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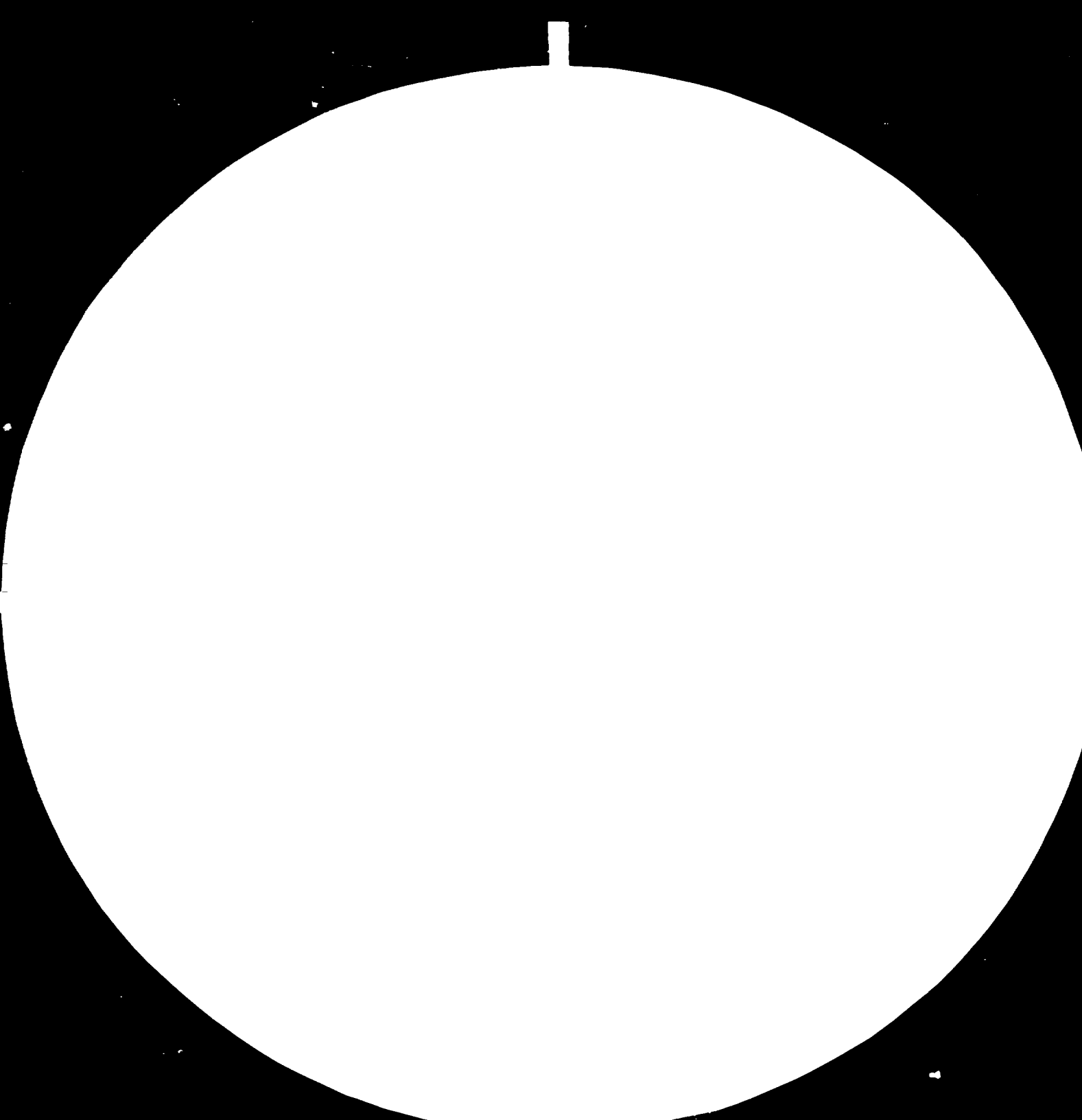

