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DEVELOPMENT OF PROTOTYPE MOBILE SEED DRESSING APPLICATORS SUITABLE FOR AFRICAN COUNTRIES

US/RAF/88/273

Technical report: Seed dressing technology - Part I*

Prepared for the Governments of the Republic of Zambia
and the United Republic of Tanzania,
by the United Nations Industrial Development Organization,

Based on the work of J.E. Elsworth,
Chief Technical Advisor

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* The document has not been edited.

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TABLE OF CONTENTS

1. Background

The mainstay of the economies of the PTA countries is agriculture. Regional and national strategies accord the highest priority to attaining self sufficiency in food. The policy on pest control is to use Integrated Pest Management, of which Seed Treatment is an important component.

The project is to develop a mobile Seed Treating machine to be available to rural farmers for effective, safe and affordable treatment of their home saved seed. Initially, it is focusing upon Zambia and Tanzania.

The present visit - by the C.T.A. - was to gain a detailed understanding of the needs of the machine in each country, to draw up the broad basis of the specification, and to initiate the design process in the respective engineering institutions.

2. Summary

A number of institutions were visited to inform and discuss the project. Some potential manufacturing companies were inspected, although others remain for a future trip. Visits were made to potential beneficiaries - rural farmers. A full list of visits appears in Appendix A.

The general reaction was one of interest and support. Some doubts were expressed as to the advisability of a *mobile* treater, where the treater visits the farm, vis-a-vis a *movable* treater, where the machine is located at a local centre, and farmers bring their seed to be treated.

Several contacts stressed post harvest storage of both seed and food grains. Storage losses of up to 30% - 40% were mentioned, mainly from weevils, and in Tanzania, the Greater Grain Borer.

Discussions were held about the trials to be put down in November/December this year (using existing machines) and about the detail design of the new treater. The 'Rotostat' principle, described by Jeffs and Tuppen[1] was confirmed as the strongly recommended basis for the new machine.

3. Recommendations

3.1 That two machines, the 'Rotostat' P500 and the Hege be imported into each of Zambia and Tanzania for trials and dissemination of the technology.

3.2 That the proposed role of the European institute be modified as follows. Rather than carrying out a detailed design, the chosen institute acts as a sounding board for the developing design and as a training centre.

3.3 That the training programmes for each country be formulated after the testing of the prototypes in real situations. That the programme be formulated by those persons involved in the testing, i.e. the local engineering and biological institutes, ministry representatives, and the project engineering and biological advisers. Consideration should also be given to the involvement of a training expert.

3.4 That a second visit be made by the C.T.A. to Zambia - provided the P500 machine has been delivered. The purpose of this visit is to:

3.4.1 Supervise the treatment of trials seed at Mt Makulu research station.

3.4.2 Discuss further the technology of the Milik mixer and possible methods of construction.

3.4.3 Visit rural farmers in the Mazabuko district (southern region).

3.4.4 Meet with Dr Deedat of UNZA.

3.4.5 Meet with the National Council for Scientific Research.

3.4.6 Liaise with I.F.A.D. - Smallholder Services Rehabilitation Project.

3.4.7 Visit 3 more engineering companies: Lenco, Africare, Esco.

3.5 That following upon this visit, a visit be made to Tanzania - provided the Hege machine has been delivered. The purpose of this visit is to:

3.5.1 Treat beans for germination testing at I.O.S.C.A.

3.5.2 Discuss further the technology of the Milik mixer and possible methods of construction.

3.5.3 Meet with Dr Mosha, Director of T.P.R.I., and with Mrs Matemu, the contact person, to try to further the collaboration of that institute

3.5.4 Meet with Global 2000 who have an interest in the development of seed production.

3.5.5 Possibly visit another potential manufacturer - Hanspaul and Sons.

Recommendations: Cont.

3.6 That provision be made for further visits in May/June 93 and Nov/Dec 93.

3.7 That provision be made for a seminar on the technology, possibly in Feb./March 94 in the region.

4. Zambia

4.1 The seed scene.

4.1.1 Maize is the most important crop. Of the two types, hybrid and indigenous, hybrid varieties yield better, but require more fertiliser and are less drought tolerant. Because of the sterile nature of the crop, seed has to be purchased each year. Thus it is always treated - normally with 'Thirasan' (thiram and malathion). The indigenous varieties can be farmer saved and are therefore normally not treated. There are many such varieties - suited to the various areas. They are mostly of the flint or dent types.

4.1.2 Sorghum is a major food crop, particularly in the southern (dryer) area. At least as nutritious as maize, it's importance is increasing because of it's drought tolerance. It is mostly farmer saved although Zamseed do process a small amount. There are two types. Red sorghum is more resistant to pests (including quelea birds) and disease, but is less palatable. It is used for brewing. White sorghum suffers from a variety of pests. It is more palatable both to humans and the quelea bird. The latter can cause losses of up to 40%.

4.1.3 Millet is also drought tolerant and is increasing in importance. It is totally farmer saved.

4.1.4 Soya bean, another increasing crop, is high in nutritional value. It is processed by Zamseed, including treatment, and also farmer saved.

4.1.5 Vegetables are grown extensively, from both farmer saved and purchased (treated) seed. They include tomatoes, cabbage, rape, and onion and are both a food and a cash crop.

4.2 Seed Prices.

The price of maize seed has risen from 1000K per 90 kg bag to 8000K in a very short time. The prices of other seeds have also suffered dramatic increases. All the rural farmers met complained about the prices of their seed. Fertiliser has also suffered a major price increase. In these circumstances farmers want to save their own seed, and would thus welcome a facility to have it treated.

4.3 The Current Situation in Low Rainfall Areas.

In the south of the country, where the average rainfall is below 800 mm there is less capacity to cope with drought than elsewhere. Farmers in this area have eaten the seed they would normally have saved. The government has, apparently, promised to distribute new seed free of charge. However the infrastructure problems will render this a very difficult operation, and doubts were expressed as to the realisation of the promise.

Zambia: Cont.

4.4 Seed Companies.

The only supplier of seed currently is Zamseed although the following companies are rumoured to be entering the market.
Cargill - world wide seed company with interests in many African countries.
Pioneer - the world's largest seed company - specialises in maize.
Svalov - Swedish company, said to be working on sorghum and millet.
Landless - a large commercial farmer near Lusaka.

4.5 Seed Treatments Used.

Products commercially available include

1) 'Thirasan' - thiram (fungicide), malathion (insecticide) and dye.
2) 'Captasan' - captan (fungicide), malathion, sodium molybdinate (for trace element supplement - molybdenum), dye and sugar.
3) Triadimenol (fungicide).
4) Carboxin/thiram mixture (both fungicides).

Items 1) and 2) are used widely as seed treatments. Their ingredients have relatively low mammalian toxicity, although thiram can cause irritancy in some individuals. This could be a problem with hand sowing but the evidence of existing practice (sowing of commercially treated seed) appears to clear the worry.

Both these formulations are Wettable Powders (W.P.) to be mixed with water before application to the seed. The mix of W.P. and water is known as slurry. This type of formulation has the advantage of long shelf life, but disadvantages as follows:

4.5.1 Possibility of error in the proportions of W.P. to water - hence incorrect application rate.

4.5.2 Possibility of insufficient mixing / resettlement by lack of agitation.

4.5.3 Lower retention on seed compared to true liquids. (Flowables would occupy a middle position.)

It may also be possible to apply the W.P. separately to the water. This would avoid the first two disadvantages above, but would exacerbate the third significantly, particularly if the temptation to leave out the water were followed.

