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DEVELOPMENT OF PROTOTYPE MOBILE SEED DRESSING APPLICATORS SUITABLE FOR AFRICAN COUNTRIES

US/RAF/88/273

Technical report: Findings and recommendations*

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

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Chemical Industries Branch

* This document has not been edited.

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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 second visit was in Nov/Dec 93, to coincide with the Zambian planting season, for the treatment of trials seed. A European machine - the 'Rotostat' P500 - had been imported into Zambia as a basis for the project and to test the recommended principal with local seed varieties. Other aspects of the project were also progressed in both countries, particularly the choice of manufacturer.

The third visit was in March/April 93. A second European machine - the Hege - had been imported into Tanzania for the same reasons. This machine was demonstrated to enable seed to be treated for trials purposes. Other aspects of the project were progressed in both countries, including the attending of the first project workshop in Arusha and an inspection of the Zambian trials.

The purpose of the current visit - the fourth in the series - was to conduct the first village trials in Zambia using up to three machines, to plan for trials in Tanzania in 1994, and to review the trials data and progress the selection of manufacturers in both countries.

2. Summary.

2.1 Zambia - 1st part.

The TDAU prototype was seen. It has many innovative ideas for cost cutting. Three kg of the local seed treatment formulation were purchased for the trials. A trial site was selected. The PTA economist assigned to the project joined the working team. Six potential manufacturers were visited.

2.2 Zambia - 2nd part.

Machine tests were conducted in villages in the Kafue district. Three machines were tested. The 'Rotostat' P500 and the Silso prototype worked well. The TDAU prototype suffered jamming of maize seed in the rotor clearance and requires further development.

2.3 Tanzania.

The author had reservations about the current design proposal using open bevel gears, and made suggestions for an alternative, belt drive, approach. It subsequently transpired that a European gearbox has been provided by the contractor, to enable the original recommendation to be followed. The result of the long rains trial (April 93) on beans was satisfactory. Maize and beans were treated for short rains trials (Nov 93). Tentative plans were made for the first testing of the prototypes in March 94. Two potential manufacturers were visited.

2.4 Formulation.

The currently available formulations are far from ideal for farmer application and will need to be replaced in the long term.

3. Recommendations.

3.1 That the availability in Zambia of suitable plough discs from UK based suppliers be investigated. Action: Author.

3.2 That T.D.A.U. further develop their prototype and test it with a range of farmer seed. That a production design be prepared and submitted to the following manufacturers for their comment and costing.

1) Lenco
2) Vortex
3) Turning and Metals
4) Gammeco

Following the quotation stage, one or two should be selected to produce a small pilot batch. This batch will probably need to be financed, or at least underwritten, by the project.

3.3 That T.E.M.D.O. design and build a prototype tractor mounted machine along the lines originally recommended, using the gearbox taken to Tanzania by the project engineer.

3.4 That urgent consideration be given to the production of a suitable liquid formulation. This will be a major undertaking and should be an agenda item for the forthcoming review meeting.

3.5 That, pending the availability of a liquid, (likely to take some years) the treatment procedure to be stipulated should be to make a separate batch of powder and water mix for each seed batch. (See section 6.2.3.2)

3.6 That if an opportunity arises to use a product colour other than red, it should be taken, since red is difficult to see on beans.

4. Acknowledgements.

Once again, the help of Dr Kwendakwema of T.P.R.I. and Mr Msolla of T.E.M.D.O. are greatly appreciated. The availability of the pick-up during the visit was a boon, enabling the various institutions to be visited on a flexible basis, and very significantly increasing the effectiveness of the CTA's time.

Mr Opio did a great deal to help the project, both before and during the visit, and the availability to the project of Mr Sichelima, an economist with P.T.A., has enabled a shift to a higher gear.

5. Zambia

The Zambian visit was in two parts - at the beginning and end of the trip, with the visit to Tanzania sandwiched between.

5.1 1st Part

5.1.1 Machine Design

The prototype machine at TDAU was inspected. A large number of very innovative ideas were incorporated which have the potential effect of reducing the cost of production over the 'Rotostat' P500 very considerably. Wood was used for a number of the components, and the whole design concept was simplified. Some sacrifice had been made to the precision of the fit between rotor and rotor housing and it remained to be seen if this would effect the performance.

The machine used a belt drive, as with earlier prototypes built by the author. Bicycle type bearings were used for pedal and rotor shafts. The rotor was built from wood, and some difficulty was reported with the dimensional stability of this material. (Plough discs, which had been recommended, appeared to be very expensive and difficult to obtain in Zambia. The author had bought one for £12 from Simba Engineering of UK. It was found that this company are represented in Zambia by Power Equipment Ltd. of Lusaka.)

