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The Gambia Grasshopper Control Campaign For 1987

Consultants Reports

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Consortium For
International Crop
Protection

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INTEGRATED PEST MANAGEMENT
AND
ENVIRONMENTAL PROTECTION
PROJECT

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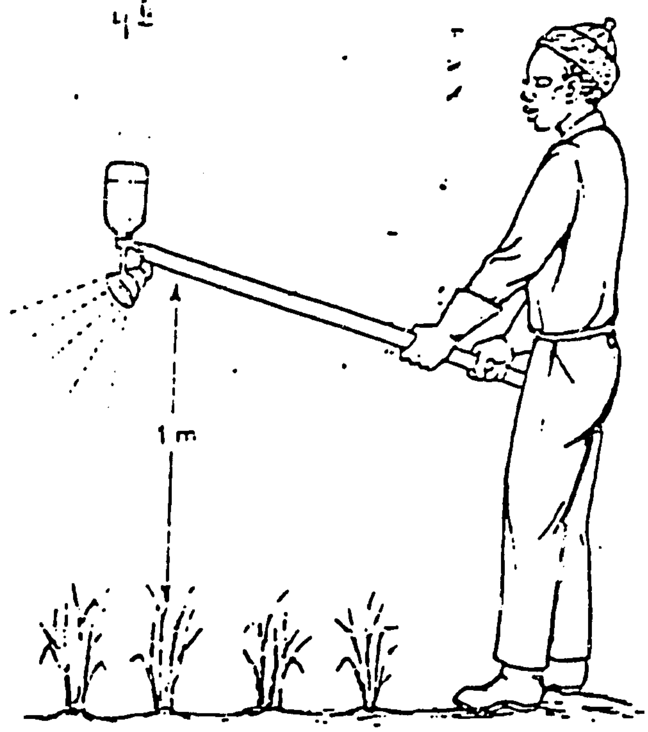
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SUMMARY:

Due to a high infestation of grasshoppers late in 1986 the Government of Gambia requested the FAO to conduct aerial spraying to save the crops. The European Economic Community, Canada, and the United States responded with 8 aircraft, and a total of 247,710 hectares were treated from October 19 to October 30. This was total area spraying of the western part of Gambia. Since this was a late effort, many of the grasshoppers had laid eggs, which fact indicates a heavy 1987 infestation.

Our assessment team was to determine the feasibility of an organized early season ground spraying effort by the Crop Protection Service and farmers themselves. The five major economic grasshopper species are not migratory, have limited mobility and two plus generations during the cropping season after the first rains. This should set the stage for early season localized ground control operations.

In preparation USAID has sponsored a training program starting April 1 to train the trainers and supervisory personnel of the Crop Protection and Extension Service. This group would then educate the farmers and ground teams on grasshopper control methods, operation of, and safe handling of, equipment and chemicals.

The country organization of a steering Committee, a Technical Task Force and Appointment of a National Coordinator appears to be a capable group.

The Crop Protection Service has prepared a well organized Country Plan of Action with control strategy details for a Phase I and Phase II effort.

This lists the requirements for the 1987 Campaign including Pesticides, Application Equipment, Vehicles, Radios, Aircraft, Landing Strips, and Miscellaneous such as Fuel, Protective and Camping Equipment.

Also included is the Timing of Events showing what has to be done during each of the twelve months of 1987. They appear to be on schedule through March although the ordering of pesticides, equipment, and starting to repair airstrips plus donor participation are of immediate attention.

The aircraft operation requirements evolve around the necessity to have an option for preventing the infestation from going beyond the ground treatment efforts. There can be considerable movement of grasshoppers from the forest and grassland areas. Farmers and the Crop Protection Service teams will not be able to reach these at their source although they could treat the edges of fields and apply bands of bait around cultivated areas.

My assignment as an Entomologist and aerial application specialist consultant for CICP and USAID to The Gambia was to review the 1986 grasshopper control campaign and assist in working up a control program for 1987. This would be based upon the following assessments.

1. The extent and severity of the estimated 1987 grasshopper problem and species involved

2. The national organization of the control effort

3. The Gambia 1987 Plan of Action

    a. Time table of events

    b. Training program schedule

    c. Survey procedures,

    d. Mapping

    e. Communications

    f. Chemicals and equipment in Country and purchase required.

4. Evaluation of the aircraft needs and methods to best utilize that capability

5. Field Trip And Observations En Route Of Agriculture And Flight Strips

The dates that I was in Banjul, The Gambia, were from March 12 to March 28, 1987. Other team members were Robert Thibeault, USAID/OFDA Washington; Dr. George Cavin, Entomologist; and Robert Herald, Logistician. They were in The Gambia from March 12 to March 18.

In August and September of 1986 survey observations in The Gambia indicated high densities of grasshoppers in localized areas. During September and October the infested area expanded to include more extensive zones in the Western Division. The Government of Gambia made a request to FAO to conduct aerial spraying. The European Economic Community (EEC), Canada and the United States provided Aircraft and pesticides.

Ground spraying teams under guidance from the Crop Protection Service accounted for 11,500 hectares - September 25 to October 24. The aircraft used the strategy of total area coverage of large areas including both cultivated and non-cultivated land as follows:

Donor	Dates of Treatment		Area Treated
1 plane EEC	10/19 - 10/30		77,800 Ha.
4 planes Canada	10/21 - 10/28		90,740 Ha.
3 planes USA	10/19 - 10/20		79,170 Ha.
		Total	247,710 Ha.

Chemicals used by air were Fenitrothion 98 ULV at 1/4 liter per hectare; Diazinon 90 ULV at 1/4 liter per hectare and Malathion 96 UVL at 8 oz. per acre or approximately 1/2 liter per hectare. Efficacy estimate ranged from 50% in rice to 90% in pastures. There were figures mentioned as 40 grasshoppers per square meter prior and one per square meter after treatment.

1. The Extent and Severity of the estimated 1987 Grasshopper Problem and Species-involved.

The 1987 estimated infestation levels are based on observations of heavy grasshopper egg laying in most of the areas that were treated by air in 1986. This is backed up by egg pod surveys which have been taken around the country that indicate a heavy infestation in the same areas as 1986. Approximately two egg pods per square meter can indicate a problem. See annex 1.

The species which are economic in The Gambia are Kraussaria angulifera, Krausella ambile cataloipus fuscococrulipea, Zacompsa festa, and Hieroglyphius species, Oedaleus senegalensis migrates from Gambia to Senegal due to rains excessive to its development here. Each species has some variation in its time of hatching and growth habits, however, a proper schedule of treatments can be made. Starting early on dusting and spraying allows for some flexibility in timing. Controls should be aimed at the dominant species such as Kraussaria, Cataloipus and Hieroghyphius. If not stopped at the first generation there can be a ten times increase in numbers with the next generation.

Details on the species is given in Annex 2.

2. The National Organization of the Control Effort

A program on a National scale requires good organization with division of responsibilities in order to function effectively. This is true in The Gambia with The Steering Committee, Chairman, Amadou Taal, Permanent Secretary, Ministry of Agriculture. This is the forum where the donor communities discuss and exchange views on matters relating to the efficient and effective execution of the campaign.

Next is the Country Task Force (C.T.F.) which will serve as the technical group of the campaign. Its purpose will be continuous evaluation of the program activities for efficient and effective implementation. It is responsible to The Steering Committee.

The Crop Protection Services is the implementing agency, Director, D.C.A. Jagne.

The Grasshopper Campaign Coordinator, Mr. B.B. Trawally, will be responsible for all technical field activities and report to the Task Force and Steering Committee.

Mrs. Alida Lauranse, an Entomologist who has just completed her assignment in Gambia for the FAO on an IPM project has been posted to work on the grasshopper program to assist the coordinator.

There additionally will be the need for an Entomologist and a logistician to oversee and direct the application of donor contributions and assist in the coordination of activities. The Entomologist preferably could be from the United States and have experience in insect control ground spraying and perhaps aerial spraying techniques. Extra help can be secured locally from the Peace Corps if needed.