Zambia: Cont.

4.6 S.C.C.I. Policy.

The Seed Control and Certification Institute has, until recently, pursued a policy of discouraging farmers from saving their own seed. The preference has been to recommend professionally grown and certified seed. This policy has recently been changed since it was recognised that the infrastructure problems effectively prohibit it. The current policy is to encourage farmers to save good quality seed, or preferably to buy good seed from other, local farmers who have had some training. This training is offered by S.C.C.I. via extension workers.

4.7 Other Machines Used in Zambia.

In addition to the commercial machines used by Zamseed (Gustafson) a range of machines are in use in Zambia. These include cement mixers, drums, shovels, etc. The National Council for Scientific Research (N.C.S.R.) intend conducting tests on the methods. Time did not permit a meeting during this visit but it is considered that the current pedal powered treater should be offered for inclusion in these tests.

4.8 Storage of Seed and Food Grains.

Crop losses during storage can be very severe - 30% - 40% have been known. The principal agent is weevils which attack during the rainy season (presumably because of the humidity). They can be controlled by the application of malathion or pirimiphos methyl dusts. As far as is known, there is no problem with the application of these insecticidal dusts, even to seed already bagged. Sorghum and millet are sometimes stored on the seed head as a means of deterring weevils.

According to Shell (the supplier), stored seeds should have a higher dose of malathion for better weevil control. This would be difficult with the standard, dry powder product, where a higher dose would not adhere well to maize seed. An alternative - viable if a treating service was available - would be a liquid formulation of malathion. Shell would be willing to make this available.

5 Tanzania

5.1 The seed scene.

5.1.1 Maize is again the dominant crop. Again the two types are grown, hybrid and consolidated. The vast majority must be consolidated since only about 10% of seed is certified, the balance being farmer saved.

5.1.2 Again there is a trend towards sorghum and millet as being more drought tolerant.

5.1.3 Beans - a range of varieties - feature strongly, but soya beans are not (yet) important.

5.1.4 There is a considerable amount of wheat - both on large and on peasant farms. Historically, Tanzania grew a lot of wheat but the villagisation programme reduced it significantly. Now that government policy leans more towards a market economy, wheat is returning - encouraged by the Canadian International Development Agency. (C.I.D.A.)

5.1.5 Vegetables are encouraged and F.A.O. is assisting the National Vegetable Seed Improvement Station (N.V.S.I.S.) near Arusha.

5.1.6 Sunflower is also grown and demand is likely to increase with the imminent completion of a large new oil extraction plant.

5.2 Seed Prices.

Again prices have risen dramatically and maize seed costs, typically, 250 TSc per kg. At current exchange rates this is even more expensive than the 90K per kg in Zambia.

5.3 Seed Companies.

Again the state seed company, Tanseed, currently dominates, but the opening up of the market to other companies is more advanced in Tanzania. Two Dutch companies, Rotian and Pop Vriend are already operating, and Cargill are building a major plant. Pioneer are rumoured to be considering taking a major interest in Tanseed.

5.4 Seed Treatments Used.

Maize, sorghum and beans are treated with 'Fernasan' D. This is a W.P. containing thiram and lindane (insecticide). It can be applied as a slurry, as by Tanseed in their Gustafson machines, and is also recommended for dry treatment in home made drum treaters, cement mixers, etc. 'Vitavax' is also used on wheat and sunflower.

Tanzania: Cont.

5.5 T.O.S.C.A.

The Tanzanian Official Seed Certification Agency also reacted to the project positively, supporting it's aims rather than seeing it as competing with their own raison d'etre. They would be in a position to help with germination testing of treated seed, but not with disease control or yield assessment.

5.6 Other Machines Used in Tanzania.

Again Gustafson machines are used by Tanseed in all their four seed processing plants. Rotian use a Gompper. Cement mixers, drum mixers and shovels are all used by (larger) farmers.

5.7 Storage of Seed and Food Grains.

Again, storage losses were mentioned by several contacts. In the case of Tanzania, the Greater Grain Borer (G.G.B.) has become a major pest of maize in recent years. Both weevils and the G.G.B. are controlled by 'Actellic Super' - a dust formulation marketed by ICI (Twiga in Tanzania) in 100g sachets - enough to treat one 90 kg bag of maize. This product contains pirimiphos methyl which controls weevils, and permethrin which controls the G.G.B. Again, a liquid equivalent of 'Actellic' Super would do a better job if efficient application equipment was available. A liquid formulation of pirimiphos methyl is available in 'Actellic' 50 EC, but as far as is known, there is no liquid formulation of permethrin at present.

6 The Future Machines.

6.1 Mobility

The concept of a truly mobile machine, touring farms and treating the farmer's retained seed on farm, was questioned by a number of contacts. A lot of time would be spent in travelling between farms - particularly in Zambia where the only practical means of transport appears to be an ox cart. The alternative would be to have machines located at convenient centres, such as those where grinding machines for food grains are located. Farmers would bring their seed to the centres for treatment. The farmers questioned did not see any problem with this process.

Thus the principle of *mobility* could be modified to one of *movability*, so that a machine could, if appropriate, spend a period of time in one centre and then move to a neighbouring one. This will be the approach taken.

6.2 Power.

6.2.1 In Zambia, the only available power source in rural areas is human or animal. Electricity is not normally available and a petrol engine would be costly and difficult to maintain. It is considered that animal power would be clumsy, so a human driven machine is recommended. Experience with the 'Rotostat' P500 with a full 10 kg charge of seed suggests that one person pedalling is insufficient. The work level is high and could not be sustained for a prolonged period. Therefore a two person pedal arrangement is suggested.

6.2.2 In Tanzania, tractors are widely available and a tractor driven machine is recommended. The greater power availability allows a larger mixing chamber. This would be particularly beneficial if treatment of food grains for storage was considered. (The problem of cross contamination of food grains by seed treatment chemicals is discussed in section 8.)

6.3 Principle of Operation.

Of the 7 classifications of seed treater given by Jeffs and Tuppen[1], the recommended principle is Group 4 - 'Rotostat' as exemplified by Group 7 - Laboratory Seed Treaters. This clear preference arises from:

6.3.1 The variable lot size to be treated which will sometimes be as small as "one handful".

6.3.2 The need for an even distribution of liquid treatments (preferred to powder for safety reasons).

6.3.3 The need for a reasonably rapid process.

The Future Machines: Cont.

6.4 Current Technology.

There are two ranges of machines currently available utilising this broad principle. These are:

6.4.1 The Hege.

A laboratory machine from the German company, Hans-Ulrich Hege. It has three options of size, 20g - 50g; 100g - 1.2kg; 1.2kg - 3kg. These three mixing chambers are interchangeable on a common drive frame. They are manufactured in stainless steel. The spinning disc is mounted on the rotor, as one assembly, which turns at 3000 rpm. It requires a 380V 3 phase 50Hz power supply, although a 220V single phase option is now available.

6.4.2 The 'Rotostat' Range.

Four sizes of machine treat batches of 30g - 350g; 100g - 2kg; (laboratory size) 500g - 10kg; (field trials/small commercial size) 2kg - 60kg (commercial size). These are separate machines. In each case the rotor turns relatively slowly (sometimes at variable speed), typically at 300 rpm, but the spinning disc is faster - 1500 rpm. This requires a separate drive for the two components. The rotors are coated with polyurethane to provide a degree of friction with the seed. The three smaller machines require a 220V/240V single phase 50Hz power supply. The largest one requires 380V/415V 3 phase 50Hz power. However, the 500g - 10kg machine also exists in a 'village treater' form, the P500. Here the rotor is driven manually (by pedals) and the spinning disc by 12V dc power. (e.g. car or tractor battery.)

