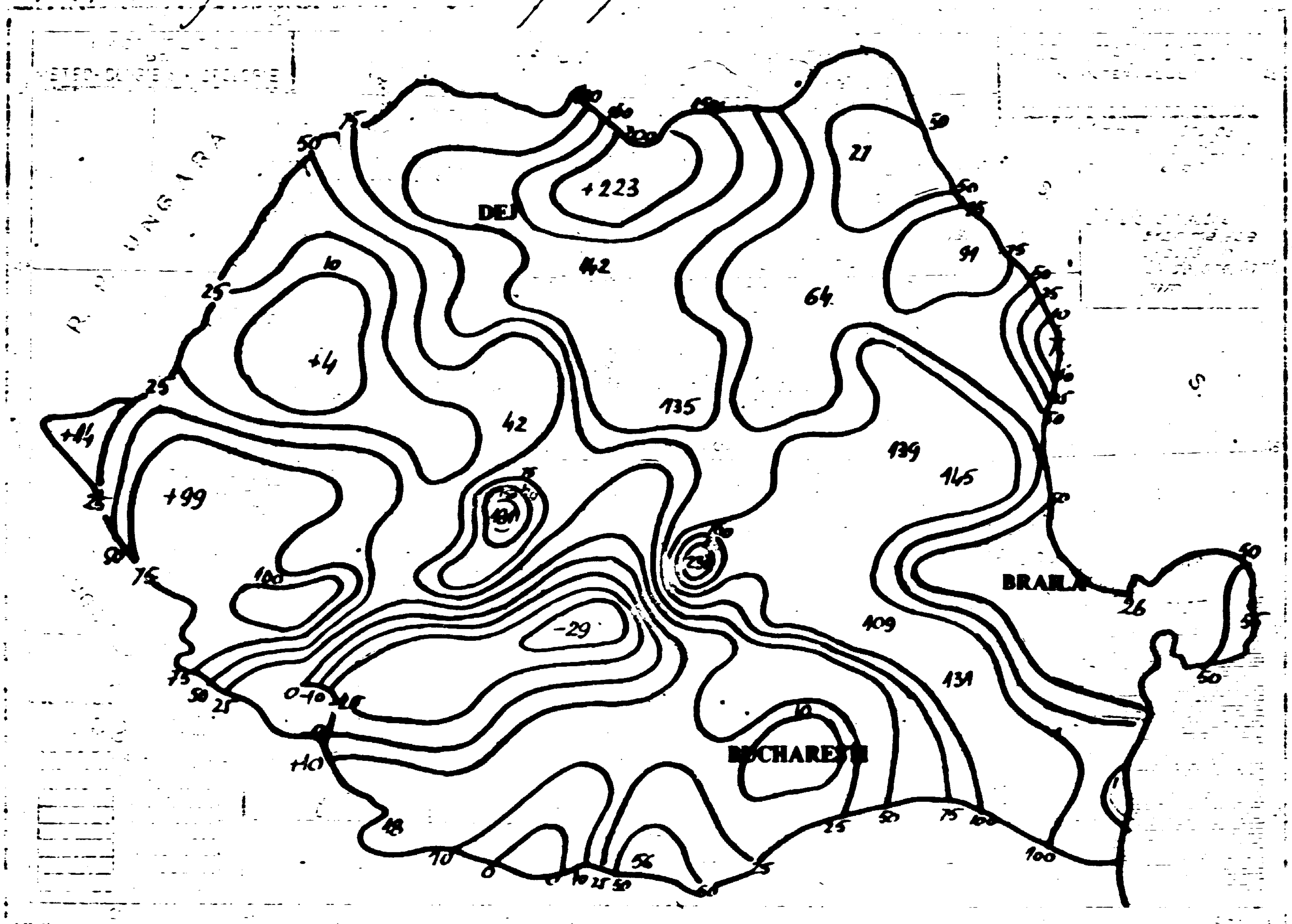
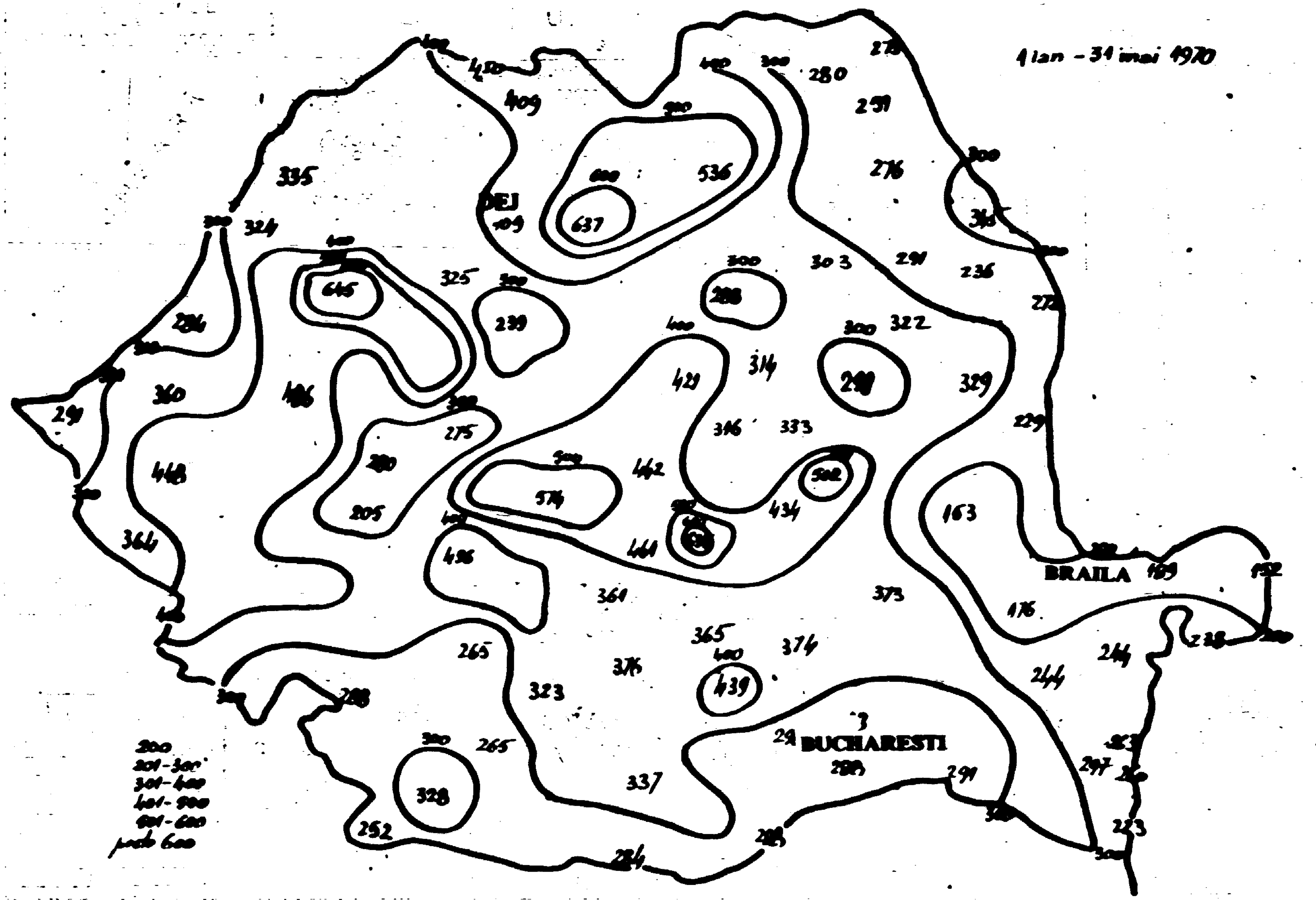