For the most convenient functioning of the above technicians it should be necessary to have an office in downtown Banjul area. This should be connected by radio and phone communications to the CPS office at Yundum and to key operational areas in other parts of the country.

The CPS headquarters area does have additional office space with air conditioning which could be used if preferred. The offices of the CPS Director and National Coordinator are located there. The technician group would need to have transportation vehicle or vehicles in that case.

3. The Gambia 1987 Plan Of Action

a. Time table of events. Annex 4.

First quarter activities are underway or completed. These include Steering Committee and Technical Task Force meetings; egg pod surveys; listing of materials on hand and those that need to be ordered. Orders for chemicals are planned to be placed around April 1.

The second quarter begins April 1 with the start of the training course for participants. Ground survey and control teams will be organized and equipped along with farmer brigades. Pesticides and equipment will be moved to operational areas. (six to ten mobile teams).

Phase I activities will start mid May to June following monitoring of survey results. The CPS control teams using vehicle mounted dusters and mist blowers, motorized knapsack sprayers and motorized ULV sprayers will cover all areas that the farmers may not treat. The farmers will be issued manual knapsack sprayers and dusters, hand dust bellows and sack dusters plus chemicals to take care of their crops. This equipment may be picked up and used in other areas in sequence.

Control operations continue into the third quarter. As indicated under the aircraft evaluation section one air operation may be used effectively to assist during this early first phase.

Phase II operations would begin on the later generations in September to October. As stated by CPS this phase may not be necessary if the first phase is effective and could be a stand-by plan for implementation if it is felt that, in view of the magnitude of the problem, complete control during phase I will not be accomplished.

This program may require more assistance from air operations although all ground operations will continue. The target areas may be expanded with perhaps more environmental complications. However, experience gained during the early campaign should help in the organization of this final effort.

At the end of operations intensive monitoring of grasshopper populations including the efficacy of the treatment will be assessed.

b. Training Program Schedule

This will be a combination effort with all agencies concerned in agricultural production. The curriculum will combine information and knowledge bringing practical skills to the participants. This group than is expected to go out to train farmers and others involved in grasshopper control. There will be around 25 to 30 people being instructed by two entomologists from USAID along with local help starting April 1.

c. Survey Procedures

At the start of the first rains all survey teams will be in position well equipped to move to areas of rainfall and start monitoring hatching grasshoppers along with the farmer brigades. The teams consist of an observer and two scouts on motor cycle. Each survey scout will note species as well as density. Their counts and information are to be tabulated, analyzed and communicated immediately back to CPS headquarters.

The grasshoppers will have 5 instars with five days between instars. This will allow approximately 30 days to treat between hatch and egg laying. One problem may be that the farmers may not recognize the situation until damage shows in the tops of the crops due to thick vegetation. They, of course, are busy on other farming activities.

CPS has requested possible use of a helicopter to assist on surveys. Our information on costs and needs indicate that this should be discouraged. With the road access in Gambia the ground survey teams with good radio communications along with early organization should be able to take care of the situation. This would be more cost efficient. There are roads north of the river in the eastern part of the country which are impossible when the rains start but infestation is not anticipated there.

d. Mapping

Country maps at 1-250,000 scale and area maps at 1-50,000 scale are available in country. The USAID Gambia mission has 1-50,000 plastic over-lay maps which delineate all the various types of cultivated crop land and adjoining non-crop types of vegetation.

These do not show the topographic feature roads, towns etc. however, matching sheets do show these features. Both of these matching maps can be copied on the copy machine by sections. Color coding can be done as illustrated in annex 5. In these two samples only current rainfed agriculture, intensive cultivation, (groundnuts, millet, sorghum, rice, maize) were coded in green and fallow fields, non-intensive cultivation were coded in orange.

It should be obvious that if this system were done for the entire infested area a series of maps valuable to the implementation of a treatment program (ground or air) would be available to the CPS and National Coordinator. These sections could be correlated to the 1-250,000 national map and a check off system used to monitor the progress of the spraying program.

A grid was prepared on overlay plastic and marked off in one km squares representing 100 hectares each along with one square divided into four, equal to 25 hectares each. This could be done on a different scale as well. By laying over the colored agricultural areas on the maps, total hectares for aerial treatment can be easily assessed. This allows for a rectangular marking of spray lines to allow for straight runs which would include adjoining grass savannas and woodlands to keep grasshoppers from those areas from moving into the crops.

On the two examples shown and using this technique the one area including Sibanor would total approximately 12,000 hectares. The entire page would equal 19,250 hectares. (62% of the area to be sprayed).

In the second example with less agricultural areas the total of spray area would equal 8288 hectare. Compared to the total of 19,250 hectares this would equal 43% of the area. These were very roughly figured but in practise would be refined to more accurate figures.

The assumption here for comparative purposes is that the entire intensive agriculture area would be sprayed by air which, of course, should not be the case. It does illustrate the possibility as to how an effective spot treating campaign by air can be organized. The coordinator could brief the pilot the night before as to the next days program giving him his detail map with rectangles or squares marked. There could be marker flags 3 feet by 3 feet or larger on bamboo poles placed along side a road at two or three locations and related to their location on the map. This would assure the pilot that he is working the right area. Any sensitive locations not to be sprayed could be marked in red. If possible some notification to the villages in the area several days in advance would alert them that the airplane soon may be covering their area and precautions listed for them when they see him in their location.

e. Communication

The importance of good communications for the grasshopper campaign cannot be over emphasized. With ground treatments and air treatments depending upon proper survey information being passed back and forth from CPS headquarters and the field, it is apparent that all departments and supervisors have to be talking to each other.

At present our assessment team has not found a working system in place. In the past some radios have been purchased that do no match the present Gamtel or Agrhymet system.

Information on costs to purchase equipment to tie in with the Gamtel system are being assembled but may be expensive.

Bob Herald has presented a summary of requirements to work with the in country Agrhymet net. It is thought that this may be the best approach.

Annex 6.

f. <u>Chemicals And Equipment In Country And Purchase Required</u>

The pesticides required for use by both ground control teams, farmers brigade and aerial spraying group are tabulated by CPS in Annex 7.

The major materials to be used are as follows:

Malathion ULV	90%
Malathion EC	50%
Malathion dust	2%
Fenitrothion ULV	98%
Fenitrothion EC	50%
Fenitrothion dust	3%

There is in stock 30,000 kgs. of Propoxur 2% dust but new supplies of this material are not available.

George Cavin has presented material for the preparation of a grasshopper bait along with projections of cost. Annex 8.

Bait would be applied to the edges and boundaries of the cultivated fields and to accessible forests and grassland areas. It is suggested that for grasshopper control a 5% bait be formulated and applied at 5.6 kg. of bait per hectare providing a 0.28 kilograms of active ingredient per hectare. Rice bran can be used as a carrier substrate. The 100 M tons here listed at 5.6 kg/ha. = 18,000 ha.

The attempt here would be to help prevent grasshoppers from moving from the adjoining areas into the fields.

4. Evaluation Of The Aircraft Needs And Methods To Best Utilize That Capability

The major effort for grasshopper control in The Gambia for 1987 should be applied to preparations and the conduct of an early season ground control campaign. This would be done by the farmers and the CPS control teams. This approach will be most efficient and cost effective. It will require training, good organization and a working communications network as is detailed in the plan of action.

Since this plan lists the need for helicopters and fixed wing aircraft it would be important to place a proper perspective on this use and estimate of requirements.

As was obvious in 1986 a last minute emergency effort required much equipment at considerable expense and the late effort could not be thought to be the most efficient solution.

Since most of my experience has been with helicopter operations I would like to discuss that part of the request first. Helicopters are versatile and can do many things very well but sometimes at considerable expense. They should be used only if there is no alternative ground means to do the same at less cost. The use of helicopters for grasshopper surveys prior to treatment can be efficient in countries without much road availability. With my very limited acquaintance with The Gambia I can only suggest that first consideration be given to the use of the ground survey teams and farmer communication, rather than relying on the expensive use of a helicopter for surveys.