The rotor housing and stator were made as one piece, using a rolled mild steel cylinder. The dimensional accuracy of the clearance between rotor and rotor housing were thus considerably compromised with a very significant effect on the likely cost, but a possible adverse effect on performance. To try to seal the gap, a flexible curtain was attached to the rotor, which it was hoped would be pushed against the stator wall by the centrifugal effect of the seed.

5.1.2 Chemical Formulation.

The only known seed treatment chemical available in Zambia is 'Thirasan' M from Shell. This is a wettable powder containing 68 % thiram and 6.5 % malathion. It is applied at 150 g / 100 kg of larger seed, (e.g. maize, beans, groundnuts) and 250 g / 100 kg of smaller seed, (e.g. millet, sorghum, ochra, vegetables.) The current price is 6,300 kwacha for a single kilogram. (c.f. a price indication of 800 K per kg for a 25 kg pack in Sep 92.) Three x 1 kg were purchased by the author for the field trials. (Sufficient for 1.2 tonnes of seed at the higher rate, or 2 tonnes at the lower rate.)

5.1.3 Selection of a trial site.

A first visit was paid to Kafue - Riverside Development Agency - by the author and Mr M.Sichelima of P.T.A. Mr Andrew Aho, the manager, was travelling, but his two assistants, Mr P.Kabuku and Mr P.Mubanga indicated their willingness to co-operate in the testing of the machine. They suggested taking the machine to local villages to demonstrate it and treat the farmers seed.

5.1.5 Potential Manufacturers.

The following engineering companies were visited.

5.1.5.1 Lenco. (Lusaka Engineering Co.)
P.O.Box No 33455
Katanga Rd.
Off Mungwi Rd.
Heavy Industrial Area
Lusaka Manager: Mr Haijboer

Lenco is a parastatal (but on the privatisation list), making a wide range of products, of which agricultural machines is one division.

The impression as recorded from the first visit was confirmed. A well organised company producing quite large batches of various agricultural products. Maize mills are included and produced in batches of around 30 - a number likely to be compatible with the seed treater.

On this occasion, Mr Haijboer was seen. He confirmed his interest in the machine and offered the comment that it would need to cost as little as $200 to be viable. He expressed his willingness to visit the trial site to see the machines in operation.

5.1.5.2 Knight Engineering Co. Ltd. P.O.Box 30702
Lumumba Rd
Lusaka. Director: Mr Gangai Farook
Technical Manager: Mr Faisal Alam

This company have the necessary machine tools and steel fabrication equipment to make the envisaged machine. Far from batch production of existing designs, their typical job is to take a problem and find a solution in the form of a prototype. However, they would be willing and able to make batches of seed treaters, and would start by quoting against actual working drawings.

5.1.5.3 Vortex Refrigerator Co. Ltd. P.O.Box No 34492
7226 Kachidza Rd.
Light Industrial Area
Lusaka Manager: Mr N.Valand

This company have a general engineering division in addition to their specialisation in refrigeration equipment. Again, they have the right types of equipment and looked a well ordered manufacturer. The suggested procedure again was to submit detailed drawings for quotation.

5.1.5.4 Alro Engineering Co.
Lumumba Rd.
Lusaka Manager: Mr Trevor Kinnear

This company have the capability, but the policy of Mr Hassan, their director, is normally to sell first and then manufacture to order.

5.1.5.5 Turning and Metal Ltd.
Lumumba Rd.
Lusaka Technical Manager: Mr Nair

Manufacture 150 - 200 maize mills and shellers per year. These are distributed via S.I.D.O. and direct. Mr Nair expressed his willingness to build one machine first, for evaluation, and then build a batch. He would like to have the chance to contribute to the design process, to influence its suitability for production.

5.1.5.6 Gameco
Lusaka Operations Manager: Mrs Chisenga
Foreman: Mr Sindase

A large company, making a diverse range of farm machinery, and well equipped for the envisaged machine. They have a hydraulic press which they say could be used for forming the dished rotors. However, their distribution system seemed rather limiting. They appear to rely on farmers visiting Lusaka, even from remote regions, to buy their implements. The author feels reservations about the suitability of this system for the seed treater.

5.1.4 Socio-Economic Aspects of the project.

Mr M. Sichelima, an economist with P.T.A., became involved with the project from the point of the first visit to Riverside Development Agency. He is to make a study of the marketing aspect of the project, including those institutions which might be involved in dissemination. This aspect will include a distribution system for the chemical involved.