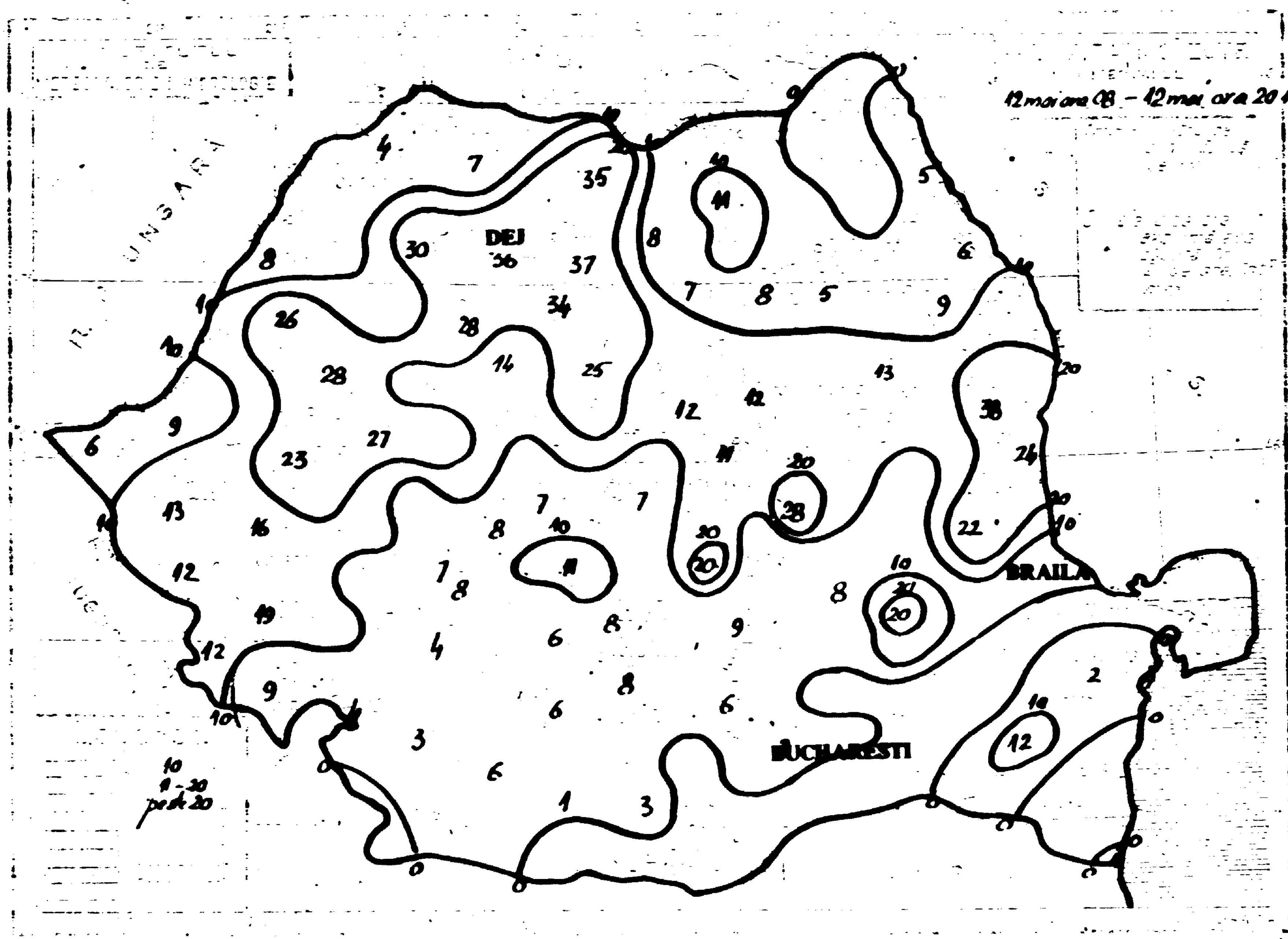
Fig 6

1 Ian - 31 mai 1970



200
201-300
301-400
401-500
501-600
peste 600

Fig 11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UNGARIA
DEJ
BRAILA
BUCHARESTI
10
11-20
peste 20

Fig. 15

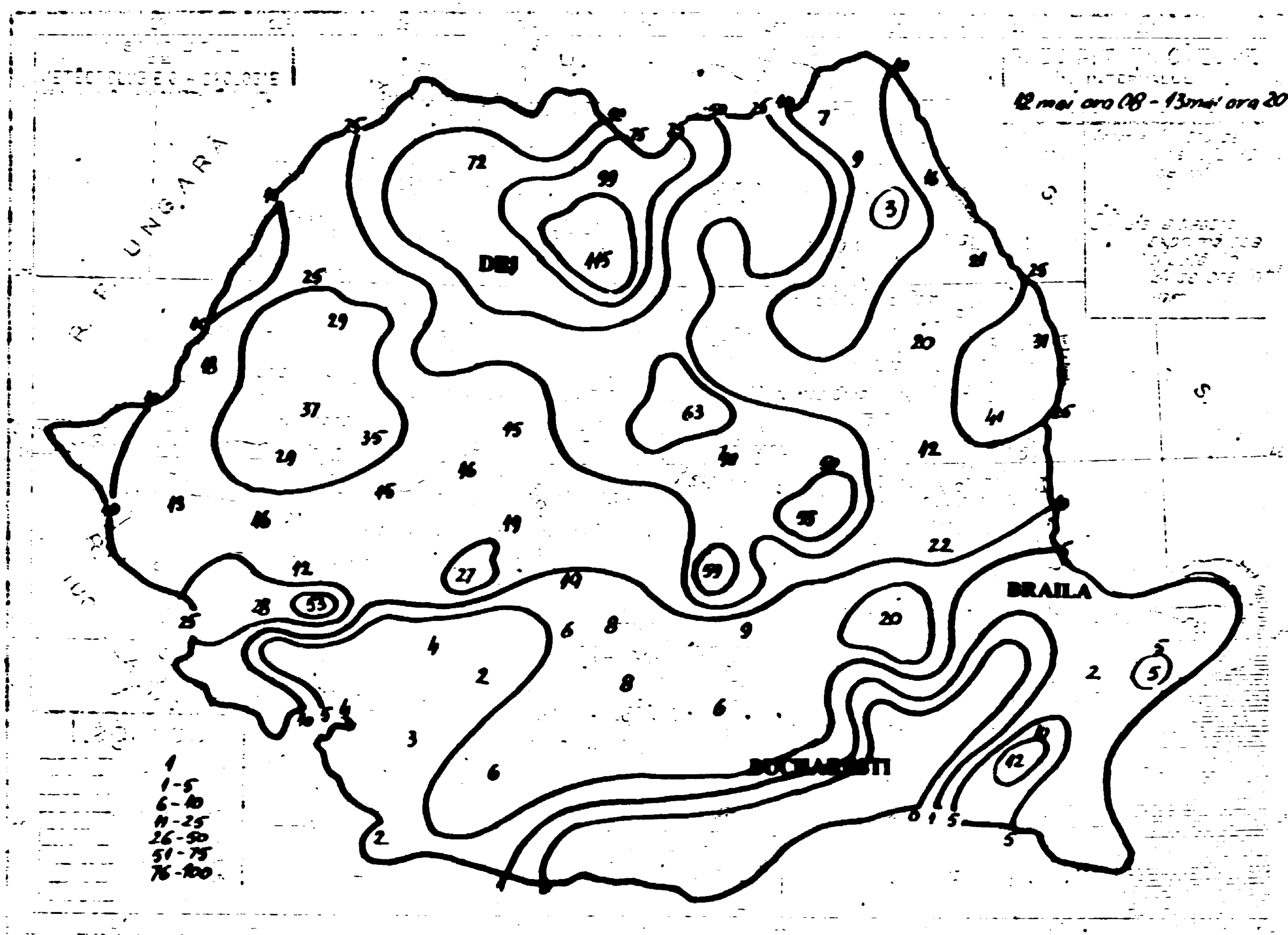
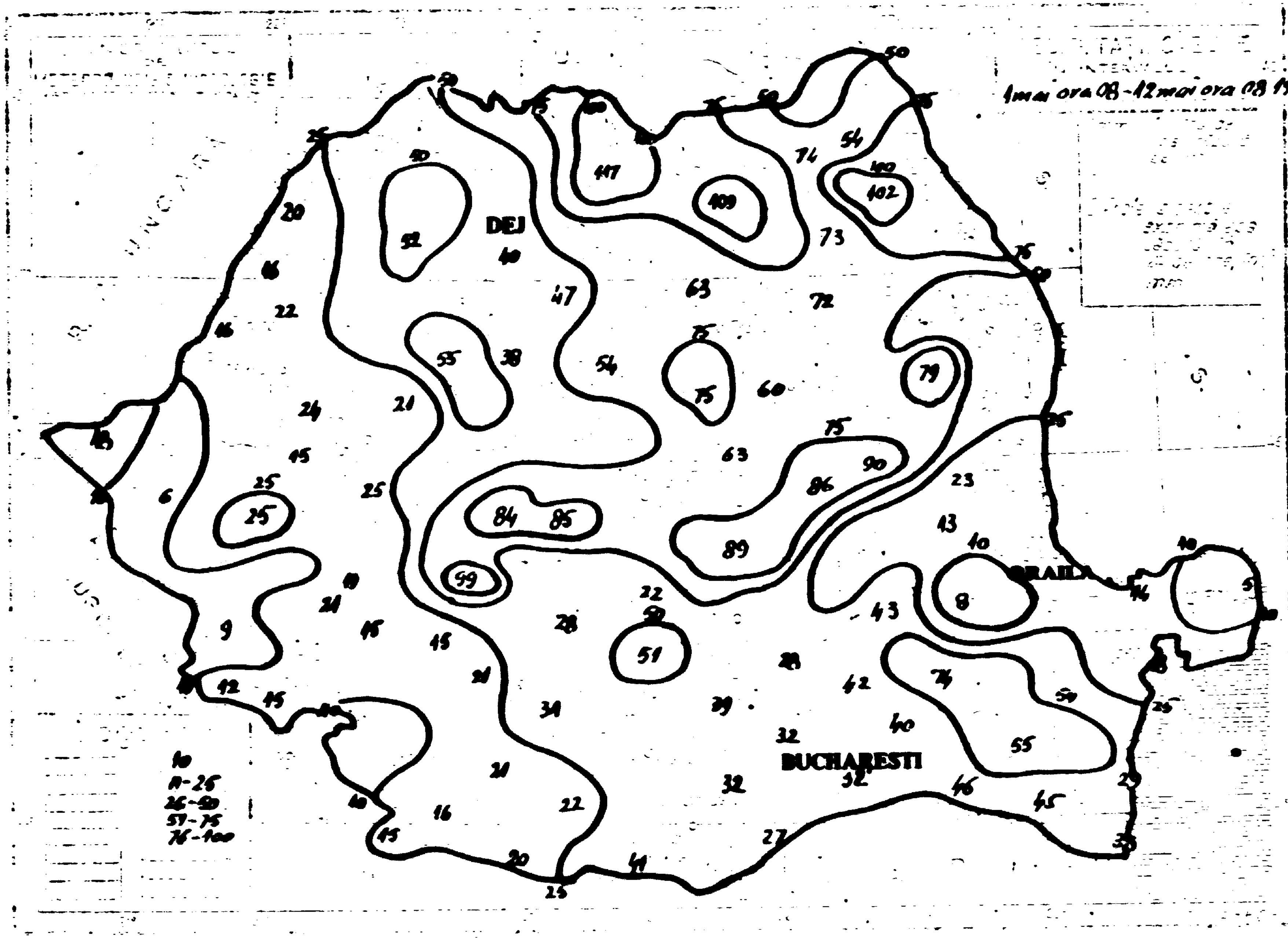