If aircraft are to be considered for spraying as an option perhaps one could be available during the early treatment or Phase I period. It could do spot treating of grassland and forest areas adjoining cultivated fields.

A second aircraft may be necessary during the later Phase II operation if a threatening situation occurs.

The number of aircraft that may be required, in case the ground spraying operations needed that additional support, could be computed as follows. This is based on the 1986 spraying operations production figures.

The EEC Cessna treated 77,800 ha. in approximately 90 flight hours. The Canadian thrush airplanes did 90,740 ha. in around 80 hours. The U.S. DC 7 flight time cannot be used for small aircraft calculation purposes. However, if the total of 168,540 ha. done by the EEC and Canadian planes was sprayed in 170 flight hours this would equal 991 ha. per hour. Then the DC 7 component of 79,170 ha. could be done by small planes in another 80 hours.

Thus, for a total of around 250 hours the entire same area could be sprayed by small planes. It would then appear that two aircrafts flying about 125 hours each could do the job with a division of these hours from sometime in June to sometime in September for most efficient effort.

These time assumptions are based upon a one time blanket treatment approach of all the area as last year. We might now assume that with an early start plus good ground operations there should be less total hectares to do by air. Also spot treatments or smaller area treatments by air of the infestations that are not being controlled would be a more efficient application than total area coverage. This would be possible based upon ground survey reports of areas needing such assistance.

Smaller area work will take more time to do (hectares per hour will be less) and areas will need to be marked. It will take the pilot time to locate these areas and there will be more turn time required in relation to the shorter spray runs. To contain the first generation there will be much forest and grassland area to cover outside of cultivated areas.

Regardless of its cost the helicopter is a viable spray vehicle as well as for potential survey. Working with an airplane it could cover areas some distance from the airstrips using a support truck. The airplane could then cover areas closer to the airstrips more efficiently.

Aerial application should be considered as an option and not a necessity. Whether one or two aircraft need to be standing by on contract needs to be determined. The costs should be balanced out after all other costs for a complete ground spraying capability are first considered.

My current assessment of The Gambia situation would be that one small aircraft such as a Cessna with a very experienced agricultural pilot should be contracted for Phase I and Phase II operations. Judgement on the need for a second aircraft could be made later based upon infestation monitoring and consideration by the Task Force and Steering Committee.

1987 cost of contracts for helicopter operations may run from $1,300 to $1,500 per hour not including fuel and crew expenses. This is based on around 150 hours of use over a two month period.

Airplane costs may amount to about half or $700 - $800 per hour not including fuel and crew expenses cost of small planes. In 1986 the average was $1,000 per hour.

This would place estimates of total cost for helicopter, fuel and crew for two months around $215,000 and for an airplane around $150,000. Any additional time would add to that cost. These costs were based on FAO projections and comparisons of cost from the 1986 aerial spray program. See Annex 9

The following comments are on swath spacing for ULV. There are some variations in aerial spraying techniques as practised by agricultural aviation operators from different countries. No fixed guide line exists in reference to the best method to spray using an ultra low volume (ULV) dosage. Generally ULV means application of straight high concentrate chemical with no mixing with a diluent such as 8oz of malathion per acre or 1/4 liter fenitrothion per hectare.

With such a small amount the droplet size needs to be quite small (100 to 150 microns) to get coverage. As an example malathion 8oz per acre (19 3/4 oz/ha.) would need about 4 drops per square centimeter for grasshopper control.

In the United States the general procedure is to use a narrower swath for light aircraft such as 35 to 40 meters for ULV. This allows for build up of deposit on sequential passes and more accurately covers the area in case the pilot does deviate some from the swath line. Without flagging it is difficult for pilots to apply an accurate flight lines without some deviation.

The other philosophy of ULV spraying is to use the drift effect. This take advantage of down wind swath displacement. With a cross wind the small drops will drift some distance and sequential passes will drift the same amount. Calibration will need to allow for a higher output of chemical to cover the wider swath. Up to 100 meters is frequently used. However, the variation in wind movement could make this a less precise technique.

Using this drift technique and 1/4 liter fenitrothion per hectare the EEC plane averaged 7000 hectares per day during the eleven days of treatment in 1986. This was admittedly done under pressure to do as much under blanket spraying conditions as possible due to the late season. Perhaps a 5000 hectare day would be more conservative.

Using the production figures for a turbo thrush airplane the following comparative exercise gives an interesting illustration of the two techniques and two chemicals.

Malathion at 8oz per acre and 45 meters or 150 foot swath calibrated for that plane in the U.S. 120 mph application speed = 36 acres/minute. 250 gallon load capacity reduced 1/4 for conditions = 187 gallons. 187 gallons = 2992 acres per load (1215 hectares). 2992 acres at 36 acres/min = 83 minutes. An estimate is frequently used to double the straight spray time which allows for ferry and turns. 83 X 2 = 166 minutes or 2 3/4 hours per load. Two loads per day = 5 1/2 hours. 2430 hectares per day - one plane. (440 ha. per hour)

By changing the formula to 100 meter swath (300+ feet) and 1/4 liter Fenitrothion per hectare we come up with the following figures. At 120 mph and 300 foot swath = 72 acres/minute. The same 187 gallon load (707 liters) = 2827 ha. or 6983 acres at 72 acre/min. = 97 min. (1.6 hour). Double 1.6 to allow for ferry and turns = 3.2 hrs/load. Two loads per day 6.4 hrs. = 5654 hectares. To interpolate what this would equal at 5 1/2 hours as in the above example it comes to 4860 hectares or exactly double the production. (880 ha. per hour)

It is recommended that the entomologists and the National Coordinator conduct a pre-treatment calibration of any aircraft assigned and determine the most effective swath for required droplet density. This would be based on no wind condition single pass followed by a series of sequential flagged passes. Once properly set up the spray pump pressure setting should be secured so that it cannot be changed in flight.

A follow up test should be done on a known grasshopper density to record the kill rate across the swath or a series of flagged swaths.

Flight strips

Considering the potential need for aircraft operations there is a definite need for air strips to supplement the one available airport at Yundum.

The FAO report states the need for air strips not more than 50 km apart. A cleared strip of sufficient length and width (600 X 40 meters minimum) with a suitably smooth and hard surface is all that is needed.

Of the six potential airstrips listed it would appear that Bwiam would be of first importance. It was indicated that Tendaba would be non-operational during any part of the rainy season.

The cost to make Bwiam site operational does not sound expensive - perhaps $3000 to $5000. A shelter for equipment and ground crews should also be included. I checked this location on the field trip. It was used some years ago, is a flat area and with a bulldozer and minimum work would be activated again. We met with the village chief to whom Mr. Trawally had previously asked permission and he granted official permission to use it again. The Tendaba airstrip is good but due to low location would be non-operational in the rains. However, the new highway from Soma to Basse Santa would have many open areas more than adequate for a flight strip tied in with traffic control for the 10-15 minutes that it would take to load a plane. One location was checked just east of Soma at Karantaba. Another open highway stretch north of Kalagi on the river flats is another very good landing strip. For any operations further east there would be good highway locations available. Annex 1C

5. Field Trip To Mansakouko Area And Observations En Route Of Agriculture And Flight Strips

On Thursday, March 26, Mr. B.B. Trawally, Mrs. Aleda Laurense and I drove from Banjul to Mansakonko and stopped at the CPS station there. We met the Division Agricultural Coordinator Mr. H. Jagne and one of the team leaders Mr. Lamin Bandeh. The team leader will be starting the April 1 spray training session in Banjul.

We checked the CPS storage building. There were stacks of bagged propoxur dust neatly stacks and barrels of malathion ULV and fenitrothion. There was one leaking malathion barrel which was laid on its side. The liquid on the floor should have been cleaned up. There was one duster which would be mounted in a truck and several back pack dusters needing repair. It was indicated that most of the equipment that needed repair were being worked on at CPS Yundum.