A questionnaire was discussed which will form the basis of a market research exercise. Initially, this will concentrate on Zambia, and the experience gained will facilitate a similar operation in the other target countries.

This aspect of the project is of prime importance because the experience of many other projects is that "suitable" prototypes are built in research institutions, only to be abandoned because of the difficulty of dissemination,

The opportunity was also taken of a meeting with Mr Martin Williams, a small business advisor working with V.S.O. in the Samfya district, Northern Province, to obtain experienced views on the marketing and distribution of the eventual machine. In his view, the co-operative structure was the only viable option. The local co-operatives are becoming re-established after a period of change following the political developments of the last two years in Zambia. They are able to give loans to entrepreneurs with quite small deposits, and using the machine itself as collateral. This procedure is well established for the purchase of other capital plant, such as maize mills. A target price of only US$ 200 was suggested by Mr Williams. In the author's view this is not likely to be achievable without very large scale production.

5.1.6 Project to encourage certain farmers to become local multipliers of seed.

A meeting was attended to plan for a project to encourage certain farmers to become multipliers of seed. Other participants were Mr Alex Mwanakasale, Agricultural Officer with World Food Programme (W.F.P.), and Dr Muliokela, Director of the Seed Control and Certification Institute. (S.C.C.I.) There are already moves in this direction by a number of organisations, e.g. S.A.D.C. and Africare are both encouraging this trend. In the case of S.A.D.C. the project has just started. The first phase involves only three countries and only one region in each of those. The second phase will bring in three more countries, etc., so Zambia might have to wait some years before a significant amount of it was covered.

The project being discussed at the current meeting would be a Zambian national project. Although it might well start in one region only, it would develop the technology quite deeply within that region and then disseminate to other regions relatively quickly. The seeds types would be those seen as desirable diversifications (from maize) by the Zambian government, e.g. sorghum, cowpeas, groundnuts, beans, millet.

The plan of action agreed at the meeting is that a project proposal will draw up - initially by Mr Mwanakasale. After completion, it will be submitted to Programme Against Malnutrition (P.A.M.) - supported by W.F.P. - for funding. S.C.C.I. would then create suitable training programmes, and select and train farmers.

This project is not directly related to the current one, but interfaces so closely with it that the opportunity to participate was taken. No further participation is expected, except to keep in touch with it and make seed treating machines available to the selected farmers.

5.2 2nd Part

5.2.1 Machine Tests and Modifications.

5.2.1.1. Chakola Village. (Kafue district.)

Present at the test were: Mr P. Kabuku of Riverside Development Agency
Mr Sichelima of PTA
Mr B. Sythes of TDAU
Author
About 20 farmers and other villagers.

Machines tested were: TDAU prototype
'Rotostat' P500

The TDAU prototype rotor seized when maize seed forced its way past the flexible curtain and became jammed in the rotor. No treatments were carried out in this machine. The 'Rotostat' P 500 was tested with the normal, high speed, spinning disc, with satisfactory results. It was then modified by mounting the spinning disc directly from the rotor, and re-tested with equally satisfactory results. (This confirms the findings of Silso Research Institute.) A total of 30 kg of seed was treated, from three farmers, in a total of 7 batches with quantities varying from 3 kg to 8 kg (considered to be the maximum for maize.)

A system of measuring the powder had been devised, using a modified syringe as a variable measuring volume. Two other, fixed volume, devices were also available. The syringe proved very tedious to use, because of its small size, and the consequent need for multiple volumes.

The procedure was to measure the required amount of powder into a beaker, and add approximately 15 ml of water per kg of seed. This was then mixed by oscillation of the beaker, and immediately poured down a funnel into the rotating machine. Even so, some sediment remained in the beaker each time.

5.2.1.2. Mulawo Primary School. (Kafue district.)

The primary school acted as a focal point of communication to the rural farmers in the area and as a venue for the tests.

Present at the test were:
Mr P. Kabuku of Riverside Development Agency
Mr Mike Dunbavin of TDAU
Mr Ray Wainwright of Silso Research Institute
Mr John Power of Silso Research Institute
Author
About 100 farmers and other villagers.

Machines tested were:
TDAU prototype - modified by the addition of a second curtain. attached to the stator, facing downwards, and overlapping the rotor curtain.
'Rotostat' P500 with rotor mounted spinning disc.
Silso Research Institute prototype.

The TDAU prototype rotor seized once again when maize seed forced past both curtains and became jammed in the rotor. Again, no treatments were carried out in this machine. The 'Rotostat' P500 and the Silso prototype were tested extensively with generally satisfactory results. However the following difficulties were identified.