RESTRICTED

20 June 1980
English

PLASTICS IN AGRICULTURE - TECHNOLOGICAL ASSISTANCE

SI/JOR/79/802
DP/JOR/80/001

Technical Progress Report No.1*

Prepared for the Government of Jordan by the United Nations Industrial Development Organization (UNIDO), Executing agency for the United Nations Development Programme (UNDP)

by

A.D. Clarke
Project Senior Technical Adviser

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CONTENTS

Abbreviations

RSS - Royal Scientific Society

ADJU - Agriculture Department, Jordan University

MA - Ministry of Agriculture

STA - Senior Technical Adviser

1. Summary

The initial steps for the implementation of the project have been taken. The Royal Scientific Society (RSS), the Agricultural Department of the University of Jordan and the Ministry of Agriculture will together represent the executing counterpart agency with the RSS acting as the co-ordinating body.

The technical programme has been prepared and detailed including modifications made necessary by changes which have occurred since the project document was drafted. An outline timetable of actions necessary to implement the experimental work has been prepared. Action has been taken to secure early quotations of equipment and supplies so that orders can be placed. Requirements of consultants has been revised and time-schedules prepared. Due to the late start of the project, in which the field trials are seasonally dependent, it is pointed out that the intial results for evalution will not now be available until July/August 1981, and additional man/months of expertise will be required in 1981 to complete this in initial stage of the project.

Two nominations have been made for the study tour which will start in late September 1980.

One recommendation has been made.

2. Recommendations

The following recommendations are respectively submitted to Government for their consideration and action:

It is strongly recommended that:

a) UNDP/UNIDO be requested to provide additonal funds to cover 3 man/months of additional time for the Senior Technical Adviser and 1.5 man/months of consultants, a total of 4.75 m/m required in 1981 to complete the technical programme to end of that year.

It should be noted that the trials being undertaken to fulfil the technical programme which will take a minimum of three years to complete as they are both time and weather oriented. Additional expertise will be required in 1982 and 1983 for advisory consultations and progressive evaluation purposes.

3. Introduction

This mission is the first part of a split mission operation. The dates of the next parts will be finalized at a later stage. The project start was delayed due to financing problems which were eventually resolved by UNDP providng funds for the equipment and mateteiral inputs and UNIDO providing funds for the consultants and study their inputs. As the project is seasonally dependent it is planned to have materials available so that the experimental programme of field trials can start in November 1980. This means the initial results will not be completed until after mid-1981.

The Senior Technical Adviser (STA) arrived in Jordan on 1 June and left 12 June 1980. Eng. Salah Darabsh Elghani and Eng. Ali Ajlouni were allocated at fulltime counterparts for the project together with other RSS staff members who joined the discussions on a part-time basis. The fullest possible co-operation was extended by all counterparts. Special consideration was given to the organization of co-operation with the Agricultural Department of the University of Jordan and the nomination of an agricultural adviser to serve with the project was assisted through the co-operation of the Ministry of Agriculture.

4. Findings

4.1 Counterpart agencies

The project is now being executed by the following counterpart agencies:

Royal Scientific Society (RSS)

Agricultural Department of Jordan University (ADJU)

Ministry of Agriculture (MA)

with the necessary co-ordination being exercised through the RSS.

RSS will be responsible for the plastics technology instruments, testing and appropriate plastics materials to execute the trials including the greenhouses.

ADJU have agreed to supply land, water supply, pump, labour for irrigation, mulch laying and crop cultivation, provision of plants and other agricultural supplies. In return the actual crop produced remains for their disposal.

MA have agreed to supply technical assistance to the project through the services of Dr. Youseff Roushdy. Provision of other services may be possible.

4.2 Counterparts

The RSS has nominated the following counterparts to the project:

Eng. Elghani - Advis : plastics technology;

Eng. Siryani - testing - fulltime on project;

Eng. Shanag - testing - 50% time on project;

Eng. Hajek - testing - 50% time on project;

Eng. Ajlouni- Environmental measurements and evaluation - full time

Eng. Naber - Measurement - part time as required

The MA has nominated the following counterpart:

Dr. Youseff Roushdy - horticulturist with experience of plastics greenhouse growing.