At Sibanor a stop was made at the meteorological station and the IPM buildings which will serve as a grasshopper headquarter site for that area. It looked good and well maintained and the weather data would be valuable for the program.

The two Gamtel towers VHF repeater towers were marked accurately on the map. One is just last of Kabokor north of the highway km 81 (Jelokoto) and one just south of Sankandi and east of the highway km. 138. A stop was made at the telephone station facility at Jenoi and it appears adequate as a manual system with 24 hour operator coverage.

En route comparisons were made of the agricultural and forestry classifications as illustrated on the maps in the earlier annex. The maps matched quite accurately with visual observations so that use of these maps will be an important guide for a pilot spot spraying the areas. They would also serve well for ground spraying documentation.

It has been a pleasure to work with the USAID mission in Banjul and the the people associated with it especially the help and guidance from Tom Hobgood. Others who were most directly involved and helped with the information compilation were Mr. Dodou C.A. Jagne, Director, CPS, Mr. Bakary B. Trawally, National Coordinator of the grasshopper campaign and Alida Laurense, Entomologist assigned to the program. There of course is a wealth of material prepared from the 1986 campaign and earlier which was provided to me by USAID. This material and especially the section on "Lessons Learned from the 1986 Campaign" should be reviewed and applied where needed. This includes the report of Richard Edwards and Ellis Huddleston and the many other knowledgeable individuals.

The key advantage for 1987 is the early start in preparing for the operations. However, this advantage can be lost if all cooperating agencies don't move expeditiously from this point on.

Gambia Country Contacts

1.	Herbert Horowitz		U.S. Ambassador
2.	Tom Mahoney		Acting AID Representative (Program Officer)
3.	Ralph Conley	A.I.D.	Supervisory ADO
4.	Tom Hobgood	A.I.D.	Assistant ADO
5.	Kenneth Klemp	A.I.D.	Controller
6	Amadou Taal	Ministry of Agriculture and Rural Development Chairman Steering Committee	Permanent Secretary
7.	Dodou C.A. Jagne	Crop Protection Services	Director
8.	Bakary B. Trawally		National Coordinator 1987 Grasshopper Control Campaign
9.	Dr. F.M. Reda	Ministry of Agriculture	FAO Representative
10.	Rick Richter	Peace Corps	
11.	Alida Laurense	(Provided by Netherlands)	Will assist National Coordinator
12.	Alistair W. McKenzie	British High Commission	Deputy High Commission

Phone Call To Dakar 3/18/87

Ellis Huddleston

Discussion regarding use of bait and effectiveness feels that perhaps a heavier rate should be effective.

Quotes Jerry Onslager (?) who has much experience with baits indicated that bran or rice hulls are attractive to the mymphs even with much green vegetation. They may be trying to balance their diet. Of course, there are some unknowns depending upon specific environments and if not work the carbaryl can be used in spray.

He met with Mr. Duran (?) a French pesticide adviser who had good results with 1% propoxur dust mixed with anything a grasshopper would eat. This could be chopped cucurbits or green grass scattered in clumps every 2 meters. The formula was 2 1/2 kilo to 1% dust in 97 1/2 kilo bait applied approximately at 20kg per hectare.

When Huddleston was in Gambia last year he felt the 12oz malathion applied to much of the dense vegetation did not penetrate well for good control. Many non-economic areas were sprayed.

Jack Henderson On Swath Width Discussion

They tested a Cessna ag. truck flying with no wind - calibrated for a 300 foot swath but got an overall 200 foot swath at 10 meters high.

This was done with micronaires and with spray boom and 80015 nozzles with the same result.

They feel that for grasshopper control there should be about 4 droplets per square centimeter (100-125 micron size) with 8oz malathion per acre.

The single pass swath test 200 feet wide gave around 3 drops per square centimeter. When sequential 100 foot swath passes were applied allowing for overlap there was a fairly uniform build up of droplets to average 4 drops per square centimeter.

It was indicated that with cross winds and proper dosage setting that wider swaths can be secured using the drift technique. The variation of air movement would make this a less precise procedure.

United States Department of Agriculture | Forest Service | NA | MFO

Reply to: 1630

November 25, 1986

Subject: Manual of Swath Widths for Aircraft Used in Gypsy Moth Suppression/Eradication Programs

To:

Bohne	Dubois	McLane	Slippey	Yendol
Bowen	Fusco	Roland	Tallman	
Bryant	Kegg	Sanderson	Voss	

There is an urgent need for cooperating Federal, State and private agencies to obtain data concerning swath widths for various aircraft used during aerial suppression/eradication programs for gypsy moth. This need has been documented for many years by numerous agencies; recently, identified as a first priority during an Aerial Application Technology Workshop sponsored by the U.S. Forest Service, Animal and Plant Health Inspection Service and Pennsylvania State University. Also, the Northeast Bt Working Group has identified a team of members to be on-site to assist in the collection of these data concerning swath widths. The team will consist of at least one member from the U.S. Forest Service (Reardon, Dubois), Animal and Plant Health Inspection Service (McLane, Roland), the Pennsylvania State University (Bryant, Yendol), Uniroyal, Abbott Laboratories, Zoecon, Pennsylvania Bureau of Forestry, New Jersey Department of Agriculture, and two aerial applicators. This team, with representatives from various agencies, will ensure the acceptance of the procedures and results from these trials as well as to minimize the costs to each agency.

The U.S. Forest Service, in cooperation with the Animal and Plant Health Inspection Service and the Pennsylvania State University intends to publish a manual containing swath widths for each of the approximately 12 types of aircraft used during aerial application suppression/eradication programs for gypsy moth. Initially, we will use the AGDISP computer code to predict swath widths for one fixed-wing and one rotary-wing aircraft. We will validate the swath width for these aircraft using various categories of meteorological conditions, etc.; if the predicted and observed swath widths for each of these aircraft are similar, we would publish a manual of swath widths for the various aircraft.

Yendol, McLane and I will develop an initial draft of the work plan for this project by December 31, 1986. This initial draft of the work plan will be reviewed by at least one representative from each cooperating agency. A

NA MFO

United States Department of Agriculture

Forest Service

Reply to: 1630

Date: January 30, 1987

Subject: Manual of Swath Widths for Aircraft Used in Gypsy Moth Suppression/Eradication Programs

To:

Bohne Slippey
Bowen Tallman
Fusco Voss ✓
Kegg

As presented in a previous letter (11/25/86), the U.S. Forest Service, in cooperation with the Animal and Plant Health Inspection Service and the Pennsylvania State University intends to publish a manual containing swath widths for each of the approximately 12 types of aircraft used during aerial suppression/eradication programs for gypsy moth. Initially, we intended to use the AGDISP computer code to predict swath widths for one fixed-wing and one rotary-winged aircraft; if the predicted and observed swath widths for each of these aircraft are similar, we would publish a manual of swath widths for the various aircraft.

Our initial effort will involve the APHIS Ag-Truck and will be conducted at the APHIS Air Operations Facility in Mission, Texas during the 1st two weeks in March. Since the Northeast Bt Working Group suggested that a team of members should be on-site during these trials, I would appreciate your response as to whether or not you or another representative would be available to assist in the project; if so, for which dates. Please respond by February 16. At this time, we do not have a completed draft of a study plan but will forward one within 2 weeks for review.

We intend to conduct the trials using the rotary-wing aircraft sometime in the fall 1987 of spring 1988.

Sincerely,

Richard

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cc: Yendol
McLane
Roland

RCR/lfc

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NIGER GRASSHOPPER CONTROL CAMPAIGN

FOR 1987

Consultants Report

Carrol M. Voss

Consortium For International
Crop Protection

March, 1987

NIGER GRASSHOPPER CONTROL 1987

Observation on the aerial application program and flight training requirement.

The Niger Plant Protection Services directorate (CPS) in their 1986 grasshopper control program treated 253,000 Hectares (Ha) by air and 135,877 Hectares (Ha) by ground. This demonstrates a commendable degree of capacity in this type of activity.