12 mai ora 08 - 13 mai ora 20 1970
R. P. UNGARA
DEJ
BRAILA
BUCUREŞTI
1
1-5
6-10
11-25
26-50
51-75
76-100

Fig. 9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DEJ
BRAILA
BUCHARESTI
10
11-25
26-50
51-75
76-100

fig 8

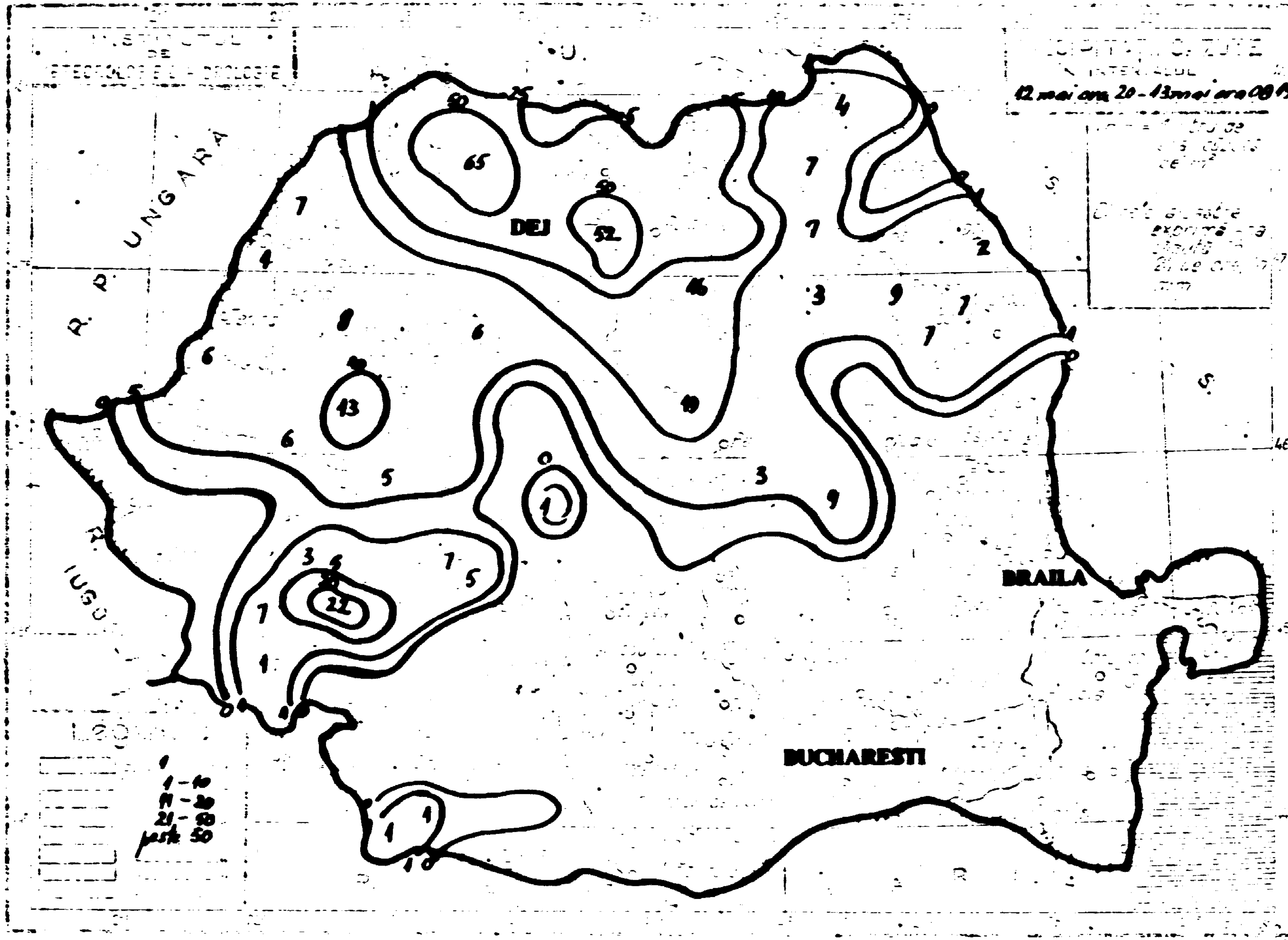
12 mai ora 20 - 13 mai ora 08 1990
R. P. UNGARA
R. IUGO
DEJ
BRAILA
BUCHARESTI
1
1 - 10
11 - 20
21 - 50
peste 50

fig 4c

SCHEDULING PLANTINGS AND PREDICTING HARVEST MATURITIES FOR PROCESSING VEGETABLES*

INTRODUCTION

To make the most economical use of labor and equipment in the vegetable processing industry, a steady flow of raw products from the fields to the factory is essential. Crop control programs are greatly affected by fluctuations in weather and must be adjustable to sudden changes. Plant growth and development are controlled by many interacting environmental factors, but of these, temperature is by far the most important. Research on temperature effects in the late twenties and early thirties gave rise to the effective accumulated heat unit technique which recently has been widely adapted by many canners and freezers of peas, sweet corn, and other vegetables. The basic research on which the heat unit method is based, the working details involved, and the merits and limitations of the technique are reported. Field departments, as well as management, have found the technique to be a valuable tool in spacing of plantings, timing of insect and disease control programs, predicting harvest maturities, and arranging for labor and supplies. Allied industries have found it useful in scheduling the manufacture and shipment of containers and other supplies.

Since temperature is the only growth factor considered, heat unit values in different areas and between seasons may vary. Recent research which offers explanations for some of the variations is reviewed and certain corrections suggested.

Many problems are encountered in scheduling plantings and predicting harvest maturities for processing vegetables. Crop production programs are usually based on an *average year*, but local weather fluctuates widely from the normal pattern and adjustments must be made as the season advances.

---

* *Scheduling Plantings and Predicting Harvest Maturities for Processing Vegetables,* by H. L. Seaton, Metal Division, Research & Development Department, Continental Can Company, Inc.

Numerous systems of scheduling plantings and predicting harvest dates of peas, sweet corn, and other processing vegetables have been used, but most of them have definite limitations. A system in general use for years was based on the number of days from planting to harvest (37). Another was based on the interval from bloom to harvest. However, neither of these systems has been satisfactory as poor correlations exist between the number of days from planting to harvest and plant growth and development.

As a result of considerable basic research, a technique referred to as the "heat summation" or "heat unit" system was developed; it is now widely used by the industry in scheduling successive plantings and predicting the incidence of insect disease infestations, as well as in forecasting harvesting dates.

Although it is realized that plant growth is the result of the interaction of the plant to temperature, moisture, light intensity length of day, fertility levels, and many other factors, and that any one of these may be a limiting or controlling factor, only the effects of temperature a single growth factor are taken into consideration in this system.

The theory of temperature summation as an index of plant growth, development, and maturity is not new. During the years 1913 to 1921, B. E. Livingston (22, 23) and co-workers published papers on the use of physiological temperature indices for the study of plant growth in relation to climatic conditions. These studies were followed in the late 1920's and early 1930's by the work of Appleman and Eaton (3), Boswell (7, 8), and Magoon and Culpepper (12, 24, 25). Close relationships were shown between the time of development to a given stage in sweet corn and peas and the mean temperatures for that period. In these studies a summation of degree hours above a base temperature at which growth takes place correlated closely with plant development in both peas and sweet corn.

Based on the above studies and their own extensive investigations started in 1927, the Green Giant Company, Le Sueur, Minnesota (1, 4, 33) found that definite planting schedules could be formulated in advance of actual planting, and that harvest dates could be predicted with reasonable accuracy. In 1936 the method was adopted by most of their canneries and has been in use ever since. In 1945, the Green Giant Company made the general principles of the method available to the industry and since then many other companies have adopted it. Interest in the method has stimulated further investigations by can manufacturers (28, 34, 35, 36), seed companies, research workers at several agricultural experiment stations (9, 10, 13, 14, 15, 16, 19, 20, 21, 29, 30, 31, 32, 38) and others (11, 17, and 27).

DEFINITIONS OF TERMS

For each species of plant there is a minimum temperature at which growth takes place, a maximum temperature where growth ceases, and somewhere between these the optimum - the point at which the most active growth occurs. The minimum or base line temperatures for peas has been established at 40 degrees F and for sweet corn at 50 degrees F.

To obtain the number of heat units in degree days, the maximum and minimum temperatures for the day are added together and divided by two to obtain the daily mean or average temperature. This daily mean temperature, minus the base line temperature equals the number of effective heat units for the day expressed as degree days. (The number of heat units expressed as degree hours is obtained by multiplying the number of effective heat units expressed as degree days by 24.) In this discussion, unless otherwise specified, heat units will be indicated as degree days.

FORMULATION OF PLANTING SCHEDULES

The greatest benefit of the heat unit system is that it provides an effective basis for spacing successive plantings of a crop so that the cannery will have an uninterrupted supply of raw materials at their optimum maturity. In setting up the planting schedule, it is first necessary to obtain from the Weather Bureau the long-term average daily mean temperature records for the area. From these, a curve of accumulated heat units above the base line is constructed for the normal season from planting through harvest. (See Figure 4-1.) It is also necessary to know the daily cannery production capacity based on a 12- to 14-hour day. An extra shift can be added if climatic conditions or above average yields demand.

From the long term accumulated temperature curve and the predetermined cannery capacity, a theoretical planting schedule is developed and shifts in the theoretical schedule are made to compensate for irregularities in temperature during the planting season. Local temperature values are taken each day, and another curve of actual values is accumulated as the season advances to show variation from the normal.