The ADJJ will provide agricultural specialists (e.g. irrigation etc.) as required by the project.

Eng. Salah Elghani and Dr. Youseff Roushdy are nominated for the study tour and appropriate fellowship nomination forms are being processed. The study tour will start in late September and will include the International Congress for Plastics in Agriculture in Lisbon, Portugal, 6 - 11 October 1980. The STA will prepare a detailed itinery and time table on return to home base as there was insufficient time available during this short mission period.

A budget revision will be required to delete the sub-contract component and transfer this sum under budget line 32 as previously discussed with UNIDO training section.

4.3 Technical Programme

In reviewing the four research proposals which this project is to assist, namely green house film, mulching, shading and coloured films it was decided to drop the latter since prior overseas work is this area had not been very productive. HOwever, in the eighteen months since the project document was formulated water conservation has become a matter of greater importance. Therefore the research proposal No.3 has now been replaced by research proposal NO.7 'Irrigation in Plastics Houses'.

a. Greenhouse film

Current imported and locally produced wide-width film (up to 12 m wide) has a maximum life of 2 years in the Jordan Valley. The objective of this trial is to produce a longer-life film with a target life of three years or longer. By this means the system-cost will be reduced. System-costs can also be reduced by the use of a thinner films. It is, therefore, proposed to utilize the latest technological advance in ultra-violet additives and to test their effectiveness in two different concentrations in three different film thicknesses.

The concentrations will be 1% and 2% in film thicknesses of 125, 150 and 180 microns, the latter being the present standard thickness for greenhouse use. The additive will be benzophenone in equal quantity with tinuvin 622 a hindered amine developed by Ciba-Geigy Co. Arrangements have been made to produce these films on local production equipment in wide-width since the evaluation has to be carried out by field-scale trials on full-sized greenhouses of approximately 8 m wide 3 m high and 60 m long.

Two Filclair greenhouse structures will be suitably clad with the experimental films and samples of film will be taken at fixed intervals so that the change in properties can be monitored. Details of the tests to be performed are given in a separate section of this report.

The greenhouses will be erected at the Agriculture Dept., University of Jordan experiemntal Station, in the Valley.

Since the project will then have two greenhouses at its disposal, it is advantageous to make use of these same units for additional experimental work.

As extension of this,trial to flat tunnels has been proposed by the STA. It is proposed to use ventilated film over a potato crop to determine its response to earliness and increase of yield. This protective cropping system has been used in Germany for several years with much success. The film is laid on top of the plants and no mechanical tunnel supports are used,thus eliminating another cost factor. As the plants grow they become the supports for the film. The trial will be a small scale field experiment.

b. Shading

Shading is required to reduce the heat build-up in the greenhouses which is also assisted by ventilation. The lowest cost system of shading is to "white-wash" the outside of the greenhouse. However, it has been pointed

out in discussions that when the hot period has passed there is a need to remove the shading. This part of the year is dry and therefore the removal of white-wash by the normal technique of waiting for the rain is not possible. Removal would therefore involve the use of scarce water resources. For this reason, shading nets are suggested as an alternative method.

Plastics nets with three different degrees of shading 40, 50 and 60 per cent will therefore be evaluated. They will be fitted, at the appropriate period of the year: March - June, and the change of properties with exposure monitored. In addition, if possible, it is hoped to try and evaluate crop response as well as recording temperature and humidity changes within the greenhouse.

c. Mulching

There has been a marked increase in the mulching of both indoor and outdoor crops since the project was formulated and almost all are combined with trickle irrigation systems. Water conservation and weed suppression are prime reasons for the use. All mulching is currently black and about 30-40 microns thick.

In the Valley the season is a long one in the greenhouses (9 months) and the mulch is then removed and burnt. In other area, in open cropping the mulch is already used for two crops, the second crop being planted within the mulch without it being removed from the soil.