For the P500, firstly the back pedalling discharge system had the effect of discharging a small amount of seed when an inexperienced "pedaller" sought to commence pedalling by a small backward movement. Secondly the seed baffle clearance was set so that seed could easily become jammed in the gap. This happened particularly when accelerating with a high seed load.

For the Silso prototype, firstly the door opening proved inadequate, requiring a long discharge time. Secondly, the belt tended to fall off the jockey pulley when back-pedalling (again, inexperienced pedallers tend to back-pedal before starting.)
The final design must be immune to any problems associated with a small backward movement of the rotor because in practice inexperienced pedallers will often be used.

A total of about 0.5 tonne of maize seed was treated, from a large number of farmers, in about 100 batches with quantities varying from 1.5 kg to 9 kg (in the Silso prototype.) Unfortunately, most of this seed was the progeny of hi-brid seed. which should not be re-planted because of it's low vigour. This point was made very clear to the farmers at the beginning of the test; they were requested to plant only part of their field with treated seed, and the remainder with the same seed, but untreated. They could then see the difference for themselves and avoid the mistake of blaming the poor growth on the treatment. The names of the few farmers bringing local varieties were recorded so that follow up visits can be made to check on the effect.

The measurement of the powder was even more tedious to use with this much more extensive test.

5.2.1.3 Modifications to Machines.

The P500 baffle and discharge guide were removed and replaced with a fabricated door, opening outwards with vertical hinge on the upstream side. The discharge guide assembly was then refitted on the outside only. This leaves no internal baffle, so a small plate was shaped appropriately to be tried if necessary.

The Silso prototype door was modified to open wider. It opens inward with a vertical hinge on the downstream side so the door itself acts as a discharge baffle. The bicycle brake cable which originally enabled the door to be opened by the pedaller was removed.

For the TDAU prototype a boss was made to mount a plough disc, brought by the contractor's staff. The idea was to use the mounted plough disc to position and centralise the rolled stator. Unfortunately this assembly was not successful as first made, and hence was not available for the last trial of the CTA's visit.

A powder metering spoon was made, sized to meter sufficient powder for 5 kg of seed.

5.2.1.4 Riverside Farm Institute. (Kafue district.).

Present at the test were:
Mr Andrew Aho of Riverside Development Agency
Mr Moffat Mwanza of TDAU
Mr Ray Wainwright of Silso Research Institute
Mr John Power of Silso Research Institute
Mr George Mulenga of Mt. Makulu Research Station.
Mr Sichelima of PTA.
Author
About 10 workers at the farm institute.

Machines tested were: 'Rotostat' P500.
Silso Research Institute prototype.
Both modified as above.

A total of 360 kg of maize seed was treated, in 5 kg lots in the two machines. No problems were encountered, and the farm workers were quickly able to perform all the necessary operations. The powder metering was far more easy using the purpose built metering ladle, but only for the fixed batch size of 5 kg.

A larger production run had been intended but, once again, it transpired that the seed was the progeny of hi-brid seed which should not, normally, be re-planted. The realisation that this was the case, illustrates the problem. The only seed available at the previous planting season was donated by aid agencies. The season before that was very dry and all of the crop, which would have included local varieties, was used for food. Thus the only material available in any quantity in the current year is hi-brid progeny. Even the manager of the farm institute had not realised that his "local" seed was in fact hi-brid progeny, or the significance of this difference. The genetic resource of "local" variety is in very scant supply.

This exacerbates the normal tenuous existence of rural farmers in the dry areas since the hi-brid progeny will perform poorly in a normal year - presumably extremely poorly in a dry year.

6. Tanzania.

6.1 Machine Design.

The drawings of the proposed design were studied. The engineer assigned to the project, Mr M. Tango, was in UK on his training session so an in-depth discussion was not possible. The design differed from that suggested following the last visit, in that the bought in gearbox had been replaced with gears to be manufactured locally. The reason is the apparent non availability of the suggested gearbox. The author had reservations about the current proposals since the manufacture of gears is a specialist activity, and unless a company has the necessary skills and equipment, it can be expensive. The gears would also necessitate a high degree of precision in assembly and it appeared that they were intended to operate open to the atmosphere.

A set of alternative suggestions was drawn up and sent to Mr Tango in UK. These suggestions were based around a belt drive concept which would avoid the need for precision and is tolerant of working in the open. The intention was to allow discussion with the engineers at Silso Research Institute, and so obtain further expert opinion. However, it was later learned that discussion had already resulted in a decision to use a European sourced gearbox, so the original design concept was again valid. A suitable gearbox was obtained in UK and taken back to Tanzania for the prototype machine.