In general, at harvest time of peas, about 30 degree days will be added each day. Therefore, plantings should be scheduled with an interval of about 30 heat units between each successive planting. For example, if a grower was able to harvest 5 acres per day and wanted to grow 15 acres of peas, he would not plant 5 acres a day

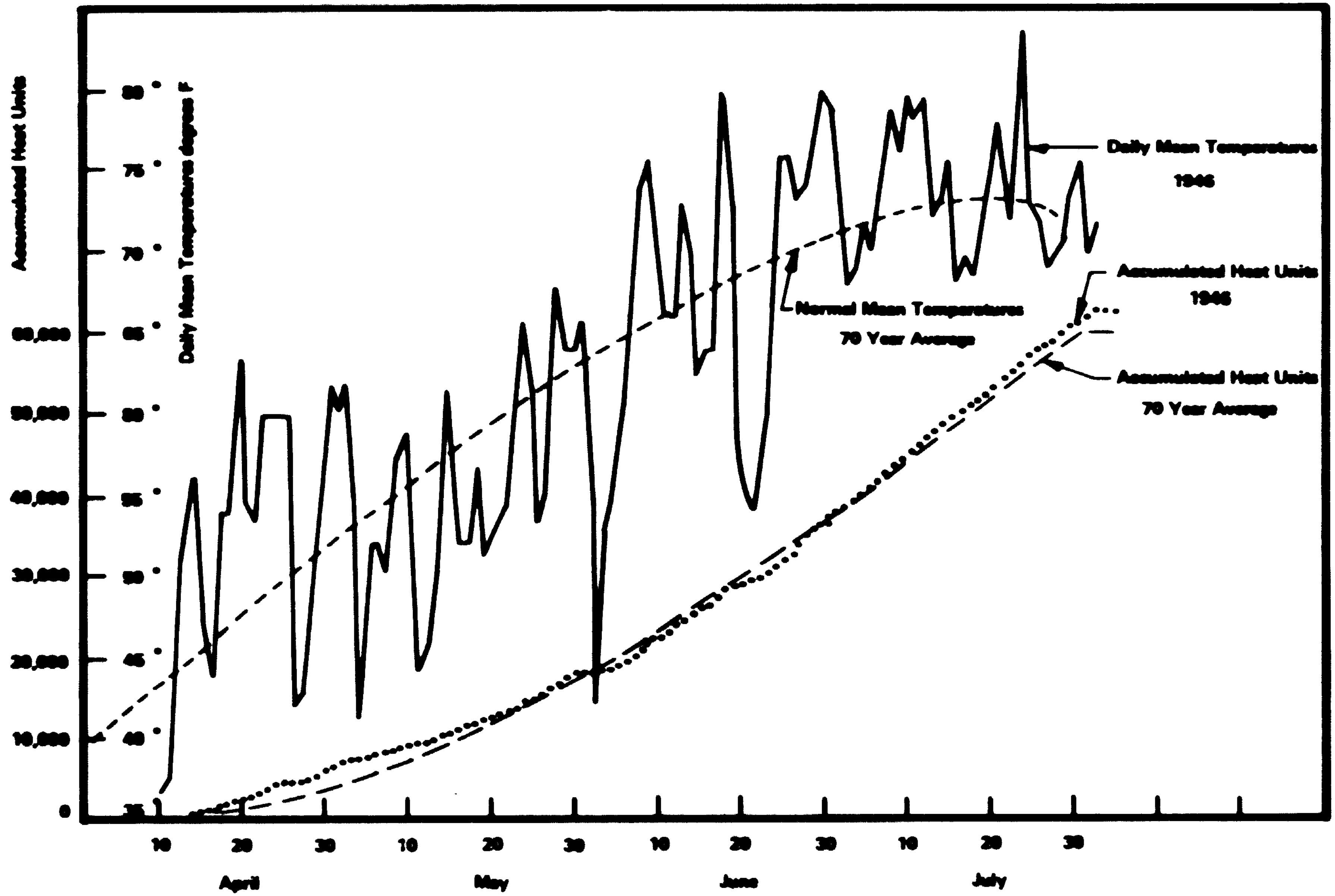

Figure 4-1. The daily mean temperatures from April through July for Madison, Wisconsin for 1946, and the 70-year average (normal) are shown by the upper two curves. Wide fluctuations occur between daily temperatures for a single season (1946), but are evened when the 70-year average is taken. The lower two curves show the heat unit accumulation above 40 degrees F for 1946, and the 70-year average. The 1946 season was near normal and the prediction made on the long-time average was essentially correct that season.

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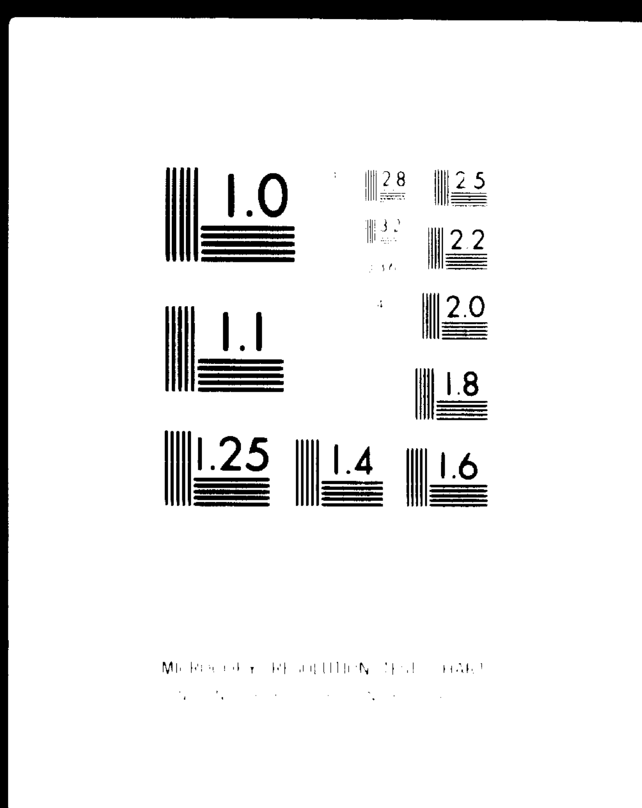

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on successive days as the peas would mature faster than he would be able to handle them. Under the heat unit system, if he planted 5 acres the first day, he would wait until 30 heat units accumulated (3 to 5 days) before planting the next 5 acres and wait then until approximately 30 more heat units accumulated before he made the last planting. Under this system, the respective plantings would reach the desired maturity in sufficient volume to take care of his capacity.

Each day during the planting season, a record of all plantings made the previous day is checked with daily accumulated temperatures, and a schedule for the next few days' plantings made. These plans are based on the prearranged schedule, weather at the time of planting, and the prediction from the official Weather Bureau 5-day forecasts. Should cold weather or heavy rains occur, adjustments in the schedule are made accordingly.

PREDICTING HARVEST MATURITIES

The heat unit system is of considerable value to both the field and factory supervisors in scheduling harvesting and canning operations, as fairly accurate estimates can be made as to starting dates and volumes of raw products to be handled within a given period.

Effects of Location on Forecasts

There is a definite need to determine the heat requirement in the area where the data are to be used. Although heat unit values for pea varieties that would apply over a wide range of conditions cannot be given, such values have been established for the major pea-growing area. Seaton and Huffington (35) reported heat unit values representative for the north central United States (Table 4-1). Sayre (32) and co-workers in New York, established the varietal requirements (Table 4-2).

Magoon and Culpepper (25) and Seaton and Huffington (35) reported that corn of an identical strain came to canning maturity with smaller temperature unit summations when grown in different latitudes. As a result, the larger canning companies with widespread operations are now making corrections in heat unit values for latitude differences.

TABLE 4-1

Heat units from planting to 100 tenderometer for various pea varieties (Representative for the north central United States)

Type	Varieties	Degree days above 40 degrees F
Alaska	Alaska, Super Alaska, Alah, Yukon, Rocket	1,200-1,250
Early Sweets	Alsweets, Pacemaker, Cansweet, Sweet Alaska, Early Harvest, Surprise, Surpass, Mardelah, Wisconsin Early Sweets, Critics 103, Ace, Early Badger, Loyalty, Lolo, Early Kay	1,200-1,300
Pride	Pride, Hardy, Canner King	1,400-1,500
Perfection	(Early)—Early Perfection, Resistant Early Perfection, Early Perfecta, Cascade, Climax, Bridger, Wasatch	1,500-1,575
	(Regular or late)—Perfection, Ranger, Commando, Dark-Skinned Perfection, Late Perfecta, Hyalite, Superior	1,575-1,650
Late Sweets	Profusion, Prince of Wales, Perfected Wales, Alderman, Bonneville, Miracle, Signal, Wisconsin Merit, Walah	1,625-1,725

Effects of Variety on Forecasts

From season to season total effective degree day units for a specific variety may vary slightly. For example, Sayre (32) at the New York Agricultural Experiment Station used a value of 1,350 degree days from planting to harvest maturity of 85 tenderometer for the Thomas Laxton variety. This value was 1,322 in 1953, and 1,349 on a different farm in 1952. Although slight seasonal variations in values for a given variety are encountered, the spread between varieties and plantings of the same variety has been found to be essentially the same. These inconsistencies have little effect on the effectiveness of the method.