Some scorching of young plants occurs especially when planting out during the summer period. There is a need therefore to evaluate the advantages that could be gained from using a reflective mulch, which still possessed weed suppression characteristics.

It is therefore proposed to evaluate a black/white mulch film and determine if it can be effectively lifted at the end of the season in the greenhouse for re-use in a second season. This trial will be extended to an open crop to ascertain if it can be monitored and the information utilized to carry out such modifications as may be required to achieve these aims, thus effectively reducing the systems costs.

Interest has been expressed in a machine to lay tunnels and mulch and for mulch removal. This is beyond the scope of this current project but could be included in a project extension.

d. Trickle (drip) irrigation

The water available in the Jordan Valley from the canal system is both dirty and turbid. Blockage of emitters has therefore been main problem in trickle systems which will only be resolved by use of effective filtering systems. As discussed in Annex I, there is a need to develop lower cost trickle systems if a wider range of growers and farmers are to benefit from the advantages that can be gained. The emphasis is on lower initial investment cost and three thrickle systems have, therefore, been selected which offered a low weight of plastics content per meter length.

The first system is of German design in which the tube is made from an extruded section which zip-closure to form a tube. The emitters are star-shaped cuts within the tube which contains a longitudinal flap-valve. It is claimed to have uniform discharge over 100 m length.

The second system is UK design in which a tube is made by sewing together the edges of length of narrow width polyethylene film. The water drips from the sewn area. It has a maximum working length for uniform flow of 30 m.

The third system is of Cyprus design (modified Israeli type). The pipe is polyethylene pipe and emitters are push-fitted at appropriate intervals into the pipe. The emitters are small, approximately 6 x 6 mm, and commonly known as press studs. The tops are colour coded to identify the output flow rate.

It has been agreed that these systems will be installed in the two greenhouses and evaluated with and without mulch. As the houses will only accommodate five drip lines, each line feeding two lines of crops the experiment will permit only of duplications and not replicates being made since/an essential parameter to be examined in the uniformity of flow along each irrigation line along the whole length of the greenhouse.

Samples will be removed for monitoring the change of properties of the materials with time of use, and cultivation experiments will be carried out to check the performance of each system with and without mulch, coupled with the effect of different degrees of shading. Soil moisture content will be determined by potentiometers, and temperatures and humidity will also be recorded.

While the replication level of the cultural trials leaves much to be desired, it is the best that can be accommodated within the limited budget of the project and the fact that they are supplementary benefits being obtained from facilities necessary for the evaluation trials of long life film. It is hoped that at the end of the season (May/June 1981) that the results

might indicate which tricle system is worthy of more detailed evaluation.

e. Trials timetable

The following outline timetable has been prepared:

1.	Manufacture of experimental films	September 1980
2.	Erection of two greenhouses	September 1980
3.	Fitting of water systems and preliminary preparation of trickle systems	October 1980
4.*	Skinning greenhouse with experimental films	November 1980
5.	Installation of trickle systems	November 1980
6.	Soil preparation	November 1980
7.	Laying mulch	November 1980
8.	Planing crop	mid-November 1980
9.	Flat tunnels on potatoes crop	January 1981
10.	Fit shading nets and supports	March/April 1981 (weather dependent)
11.	Removal of mulch at end of cropping period	June 1981
12.	Removal of tricle systems at end of cropping period	June 1981
13.	Evaluation of results and prepare continuation programme for follow-on season	August/ September 1981
14.	Sampling of plastics:	
	a) Greenhouse film at four monthly intervals for first year	at the end March 1981 at the end July 1981 at the end Nov. 1981
	thereafter at three monthly intervals subject to review at evaluation of results;	
	b) Flat tunnels - at beginning and end of each season's use	
	c) Mulch as for greenhouse film	
	d) Netting - as for flat tunnels;	
	e) Trickle systems - as for flat tunnels.	

* Includes painting of film with reflective paint over contact points with metal supports.