CPS operates two Cessna Ag Truck airplanes and one Cessna 185 high wing airplane bottom tank spray model. The two Ag Trucks are in good shape for 1987 operations with routine maintenance requirement. The Cessna 185 is in the Trans-Niger shop for maintenance, clean up and painting. The wings are removed The indication is that it will be ready in July for the late rush of grasshopper work.

The full time pilot for CPS is Guy Lamcon, an experienced ex-OCLALAV pilot. He, with two French pilots on temporary assignment handled the 1986 spray program.

Last years spray operation ran from July 15 through September 15 on a continuous basis. This was possible by following the grasshopper migration from south to north and back again. The pilots carried between 200 and 300 liters per load depending upon ferry distance and condition of airstrip. They averaged two hours per round trip. On some good weather days it was not unusual for them to continue flying through a 10 hour day. It took them 15 minutes to fuel and load and the pilot stated that there was no down time due to lack of fuel or chemical. Ground support supplied at the airstrip seemed satisfactory.

Insecticide fenitrothion was used at ¼ liter per hectare which allowed for 800 Ha to 1200 Ha per load. Due to this small quantity used, the pilot was able at times to treat 4000 Ha per day per plane. As shown on the attached sheet a more conservative estimate would average 1000 Ha per load, two loads per day with 3 aircraft doing closer to 200,000 Ha for the full period of spraying. Table I

The aerial program appeared to be effective where the spraying was done. There were some constraints in 1986 that did not allow for optimum utilization of the aircraft. These included a lack of adequate number of landing strips which created some long ferry flights. The Canadians are improving the present strips but there is a need for new ones to be built.

The Niamey Office would at times re-assign an aircraft to a new grasshopper pressure area before finishing where it was, thus causing inefficiency.

The pilot indicated a need for a pick-up truck and journeyman mechanic to follow the airplane. It should contain hand pumps for fuel and chemical plus food and emergency equipment and parts.

There was a need for lodging to be arranged at the various airstrip locations.

The automatic flagging system as used in the United States by some operators could be attached to the aircraft here. This cardboard paper streamer flag deposited occasionally in the swath can serve as a guide to space the next swath.

Table 1

GOVERNMENT OF NIGER, PLANT PROTECTION UNIT

1986 — 2 Cessna Ag Truck Airplanes
1 Cessna 185

15 July to 15 September - 8 weeks at 5 days = 40 days
Hectares sprayed - 250,000 Hectares

1/4 liter/hectare Fenitrothion	- 200 L Load 800 Ha)	
	300 L Load 1200 Ha)	Average 1000 Ha/load

1000 Ha/load	- 2 loads/day at 2 hours	= 4 hours	2000 Ha per day
	- 3 loads/day at 2 hours	= 6 hours	3000 Ha per day

	5 day week	8 weeks
2 Aircraft at 2000 Ha = 4000 Ha/day	20,000 Ha	160,000 Ha
3 Aircraft at 2000 Ha = 6000 Ha/day	30,000 Ha	240,000 Ha

Average 200,000 Ha Total

There is a maintenance requirement of 25 hours, 50 hours, 75 hours, 100 hours checks on the aircraft. The 25 hours and 75 hours oil changes could be done in the field but the pilots need to fly back for the 50 hours and 100 hour checks to Niamey. This can lose 2 and 3 days from operations every 10 days depending upon distance from Niamey. The work is done by Trans Niger Aviation, a qualified repair service and Cessna dealer.

Radio equipment (HF and VHF units) are necessary and are being ordered in or included in the request package.

One Cessna Ag Truck and the Cessna 185 both used two AU 3000 micronaire atomizers. The one Ag Truck used four AU 5000 micronaire atomizers. The fan blades were set at the factory mark to create a screen speed which would produce an average droplet size of 100 microns.

There was a report that on some occasions when the wind was blowing that a setting was made that would create larger droplets. These would settle faster but in effect could narrow the swath and perhaps create an overdose.

Swath width to use that is correct for ULV applications remains a bit of a question in Niger. The Cessna aircraft are being used at a 100 meter swath. The USDA-APHIS charts show a 100 foot (35 meter) swath for that aircraft. There are two points of view on ULV swath.

1. A drift spraying technique flying a bit higher and allowing a side wind to spread the small droplets over a wide swath. Variation in wind speeds can make this less precise.

2. The accurate placement over a narrower swath somewhat eliminating wind effects and averaging out pilot deviation in swath placement. Tests have shown that a plane like the Cessna under no wind conditions would show an over all droplet coverage up to 200 feet. But by selecting an effective swath of 100 feet this allows an over lap on both sides and eliminates skips in coverage.

Fine mist sprays do spread and drift into a wider swath and if the timed dosage matched that width than the economics of production could be greatly enhanced. Since aircraft fuel and range in ULV spraying is frequently the limiting factor and not the quantity of ULV material then flying the field twice with a narrow swath could cut production in half. This would require contract and cost of another aircraft in order to get the same amount of work done. I have discussed this further in my report on the Gambia.

The subject of aircraft calibration and swath testing will be covered at a meeting scheduled in early April at Niamey, Niger for the agricultural representatives of the various countries involved in grasshopper control.

An understanding of the principles of ULV spraying and droplet dynamics is important for this type of small quantity pesticide application. One discussion that covers this quite well is included in the title "ULV Spraying" by R. J. Courshee, Cranfield Institute of Technology and Ciba-Geigy Agricultural Research Unit. Annex 1 Also included is a copy of calibration techniques from the ICAO Manual on Aerial Work.

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The infestation outlook for 1987 is estimated at 300,000 to 350,000 hectares. This calls for some expansion of aircraft capability.

With the previous assessment of 200,000 hectares for the current three aircraft fleet it appears that perhaps two more aircraft may be needed for the remaining 150,000 hectares. This may be required by late summer.

One of these aircraft could be a contract airplane of similar capacity and one could be a light turbine helicopter with good range capacity. The helicopter with spray equipment could theoretically cover as much spray area as one of the Ag. planes. This would depend upon a ground support truck to carry chemical and fuel to loading sites close to operations. Obviously use of the pilot and equipment for other non-spraying activities would reduce the amount of spraying done. The helicopters major advantage would be as a survey vehicle to determine areas of infestation prior to spraying. As proved in other countries last year this was very valuable in assisting the airplanes to spray accurately defined infestation areas. Maps that are generally used by the pilot are 1 - 250,000 scale; 1 - 50,000 scale maps should be available.

One important point is the safety of operations - both to the environment and to the pilot. This type of flying under these conditions can be very wearing. There is the sand, visibility, and heat problems and the need to watch fuel on long ferries. A tired pilot is not an efficient pilot. If there is pressure for pilots to do more than they should this would be poor planning. He may not be careful where he sprayed or careless on swath spacing or continue under poor meteorological conditions. This could create lack of control and possible environmental problems.

To improve efficiency and offset the above, there should be consideration that an aerial operational unit be established in the Plant Protection Department. This could create a knowledgeable entity with a person in charge dealing with the aerial units equipment and assignments on rational basis. With the addition of contract aircraft to the CPS present fleet it should be obvious that it will require the need for aerial operational specialists, including a consultant. It will take a separate organization to efficiently handle all the problems associated with air operations covering so many hectares in such a large country.

PILOT TRAINING:

The pilot of CPS has checked and interviewed five potential licensed pilots From these he has recommended two as potential for agricultural work. Both hold U.S. commercial licenses and flew for Air Niger airlines before it went bankrupt. A dossier on each of these pilots is enclosed. Annex 2

There is no potential for training in Niger, due to CPS dual control spray plane being laid up for maintenance.

If the French supply one experienced part time spray pilot there will be the minimum need for at least one more pilot. One or both of these pilots could be sent to an agricultural pilots school in the United States. There may be value in having both trained as soon as possible then return to begin operations under the supervision of the CPS pilot. He has expressed a willingness to do this and should have the dual control plane available later. He would be in a position to select the better of the two or use them equally to spell each other off under these difficult type of operations. A back up pilot should be available for a three ship operation.