6.5 Design Considerations.

6.5.1 Size.

The size of the Zambian machine is limited by the power source. Experience indicates that two men pedalling could support a 500 mm dia, 10 kg machine.

The Tanzanian machine could be a little larger because there is more power available from a tractor power take off. Indeed the possibility of offering a protection service for food grains indicates a larger capacity. The recommendation is for a 625 mm dia machine which, it is considered, would take batches of 25 kg. (Enough maize seed for one hectare.)

6.5.2 Rotor Speed.

From the drive point of view, a low speed rotor is preferred - pedals can conveniently be turned at about 100 rpm maximum, and a tractor power take off turns at 540 rpm. A modest speed change is practical - say up to a factor of four either way. On the other hand, a high speed rotor can carry the spinning disc with it, avoiding the need for a separate drive.

Some experimentation is required to ascertain the minimum speed at which spinning discs of appropriate sizes can effectively distribute the liquid. This would test the possibility of reconciling the above conflicting requirements.

6.5.2 Rotor Surface.

The application of polyurethane to the surface of the 'Rotostat' machines is a relatively high cost process, and would involve importation of the polyurethane. Liptrott[2] suggested applying ridges to the rotor surface as an alternative means of driving the seed. This technique may enable a rotor design suitable for a speed equivalent to the minimum spinning disc speed, and thus facilitate a combined rotor/spinning disc assembly. Again, some experimentation is required.

6.5.3 Rotor Clearance.

A relatively high cost feature of both existing machines is the need to maintain a fine clearance between rotor and housing. It is suggested that experiments also be conducted to ascertain the maximum allowable clearance. These experiments should involve the smallest seed intended for treatment - perhaps some vegetable seed, or millet. The effect of a wide clearance, the spilling of seed, might be mitigated by a design which entrains air - acting like a fan.

6.5.4 Seed Discharge.

Various discharge systems are used on existing machines.

6.5.4.1 Roll-Over - as with a cement mixer. Used by the Hege.

6.5.4.2 Reverse Rotor Direction. Used by the P500. Only really suitable for pedal driven machines.

6.5.4.3 Openable Gate in Stator Wall. Various types of opening have been used - guillotine, side hinge, top hinge.

The recommendation for the pedal (Zambian) machine is for reverse direction, and that for the tractor machine (Tanzania) is side hinge.

The Future Machines: Cont.

6.5.5 Rotor/Rotor Housing Construction.

This issue interfaces with rotor clearance and surface. Existing rotors are in mild steel ('Rotostat') or stainless steel (Hege) made by spinning or turning from solid (small rotors). A possible alternative would be glass reinforced plastic, but this technology is not yet common in either country. Spinning is a very specialised process, and this issue remains a problem area. One suggestion, worthy of serious consideration, is to use a disc from a disc plough or disc harrow. These discs are available in a range of sizes and shapes. This idea should be discussed with the two African design institutes and the chosen European institute.

7 Manufacturer.

7.1 Zambia.

Two potential manufacturers were visited.

7.1.1 Northlands, Ndola. Mr Tango - M.D.

The work in progress seen was mostly of a heavy engineering nature, although a hammer mill is made in batch quantities. Organisation appeared poor. The workshop was untidy and workmanship generally rather poor. The management attitude was not encouraging, being more concerned with profit, including the acquisition of additional plant, than with nurturing a potential new product.

7.1.2. Monarch, Kitwe. Dr Penselo - G.M.

Monarch is currently a parastatal, high on the government list for privatisation. Organisation appeared good, and the factory tidy, but the products are generally made to a flow line, mass production regime. Dr Penselo stressed that they do have a design department and can make prototypes and development batches, but the author has doubts about the match between the seed treater product and the company.

Neither company is considered ideal. Monarch would be preferred of the two, but more potential manufacturers should be visited. Suggestions made include Lenco, Africare, and Esco.

7.2 Tanzania.

One potential manufacturer was visited - Small Industries Development Organisation. (S.I.D.O.) Mr Malya - Deputy Manager.

This is one of a set of similar organisations located in all regions of Tanzania. It is managed as a factory with products built on a batch basis, including oil presses, maize mills, circular saws, spare parts for imported machines, etc. Work was generally to a reasonable standard, although the welding of light plate looked a little rough. There is a close relationship with T.E.M.D.O. and a lot of products designed by the latter are built at S.I.D.O.

A visit was also made to Kilimanjaro Metal Shapers Ltd., although it was not possible to see the factory. They make aluminium vessels by pressing and spinning. Limits for spinning of 615 mm dia and 2mm thick in aluminium are imposed by the hand nature of the operation

8 The Treatment of Food Grains.

Many contacts raised this subject, particularly in Tanzania where the prevalence of the G.G.B. makes food preservation a particularly urgent topic. The existing, widely available, technology is treatment with powder by hand. This is at best a crude system. Distribution will be poor and powder will be lost on air currents. However, the technique is practical for two reasons. Pirimiphos methyl, the weevil product, is volatile. Although permethrin, the G.G.B. product is not, the insect itself moves about, covering many seeds before deciding on one to attack. This increases the chance of it picking up insecticide on unevenly treated seed.

There was a general feeling that treatment with liquid in an effective machine would be an important advance in the fight against these pests.

The question then arises as to the likelihood and consequences of cross contamination of food grains with chemicals intended only for seed. Contamination could arise either by the treatment of food grains in a machine already contaminated with seed treatment products, or by the treatment of seed for field pests as well as storage pests , and the subsequent change of use of the seed to food. There could be three parts to the defence against this eventuality.

8.1 It may be possible to treat seed only with products which are acceptable for use on human food. This would include permethrin, malathion and pirimiphos methyl. Advice should be sought concerning suitable fungicides.

8.2 The operator of the machine could be trained to clean it thoroughly after treatment of seeds, before handling food grains.

8.3 Seed could be treated twice. Firstly at harvest with chemical preservatives, as with food grains. Secondly before sowing when it would be certain not to be confused with food. The seed treatment would, as is always the case, incorporate a strong dye to identify seed as treated. Storage chemicals would be applied at a different time of year to seed protectants so there should not be a problem of contamination by the machine.

9 The Continuing Project.

The following programme is envisaged at this time, keeping in mind that most plans are subject to change.

9.1 Importation of Existing Technology.

Both collaborating engineering institutes stressed the avoidance of "re-inventing the wheel". In order to make use of existing technology a P500 machine is in course of importation into Zambia and a Hege into Tanzania. A second use for these machines is to lay down trials. In the case of Zambia, Mt Makulu (Mr Chalabesa) would not be willing to sanction farmer trials until research station trials had indicated the safety and benefit of the proposed system. This would put an additional year onto the programme if availability of the Zambian prototype was necessary. In the case of Tanzania, T.P.R.I. are more relaxed about the project, but the author's experience indicates the desirability of the earliest possible biological trials. The proposed trials for both countries is discussed in detail in section 9.3.

These importations follow recommendation No 1 but save money by importing only one machine to each country rather than one of each type to each country.

9.2 C.T.A. Visit for Next Planting Season.

A trip is planned for late November 92 to advise on the use of the existing machines in the treatment of trials seed (see 9.3) and to further the understanding of the technology. This trip is dependant upon the arrival of the two machines in their respective countries. Activities would be generally as recommendations 3.4 & 3.5. It should be possible to identify the chosen manufacturers at this time so that liaison with the engineering institutes can begin immediately.