4.4 UNIDO International Staff - timetable of requirements

1)	Senior Technical Adviser(STA)	September 1980	1 m/m
		December 1980	0.5 m/m
		Spring 1981	1.0 m/m
		Summer 1981	1.0 m/m
		Autumn 1981	0.5 m/m
	Continuity consultancy(when out of Jordan)	1981	0.5 m/m
2)	Plsticulturist-intensive cultivation (plastics greenhouses mulching etc.)	November 1980	1.0 m/m
	Recommended: Dr. Olympios		
3)	Plasticulturist - trickle irrigation systems	Oct./Nov. 1980	0.75 m/m
4)	Plasticulturist - flat tunnel systems and other film applications	Janunary 1981	0.75 m/m
	Recommended Mr. H.R. Spice - specialist in film applications		
5)	Plasticulturist - shading systems	March 1981	1.0 m/m
	Recommended Mr. H.R. Spice		

Note 1: STA will supervise production trials of experimental films in September as the wide-width film unit will be operating at this period. The STA has been requested to visit Ciba-Geigy for informal discussions to arrange for weather-o-meter (accelerated testing) of film samples since this facility is not available at RSS.

He has also been requested to prepare a draft project document to cover the extension of this project beyond 1980. This work will be undertaken at home-base. In addition he has been requested to keep project continuity by cables, correspondence etc., or other such means as may be necessary.

To cover missions and continuity work will require 2.5 m/m 1981

Note 2:

Experts required in 1980 is	1.75 m/m
Experts required in 1981 is	1.75 m/m
STA in 1981	3.0 m/m

These are required to complete this first stage of the programme and it is therfore strongly recommended that UNDP/UNIDO be requested for additional funds of 4.25 m/m required in 1981 to complete the technical programme to the end of 1981.

5) Testing

The following tests wil be used in monitoring the changes in performance characteristics of films used in the technical programme:

1) Thickness;
2) Tensile strength and elongation at break;
3) Tear resistance;
4) a) Weathering - accelerated (Xenon weatherometer);
   b) Weathering - out-of-doors on greenhouse
5) Dart impact strength;
6) Differntial thermal analysis;
7) Brabender - viscosity changes;
8) Infra-red of film surfaces.

Testing of cultivations - this will be determined later, but will involve checking daily crop yields and quality of produce for each experimantal section.

4.6 UNDP provided equipment and supplies

Due to changes in the programme as indicated at the beginning of this report and acquisitions made by RSS since the project document was drafted, there is need therefore to modify the equipment and supplies details as indicated below. Purchase and Contracts Section (PAC) UNIDO, Vienna, have been cabled to urgently obtain quotations, catalogues etc., so that decisions can be made quickly to purchase these items so that the project can move forward as per the outline timetable which is seasonally dependent.

Equipment Qnty.	Revised list. June 1980
Two	Filclair greenhouse structures 8.5 m wide, 3.2m high, 50m long with 2.5 spacing. Crop-supports. Erection supervision no covering required. Filclair RN 96, 13770 VENELLES, France Approx. 4,200 US Dollars. representing 50% discount.
600m	Black/White LDPE mulch film. 1.0m wide.
2 each	Shading nets: 40%, 50%, 60%. 8 x 10m size. Or equivalent in widths. Supplier: Roko Containers Or Netlon Ltd.
400m	Perforated LDPE film approx. 4 or 6 metres wide for flat turnels.
1000Kg	LD Polyethylene MF1 0.2 film grade ICI or Dow Chemicals. UV master-batch granules in LDPE with equal parts of benzophenone and tinuvin 622-Require sufficient master batch contain 15kg total active ingredients for long life film trials on green-house. Ciba-Geigy.
8	Water potentiometers. One in each plot Specification: Supplier:
1	Reading pyranograph Model 5-3350-A. Light measurement
25	Thermohygrographs.
1	Tear tester Now available.