Thus the availability of a prototype machine in time for the end February test schedule remains a reasonable prospect.

6.2 Biological Trials.

6.2.1 Long rains 1993

The results of the trials on beans conducted during the long rains in the current year were discussed with Dr Orono of T.P.R.I. Unfortunately, the report was not yet fully written up, but a verbal description was given. Two varieties of beans were trialed, with three treatments and two trial sites.

Varieties: Canadian Wonder. (Hard bean.)
Lyamungu 85. (Soft bean.)

Treatments: Standard treatment by Seed Farm. (Drum treatment with 'Fernasan' D.)
Treated by T.P.R.I. in the Hege machine with 'Thirasan' M slurry.
Untreated control.

Sites: Both sites were within the T.P.R.I. grounds.

Results: The two treatments gave similar results, both significantly better than the untreated control.

Unfortunately, the trial was planted late, and the long rains were very poor in the Arusha area. Thus the yield was low in all treatments.

In addition, to the main trial, some seeds were planted in pots. This type of trial is independent of the weather and thus allows a standard regime to be imposed. However, it can assess only early growth - it cannot be taken to yield. This trial showed that the two treatments both improved early growth when compared to the untreated. Again there was little to choose between the two treatments.

6.2.2 Short rains 1993

A further trial was planned for the short rains season. The treatments for this trial were made during the visit.

This time both beans and maize were treated. The source of the seed was the normal market place, where a small farmer would typically buy his seed (from another small farmer).

6.2.2.1 Maize.

Variety: Local (non-hybrid) varieties. Bought in the market from two vendors. The two lots were thoroughly mixed to make one homogeneous batch.

Amount: 10 kg of seed for each treatment.

Treatments: 1) Treated by T.P.R.I. and the author in the Hege machine (large chamber) with 'Thirasan' M slurry at 1.5 g / kg, mixed in to 15 ml water / kg.

2) Untreated control.

Sites: A possible three sites will be employed, in different climatic zones.
1) T.P.R.I. grounds.
2) Kilimangaro area. (Relatively high altitude - favoured for bean growing.)
3) Babati area. (Higher average rainfall.)

The choice of sites, from these three possibles, will be made when the rains start, and the local pattern is known.

6.2.2.2 Beans.

Varieties: Canadian Wonder. (Hard bean.)
Lyamungu 85. (Soft bean.)

Treatments: 1) Treated by T.P.R.I. and the author in the Hege machine with 'Thirasan' M slurry at 1.5 g / kg, mixed in to 4 ml water / kg.
2) Treated by T.P.R.I. and the author in the 'Rotostat' P500 machine, borrowed for the purpose from a local farmer. Rates of product and water as above.
3) Untreated control.

The reason for the reduced quantity of water as compared to maize is that the surface area of beans is small, and the seed coat is non absorbent.

Note: These treatments were carried out in the company of Mr Fredrik Gestblom - J.P.O. at UNIDO, Dar-es-Salaam.

Sites: As for maize.

6.2.3 Experience of the Treatment Process.

6.2.3.1 The Hege Machine.

The large mixing chamber was used. The plan was to treat 3 batches of 5 kg of seed. However the action of the machine was destroyed by the application of so much water. The torus 'sank' because the friction between seed and stainless steel rotor was reduced by the lubrication effect of the water. Seed then flowed onto the central spinning disc. The interchange of seeds was greatly reduced so further chemical application favoured those seeds actually on, or adjacent to, the disc. Eventually, the seeds dried sufficiently for the proper mixing action to return, and allow some redistribution of the product. The net result was considered 'commercially acceptable' by the author. However, it was clearly unsatisfactory as a process, taking 1.5 - 2 mins, so the remaining 2 batches were each divided into two 2.5 kg lots.

To cater for the first pair of 2.5 kg sub-batches, the chemical powder, which had been pre-weighed to suit 5 kg seed batches, was mixed with water and then divided into two lots. Separate application of these sub-batches of product onto the sub-batches of seed were then made. This gave a much improved mixing action, although still with some reduction in the torus height during the wettest part of the cycle. Cycle time was still about 40 seconds, c.f. about 15 secs in polyurethane lined machines.

However, the degree of colour on the two sub-batches when they were both dry were markedly different. The conclusion was drawn that the division of the powder/water mix, even though made carefully, was not satisfactory. Although the volumes of the two sub-batches were equal, the amount of chemical (as judged by eye) was not. It was therefore recommended that these be rejected. The remaining seed was still ample for the trial.