9.3 Biological Trials - Next Planting Season.

9.3.1 Zambia.

A protocol is already agreed with Mt Makulu for initial trials using the P500. This is to treat 3 varieties of each of 2 seed types with 2 chemical products at one rate each (the recommended rate).

Seed Types - Maize and Sorghum.
Varieties - Suitable for low, medium, and high rainfall areas.
Treatments - 'Captasan' and 'Thirasan'. (Copper Oxychloride. the only agrochemical manufactured in Zambia, is not effective as a seed treatment.)

These will be sown in replicated plots. The seed lots to be used are already available at Mt Makulu. Mr Chalabesa is confident of their representation of the seed farmers would save.

The location of the trial site will preferably be at the appropriate research station, i.e. one in each of the low, medium, and high rainfall areas. Otherwise, they will all be conducted at Mt Makulu. Observations will be made on germination and disease levels and on yield.

The Continuing Project: Cont.

9.3.2 Tanzania.

The chosen biological institute, T.P.R.I., is not yet in a position to co-operate with trials. T.O.S.C.A. (Mr Mateni) have agreed to conduct germination work on beans. This would be lab tests only, assessing the effect of the mixing action in the machine as well as the chemical treatment on the viability of the seeds. It would be conducted on two varieties - Canadian Wonder and Masai Red. Beans would be obtained from rural farmers by the District Agricultural and Livestock Development Officer. (D.A.L.D.O.)

9.4 Further Visits.

It is recommended that a trip at harvest time 1993 should be made to check on the trial results and further the design of the prototypes. Thereafter, a trip at sowing time 1993 (say November / December) would be necessary if the prototypes are undergoing field trials.

9.5 Field Testing of Prototypes.

If laboratory tests prove satisfactory, then the prototype in each country should be field tested in a rural area, using farmer's saved seed during the planting season of 1993/94. This will be an important milestone in the project, enabling not only the functioning of the machine to be assessed, but also the socio-economic parameters to be tested. (Price structure, farmer acceptability of the concept, etc.) For this exercise it will be necessary to find a suitable person to be the pilot "entrepreneur". It should be someone familiar with farmers, and with agricultural chemicals, as well as having some understanding of machinery. In Tanzania a very strong candidate was identified in Mr E.Ndemasi, who will be retiring from his job of Twiga Technical Representative in June 1993.

9.6 Seminar.

It is felt that a forum will be needed in which all the interested parties can consider the experience of the testing of the first prototypes, and to agree the further course of the project. It is suggested that this take place around June 1994, assuming that both machines are tested during the planting seasons of late 1993 / early 1994. This might also be a forum in which representatives from other P.T.A. countries could be introduced to the technology.

9.7 Pilot Production.

Assuming successful trials with the prototypes, a pilot batch of about 6 machines in each country should be made and positioned in time for the 1994/95 planting season. This would be a semi - commercial operation, with the owners paying at least something towards the machines, and undergoing the operators training course. This small number could be monitored and lessons learnt incorporated in future training courses and machines designs.

The Continuing Project: Cont.

9.8 Dissemination.

The all important phase of the project will be to guide the setting up of a system by which machines are available to entrepreneurs, or other users, so that wide benefit can begin to accrue. Although consideration should be given to this subject throughout the project, the seminar would be an important "node" in this planning process. Some suggestions for the economics of the job are put forward in Appendix B.

9.9 Training.

9.9.1 Of Design Personnel.

The African designers of the machines should have some knowledge of the process of seed treatment, and requirements of treated seed in order to enable them to create a suitable machine. To this end, at a fairly early stage in the project, a tour of developed country installations should be considered. This could take in Hungary, Germany, and U.K. which would provide a wide spectrum of techniques and practices.

9.9.2 Of Seed Treatment Machine Operators.

A training course should be devised, based on the experience of the prototype testing, and established knowledge, constructed with the help of training experts. Completion of this training course should eventually be mandatory for entrepreneurs intending to purchase machines.

Appendix A - 1

Institutions / Personnel Visited.

Zambia.

1. U.N.I.D.O.	Dr Taylor; Mr K.Jorgnson.
2. P.T.A.	Mr J.Mwencha, Director of Industry & Energy; Mr J.Opio, Senior Industrial Expert. **Project Manager.**
3. F.A.O.	Mr B.Thompson, Programme Officer.
4. T.D.A.U.	Dr N.Kwendakwema, Director; Mr J.Tambatamba. Project Engineer Mr B.Sythes, V.S.O. Designer.
5. U.N.Z.A.	Dr K.Chinonge, Horticulturist; Dr C.Mwiidilila, Plant Pathologist.
6. Mt. Makulu.	Mr A.Chalabesa, Entomologist; Mr G.Malenga, Plant Pathologist.
7. S.C.C.I.	Dr Mulcokela, Director; Mr E.Zulu, Chief - Seed Research & Development.
8. Min. of Ag.	Dr Munyinda, Assistant Director - in Charge of Research.
9. Zamseed.	Mr P.Lloyd, Processing and Storage Manager.
10. ICI Zambia Ltd.	Mr F.Tembo, Agrochemicals Manager.
11. C.I.D.A.	Mr H.Hill, Project Co-ordinator. Wheat Extension: Mr H.Ngoma, Successor.
12. Shell Chemicals.	Mr M.Malumo, Commercial Manager.
13. Prov Ag Office.	Mr A.Ngoma, Provincial Officer; Mr P.Michelo, Crop Husbandry Officer. (Copper Belt Province.)
14. Dist. Ag. Office.	Mr W.Waloubita, District Officer; Mr Dakar, Extension Officer. (Ndola Rural District.)
15. Rural Farmers in Ndola Rural District.	
16. Northlands, Ndola.	Mr Tango, Managing Director.
17. Monarch, Kitwe.	Dr E.Pensulo, General Manager.
18. Z.C.F.	Mr H.Gondwe, Marketing Manager.

Appendix A - 2

Tanzania - Dar-Es-Salaam.

1. U.N.I.D.O.	Mrs A.Kostain, JPO; Mr Akem.
2. S.A.D.E.C.	Mr Z.Masanja, Senior Industrial Economist.
3. Min. of Ag.	Mr Mtolera & Mrs Masawe, Seed Unit.
	Mrs Bandawe & Mr Swai, Seed Improvement Scheme.
4. F.A.O.	Mr F.Mathenge, Project Director. National Seed Development Project.
5. Min of Industry & Trade.	Mr A.Ngemera, Senior Economist.
6. Hoechst	Mr R.Mbonika, Country Manager, Agriculture Dept.

Tanzania - Arusha.

1. T.E.M.D.O.	Mr G.Msolla, Director General. **Contact person for the Project in Tanzania.** Mr M.Tango, Design Engineer. Mr R.Malima, Design Engineer; Mr F.Mungo'ng'o, Design Engineer.
2. T.P.R.I.	Dr. F.Mosha, Director. Mr J.Chogo, Chief Scientific Officer & Head of Technical Services Dept.; Mr J.Akhabuhaya, Registrar of Pesticides; Dr Urono, Entomologist; Mrs Urono, Plant Pathologist.
3. Tanseed.	Mr M.Kibada, Production Manager; Mr Lwegezya, Process Engineer Mr E.Manyiri, Contact person for this project. (Currently Manager of Mwanza Depot, but expects to move to Arusha.)
4. Rotien.	Mr Bruinsma, General Manager.
5. T.F.A.	Mr A.Pishori, Trading Executive; Mr Kileo, Warehouse Manager.
6. Cargill.	Mr R.Juhl, General Manager; Mr R.Banfield, Production/Processing Manager. Mr G.Kavishe, Accountant.
7. N.V.S.I.S.	Mr D.Chilosa, Assistant Manager.
8. C.A.M.A.R.Tech.	Mr A.Kaaya.
9. Min. of Ag.	Mr D.Rugangila, Dist. Ag. & Livestock Dev. Officer, Arumeru District (around Arusha.) Mr Zablon, Assistant to Mr Rugangila.
10. Rural Farmers in Arumeru District.	
11. T.O.S.C.A.	Mr J.Matemu, Officer in Charge - Seed Testing Unit.
12 Twiga.	Mr E.Ndemasi, Technical Representative.
13. S.I.D.O.	Mr Malya, Assistant Manager of Arusha Unit.