1		Dart impact tester
2 each		Dumb - bell cutting knives for film (12.7 mm & 25.4 mm cutters as per Films 301.5 and 301.6 of BS 2782 fact 3 1970)
1		Thickness meters Dial gauge bench model in microns sub-divisions with anvil unit not less than 6.3 mm diameter and loaded to give a pressure of 10 - 20 KN/m^2 on the test specimen . (BS 2782 part 3 1970 method 3010)
1		As above hand model .
1		Haze & optical meter — Gardiner (USA)

Irrigation Systems:

A	750	Lego drippers one litre per hour
	750	Lego drippers two litre per hour
	1000 m	½ inch pipe LDPE for use lego drippers supplied by RSS .
	4	½ inch T Joints
	4	½ inch Filters
	8	½ inch valves
	4	T's 1 inch to ½ inch side branch
	8	90 degree bends ½ inch
	4	Closures (end - stops)
	4	linear coupling units (from valve to drip line)
B	500 m	German zip type tube
	4	½ inch T joints
	4	½ inch filters
	6	½ inch valves
	6	T's 1 inch to ½ inch side valve
	6	90 degree bench ½ inch
	6	Closures (end-stops)
	6	linear coupling units (from valve to drip line)

C	500 m	Sewn LDPE film tube
	2	½ T joints
	2	½ inch filters
	4	½ inch valves
	1	one inch valve
	1	reducing T 1 inch to ½ inch side branch
	4	90 degree bench ½ inch
	1	90 degree bend . one inch
	4	Closures
D	7	Water meters ½ inch connexions in litres or cubic meters
		Pen markers - felt-tip in three colours supplied by RSS
		Acrylic white paint Supplied by RSS

Testing: Environmental conditions as follows (for greenhouses)

1. Aire temperature inside and outside greenhouse;
2. Soil temperatures;
3. Light level inside and outside greenouse;
4. Wind speed.

5. Acknowledgements

The expert wishes to place on record his sincere thanks and appreciation for the services and excellent hospitality extended by the Director General, Dr. Albert Boutros, and Deputy Director General Dr. F.A. Dagonestini, to his counterparts Eng. Salah Elghani and Eng. Ali Ajlouni, and other staff members with whom it was a great pleasure to work and for their kindness and assistance. They have at all times given their fullest co-operation in the execution of the project.

Acknowledgments and thanks are also due to Dr. Subhi Qasem, Dean of the Department of Agriculture, University of Jordan for his kind help and assistance, and also to Dr. Youseff M.Roushdy of Ministry of Agriculture who so rapidly responded to a request for assistance.

Thanks are also due to Mr. Adrian Maghaway and other staff members at UNDP office for their assistance and support given to the project.

Finally, many thanks are due to the various sections of UNIDO, Vienna, who have extended their kind co-operation and assistance which have been much appreciated, and particularly to recruitment section who so hastily completed the administrative work which enabled this mission to be undertaken at short notice.

Annex I

Notes of discussions:

Agriculture Polyethylene Film Manf. Co.,
P.O. Box 5010
Amman Tel: 22052, 25045 Date of visit:4 June 1980

Mr. Suleiman A. Daoud, Prod. Manager
Mr. Salah Elghani, RSS
Mr. Ali Ajlouni, RSS
A.D. Clarke, UNIDO senior technical adviser

This new factory specializes in plastics products for agriculture,
cosmoplastics 3 extruder line for 12 m wide film up tc 300 microns;
cosmoplastics extruder for black mulch max. 1.2 wide
Krauss Mafer line for pipe extrusion 16 mm to 110 mm in LDPE, HDPE and PVC
Fittings are imported from Italy.

Wide width runds about 300-400 kg per hour,
mulch at 70 kg per hour

Raw material from ICI, Shell Chemicals, Dow, BASF and ESSO,
Mostly LDPE but some 4% and 40% EVA from ESSO,
UV screening agent from Ciba-Geigy - with nickel complexing agent.