The two remaining sub-batches of 2.5kg of seed were treated with the appropriate amount of chemical and water, each measured and mixed separately. This gave a similar colour between the two batches.

6.2.3.2 The Product Mix.

This important observation led to the conclusion that the homogeneity of the mixture of wettable powder and water was very uncertain - even under laboratory conditions. It was supported by tests of the stability of the product mix in a glass measuring cylinder. These tests showed that a sediment formed within 10 seconds of the cessation of agitation. After one minute, the supernatant liquid was translucent.

The implication of these observations for the commercial use of the machine under the expected conditions is very significant. Hitherto, it had been assumed that an operator would make a quantity of mix and draw the appropriate amount from this mix for each batch of seed. Frequent agitation would be necessary. It is now evident that the first batches of seed treated from this batch of product mix would be likely to be under-treated. The last few would be over-treated. This is clearly unacceptable and would be likely to result in inadequate protection of the early batches and damage to later ones. Thus the recommendation will be, firmly, that each batch of seed is treated with a separate mix of wettable powder and water.

There is a secondary advantage of this recommendation in that there are fewer opportunities for error in the application. The only critical measurements will be the amount of seed per batch and the amount of powder per batch. The amount of water will not be critical. The difficult issue of frequent agitation of the mix is also avoided.

6.2.3.3 The 'Rotostat' P 500 machine.

The existence of a machine of this type (the same as the machine imported by the project into Zambia) in the warehouse of a local bean seed farmer, enabled that machine to be used to treat the beans so that a comparison between the two machines could be made. It was not considered likely that the treatment quality would be greatly different, but it was conceivable that the more vigorous action of the 'Rotostat' could cause some degree of mechanical damage. The current design of tractor mounted machine in Tanzania is likely to produce the same vigorous action as the 'Rotostat' so this could be a useful comparison. The 'Rotostat' was easily able to treat the seed in 5 kg batches so this was the chosen batch size. The machine was only used for beans - more likely than maize to be susceptible to mechanical damage. No difference in the treatment quality was evident from the samples treated by the two machines.

6.3 Planning for Village Trials.

6.3.1 Camartech. (Centre for Agricultural Mechanisation and Rural Technology.)

A visit was paid to Camartech - the institution charged with the testing of the Tanzanian machine - to obtain their advice on a strategy for testing. Mr Kaaya, the director of testing, was seen. His advice was as follows:

Initial testing - 1st application of chemical in the machine - should be at Camartech. Thereafter in farmer venues, beginning in early March.

The hire of tractors may be difficult at that time of year because ploughing will be in progress. In any case, the rate is likely to be TSh 5,000 per hour. (Current exchange rate TSh 450 = US$ 1)

We should have a pedal powered machine available as well to test the reaction to that size of machine.

Since Camartech do not have a separate contract with UNIDO, they will need to be compensated for any expenditure incurred.

For suggestions of actual villages where the first trials might take place, Mr Kaaya suggested Mr Mtambi, Regional Mechanisation Officer.

6.3.2. Regional Mechanisation Officer.

The advice of Mr Mtambi was to first test the machine at the Arusha Seed Foundation Farm (see 6.5 below), and then at a village. He would identify a suitable village in consultation with the District Mechanisation Officer and pass the information to Mr Msolla / Mr Tango of TEMDO.
He supported the idea of including the pedal powered machine, particularly in view of the high cost of tractor hire.

A third phase of testing could be considered at the Makuyuri National Service Farm. (Staffed by National Service men when not on active military duties.) This farm is commonly used as a testing ground for new machinery. The work on this farm would be carried out at harvest time - July.

6.4 Potential Manufacturers.

6.4.1 Dharam Singh Hanspaul & Sons Ltd.

The managing director, Mr K.S. Hanspaul, once again eluded the author, despite several attempts to see him. His brother, newly returned from a number of years in UK, and poised to become workshop manager, was seen. He expressed great interest in co-operating with the manufacture of the Seed Treater, and looked forward to receiving detailed engineering drawings in order to be in a position to quote.

6.4.2 United Engineering Works Ltd.

The Managing Director, Mr Dev Manik, was seen. He was keen to co-operate with the project and likewise looked forward to studying the design. This was the first opportunity to inspect his factory, and it presented a picture of innovation and industrious production. (For example he had made a heavy press for use in the factory.) All operations likely to be needed could be carried out by this company, with the exception of casting, for which no facilities exist in Arusha.