Appendix B - 1

Economics of the Job.

Whilst the author does not claim to be qualified to make an authoritative assessment of the economics, the following figures are put forward as an initial suggestion. They are based on maize. Unit of currency is Tanzanian Shilling. No equivalent data is put forward for Zambia - it is assumed that values would approximately equate.

Farmer

Farmer cost of seed:	250 per kg.
Farmer price for crop:	3000 - 5500 per 100 kg.
Hence mean price - say:	42.5 per kg.
Thus money saved by retaining seed:	200 per kg.
Mean yield:	1.5 tonnes per hectare.
Expected increase in yield by treating - say:	5% - 75 kg per hectare.
Value of additional crop:	3,187 per hectare.
Realisable cost of treatment - say:	1/5th of additional value.
Hence realisable cost:	637 per hectare.
Sowing rate:	25 kg per hectare.
Hence realisable cost:	637 per 25 kg treatment batch.

Appendix B - 2

Treating Agent.

Cost of 'Fernasan' D:	55,000 per 30 kg bag.
Application rate - say:	300 g per 100 kg.
Hence chemical cost:	137 per 25 kg batch.

Amortisation of capital cost of machine.

Say:	cost of machine:	350,000 ($1,000),
	batch size:	25 kg.
	payback period:	1 year.
	number of batches treated:	50 per day.
	duration of treatment season:	50 days.

Then amortisation of capital is:	7,000 per day.
Say gross income of operator:	1,000 per day.
Say tractor hire costs:	10,000 per day
Total cost of above items per day is then:	18,000
Cost of above items is then:	360 per batch .
Cost of chemical is:	137 per batch
Total cost:	500 per batch.

At these values, some of which are guesses, the idea appears viable.

It is suggested that an assessment of this type should be made by a qualified person at an early stage in the project

Appendix C

Other crop processing operations.

It has been suggested that the project be widened to encompass crop threshing and grading in addition to treating.

The author is of the view that this would be a distraction to an already quite complicated project.

The addition of food grain treatment, which is a very similar process to seed treatment, is acceptable because the same machine will accomplish both tasks. However, the addition of other machines would constitute a significant increase in the project size.

UNIDO COMMENTS

The first report gives a clear picture regarding the nature of approach that should be adopted in Africa for the development of seed dressing machines.

While there is much interest in seed dressing and also in post harvest storage, the report gives the extent of activities being carried out by a number of agencies in propagation of good quality seeds. This in turn raise the question of treatment of those seeds which the present project could also take up.

Still some agreements need to be finalized prior to taking up full implementation of the project. The type of pesticides available in Africa would be the prime candidates for seed treatment.

The basic economic analysis looks promising and based on the output of the project a detailed analysis would be carried out regarding the economic viability.

With regard to the type of machine likely to emerge should be kept open until the first meeting possibly to take place sometime in April 1993. Obviously safety and quality of treated seeds would be of paramount importance.

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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

DEVELOPMENT OF PROTOTYPE MOBILE SEED DRESSING APPLICATORS SUITABLE FOR AFRICAN COUNTRIES

US/RAF/88/273

Technical report: Seed dressing technology - Part II*

Prepared for the Governments of the Republic of Zambia
and the United Republic of Tanzania,
by the United Nations Industrial Development Organization,

Based on the work of J.E. Elsworth,
Chief Technical Advisor

Backstopping officer: B. Sugavanam, Chemical Industries Branch

* The document has not been edited.

TABLE OF CONTENTS

1. Background

The mainstay of the economies of the PTA countries is agriculture. Regional and national strategies accord the highest priority to attaining self sufficiency in food. The policy on pest control is to use Integrated Pest Management, of which Seed Treatment is an important component.

The project is to develop a mobile Seed Treating machine to be available to rural farmers for effective, safe and affordable treatment of their home saved seed. Initially, it is focusing upon Zambia and Tanzania.

The first visit by the C.T.A. was made in Sep/Oct 1992 for familiarisation of the context for the machine. Broad recommendations for the design approach were made during that visit.

The primary purpose of the present visit was to conduct trials on appropriate seeds using the European machines imported upon the recommendations resulting from the first visit. Other aspects of the project were also to be progressed - particularly the choice of manufacturer.

2. Summary.

2.1 Zambia. A P500 (UK built, pedal driven, "village" treater) had been imported. This was used to treat sorghum for trials at the state research station. Plans were made for the treatment of maize. A possible co-operator for village testing of the prototype was identified. A likely manufacturer was also identified.

2.2 Tanzania. The Hege treater, ordered by U.N.I.D.O., had not arrived so no trials could be treated. An alternative, preferred, manufacturer was identified. Some possible sites for prototype testing were identified. A visit to T.P.R.I. was not possible but the C.V.s of the three professional staff involved were collected.

3. Recommendations.

3.1 That the contracts for the principal, and if necessary the secondary, institutes in each country be urgently finalised. The project is being held back by the lack of contracts.

3.2 That the responsibilities and lines of communication for the various institutes and personnel be clearly defined in writing and distributed to those affected. If necessary, a workshop of all concerned parties be held to agree these working relationships.

3.3 That the programme recommended after the 1st visit be maintained in the plan - i.e. C.T.A. visits in May/June and Nov/Dec 93 and a seminar in spring 94, with an additional visit in Feb 93 to Tanzania for the treatment of trials seed. This could be combined with the workshop in 3.2 above.
That the whole programme be re-defined in the light of the changes in circumstances since it's original construction. (See Appendix A for suggested programme.)
That flexibility be maintained regarding this programme.

3.4 That the purchase of the project vehicles be expedited in order to alleviate the transport difficulties. Toyota 'Land Cruiser' (4 x 4) which are already used by T.D.A.U. and have integral metal bodies are recommended.

3.5 That the European contractor be commissioned to carry out certain tests on potential machine components as soon as possible.

3.6 That consideration be given to the placement of the two European built machines into villages at harvest 1993 to treat farmers crops with storage insecticides.

3.7 That consideration be given to the preparation of a leaflet to be handed out to farmers providing information on safety precautions and the appearance of treated seed.

3.8 That discussions be opened between T.D.A.U. and Lenco, Lusaka, as possible manufacturers of the Zambian machine, when the contract with T.D.A.U. is signed.

3.9 That T.D.A.U. maintain contact with World Food Programme regarding field testing of the prototype seed treater, including the possibility of utilising the P500 in May for food grain storage treatment.

3.10 That discussions be opened between T.E.M.D.O. and Dharam Singh Hanspaul & Son Ltd, Arusha, as possible manufacturers of the Tanzanian machine, when the contract with T.E.M.D.O. is signed.

3.11 That T.E.M.D.O. maintain contact with Mr Ndemasi of Twiga, and Global 2000, regarding the siting and supervision of the prototype machine.