It should be noted that a newly graduated pilot from an agricultural course would not have the level of experience for maximum operations which may be required for this type of emergency. It would not be safe to place him under a pressure situation but he could begin on the closer ferry locations and perhaps the better defined areas.

Another alternative would be to supply an experienced contract pilot for a short term to fly the third plane and assist the new pilots to gain experience or to carry the bulk of the third plane work.

In any event there is a long term value in training one or two local pilots who are acquainted with the country and its operational environment. They would gain valuable experience on this years program assisting the experienced pilots and gradually being assigned flight activities without being under pressure.

Upon my driving into the countryside plus two hours flight with the chief pilot and agricultural pilot with Trans Niger I have the following observations. I was impressed with what appears to be a very difficult and hostile environment for the agricultural pilot. The normal geographic definition of areas that one expects in most countries and such as roads, streams, trees, hills are lacking here. There would be a bit of difficulty for a pilot to ferry some distance and still find a specific area to spray along with difficulty to space his swaths accurately without many landmarks. This could prove more difficult for a contract pilot. It would be assumed that a local Nigerien pilot would be better able to handle this environment. Annex 3

Also enclosed in Annex-2 is the brochures and information about one agricultural flight school with which I am acquainted and that I recommend for the training of these two pilots. I have enlarged the course cost from $6175.00 to $8000.00 per pilot to allow extra training and check out at the end to a Cessna aircraft similar to what they will fly in Niger.

Training for 6 - 8 weeks ($8000.00 each)	$16,000.00
Per Diem (50 days at $75.00 per day)	7,500.00
Air Fare ($3000.00 each)	6,000.00
Miscellaneous ($250.00 each)	500.00
	$30,000.00

Mechanic Training: I know of no short term course in the United States for this type of training? It could take a year to a year and a half to secure an A & P license (aircraft and powerplant). It could be possible for the Trans Niger shop to check out local maintenance type individuals to do oil changes and certain routine checks in the field. It still would be safer to have the aircraft return to the shop periodically for the required inspections.

Enclosed with this report is a brochure of the Transniger Aviation Co. and the self contained spray pod. Also, included is some literature on a new development adapting a light twin Piper Aztec to a ULV type sprayer with high performance characteristics. This system could be very adaptable to the African work and still retain small aircraft size with twin engine safety and range.

Equipment and Fuel Availability

Trans Niger Inc. Andre Arout, Managing Director, along with other aircraft they own a Cessna 185 which can be rigged for spraying. They have a Brittain Aviation Islander BN2B passenger plane on order (twin engine). They can purchase two spray pods which hold 50 gallons each and hang under the wings. Each tank has a built in pump and micronaire ULV spinner unit. This could be available for grasshopper spraying.

Quote 206,000 CFA per hours 3 hours per day minimum. The Cessna 185 is 15,000 CFA per hour.

Military aircraft

2-C130 transports
1-Dornier 228, 1-Dornier 28
2-Hawker Sibley (inactive)

SIMAR - Sudan Interior Mission

Jim Rendel, operates 2 Cessna 185 on missionary activities. Available for emergency flights.

Fuel availability - tank volume

At airport - Niamey) Aviation gas 200/300 m^3
Jet Fuel 3000m^3

Niamey and Agadez Airports both carry fuel

Price from Mobil

Aviation gas 270 CFA per liter
Jet Fuel 150 CFA per liter

To secure fuel in barrels will take one month prior order for delivery.

Trans Niger Aviation

Shop labor costs

Mechanic	11.600 CFA
Radio Technician	12.600 CFA
Mechanic aide	3.850 CFA

The Niamey airport has parking for two DC7 size aircraft. There is no forklift type tractor for unloading.

Parking charge 10 F/hour/ton
No overflight fee

Drafted: C. Voss:oh/03/11/87:1181o

I wish to thank the Niger USAID Mission for all their help during my short stay there and especially Charles Kelly, USAID, from Burkina Fasso who was my co-worker on this project and responsible for the final completion of the report The Crop Protection Service personnel and others involved with the grasshopper program also were very helpful.

Carrol M. Voss

TRIP REPORT SUMMARY TO NIGER AND THE GAMBIA, WEST AFRICA

My assignment as an Entomologist and Aerial Application Specialist to Niger and the Gambia was to review the 1986 Grasshopper Control Campaign and assist in working up a control program for 1987.

The time in Niamey, Niger, with team member Charles Kelly, from Burkina Faso was from March 5 to March 11, 1987. Dates in The Gambia were March 12 to March 28, 1987. Team members for part of thistime were Robert Thibeault, George Cavin, and Robert Herold.

NIGER

The objective of the mission was to assist USAID - NIGER in reviewing Government of Niger (GON) proposals for assistance to counter grasshopper infestations during the 1987 crop year. The review focused on the training of GON personnel for aerial spraying and the requirements for developing adequate operational procedures for aerial operations; the technical, material, manpower and funding requirements for aerial treatment in 1987; the acquisition of accurate information on the magnitude and location of grasshopper and locust infestations for early warning and control activities.

Meetings were held with CPS staff, French pilot, several donors and a commercial air service operator. A field trip by air and ground was made to assess the environmental and operational aspects of the aerial program.

The Crop Protection Service, with its own aerial application group of three spray planes (Cessna), accomplished in 1986, treatment on 253,000 hectares by air and 135,377 hectares by ground. They were able to run operations from July 15 to September 15, although with a migratory grasshopper, schedules were difficult to maintain.

Action is required to train two local pilots in the United States. These two were interviewed and documentation included in the report, along with a suggested training school in California. One additional experienced agricultural contract pilot will be required for a short period to assist while the new pilots are being gradually worked into the program. It is recommended that an aerial operations unit be created separate from the Crop Protection Service. This could operate more safely and efficiently with separate, properly trained management. A competent advisor should be made available to assist in this organization. Support vehicles fuel and maintainance costs and multi-channel HF radios for the aircraft plus VHF short distance ground to air radios are necessary.

With a projected 200,000 hectares to be treated by the aerial unit, there is also an estimate of an additional 150,000 hectares that may be needing treatment. This will require one or two additional aircraft from 30 to 60 days. One aircraft should be a light turbine helicopter as there is a real need to survey much of the inaccessible areas for grasshopper/locust infestations. The Canadians are repairing existing airports, but there is the need to have flight strips at several new locations. Perhaps highway sections can be used, as will be the case in The Gambia. Consideration needs to be given to the possibility of hiring a management individual (perhaps locally) to assist the USAID Niger staff on the implementation of the program activities.

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THE GAMBIA

In the 1986 grasshopper campaign, the United States and other donor countries supplied 8 aircraft. 247,710 hectares was blanket-sprayed in the western half of the country from October 19 to October 30. Due to late date, much egg laying occured, indicating a heavy 1987 infestation. Grasshopper species in The Gambia are generally non-migrating. First generation control (Phase I) will rely on farmer treatment and Crop Protection Service teams with motorized spray equipment. In prepartion, USAID has a training team holding classes on proper use of equipment and chemicals for grasshopper control, as of April 1.

The Country Plan of Action and the timing of events was reviewed with the SteeringCommittee, the Technical Task Force, the National Coordinator, and donor representatives. The list of equipment and materials was prepared for donor action. There appears to be a good organization shaping up for effective early action, starting with survey teams to monitor the infestation. With road availability, a helicopter should not be required for survey work. There is a need for limited aircraft support to include one small plane for spot treatments to assist in control where needed. Late season Phase II operations may require an additional aircraft, based on later assessment.

Action is required to prepare at least one airstrip at a site that was selected. Two other locations were established on clear highway sites.

There is a requirement to improve the existing radio net with additional equipment, so as to have adequate country communication for the Crop Protection Service. The necessary materials and equipment need to be purchased and positioned within the next two months.

Mapping for the ground and air phase of the campaign needs to be prepared. Samples were made to illustrate the procedure.