6.5 Arusha Seed Foundation Farm, near TPRI.

This farm multiplies seed for Tanseed. A visit was made in company with Dr Orono of TPRI. The manager, Mr Swai, demonstrated the seed processing facilities, which included two home built drum treaters, made from 40 gall (200 l) drums. The farm was originally equipped with a Gustafson slurry treater, but this has now broken. (It is an old model, probably dating from the immediate post war period.) The farm is suffering severe problems of electricity cuts and has difficulty in cleaning all it's seed production in the time available. Mr Swai was keen to co-operate in the initial testing of the prototype machines.

7. Formulation.

Section 6.2.3.1 relates the experience leading to the recommendation that, while using wettable powder formulations, a separate mix of powder and water is made for each batch of seed. Some development work will be needed to find a system of doing this without undue tedium and with a reasonable chance of correct dosing. Even so, it will not be an entirely satisfactory procedure, and for the long term, if the dissemination of the applicators is achieved, a true liquid formulation is needed.

A second worry concerning formulation is that the normal Tanzanian formulation contains lindane and is designed as a dry, rather than wettable, powder.

It was hoped that these points could be discussed with the registrar of agricultural chemicals in Arusha, Mr Jonathan Akhabuhaya. Unfortunately, he was not available, so the details of the author's thoughts were set out in a letter addressed to Mrs Matemu, project chemist, with the request that she discuss them with Mr Akhabuhaya. This letter is reproduced as Appendix B. It is also recommended that the formulation situation be put down as an agenda item for the forthcoming review meeting.

Appendix A

Institutions / Personnel visited.

1. Zambia.

1. U.N.I.D.O. — Dr Taylor, UCD.
Mr K.Jorgnson, Junior Professional Officer.

2. P.T.A. — Mr J.Opio. Senior Industrial Expert.
Mr Sichelima, Agricultural Economist.

3. T.D.A.U. — Dr N.Kwendakwema, Director; **Contact person for the project in Zambia.**
Mr B.Sythes, V.S.O. Designer.
Mr M Dunbavin, V.S.O. workshop supervisor.

4. Mt. Makulu. — Mr A.Chalabesa, Entomologist.
Mr G.Malenga, Plant Pathologist.

5. World Food Programme.
Mrs F.Luhila, P.A.M. Manager.
Mr A. Mwanakasale, Agricultural Officer

6. Seed Control and Certification Institute.
Dr Muliokela, Director.

7. Riverside Development Agency
Mr A Aho, manager.
Mr P.Kabuku, assistant manager
Mr P.Mubanga, assistant manager.

8. Lenco. — Mr Haijboer, Manager, Agricultural Machinery Section.

9. Knight Engineering Co. Ltd.
Mr Faisal Alam, Technical Manager.

10. Vortex Refrigerator Co. Ltd.
Mr N.Valand, Manager.

11. Alro Engineering Co.
Mr Trevor Kinnear, Manager.

12. Turning and Metal Ltd.
Mr Nair, Technical Manager.

13. Gameco — Mrs Chisenga, Operations Manager.
Mr Sindase, Foreman.

14. SIDO Financing — Mr Muliwna, External Services Development Manager.

15. Silso Research Institute.
Mr R.Wainwright, Overseas Division.
Mr J.Powers, Chemical Applications Division.

Tanzania.

1. T.E.M.D.O. — Mr G.Msolla, Director General. **Contact person for the Project in Tanzania.**
Mr Beytani, Workshop Manager
Mr Lauwo, Assistant Workshop Manager.

2. T.P.R.I. — Dr F.Mosha, Director.
Dr Orono, Principal Scientific Officer.
Mrs D.Matemu, Formulation Chemist.

3. Camartech — Mr Kaaya, Director of Testing.

4. National Seed Foundation Farm
Mr Swai, General Manager.

5. U.N.I.D.O. — Mr F. Gestblom, Junior Professional Officer.

6. Tanseed — Mr Lwegezya, Process Engineer

7. Dharam Singh Hanspaul & Sons Ltd.
Mr Hanspaul, Workshop Manager. (Newly returned from UK - the brother of the current General Manager.)

8. United Engineering Works Ltd.
Mr Dev Manik, Managing Director.

Appendix B

Letter to Mrs Doreen Matemu, Project Chemist.