4. Acknowledgements.

Thanks are due to Mr Opio of P.T.A., to Dr Kwendakwema of T.D.A.U. and to Mr Msolla of T.E.M.D.O. for their time spent and for their help with transport - particularly in view of the many demands made upon their vehicles. Shell Chemicals (Zambia) Ltd. supplied the 1 kg sample of 'Thirasan M'.

5. Zambia.

5.1 Further to the background information given in 1st visit report, the following points arose:

5.1.1 Current situation in Low Rainfall Areas. The government claims that all farmers have been supplied with new seed. World Food Programme claim that much of it was supplied by the Programme Against Malnutrition (P.A.M.) - a consortium of U.N. organisations, N.G.O.s and religious and medical organisations. In some areas, seed banks are being set up by Oxfam. Farmers receiving free seed this year have undertaken to provide twice the quantity of seed back into the store at harvest.

5.1.2 Seed Companies. An additional company starting in the seed business is Pana. There are also a number of farmer associations being formed with seed production as one aim. (An important phase of the development of the seed industry in Europe.) These might be candidates for use of the eventual machine.

5.1.3 Products used. 'Captasan' is no longer available.

5.2 Trial.

5.2.1 During the 1st visit a comprehensive trial design was agreed with Mt Makulu involving three varieties each of sorghum and maize. However, at the present visit Mt Makulu staff expressed concerns that the project had been abandoned, since no contact had been made during the intervening period, and no contract had been received. Thus the seed stocks had been used for other work, and the retention of effort in the Mt Makulu programme for the current project was on a contingency basis only.

5.2 **Zambia** - Trial (cont.)

5.2.2 Sorghum. Sufficient of one variety only of sorghum was located. The contingency provision of effort only allowed four treatments, and Mt Makulu staff insisted upon the inclusion of Zamseed treated seed as one treatment. Thus the four treatments used were:
Treatment 1: Untreated control.
2: 'Thirasan M' - treated at standard rate (250 g / 100 kg.) in the P500.
3: Zamseed treated. ('Thirasan M' at standard rate in the Gustafson machine.)
4: "Traumatised" - i.e. mixed in P500 but not treated.
The variety available was Kuyuma - recommended for low and medium rainfall areas.

The Gustafson machine is not capable of treatment of a small batch, but Mt Makulu was adamant that the sample they would obtain from Zamseed was from the same batch as the seed used for the other three treatments. The seed batch was from a 200 hectare site, so some variation across it cannot be ruled out.

The 1 kg sample of 'Thirasan M' used was supplied gratis by Shell Chemicals (Zambia) Ltd.
The process of treating seed in the P500 is described fully in Appendix B.

The four treatments will be planted on two research station sites - Msekera (near Chipata in Eastern Province) and Golden Valley (near Lusaka). These are both within the medium rainfall area.
The trial design will be Randomised Complete Block Design. (R.C.B.D.) Each site will have 4 replicates, each of 4 rows x 5 meters long.

5.2.3 Maize. Again, seed availability was a problem. The variety Pool 16 was recommended but no untreated stocks were available. However, a late crop grown by the research station was due to be harvested on 4th December. Plans were therefore made for T.D.A.U. staff (Mr Sythes) to return to Mt Makulu on Wed 9th Dec with the P500 to treat this trial. The design of the maize trial was exactly the same as the sorghum except that the application rate was 150 g / 100 kg.

5.3 Press / T.V. Event.

A hand-over ceremony for the P500 - from U.N.I.D.O. to P.T.A. took place at the University of Zambia, hosted by the Dean of the Faculty of Engineering, Professor Jolly M.Mwenechanya.
The U.N.I.D.O. Country Manager, Dr Taylor, officially handed the machine over to the Secretary General of P.T.A., Dr M.Wamutharika. The machine was then demonstrated by the C.T.A. Press were invited but only the Z.N.B.C. (T.V.) attended. A short item appeared on the evening news programme and an invitation was received from a current affairs programme - "Kwacha Good Morning" - to appear on their Saturday morning programme. A second demonstration was therefore made, this one live. In both these demonstrations, ink was used to show the effect of the treatment on the seed.

5 Zambia (cont.)

5.4 Manufacturer.

A visit was made to Lenco (Lusaka Engineering Company) - Agricultural Section. The production facilities were inspected. Products include ploughs, harrows, carts, (all ox drawn) and hammer mills. The latter is a relatively complex machine, built in batches of 10. The others are built in batches of 500 or 1000. The organisation, standard of workmanship, and housekeeping all appeared good, and the skills and production techniques relevant to the seed treater project. Further advantages of this company are it's proximity to T.D.A.U. and a history of co-operation between the two organisations. Lenco becomes the preferred company of the three inspected.

5.5 I.F.A.D. - Smallholder Services Rehabilitation Project.

Operating in two provinces, Eastern and Luapula (northern area), this project, among other activities, encourages the formation of farmer groups for collective investment in capital equipment. Funding is from the World Bank. The current 8 year project is due to end in 1995 but is likely to be extended. This could be a useful contact in the dissemination phase of the seed treater.

5.6 Africare.

A pan-African charity involved in development of agriculture, nutrition, health and water supply / sanitation, Africare is a participating charity in the Programme Against Malnutrition (P.A.M.) mentioned above.

5.7 World Food Programme. (of U.N.)

W.F.P. is the co-ordinator of P.A.M. which involves a number of N.G.O.s. The programme has distributed seed to farmers whose crops suffered from the draught. Farmers have undertaken to repay this "loan" by contributing seed from their harvest to newly formed seed banks, at the rate of 2 kg for every 1 kg received. The seed banks are to be controlled by local authorities. There will be a need for ingoing seed to be treated for storage pests (not fungicides since it may, in some circumstances, become food). When taken out for planting, there will be a requirement for fungicide treatment. One of the groups was suggested as a possible venue for the testing of the prototype seed treater, for example Mazabuko or Kafue Gorge, both of whom are in the low rainfall area, and within half a day drive of Lusaka.

Much could be learned of the logistics of operating a village treater by placing the P500 into the chosen group at harvest for treatment of the food grains being put into store. Discussions with the various authorities and chemical companies would be necessary in this development to obtain any necessary clearance, the support of the district agricultural office, and to decide upon the preferable formulation of insecticide.

6 Tanzania.

6.1 Trial.

No trials were treated because:

a) The Hege machine had not arrived,

b) Treating beans in an alternative machine would not advance the knowledge base,

c) The main bean planting season is February / March. together with the maize and sorghum planting season. (Some beans are planted in December - in the hope of sufficient precipitation during the "short rains" to maintain plant health until the "long rains" - Feb / April.)

d) Administration problems concerning the lines of communication, contracts etc., which must be resolved before T.P.R.I. can become involved. It is essential that these problems be solved in time for the February planting season.

6.2 Manufacture.

A visit was made to Dharam Singh Hanspaul & Sons Ltd., P.O.Box 613, Arusha. The production facilities were inspected. Products include a range of 4 sizes of hammer mills and a tractor powered maize sheller. These are produced in batches of about 20. The facilities and standard of workmanship were considered quite good and the products require skills similar to those of the current project. There is some history of co-operation with T.E.M.D.O., although less than with S.I.D.O. Never-the-less, Hanspaul is considered the more suitable co-operator

6.3 Sasakawa Global 2000 - Dr Abu M. Foster.

This American based organisation operates across Africa, working on technology transfer, including the strengthening of the existing extension services. It has introduced into Tanzania a seed treatment technology package for maize and sorghum for controlling army worm. Dr Foster suggested some villages, where S.G. 2000 has been active, as possible sites for the field testing of the prototype. These were Kingori, Maren Ugama, Mararoni, and Kikatiti.