TABLE 4-2

Heat Unit and Tenderometer Values for Pea Varieties Harvested at Two Maturities at Geneva, New York, in 1952

Variety	First Harvest			Second Harvest		
	No. of growing days	Total heat units degree days	Tenderometer field-run sample	No. of growing days	Total heat units degree days	Tenderometer field-run sample
Canning Varieties						
Pacemaker	61	1,288	93	63	1,349	114
Sweet Alaska	61	1,288	92	63	1,349	105
Tenex	61	1,288	93	63	1,349	114
Can Sweet	61	1,288	91	63	1,349	113
Surprise	61	1,288	90	63	1,349	107
Lolo	63	1,349	85	65	1,404	97
Ace	64	1,376	97	65	1,404	99
Bridger	68	1,514	98	70	1,582	118
Early Perfection	68	1,514	94	70	1,582	110
New Era	68	1,514	93	70	1,582	107
R. E. Perfection	70	1,582	85	71	1,621	115
Perfection	70	1,582	85	71	1,621	110
Superior	70	1,582	86	71	1,621	124
Shoshine	70	1,582	88	72	1,660	100
Freezing Varieties						
Early Freezer	61	1,288	90	63	1,349	103
Thomas Laxton	61	1,288	88	63	1,349	91
Thomas Laxton	63	1,349	85	65	1,404	95
Freezonian	63	1,349	88	65	1,404	98
Pluperfect	66	1,440	97	67	1,481	106
Wyola	66	1,440	90	67	1,481	101
Hyalite	67	1,481	86	68	1,514	86
D. G. Perfection	67	1,481	88	68	1,514	87
Perfected Freezer	67	1,481	88	70	1,582	100
Perfected Freezer	68	1,514	75	70	1,582	100

Effect of Soil, Topography and Other Variables

Actual experience has shown that in most locations differences in soils, fertility levels, slope and similar variables may account for a range of ±2 days of the predicted maturity date. This amount of variation in the system is to be expected for any season. Compensation for it is made in planting schedules by doubling the acreage of the first planting. This provides a backlog on which to work. Variations among different fields are apparent at the time of bloom and can be readily determined in the pregrade samples taken 2 or 3 days before actual harvests.

Bomalaski (6) showed that peas planted early, when the soil is cool, require a lower heat summation for maturity than those planted later in the season. Variability in heat summations due to soil type and fertility topography, and field stands, are reduced in the plantings made later in the season. In reporting the effects of combined heat and drought periods, Phillips (28) showed that peas failed to mature properly and had to be harvested when the heat units were 10% to 20% below normal. Fletcher (14) working with several soil types in Pennsylvania concluded that from the canner's standpoint, air temperatures are significant enough for peas planted on different soil types if checked at several critical points in their development.

Correcting Estimated Forecasts

There is a definite relationship between blooming or silking dates and final harvests which provides a further check and an opportunity to correct estimated harvest forecasts 2 to 3 weeks before actual harvests. For example, most varieties of peas have a heat requirement of approximately 420 heat units above 40 degrees F from the time they reach 80% bloom until they reach a tenderometer reading of 100. Similarly, most varieties of corn require 500 heat units above 50 degrees F from 80% silking to reach prime canning maturity for whole kernel corn at 72% moisture. As a final check, at 350 heat units from 80% bloom, the fieldman begins pregrading or sampling the pea fields. Similarly, at 420 heat units after 80% silking, pregrades are taken in the sweet corn fields and tested for moisture content. These actual samples are the final check prior to harvests and when taken, the fieldman can make yield estimates of the respective fields.

MERITS AND LIMITATIONS OF THE METHOD

As stated previously the heat unit system is based on only one of the many growth and development factors; namely, temperature above the point at which growth takes place. This is by far the most important element and over-shadows all others in its effects on the varieties of vegetables grown for processing in the United States.

Numerous articles have appeared recently to offer means for correcting the technique or to condemn it as not being an accurate measure of development and maturity. Some articles offer practical explanations for the slight discrepancies encountered while others seem to indicate a lack of understanding of the primary purpose of the technique.

The system is used to provide a means for scheduling plantings so as to provide an orderly flow of raw materials of optimum maturity to the cannery and to act as a measure of crop development. Apparently, some investigators are not familiar with the checks offered during the season such as time of emergence, time of bloom, and others that are operative. Seasonal differences which occur seem to affect all varieties and plantings equally. The system should be considered as a yardstick not a micrometer to be used along with other tools such as the microscope and the tenderometer.

In 1950, Seaton and Huffington (35) reported on an extensive survey of the heat summation system of crop control. Information was obtained from 75 companies operating 145 pea canneries and from 47 companies operating 93 sweet corn canneries in 19 states and 4 provinces in Canada, with combined acreages for the two crops exceeding 350,000 acres. In addition, 8 of the larger seed companies furnished records from their trial grounds. A total of 163 different varietal observations on 48 varieties of canning and freezing peas and 28 sweet corn hybrids were received.

The general consensus was that the heat unit system (a) made for more orderly harvests; (b) was a means for the prevention of bunching of harvests and the elimination of slack periods during the canning program; (c) was a definite aid on forecasting and setting up factory operations; (d) was a fairly accurate measure of performance of different varieties; and (e) was a definite aid in quality control.

Plotting varietal response to temperature accumulations as illustrated in Figure 4-2, revealed a rather uniform spread between varieties for any one location. Much the same type of curve was secured for the same varieties in different locations or geographic areas. The same varietal relationships held between varieties in any one

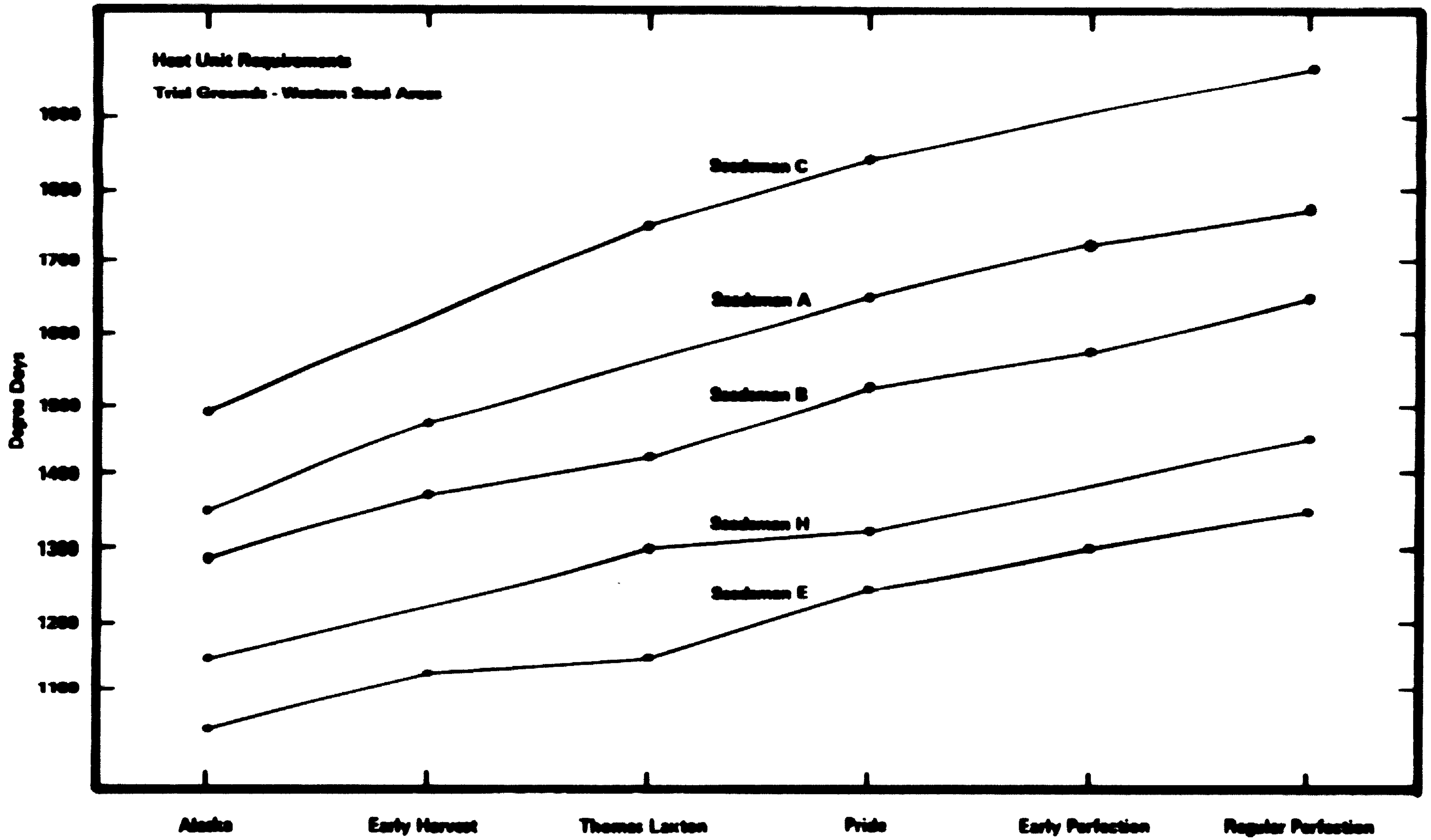

Figure 4-2. Heat unit requirements for several standard varieties of canning peas as reported by seed companies (A, B, C, E, and H) from records on their trial grounds in western seed-producing areas.

location for different seasons. The inconsistencies in the various reports received seem to be attributable to variations in methods of temperature recording, latitude, elevation, soils, and other modifying factors. It was apparent that each company must of necessity establish its own values for its location and that it is not feasible to set a definite value for any one variety and expect it to be usable under all conditions.

Katz (19) experimented with the exponential index based on the supposition that plant growth rates follow the rule of Van't Hoff and Arrhenius, doubling with each 18 degrees F increase in temperature, derived from the sum total of daily mean temperature efficiencies, where the daily efficiency U, is obtained by the formula:

$$U = \frac{(t - 40)}{18} \qquad \text{or } \log = \frac{\log 2(t - 40)}{18}$$

Katz's studies were based on 3 years' records in Wisconsin and show (a) that essentially a linear relationship existed; (b) that the differences between the results obtained by using the direct summation and the exponential methods were small; and (c) that from year-to-year the difference between varieties was nearly constant and did not vary significantly

Went (39) emphasized the fallacy of assessing equal importance to both day and night temperatures, as well as the importance of diurnal variations. Walls (38) suggests that more accurate results may be obtained if summations began, not at the planting date, but when emergence of 60% to 75% of the plants occurred. Some canners use soil rather than air temperatures during the planting season and then change to air temperatures during the growing period. This seems to have some merit.