A consultant team of an entomologist and logistician experienced on such field operations is required to assist the proper utilization of donor supplies and help in the control campaign.

PROPOSED TALK FOR NAAA MEETING
DECEMBER 1981

R. J. Courshee

CIBA-GEIGY, Agricultural Aviation Research Unit,
Cranfield Institute of Technology, Cranfield, Bedford

ULV SPRAYING

SUMMARY

The conventional reasons for adding water to a spray chemical are looked at critically. Some reasons why we in CIBA-GEIGY use ULV spraying and do not add water to spray, under certain circumstances, are given. Finally, suggestions are made about the chances of being able to get both the advantages of not adding water to spray, while still avoiding the principal disadvantage of ULV spraying - spray drift.

Annex 1

ULV SPRAYING

Mr Chairman, Ladies and Gentlemen

INTRODUCTION

It is a pleasure as well as a privilege to join in your work and tell you a little about ours.

I work in an Aerial Spraying Research Unit, the AARU, which is funded by CIBA-GEIGY to make spraying - especially of our own products - as good as possible.

This, you will see, is not just physically good but effective, economic, safe simple and robust.

Most of our work has been in the area of Ultra Low Volume spraying, that is application with less than 5 litres of liquid a hectare. I have been kindly invited to tell you something of our ULV spraying.

ULV spraying had advantages. An obvious one is that an aeroplane can treat 500 acres before reloading instead of 50 acres with Low Volume Spraying at 5 gallons an acre, 95% of which is water. This is a very important advantage to us where we work, saving at least a dollar a hectare. There are also other more important advantages which I will mention later.

However, ULV has one big potential disadvantage - drift. That is to say small droplets drift and ULV uses small droplets.

The parallel and associated development of the two subjects

ULV spraying

and small droplet spraying

is quite logical. However, it is not correct to say that ULV spraying inevitably uses drops so small that they drift excessively, ULV is what it says it is - a small volume. The question of droplet size is separate.

We actually monitor spray drift in our commercial ULV spraying by allowing the droplets to impact on tall masts downwind from the sprayed field. We aim to control drift in this work but not to prevent it and find 5 to 13% of the spray active ingredient drifting - i.e. leaving the sprayed field - when our drop size is 90 microns.

Drift can be reduced to much lower levels than this by using coarse spray, which may require 50 litres of liquid per hectare 96% of which is water. In our work, the cost of carrying the 45 litres of water applied from the air would be prohibitive and we do not usually add water to the factory prepared formulations.

A less costly way of reducing drift to negligible levels, might be available by controlling drop size appropriately in a practical way.

I first ask you to consider water in spraying particularly in aerial spraying and particularly for controlling drift reliably and cheaply. Then there is a short section on why the projects I am involved in do not use water. Finally there is a section on both controlling drift and also using ULV spraying.

In this talk I am looking into the future. I am speaking about what might become available rather than what is available.

Good ULV spraying is probably dependent upon using the right drop size. Drift control is definitely dependent upon using the right drop size and, if you want to do ULV spraying, the right shape of drop spectrum also. The nozzles which have started to give the right shape of drop spectrum are still mainly in the development stage. So please do not expect to go and buy a set and put them on your aeroplane yet.

Finally, there is no doubt that ULV spraying with drops big enough to settle quickly cannot possibly give you a large number of spray drops per square centimetre. So the whole thesis depends upon selecting only those tasks where you know that a small number per sq. cm. will be fully effective.

2. WHY DO WE ADD WATER?

Originally in spraying, a lot of water was added to the spray:

to provide momentum
to ensure total spray cover
to do run-off spraying and thus
avoid the risk of phytotoxicity.

However, with aerial application of modern pesticides, none of these reasons now apply.

But there are two other dominant reasons:

to give sufficient spray cover,
to manufacture droplets large enough not to drift,

i.e. just as we do not seek to achieve complete pest control - for one thing it would be too expensive - so we also do not want complete spray cover, just sufficient cover will do, and we seek droplets which are only just large enough and not unnecessarily oversized.

Let's look at these two reasons in turn.

Droplet Size and Cover

Table 1 shows the volume per hectare needed to give 20 droplets/sq.cm. with different drop sizes (assuming no loss and a leaf area ratio 1).

TABLE 1

	Drop Diameter Microns*	Volume Litres/Hectare
DRIFT	50	0.3
	70	1.2
	100	2.3
	150	6.0
NO DRIFT	200	18
	250	36
	350	60

(This droplet size* is the average volume diameter - somewhat less than the drop size normally quoted, the v.m.d.).

We see that at just the point where drift stops completely, we have to apply 10 l/hectare or more. So we probably do have to add water to prevent drift completely by the use of large drops.

Two questions then arise:

a) Are 20 Drops/sq.cm. Essential?

Would not 10 or 5 be enough? It is a generally held view that 20 is a good and safe number. However, perhaps we are being extravagent and need to find out under what circumstances and with what products, 10 or 5 droplets would be enough. We have to find out, if we wish to avoid using water because in general, we cannot have at one and the same time all of these:

ULV
and 20 droplets/sq.cm.
and no drift.

At least one of them must go. If we want ULV then we have to consider modifying the other two a little.

b) Are 200 Micron Droplets Essential?

Although 200 micron droplets do not drift and 100 micron droplets do, there is also an eight fold difference in the amount of liquid needed between these drop sizes. So it is important to establish accurately what droplet size is essential - to reduce drift, not prevent it entirely.

2.2 Drop Size and Drift

Drift is a bit complex depending as it does on:

- droplet size,
- flying height,
- meteorology
- canopy conditions,
- aircraft flying conditions,
- evaporation.

However, consider one simplistic approach. Table II shows the time it takes for a droplet to fall 2 metres (if it does not evaporate. One good reason to consider avoiding water is because water does evaporate and in doing so it might cause more drift than a ULV spray which does not evaporate.)

TABLE II

Time to Fall 2 Metres/Size

Droplet Diameter Microns	Time Seconds
50	28
70	15
100	8
150	4.3
200	2.8
250	2
300	1.6

Can we somehow reconcile the figures in Tables I and II and still leave out the water? I think we can, probably in this way:

3. A POSSIBLE STANDARD

We have to accept that a proportion of the smallest drops will drift some distance. So we need, by way of example, to suggest some limits on drift which could possibly be tolerated.

Consider for example, these suggestions for drift which might be tolerated:
- Spray fall out closer than 10 metres to be acceptable,
- Maximum cross wind component of wind speed 2 m/sec,
- Maximum of 10% drift beyond 10 metres.

3.1 Volume of Drift

We now have a model set of criteria, which deviate realistically from any notion of perfect absence of drift. Can we comply with them all and what would the consequences be for spray cover?

. The first two criteria when combined, show that only droplets smaller than 140 microns drift further than 10 metres (plus or minus a few metres to allow for turbulence).

The third criterion then says - only 10% of the spray volume should be in the form of droplets smaller than 140 microns.

So our first simple rule for minimising drift is not more than 10% of material sprayed should be present as drops smaller than 140 microns.

3.2 Spray Cover

Cover, inthe sense numbers/cm.sq. depends upon the average volume diameter of the droplet spectrum.

TABLE III

Litres/ha	a.v.d. needed, microns		
	5	10	15 (drops per sq.cm.)
3	187	150	131
6	233	187	164
10	279	223	195

Table III is our second simple rule. These a.v.d.'s will give the indicated number of drops per sq. cm.

Step No. 1

To get both limited drift, and also spray cover we have to comply with the two criteria:

$D_{10} > 140$ microns

and a.v.d. according to Table III

Step No. 2

To use ULV also we have to stay with the first line of Table III. For example, nearly 10 drops per sq. cm. can be achieved with 4 litres/ha if the a.v.d. is 160 microns (remember the limitations - no losses and leaf area ratio of one).

Can we get this performance?

$D_{10} > 140$ microns

a.v.d. $<$ 160 microns

and still the volume $<$ 4 litres/ha.