7 Technical Discussion.

7.1 A development of the ideas discussed with T.D.A.U. during the previous visit is to envisage the Zambian machine in two parts, namely mixer and drive unit. The drive unit would consist of a twin pedal assembly, seat and hand hold, and could potentially, form a drive unit for other machines, e.g. a winnower. The mixer unit would accept power from the drive unit by a twisted vee or flat belt (the latter is more efficient but less available). The two units would be joined via removable links for easier handling when moving.

7.2 Following the trial at Mt Makulu, it is evident that attention must be given to the mixing of the slurry, the continued agitation, and the method of introduction into the machine of metered quantities. These quantities will be dependent upon the seed type and the batch size. Furthermore, the mixing and metering systems will have to be firmly attached to the machine to prevent theft.

7.3 The technical questions raised in the report of the previous visit were again reviewed. It was felt that the European contractor would be in the best position to conduct tests in the areas of untried ideas. Since the training programme will involve this contractor, it should be timed such that the tests are completed by that point and discussions on the results can be held. This will require a rapid appointment of the contractor.

7.4 The idea of utilising a standard disc made for soil working machines was presented, and details of available discs were left. For Tanzania, a suitable disc, available as a spare part in Arusha for TSh 27,000, was located. The machine, for which it is a spare, is a Zimbabwe built disc plough.

7.5 The two publications mentioned in the bibliography of the previous report were handed over to both T.D.A.U. and T.E.M.D.O. The monograph "Seed Treatment" provides a broad background to the practice, including information on a wide range of crops and descriptions of application methods. The M.Phil. thesis paper on the design of the mixing chamber gives a valuable insight into the working principle of the Milik mixer, and a lead to the design of "bumpy" rotors and stators.

8 Project Administration.

There appears to be some confusion concerning the protocol of the project, with many conflicting opinions about lines of communication. In addition, there is a lack of emphasis in the design institutions, arising from the absence of a contract, combined with pressure from other projects. These factors inhibit progress except when the C.T.A. is present. There are also transport problems with many demands upon the existing vehicles of both design institutes and, in Zambia, P.T.A. The efforts of these three organisations in the face of their difficulties is greatly appreciated, and for the most part, transport was effective. However, it clearly added extra strain to already stretched transport services.

A suggestion made by Mr Opio is for a workshop to be convened as early as possible in 1993 to consider and resolve these matters. A similar suggestion was made by Dr Mosha in a letter to Mr Msolla. This workshop would also consider the re-alignment of the programme in the light of the changed circumstances since it was drawn up. A proposed revised programme is given in Appendix A.

Appendix A - 1

Suggested re-alignment of activities in the light of developments since the project was drawn up.

The following suggestions are based on the original document and attempt to follow the same format as far as possible.

Output 1. Production & Testing of Prototype Machines.

1.1 / 1.2 Finalisation of sub-contract and appointment of contractor.

Delayed - expected to be finalised Dec 92 by U.N.I.D.O. Role now changed to rig testing, training and techno-economic analysis.

1.3 Selection of African Institutes.

Completed by C. MacFoy visit July 92.

1.4 Assignment of roles of African Institutes.

Completed by C.T.A. Sep / Oct 92. The role for the engineering institutes is the major one of design and development of the prototype machines. For the biological institutes it is the monitoring of the field performance of the machine through to dissemination.

1.x (Additional Item) Rig Testing of Ground Breaking Ideas.

Specifically:

Large slow running spinning disc,
High clearance rotor with incorporated fan,
High speed rotor,
"Bumpy" rotor and stator surfaces.

European Institute. Jan / April 93

1.5 Detailed Design.

Now planned for the African Engineering Institutes. Jan - May 93. Design to incorporate the results of test work at the European contractor.

1.6 Fabrication of Prototype.

Planned for African Engineering Institutes. April / Aug 93 (Zambia) & April / Sep 93 (Tanzania - because of rather more complex machine). Timing includes procurement of "Bought In" parts.

1.7 Preliminary Trials and Modification of Prototype.

Planned for African Engineering Institutes. Sep / Oct 93 (Zambia) & Oct / Nov 93 (Tanzania)

Appendix A - 2

Output 1 (cont.)

1.8 Preparation for Field Testing.

Planned for African Institutes / C.T.A. Sep / Oct 93 (Zambia) & Oct / Nov 93 (Tanzania)

1.9 Preparation of Chemical Formulations.

Chemical formulations already exist in both lead countries, which are registered and established in the commercial seed business. In Zambia the formulation is satisfactory, containing as active ingredients only thiram and malathion. In Tanzania the formulation contains lindane and thus should be viewed as a first (formulation) priority. An insecticide with lower mammalian toxicity, and less persistence, would be preferred. The need for, and role of, the insecticidal component in the proposed rural practice should be reviewed. (*In* many cases the seed will be already protected against storage pests.)

Thereafter, chemical formulations should be kept under constant review as experience is gained and the scale of the operation increases.

The currently available formulations are W.P. (slurry) type. A serious practical disadvantage is envisaged in the need for mixing and continuous agitation of the slurry. True liquid formulation would be preferred because of easier handling, lower application rate, better retention on the seed, and less contamination of farmers hands.

Chemist / Biologist / C.T.A. Continuous.

1.x (Additional Item) Preparation of a Hand-Out Leaflet for Farmers.

To be given either by agricultural extension workers, when informing farmers of the provision of the service, and/or by the field test team. The leaflet should give, broadly, the same information that the label on a sachet or bottle of agrochemical would give - particularly safety information and precautions. The language could be pictograms, and a colour picture of treated seed would give farmers an idea of the correct loading by visual assessment. This would enable him/her to check the correctness of the loading.

African institutes / contractor / C.T.A. Feb / Oct 93.

1.10 Field Testing.

This phase will take several weeks. The latter part is an opportunity to introduce representatives from 2nd line countries.

African institutes / contractor (for techno-economic analysis) / chemist / biologist / C.T.A.
Nov / Dec 93 (Zambia) & Feb / March 94 (Tanzania)

Appendix A - 3

Output 1 (cont.)

1.11 Training Programme for Technical Personnel.

The personnel engaged in the design of the machines in the African Engineering Institutes are qualified engineers to MSc level. Training in basic engineering would be inappropriate. It is suggested that a visit be made to Europe by the key staff involved from the African engineering and biological institutes to:

a) Review the results of the rig testing work to be carried out be the contractor.
b) Tour a selection of seed companies, research stations and chemical companies.

Organisation: C.T.A. / contractor / U.N.I.D.O. Jan / April 93
Implementation: African institutes / C.T.A. / contractor. April / May 93.

Output 2. Report on Prototype and Techno-economic analysis of experience.

2.1 Compile Information.

African institutes / contractor / C.T.A. Continuous.

2.2 Techno-Economic Analysis

Contractor Jan / April 94

2.x (Additional item) Appoint Representatives from 2nd line countries.

Representatives should be knowledgeable about the agronomic practices and culture in their countries. They will take a key role in transferring the technology into their countries.

P.T.A. / C.T.A. July / Oct 93

2.3 Investigate Viability in Other (2nd line) Countries.

The representatives should witness the latter part of the field trials in the lead countries.

Representatives / contractor / C.T.A. Nov 93 / April 94

2.4 Prepare Report of Experience and Findings to Date.

This should include recommendations for the way forward.