An excellent study, under controlled conditions, on the effects of temperature and photoperiod on the development of pea varieties was conducted in Michigan by Reath and Wittwer (29). Pea varieties, representative of important commercial types, were grown in the greenhouse at 9-, 12- and 16-hour photoperiods each at 50 degrees F and 60 degrees F night temperatures and in successive field plantings. Observations as to days requisite to flowering, days to maturity, degree days from seeding to flowering, pod characteristics and vine heights suggest that both photoperiod and temperature have a marked influence. At 60 degrees F night temperature, Alaska and Surprise were day neutral with respect to flowering and pod production, but at 50 degrees F flowering was hastened by long days. Other varieties behaved as long-day plants at both 50 degrees F and 60 degrees F night temperatures. In all midseason and late pea varieties the number of degree days required for flowering was reduced progressively by exposure to 12- and 16-hour photoperiods. For field plantings the multiple of degree days summation and average length of daylight was found to be a less variable expression than the heat sum alone.

Unpublished data from Carstens (10) of daily pea harvests in 1950 and 1952 show the general relationships existing during the harvesting period between the daily increments in heat units, yield increases and maturity as measured by the tenderometer. (See figure 4-3.) While the number of samples reported is limited and insufficient for calculation of curvilinear regression, the data indicate: (a) the daily heat unit accumulation during harvest is a straight line function; (b) the daily yield increases are closely related to heat unit values but fall off with advanced maturity; (c) the tenderometer values show a definite curvilinear relationship with advancing maturity; and (d) the daily rate of change in tenderometer values is relatively slow between 85 to 100 but quite rapid beyond 100.

Variations in accumulated effective temperature requirements from planting to harvests for sweet corn between locations, between seasons and time of planting for a single season are apparently of greater magnitude than those reported for peas. Huelsen (18) describes 5 temperature indices as means of forecasting maturity and concluded that the degree-hour summation method, although subject to error, is apparently the only one of practical use. The results over a 13-year period with hybrid sweet corn strains reported by Lana and Haber (20, 21) further substantiate merits of the heat summation system.

Investigations with sweet corn on organic soils in Michigan reported by Davis (13) show the number of days to maturity to be influenced by season, varying as much as 20 days in successive seasons (1949-1950). Heat units were recorded at 4 levels: 8 inches above the surface, at soil level, 3½ inches below the surface, and 7½ inches below the surface. There was fair agreement at each level between the number of heat units required to mature the crop with different dates of planting and with different seasons, any one of which may be used in calculating the number of heat units required by a particular variety.

Gould and co-workers (16) in quality evaluations of fresh, frozen, and canned yellow sweet corn used accumulated growth degree days as a measure of maturity in their correlations with various yield and quality factors. Correlations (r values) of +0.684 were obtained between growth degree days vs. percent cutoff; -0.646 degree days vs. Succulometer; +0.916 degree days vs. A. I. S.; and +0.882 degree days vs. Soluble Solids. All of these values were significant to the 1% level.

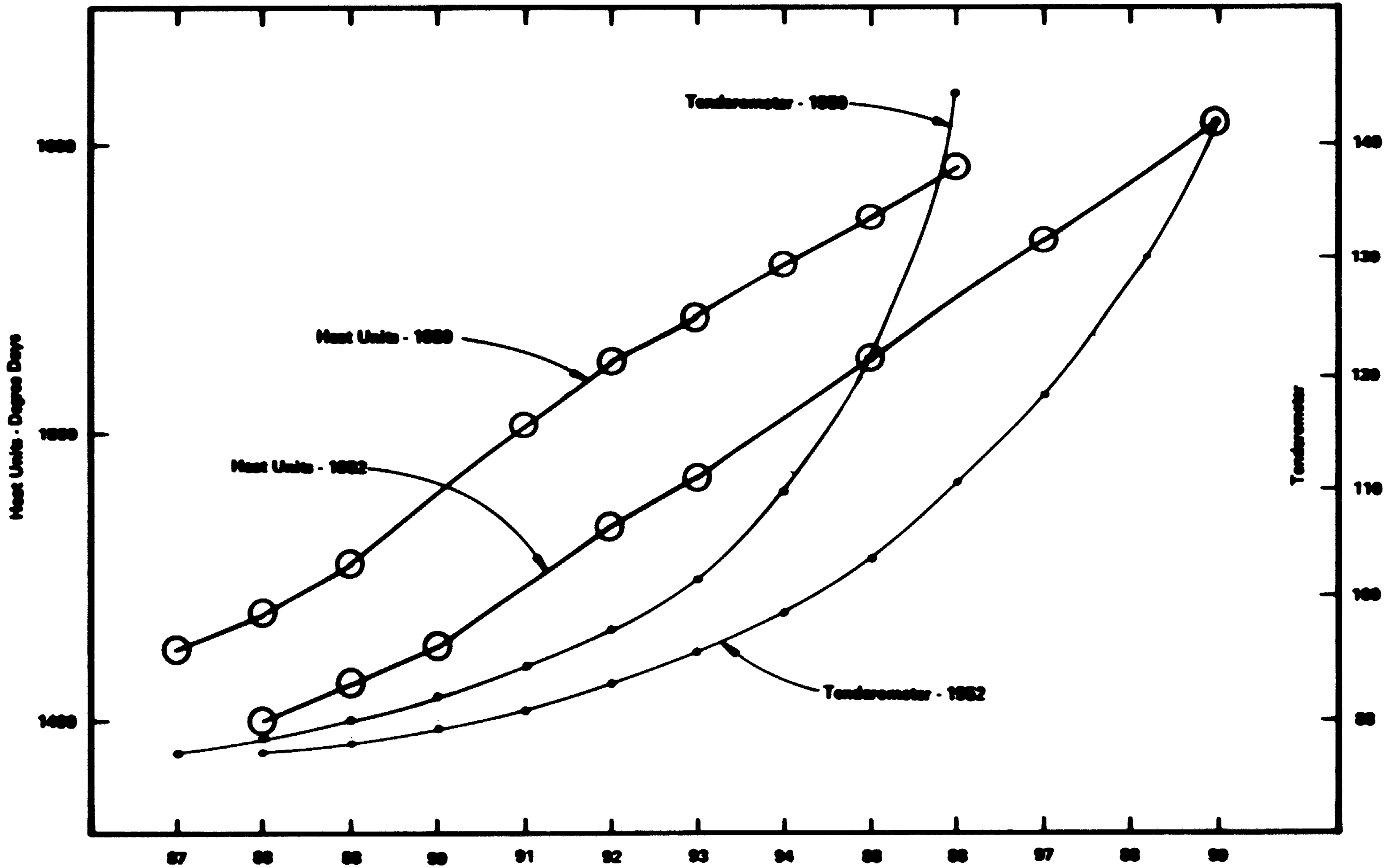

Figure 4-3. Data from Carstens (10) showing the relationship between daily heat unit increases and maturity in peas as measured by the tenderometer.

System Found Useful in Estimating Can Requirements

For several years Continental Can Company has used the heat unit system as an aid in planning manufacturing and shipping schedules for pea and corn cans in Wisconsin and other areas. Near the end of the planting season (mid-May), key customers in representative areas supply data by variety on the acreages planted each day. Temperatures are acquired from representative weather stations in the areas, and the anticipated daily can requirements, based on average yields during the canning season are calculated and plotted as shown in Figure 4-4.

As the season advances, the original forecasts are corrected weekly for prevailing temperatures, as shown in Figure 4-5.

These samples represent approximately 35,000 to 40,000 acres of peas or roughly the equivalent of 85 to 100 million 303 x 406 size cans. The value of the heat unit system in scheduling production is apparent.

Forecasting the Incidence of Insect and Disease Attacks

According to Miller (26), the forecasting of plant disease occurrence on the basis of known weather relations is well established in this country. Forecasting of the incidence of certain diseases has been regularly a part of the control program in one region or another for nearly 30 years and includes such diseases as bacterial wilt of sweet corn, wheat leaf rust, late blight of tomatoes and potatoes, tobacco blue mold, cucurbit and lima bean mildew and others.

Observations on the incidence of sweet corn bacterial wilt and a study of weather records revealed that severe infections followed unusually warm winters and were scarce or absent after average or cold winters. It was found that a summation of the average temperatures for December, January, and February would show very accurately whether or not the disease could be expected during the following season and how much damage it would cause. If this temperature index is 100 or above, the disease will be destructive; with lesser sums the incidence is correspondingly less severe. Since this relationship was established it has been found that it depends upon the winter survival of the insect vector, the corn flea beetle. Based on this knowledge, Boewe (5) and others now make annual predictions for use by processors. When severe infestations are indicated, resistant types may be planted.