J.E.Elsworth C Eng. MI Mech E.
Engineering Developments
Consultant in Seed Treatment Application

Taybridge Cottages, Broomsthorpe Road, Helhoughton, Fakenham, Norfolk. NR21 7BU UK
Tel: +44 (0) 485 518158 Fax: +44 (0) 485 518157

Mrs Doreen Matemu
Tropical Pesticide Research Institute,
P.O.Box 3024
Arusha
Tanzania

3rd November 1993

Ref: Project No. US/RAF/88/273

c.c. Mr G Msolla - T.E.M.D.O.
Dr F.Mosha - T.P.R.I.
Mr J.A.A.Opio - P.T.A.
Dr. B. Sugavanam - U.N.I.D.O.

Dear Mrs Matemu,

Seed Treatment Formulation.

I am writing to you as the chemist assigned to the above project. I realise your responsibility is for Tanzania only, but I would like to discuss the above subject for the whole PTA region since a solution to the current Tanzanian problems could apply across the region.

The only two countries in which the project has operated so far are Tanzania and Zambia. In both of those countries I have been able to identify a Seed Treatment formulation as the "normal" one for that country, and I believe that neither of these are satisfactory for use by rural farmers. As far as I have been able to ascertain, there are no viable alternative formulations in either country.

In the case of Zambia the formulation is "Thirasan" M, available from Shell Chemicals Ltd. of Lusaka. In the case of Tanzania, the formulation is "Fernasan" D, available from Twiga Chemicals Ltd of Dar-es-Salaam, and sourced from Zeneca Agrochemicals of UK. Both these formulations are powders, in practice applied as slurry, i.e. mixed with water. "Thirasan" M is designed for this mode of application, but "Fernasan" D is a "dry" powder, i.e. it is designed for application without water. Even in the case of "Thirasan" M the formulation has been found to settle after mixing in water, in just a few seconds.

Appendix B (cont'd)

Letter to Mrs Doreen Matemu, Project Chemist. Page 2.

In view of the very unstable nature of the mixed "slurry" of both formulations, I will recommend that a separate mix is made for each batch of seed treated. In my view this is the only way to achieve a reasonable accuracy of application of the active ingredient. This process would enable the technology to be developed up to pilot scale, but would not be satisfactory for the long term. This represents my first worry, and applies to both countries.

My second worry is applicable only to Tanzania and is centred around the actual active ingredient used in the formulation. The insecticidal component in "Fernasan" D is lindane which has a toxicity level incompatible with the manual seed planting practised by many small farmers.

As you know, I wanted to discuss these problems with the Registrar of Pesticides, but unfortunately he was not available during my visit. I would therefor request that you pass on to him these concerns, and also convey my ideas for a solution to the problem, for his consideration and comment. These ideas are set out below.

The ideal formulation should be a true liquid containing a fungicide and an insecticide, both of which have a low mammalian toxicity. They should each control the relevant organisms likely to attack the crops planted by rural farmers in all of the target countries. (i.e. in addition to the above mentioned, also Malawi, Zimbabwe, Kenya and Rwanda.) Provisionally, my recommendation would be to use malathion insecticide and thiram fungicide, and I think the opportunity should be taken to investigate any possible alternatives. This should best be done as a consultancy using specialist agriculturists experienced in the countries concerned.

The concentration of the active ingredients should be such as to give a recommended application rate to beans (probably the least absorbent of the target crops) of 4 ml / kg. Application rates to other crops will then be according to the recommendations of the plant pathologist and entomologist.

In order to avoid the possible practice by entrepreneurs of diluting the formulation to maximise profit, it should be non water miscible. Of course, any solvent, or indeed any other ingredient used in the formulation would have to be non phyto-toxic itself.

I believe the task of developing this formulation, if it were to be undertaken, would be a significant one, presenting a challenge to the most experienced of formulation chemists. I do know of a German company, S.A.T.E.C. of Elmshorn, Hamburg, who do have some formulation expertise, and might be willing to tackle it. I consider that it is necessary for the long term success of the project, and I will be recommending that it be an agenda item for the forthcoming review meeting.

I would be grateful if you would discuss these concerns with Mr J. Akhabuhaya, and I hope that we can progress our thinking jointly at our various meetings in the future.

Yours sincerely,

J.E.Elsworth. Project C.T.A.

UNIDO COMMENTS

This report clearly indicates that the progress, though slow, is making the project move in the right direction. Now that the first prototype machines are available and there is a greater coordination and understanding existing between Tanzania/Zambia, the next 6-12 months are crucial for the project. The completion of training of fellows from Zambia/Tanzania/Malawi will provide more substantial inputs from the African institutions to optimize the first prototype machine model. The report also identifies potential entrepreneurs who could be involved in the future commercialization of the ideal, safe and economic seed dressing machine. Obviously this would need support from the Governments for any investment proposal.