African institutes / contractor / representatives / C.T.A. May / July 94

Appendix A - 4

Output No 3. Report on marketing survey and potential for local manufacture.

The prototype test phase (item 1.10) will also act as a test marketing operation. If a more broad survey of the requirement for a seed treatment service is required, it is suggested that this should be implemented immediately since the project is based on the assumption that there is a need.
An assessment of the economic viability of the proposed machine is practicable at the present time (Dec 92) and should be conducted as early as possible so that any requirement for continued support can be evaluated.

The potential for local manufacture is being assessed continually with early appointment of chosen companies recommended. These companies will then be encouraged to liase closely with the design institutes in order to facilitate a smooth transfer of the manufacture.

Output No 4. Identify Organisation Responsible for Dissemination & Commercialisation.

It is suggested that P.T.A. is well placed to drive the dissemination and commercialisation phases of the project, by virtue of it's long term involvement. S.A.D.E.C. could be in a position to back up the work if additional management was required.

Output No 5. A Core of Trained Personnel (12 - 18) to support the project.

All the African institutes involved have staff qualified in the various disciplines needed for the project. They will benefit from the experience of working within their professions as members of a multi-disciplinary team, and will constitute the above core.

5.1 Preparation of Framework.

See section 1.11 above. This applies to the professional staff of the African institutes.

5.2 Design Training Programme.

This could include visits to the European contractor, seed companies, research stations, and chemical companies.

Contractor / U.N.I.D.O. / C.T.A. Jan - April 93

5.3 Implement Training Programme.

African institutes / contractor / C.T.A. April / May 93

Appendix A - 5

5.4 Training of Machine Entrepreneurs and Operators.

A training programme should be constructed following the field trials.
African institutes / contractor / C.T.A. Jan / April 94.

Additional Activities Required

In order for the project to make a difference to the development of P.T.A. countries, some initial plans for dissemination will also be required. The following is suggested:

6.1 Formulate Plans for Pilot Year.

Decisions required include
a) The number of machines to be made for the 1994 / 95 season, for each participating country. (Including, at that stage, the 2nd line countries.)
b) The financing of these machines, including the provision of working capital, and the commercial arrangement with the pilot entrepreneurs.
c) The method of selection of the entrepreneurs / users of the pilot machines in each country.
d) The construction of a training programme for these entrepreneurs and any support staff.

U.N.I.D.O. / P.T.A. / African institutes / Reps from 2nd line countries / contractor / C.T.A.
Zambia, Malawi, Zimbabwe: Jan / Feb 94
Tanzania, Kenya, Rwanda: April / May 94

6.2 Assessment of Needed Design Changes.

The field testing of the first prototype will inevitably result in ideas for improvement of the design. The various ideas will need to be discussed and decisions made as to what changes will be made.

African engineering institutes / Reps from 2nd line countries / Manufacturer / C.T.A.
Zambia et al: Jan / Feb 94
Tanzania et al: April / May 94

6.3 Implementation of Design Changes

African engineering institutes.
Zambia et al: Feb / March 94
Tanzania et al: May / June 94

6.4 Construction of Pilot Production Machines.

Manufacturer / African engineering institutes
Zambia et al: April / July 94
Tanzania et al: July / Nov 94

Appendix A - 6

Additional Activities (cont.)

6.5 Appointment of Users

African engineering institutes / C.T.A. June / July 94

6.6 Training of Users.

African biological institutes / contractor / C.T.A. Aug / Sep 94

6.7 Field Use of Pilot Production Machines.

Users. (Monitored by contractor / African institutes / Reps form 2nd line countries / C.T.A.)
Zambia et al: Nov / Dec 94
Tanzania et al: Feb / March 94

6.8 Report of 2nd year of use.

This should contain recommendations for the further way forward, which, in principle, should be an expansion of the previous year.

Appendix B.

Procedure for the Treatment of Sorghum in the P500 Seed Treater.

1. An arbitrary choice of water rate was made of 10 l / tonne.

2. A mix of 'Thirasan M' formulation with water was then made.
   27.5 g of formulation was mixed into 110 ml of water. (Sufficient for 11 kg seed.)

3. The density of the mix was measured. 100 ml was found to weigh 107 g. Thus the total amount mixed would be equivalent to 128.5 ml, and would give a volume application rate of 1168 ml / 100 kg.

4. A batch of 8 kg of seed was weighed out. (Short of the 10 kg ideal because of the seed shortage.) The seed was placed in the mixer, the spinning disc was switched on and the pedals turned vigorously. 94 ml of the slurry were then poured onto the spinning disc. It took 15 seconds for the slurry to run down the supply pipe to the spinning disc - longer than the 10 sec normal recommendation. Thus the supply pipe in the prototype should be made slightly larger.

5. The pedals were then turned backwards to discharge the seed.

Appendix C - 1

Institutions / Personnel Visited.

Zambia.

1. U.N.I.D.O.	Dr Taylor.
2. P.T.A.	Dr M.Wamutharika, Secretary General. Mr J.Mwencha, Director of Industry & Energy; Mr J.Opio, Senior Industrial Expert. **Project Manager.**
3. T.D.A.U.	Dr N.Kwendakwema, Director; Mr J.Tambatamba, Project Engineer Mr B.Sythes, V.S.O. Designer.
4. U.N.Z.A.	Dr Y.D.Deedat, Entomologist.
5. Mt. Makulu.	Mr A.Chalabesa, Entomologist; Mr G.Malenga, Plant Pathologist.
6. S.C.C.I.	Mrs M.M.Chipili, Chief - Official Seed Testing Laboratory.
7. Zamseed.	Mr P.Lloyd, Processing and Storage Manager.
8. Shell Chemicals.	Mr M.Malumo, Commercial Manager.
9. I.F.A.D.	Mr N.A.Lunga, Financial Controller - Smallholder Services Rehabilitation Project.
10. Africare	Mr M.C.Homer, Resident Representative - Zambia. Mr L.M.Phiri, Edible Oils Project Co-ordinator.
11. Oil Seeds Industry Liaison Service.	Mrs B.M.Lubozhya, Oils Co-ordinator.
12. World Food Programme.	Ms Chastain Fitzgerald. Co-ordinator.
13. Lenco.	(Very knowledgeable manager - unfortunately no record of his name.)

Tanzania - Arusha.

1. T.E.M.D.O.	Mr G.Msolla, Director General. **Contact person for the Project in Tanzania.** Mr M.Tango, Design Engineer.
2. Cargill.	Mr R.Banfield, Production/Processing
3. Twiga.	Mr E.Ndemasi, Technical Representative.
4 Global 2000	Dr A.M.Foster, Senior Scientist.
5. Hanspaul	Mr Hanspaul, Senior (now retired), Mr Nishit, Manager.
6. Valmet Dealer	Mr A.Rowan, Branch Manager.

UNIDO COMMENTS

The second report of the Chief Technical Advisor covers the work carried out in organizing seed treatment trials in Zambia. Some of the transport problems that could be faced in Zambia is expressed by the author and hence the adaptation of existing machines to suit Zambian conditions will be one of the prime considerations of the design team both in Europe and Zambia.

The two types of machines, one to suit Zambia and another for Tanzania, support the project's view of the necessity of having two focal points in the sub-regional project.

The trials planned in Tanzania had to be postponed since the Tropical Pesticide Research Institute, Arusha, is not yet formally included in the project. Once this is confirmed, the trials could be started in Tanzania region.

The work plan given in the report will be further discussed in the proposed meeting due to take place in April 1993.