For several years, canners in the north central states under the guidance of J. W. Apple of the University of Wisconsin - have been using the heat unit procedure for

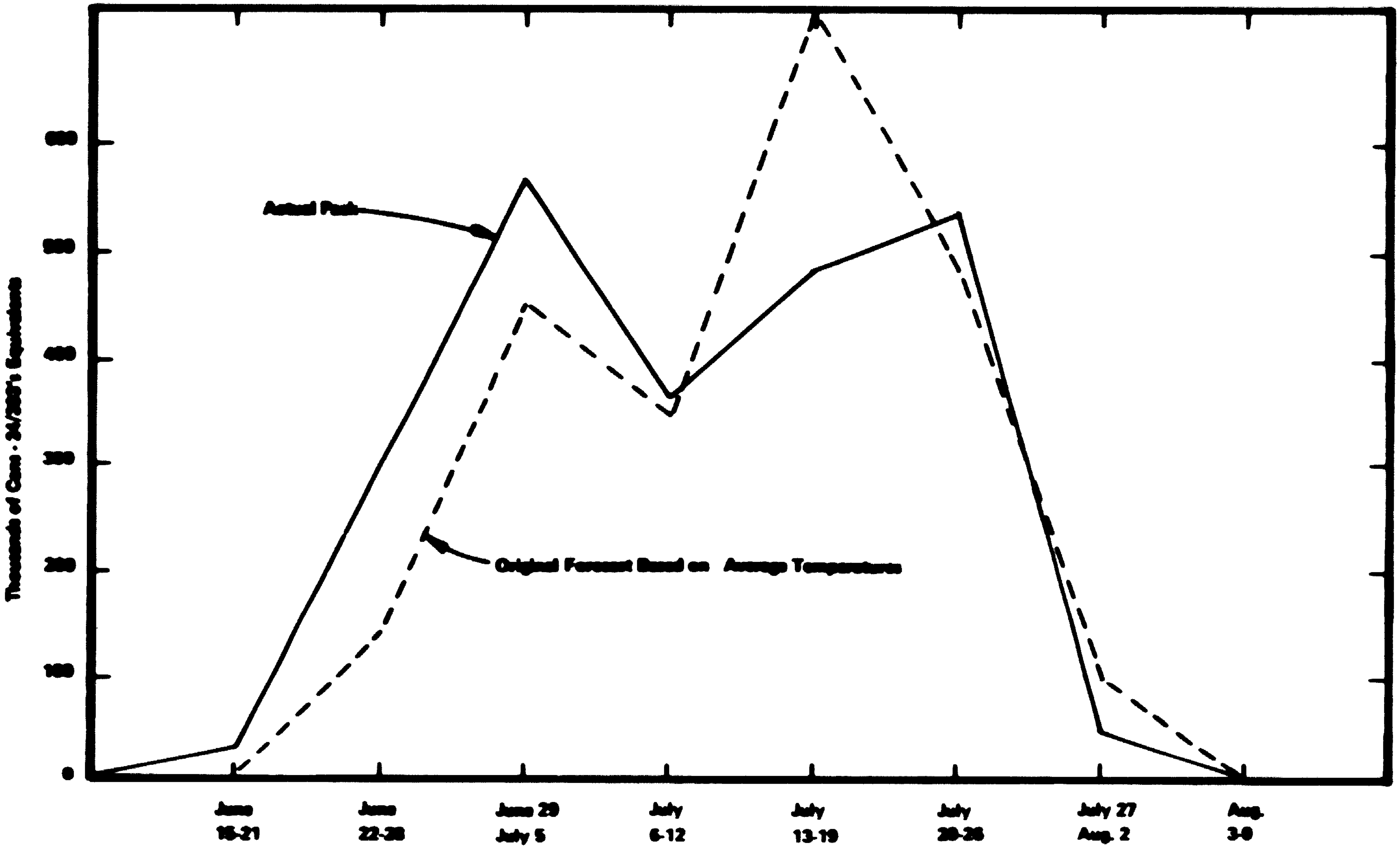

Figure 4-4. Original forecasts based on average temperatures and actual packs by weeks for 10 canneries in Wisconsin in 1933. A total of 17,826 acres of peas and a total pack of 2,287,887 cases of 24/303's equivalents are represented.

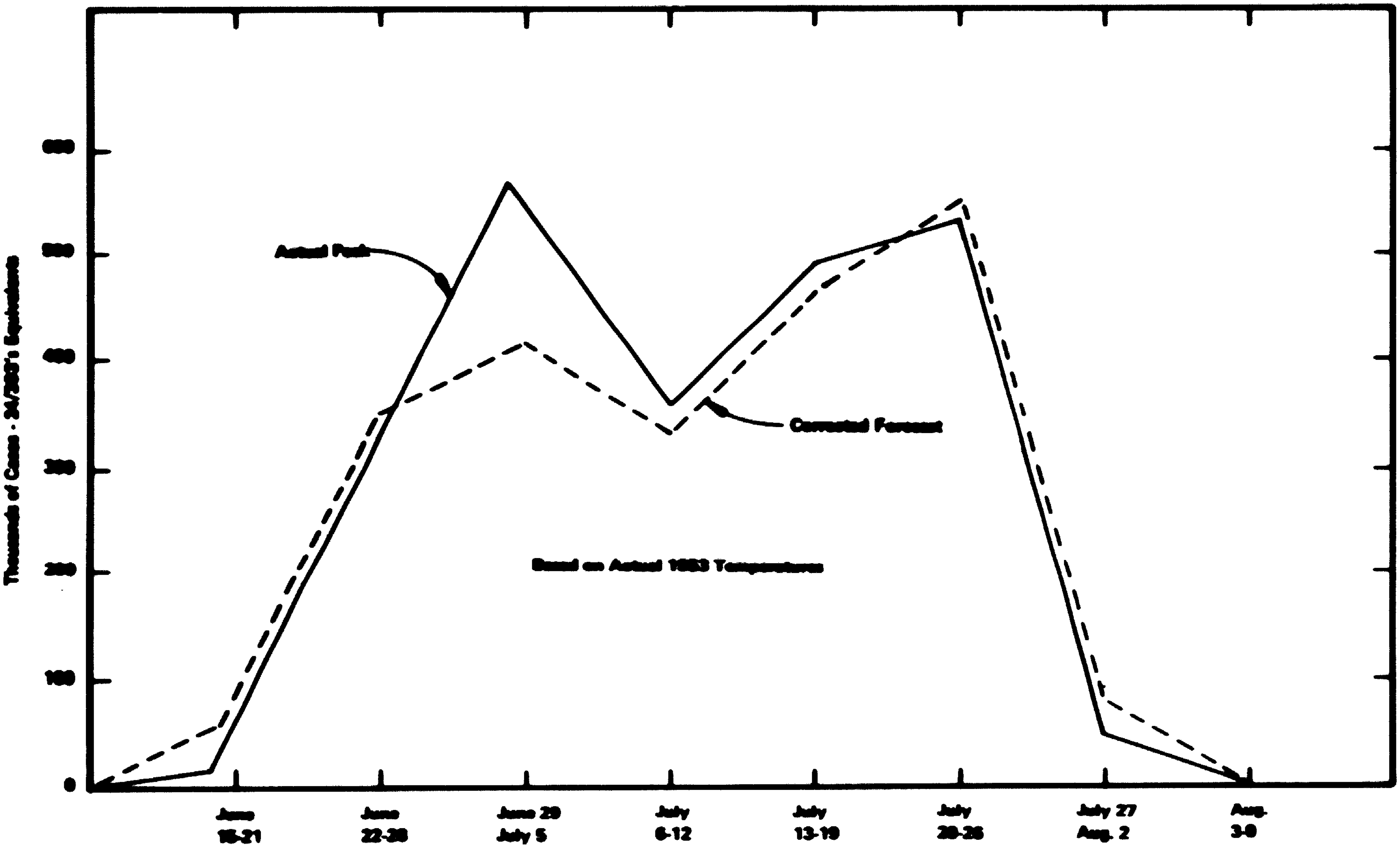

Figure 4-5. Forecast shown in Figure 4-4, corrected for 1953 actual temperatures and actual peak by weeks.

scheduling sprayings of agricultural chemicals for the control of corn borers. Apples's (2) technique consists of recording as degree days all temperatures above 50 degrees F occurring in the spring and during the growing season and correlating them with the development stages of the insect. The accuracy of Apple's technique is revealed by data accumulated over 3 seasons in northern Illinois and 3 seasons in south central Wisconsin. (See Table 4-3.)

TABLE 4-3

Degree day accumulation above base 50 degrees F for appearance of various stages of corn borer.

	North Central Illinois			South Central Wisconsin				
Appearance	**1946**	**1947**	**1948**	**1949**	**1950**	**1951**	**Average**	**Standard deviation**
Pupa	243	252	258	238	256	230	246	±11
Moth	446	409	423	338	450	...	423	±26
First generation								
Eggs	554	493	640	633	620	680	603	±67
Hatch	649	579	736	730	742	759	699	±70
Pupa	...	...	...	1400	1490	1448	1446	±45
Moth	...	1625	...	1760	...	1764	1716	±79
Second generation								
Eggs	1724	1717	1827	1830	1780	1847	1787	±57
Hatch	1849	1855	1969	1900	1885	1947	1901	±49

SUMMARY AND CONCLUSIONS

Considerable planning by the processor and his field department is required to assure the adequate and dependable supply of raw products imperative for a successful vegetable canning or freezing operation. A well-planned field production program must take into account the uncertainties of the weather and attacks of insects and plant diseases. From the knowledge accumulated by research, some of the interactions between the plant and its natural enemies, climatic and other factors have been established. Certain techniques quite widely adapted by industry for arranging planting schedules, predicting crop development and maturities, as well as predicting the incidence of insect and disease attacks have evolved.

It is not very likely that predictions can be entirely correct. This is just as true of forecasts of crop maturities as of weather or political elections or anything else. The possible accuracy of such forecasts depends upon the complicity of the critical periods and on how far in advance they are operative. Useful predictions can be made without knowing all the reasons for the observed reactions to weather, and even conditional forecasts will be helpful. Obviously, however, the more that is known about the importance, operation, and timing of factors favoring or inhibiting plant development and the longer ahead of time that weather can be known, the more accurate the predictions will be and the earlier they can be made. Improvement in and extension of the long-range weather forecast is the answer to the latter need.