Greenhouse film; 180 microns but requests for 200 microns this year,
Tunnels 80-100 microns, one season use only and scrap film disposal by burning,
Black mulch 40-50 microns - also 35 microns by master batch colouring
3.5% colour black, 1 m width is normal and puncher holes 100 mm at 30 cm x 50 cm spacing for tomato and cucumber planting.
Thinner mulch not economic on production unit.
Has waste film reprocessor but reported flakes give extrusion problem;
Was therefore considering pelletising by extrusion process; suggested try anti-oxidant additive to improve processing of flakes at 0-1% level.
Also possible change of screw compression ratio to improve mixing in barrel;
Also discussed fluidized bed technique of cleaning dies and heads, also screws,
Equipment obtainable from Techne Ltd., Cambridge, England.

Rework PVC used for cable conduit, relatively new application in Jordan, Suggested its use for centres for film in place of cardborad; Also suggested making-up floor and sealing concrete to prevent surface-dusting. With a clean floor plus LDPE film surround on floor area of extruder then film scrap would be kept clean and therefore easier to re-work.

In Jordan Valley growing season is extensive,9 months ending April, while in area near Amman there are two seasons for tomatoes and cucumbers. Winter planting starts August/September period. For potatoes about October.

Winter weather in Jordan covers about 7 days with temperature at zero centigrade, and some years the lowest temperature is $-3^{\circ}C$. This would suggest attention to greenhouse insulation by erection of interior PE film (40 micron) to form air insulation layer, or use of inflated roof type. Doubtful if EVA film of improved infra-red characteristics could be justified or give sufficient temperature lift. However, 3 or 4% EVA co-polymer use justified to prevent edge-cracking of folded film in transport handling.

Mulch is being used both inside greenhouses and outside with and without trickle (drip) irrigation. Cost is a prime factor in such trickle systems.

Some plants are scorched by the heat developed from black mulch which therefore means reduced harvest yields. The use of reflective mulch could resolve this problems and a two-colour mulch should therefore be tried. It should be examined for possible re-use in a second crop and thus, reduce investment cost. There are no facilities to produce such a co-extruded film in Jordan, but if a need were established additional plant could be added on to existing units for this purpose. Two-colour mulch is normally 80-100 microns thick and this would represent almost double current cost of single-colour mulch. It is important therefore to maximize its use to achieve the necessary cost-benefit.

Tunnel covers are used one season only and destroyed. Film is applied by hand. Interest was expressed in an automatic tunnel-film layer. This can be followed up on the study tour. It would appear worthwhile to try and develop a technique for re-winding the film(by hand) at the end of the season and store under black PE covers to prevent daylight reaching the wound-up film, thus extending its useful life as a tunnel cover. For this re-use type of application UV protected film should be used at 100 - 125 micron thick.

'Flat tunnels' is the name given to tunnels without any frame support. The necessary mechanical support is given by the plants as they grow. To prevent wind lifting such a film from the ground it requires to be perforated with holes. In German conditions 100 mm holes at 500 per square metres are generally used for spring salad and vegetable crops such as lettuce, cabbage and also potatoes. Benefits are earlier cropping (2-3 weeks) and increased yields. It would be interesting to examine such type tunnels in Jordan on potatoes. Film is normally 125 micron and 6 metres wide.

Water-mattress heating for greenhouses: This technique makes very efficient use of low temperature water (up to 40 C maximum) and uses a welded block lay flat PVC tube through which water is pumped (circulated). Provided 50 to 70% of the greenhouse area is covered,then it will provide adequate growing conditions with an outside temperature of minus 17°C. A low cost solar panel heater unit is under trial in Cyprus using clear (transparent) and black polyethylene film. If successful, this might have application in Jordan. Electric power is required for water circulation. PE black film could be used instead of PVC for the black water mattress. (Subsequently learnt that Agriculture Dept., Jordan University, plans to order some.)

Discussed also covered trickle irrigation. Some Cyprus type systems (based on Israel designs) are being used as well as the USA bi-wall system, and also a German system. It would seem that no design work is undertaken in Jordan that aims at reducing the capital investment cost of trickle irrigation fittings and pipes. This could be a useful area for RSS to examine.