More factual information is also needed on the relationships between and corrections for accumulated heat units above a base temperature, and other climatic factors such as optimum and maximum temperatures at which accumulated temperatures are operative, length of day, light intensities, latitude, and altitude, and edaphic factors such as soil type, soil moisture levels, soil nutrient levels, and related phenomena.

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SELECTED VEGETABLE AND FRUIT PACK DATA BY COMMODITY AND COUNTRY

Vegetable Packs in Specified Countries by Commodity

Country & Item	1961	1962	1963	1964	1965	1966	1967	1968	1969
	1,000 cases, equiv. 24/303's (24 lbs–approx. 11 kg)								
BEANS, GREEN									
Canada	1,139	1,101	1,073	1,521	1,363	1,528	1,813	1,952	1,461
France	1,745	1,773	2,203	2,324	2,025	3,071	2,259	n.a.	n.a.
Germany, West	6,081	5,658	7,413	7,137	4,483	7,459	7,248	5,658	n.a.
Italy	643	735	1,378	367	459	n.a.	n.a.	n.a.	n.a.
New Zealand	28	121	177	140	140	205	271	n.a.	n.a.
South Africa	345	441	879	885	849	463	992	762	430
United States	36,107	32,601	34,049	33,613	41,024	36,564	48,150	47,136	42,481
PEAS, GREEN									
Canada	4,424	5,600	3,696	4,891	5,742	4,502	4,008	6,521	4,370
France	15,157	15,465	18,312	19,441	16,968	17,108	23,473	n.a.	n.a.
Germany, West	4,079	4,409	4,446	2,544	2,939	3,463	4,510	4,290	n.a.
Italy	2,205	2,756	2,021	2,205	2,480	n.a.	.....	.....	.....
New Zealand	196	467	653	411	280	457	373	n.a.	n.a.
South Africa	744	879	786	939	1,067	949	1,453	1,521	953
United Kingdom	5,880	6,048	7,607	8,148	6,888	8,335	8,447	6,375	7,905
United States	32,399	33,725	33,588	30,045	37,585	31,856	37,692	36,231	32,071
TOMATOES									
Canada	3,733	4,396	3,388	3,463	4,224	3,704	4,138	3,362	2,659
Italy	17,453	18,372	22,965	32,150	33,069	33,150	31,232	27,557	36,743
United States	34,034	35,541	33,041	36,431	36,015	32,662	39,127	48,400	32,036
TOMATO CATSUP									
Canada	1,577	2,193	2,548	2,548	3,201	3,267	3,233	3,354	3,686
United States	28,314	36,940	28,556	32,587	34,084	35,345	37,780	n.a.	n.a.
TOMATO CONCENTRATES									
Canada	271	131	93	.....	.....	.....	159	n.a.	116
France[2]	2,865	3,892	1,997	3,416	5,479	5,863	4,277	4,083	4,253
Italy	12,860	12,860	14,146	13,779	13,319	14,697	13,319	11,023	15,157
Portugal	1,222	2,480	3,022	4,492	6,779	8,409	13,057	13,486	12,600
Spain[2]	2,607	5,514	7,016	7,932	9,237	9,954	.....	12,348	13,687
United States	32,353	44,577	29,164	38,763	31,474	39,913	42,413	n.a.	n.a.
South Africa	598	977	392	356	958	966	604	1,004	542
TOMATO JUICE									
Canada	8,241	9,371	7,243	8,745	9,478	7,790	9,466	7,755	5,728
Italy	827	827	827	827	827	1,010	919	919	1,010
Spain	156	106	226	339	446	490	.....	650	919
United States	38,545	48,993	42,114	43,067	40,047	38,907	42,815	40,169	33,653

2 Includes small quantities of canned tomatoes.

Source: The Almanac, 1971.

Vegetable Packs by Country

Country & Item	1961	1962	1963	1964	1965	1966	1967	1968	1969
			1,000 cases, equiv. 24/303's (24 lbs–approx. 11 kg)						
CANADA									
Beans, green	1,139	1,101	1,073	1,521	1,332	1 528	1,813	1,952	1,461
Peas, green	4,424	5,600	3,696	4,891	5,742	4,502	4,008	6,521	4,370
Tomatoes	3,733	4,396	3,388	3,463	4,224	3,704	4,138	3,362	2,659
Tomato Catsup	1,577	2,193	2,548	2,548	3,201	3,267	3,233	3,354	3,686
Tomato Concentrates	271	131	93	.....	.....	.....	159	n.a.	116
Tomato Juice	8,241	9,371	7,243	8,745	9,478	7,790	9,466	7,755	5,728
FRANCE									
Beans, green	1,745	1,773	2,203	2,324	2,025	3,071	2,259	n.a.	n.a.
Peas, green	15,157	15,465	18,312	19,441	16,968	17,108	23,437	n.a.	n.a.
Tomato Concentrates	2,685	3,892	1,997	3,416	5,479	5,863	4,277	4,083	4,253
GERMANY, WEST									
Beans, green	6,081	5,658	7,413	7,137	4,483	7,459	7,248	5,658	n.a.
Peas, green	4,079	4,409	4,446	2,544	2,939	3,463	4,510	4,290	n.a.
ITALY									
Beans, green	643	735	1,378	367	459	.....	.....	.....	.....
Peas, green	2,205	2,756	2,021	2,205	2,480	.....	.....	.....	.....
Tomatoes	17,453	18,372	22,965	32,150	33,069	32,150	31,332	27,557	36,743
Tomato Concentrates	12,860	12,860	14,146	13,779	13,319	14,697	13,319	11,023	15,157
Tomato Juice	827	827	827	827	827	1,010	919	919	1,010
NEW ZEALAND									
Beans, green	28	121	177	140	140	205	271	n.a.	n.a.
Peas, green	196	467	653	411	280	457	373	n.a.	n.a.
PORTUGAL									
Tomato Concentrates	1,222	2,480	3,022	4,492	6,779	8,409	13,057	13,486	12,600
SOUTH AFRICA									
Beans, green	345	441	879	885	849	463	992	762	430
Peas, green	744	879	786	939	1,067	949	1,453	1,521	953
Tomato Concentrate	598	977	392	356	958	966	604	1,004	542
SPAIN									
Tomato Concentrates[1]	2,607	5,514	7,016	7,932	9,237	9,954	.....	12,348	13,687
UNITED KINGDOM									
Peas, green	5,880	6,048	7,607	8,148	6,888	8,335	8,447	6,375	7,905

1 Includes small quantities of canned tomatoes.

Source: The Almanac, 1971.

Fruit Packs by Country

Country & Item	1963	1964	1965	1966	1967	1968	1969	1970
	1,000 cases, equiv. 24/2½'s (45 lbs—approx. 20 kg)							
AUSTRALIA								
Fruit Cocktail[1]	442	616	894	1,220	1,406	1,902	1,568	2,394
Peaches	3,331	3,333	4,319	4,565	5,038	5,134	4,063	3,936
Pears	2,653	3,207	2,455	3,384	2,797	3,206	1,795	4,384
Pineapple	885	1,150	1 220	1,363	1,755	1,499	1,414	1,585
CANADA								
Cherries	189	304	234	274	305	107	288	190
Fruit Cocktail	229	n.a.	.....	.....	253	260	226	n.a.
Peaches	949	1,010	633	655	349	493	463	n.a.
Pears	637	831	607	856	571	743	593	n.a.
GERMANY, WEST								
Cherries	453	732	488	578	726	1,032	837	1,213
Peaches	8	17	6	11	12	8	6	8
Pears	15	19	11	15	10	15	17	10
ITALY								
Cherries	196	220	157	147	196	196	147	196
Fruit Cocktail	294	269	333	343	441	588	735	882
Peaches	1,225	1,690	1,225	1,004	867	1,225	490	833[2]
Pears	1,053	857	686	1,029	1,372	1,764	2,254	2,450[3]
JAPAN								
Cherries	207	178	346	352	386	330	538	533
Fruit Cocktail	347	297	269	255	274	306	343	320
Peaches	3,134	2,820	3,057	3,743	3,096	3,213	3,708	2,880
Pears	512	221	326	433	343	314	463	448
SOUTH AFRICA								
Fruit Cocktail	297	343	531	685	738	1,013	1,119	1,187
Peaches	3,533	3,439	4,283	4,646	4,918	4,541	4,927	4,729
Pears	914	1,318	1,126	1,486	1,131	1,302	1,547	1,503
Pineapple	1,914	1,944	1,689	1,695	2,240	2,073	1,885	1,731
SPAIN								
Peaches	876	1,140	1,195	1,320	1,294	1,371	1,407	1,200
UNITED KINGDOM								
Cherries	80	50	50	30	15	35	30	n.a.
Fruit Cocktail	796	901	981	806	642	408	682	n.a.
Peaches	139	154	169	134	105	80	70	n.a.
Pears	100	75	95	80	35	45	25	n.a.
UNITED STATES								
Cherries, red pitted	946	3,564	2,424	992	784	1,132	1,505	978
Cherries, sweet	503	976	714	607	832	531	947	663
Fruit Cocktail	13,741	17,869	15,661	17,121	14,319	17,877	18,202	14,000
Peaches	32,729	37,251	29,392	36,194	26,349	35,855	37,163	27,100
Pears	5,633	11,371	6,408	11,040	5,756	10,262	10,590	8,610
Pineapple	14,982	13,633	14,961	16,739	16,378	16,469	15,163	n.a.

1 Total mixed fruit, includes two fruits and salad.
2 1971 peach production 979.8 according to USDA/FA, 11/1971
3 USDA/Foreign Agriculture, November 1971 gives 1970 and 1971 pear production as 2,986.5

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