The use of trickle systems with mulch is already being practised, and the use of PE film for methyl-bramide fumigation started last year. The use of clear film for solar sterilization of the soil, based on Israel development work, was tested by one grower last year with apparently satisfactory results. This is an area which requires parameters to be measured to establish the degree of sterlization that can be achieved. In the spring 1980 there were 100 hectares of greenhouses. It would appear that this figure will be significantly increased in the autumn planting period judged by film demand and other information. The area under tunnels has remained steady for three years.

With increasing use of plastics in agriculture, particularly film, there will evolve a large waste disposal problem. Currently film is burnt and this represents a waste of valuable resources. RSS could examine more effective methods of re-cycling such film provided cost-effective collection system for such film could be visualized.

Mr. Daoud offered his fullest co-operation to produce experimental quantities of film on his plant for the RSS trials. He plans to start wide-width film production in August and will finnish in October. This would enable some formulations to be run in September and others (where there is a thickness change involved) to be included at the end of this run during October. If trial greenhouses were all made ready beforehand, then this would enable comparative field-scale trials to be started this autumn.

Annex II

Note on discussions at University of Jordan, 7 June 1980

Dr. Sabli Qasem, Dean of Agriculture Department, University of Jordan
Eng. Salah Elghani, RSS
Eng. Ali Ajlouni, RSS
A.D. Clarke, UNIDO Senior technical adviser

Dr. Qasem agreed he will extend co-operation to cover following items:

1. Provision of land;
2. Water supplies;
3. Pump;
4. Labour for irrigation;
5. Labour for mulching;
6. Cultivation (plants, fertilizer etc.) on basis that crop remains for their disposal;
7. Manpower for technical co-oeration (adviser and will also undertake the study tours).

They have a Honeywell, believed to be intermittent sampling, vendor for 40 points, but is not working. RSS will investigate and rectify.

15 thermohydrographs are required together with accesscries and spares. Supplier recommended Casella London Ltd., Regent House, Britannia Walk, London N1, Tx. 261641, telephone 01-253-8531.

Thermohydrographs T 9154/C or more sophisticated ones. (Approximately £200 each).

Reference greenhouse trials recommends keep to basic crops either tomatoes or cucumbers. Programme trials on basic type of current type of houses approximately 8 m wide, 2.85 m high(or higher) with separation between arches of 2.5 m. (Cost approximately 2 JD per square metre covered area), Agriculture Dept., recommends 50 m length but 60 m and 70 m are in use in the Jordan Valley.

Also instruments required for measuring wind velocity and amount of water used in irrigation trials (water-meters).

Dr. Qasem offered financial assistance of few thousand dollars, if required, towards purchase of greenhouse structure. Thus, we should not let financial limitations limit greenhouse size selection.

The proposed study tour to European plastics in agriculture experimental stations, also including the International Congress for Plastics in Agriculture in Lisbon, Portugal, was outlined. Dr. Qasem will propose a person for technical co-operation, and he will be nominated for fellowship on this study tour to accompany Eng. Salah Elghani who will be nominated by RSS. The study tour is for two persons for approximately one month period, September/October 1980.

It is necessary to send to UNIDO through UNDP completed nomination forms together with English language certificates and medical certificates to be completed before 14 June 1980. This urgency was stressed.

Noted on meeting at British Embassy - Amman

Mr. Ivan Savidge - First Secretary (Commercial)
A.D. Clarke
J. Nightingale) UNIDO experts

General discussion on plastics applications in Jordan Valley; Suggested contacts with following persons:

1. Mr. Fred Howarth (co-op adviser)
Jordan Co-operative Organization
Telephone: office: 65171/2/3
at Embassy: 41064

2. Middle East Development Division
Agricultural Advisers
Mr. John Goldsack, tel:43919 (home) 41064
Mr. Maurice Vick on leave

It was also noted that the above unit will be closing down at the end of 1980.

Jordanian mission visited UK about 18 months ago and had discussions with British Agricultural Expert Council. As far as plastics are concerned little seems to have happened.

[redacted]

B-512