The answer is yes we can. However, only with field prototype equipment at present. For example, my colleague Professor Spillman has spray equipment which provides such performance. Whether it will become commercially available or not, depends upon whether it is really needed or not.

I conclude that (under the assumptions for tolerable drift) that we could,

use ULV and omit the water,
have limited drift,
and still get sufficient spray cover for many tasks.

providing we can get this drop spectrum available commercially:

10% volume diameter > [illegible] microns
average volume diameter < 160 microns.

Now I want to consider whether you would want ULV - if you were permitted to have it.

4. WHY ULV?

4.1 Water

Firstly, what good does the water do? Anybody got any proof to show how much of it comes down in USA summer weather or that it does any good when it does come down?

Figure 10 shows the sort of things we usually find. By leaving the water out, we usually get biological results which are slightly better and last slightly longer. And it is cheaper to leave the water out.

Secondly, I do not think you will stop drift or even check it very well, if you leave the water in, except by using very large volumes.

Large water volumes are expensive and moreover not all that successful in preventing drift. Droplet spectrum control to avoid all the small drops has turned out to be very difficult using large volumes of water. If we leave the water out, three major factors help us:

a) We can modify liquid properties widely and we then have scope for controlling the droplet spectrum through viscoelastic effects.

b) The atomising equipment handles only small flow rates. It is easier to change the shape of droplet spectra, if you can keep flow rates through an atomiser low.

c) We do not get appreciable drop size reduction through evaporation. So with ULV, we might limitdrift both adequately and also reliably at different temperatures and humidity.

4.2 Cost

Table IV shows how, under one of our sets of conditions, the cost of the work shrinks as a result of ULV spraying, at 1.25 litres/hectare.

TABLE IV

Width	20 m	30 m	40 m	60 m	Metres
Work Rate	85	120	147	208	Hectares/Hour

The results for volume application rate are (for 20 metres run spacing).

Volume	4	6	8	Litres/Ha
Work Rate	62	49	40	Hectares/Hour

The cost reduction is mainly due to quicker work. Our planes spray some 2000 hectares a day ULV under the conditions of the Sudan, with a payload of only 800 litres. The very long, standard field length of 1,300 metres helps this work rate.

4.3 Effectiveness of the Work

It is our experience (with insects under our conditions) that getting the timing right (and thus working quickly enough to get the timing right over a very large area), is normally the most important application variable for getting good biological results economically (except for distribution which is usually adequate). We can get the timing right with ULV. We could not with LV under our circumstances because we would be late at least in some parts of the area and we would be ineffective there.

4.4 Environmental Protection

If we were compelled to go to LV, our biological performance would drop with present dose rates and pesticides. We use mainly Nuvacron[R] and it is simply ineffective against 3rd instar *Heliothis armigera*. Against 3rd instars we would be compelled to turn to ecologically harsher pesticides or larger dose rates to be successful. By using ULV we can control 1st instar larvae and use minimal dose rates which cause minimal disturbance.

In Scotland my colleague Professor Joyce, has developed a means of spraying forests, with maximum protection of the environment by ULV spraying. And this he has achieved in areas which are intersected by some of the best salmon rivers in Britain! He is right and ULV is right, especially in this ecologically sensitive area.

3.5 DUE Data

Part of the increase in effectiveness of ULV arises from the heavier and more persistent spray deposit we get. DUE means deposit per unit emission - a sort of value for money. We get more deposit per kilo of chemical in the spray tank, with ULV than we do with LV.

Figure 12 shows a result obtained by another colleague, Dr Parkin. With our research aeroplane which is equipped with two sets of spray gear, we can apply ULV and LV simultaneously to the same plants at the same time. When we do this, the differences between ULV and LV are not blurred by weather and crop changes. This result illustrates how much more you can get for your money, with a ULV spray, but I would not claim that we can always do as well as this.

5. WHAT MIGHT BE DONE

Most real world problems are complex. So also, ULV spraying which is reasonably free from drift, is only likely to be attained if the whole range of controlling factors and their interactions are taken into account.

5.1 Droplet Spectrum Control

There is considerable work being done already in the United States. Our own work is concentrating principally upon improvements to the well known Micronair rotary atomisers.

Figure 13 and 14 shows two of our units - one based on a Micronair drive and the other, using a pneumatic motor, for jet helicopters.

5.2 Aircraft Aerodynamic Forces

You also all know of the Whitcomb winglets of NASA. You may not have encountered Cranfield Institute of Technology sails which do a similar job in reducing the strength of wing tip vortices.

We were involved in their early development and in a very preliminary trial on a Pawnee, we managed to cut the drift by up to about 60% (without altering the drop spectrum).

CIT's objective is for a far more complete reduction than this and the work is continuing.

5.3 Biological Efficacy

Although a saving on ferry flights would be helpful, it is not such a valuable saving for you in the USA with your numerous strips and larger aircraft, as it is for us. So ULV spraying is probably only worth pursuing if it brings other gains for you in biological effectiveness, in environmental protection as well as economy. We use ULV for reasons of higher biological effectiveness. How this comes about is another story.

5.4 A ULV Operation

Professor Joyce also set up one of the largest ULV crop spraying operations in the world against Heliothis in cotton in the Sudan. This has been so successful that all Heliothis spraying on 300,000 hectares there is now ULV spraying, whoever does it. Against another pest, whitefly, all the spraying is at present LV spraying

6. CONCLUSIONS

ULV will not always be the way you should spray to your and your customer's advantage in your circumstances.

Our experience makes us suggest to you however, that there are probably situations, and they may be numerous, where ULV spraying is best for everyone concerned. But then careful control over mean drop size and the shape of the droplet spectrum is needed if drift is to be limited. Equipment to provide adequate droplet spectrum control for this task is past the prototype stage but not yet available commercially.

R. J. Courshee
1st June 1981

ICAO Flight Manual (part)

ATTACHMENT D

AIRCRAFT DISPERSAL CALIBRATION

1 - GENERAL

1.1 The purpose of calibration procedures is to determine that the amount of material being applied per hectare is uniform and correct for the job to be done. The factors involved are:

a) the specified treatment density in terms of litres of solution per hectare and litres of active chemical per hectare for liquids or kilograms of material per hectare for granulars. This information is normally provided by the chemical manufacturer or by a specialist trained in this task and assigned by the appropriate authority;

b) the flow rate in litres per minute or kilograms per minute, which is determined by the aircraft's dispersal system; and

c) the rate of coverage of the area being treated in hectares per minute, which is determined by the aircraft speed and the effective swath width.

These factors are independent of each other and it is necessary for the applicator to co-ordinate them in order to achieve the desired treatment density as specified for the given material.

1.2 The effective swath width should not be confused with the total swath width. The total swath width is the width from one end of the chemical deposit on the ground to the other. However, as was discussed in Chapter 12, swath characteristics must be determined and swaths must be overlapped to obtain uniform and effective distribution of the chemical. The effective swath width is the width from the start of the last overlapped swath to the start of the next one, or in other words, it is the separation distance between swaths which is marked by the flagmen and flown.

1.3 Once the effective swath width is established and the aircraft speed to be used during application runs is known, the hectares per minute of coverage can be calculated by the following formula:

$$\text{Coverage (hectares/minute)} = \frac{\text{swath width (metres)} \times \text{groundspeed (km/h)}}{600}$$

This formula has been used to generate Table D-1 below from which the coverage in hectares per minute may be found without calculation for a range of speeds and effective swath widths. Once the coverage has been either calculated or determined from the table, and if the desired treatment density in terms of litres of solution per hectare or kilograms of solid material per hectare has been specified, the required flow rate to be used can be found as follows:

Flow rate (L/min) = treatment density (L/hectare) x coverage (hectare/min) for liquids or

Flow rate (kg/min) = treatment density (kg/hectare) x coverage (hectare/min) for granular materials.

Table D-1

Coverage Versus Groundspeed and Effective Swath Width

Groundspeed (km/h)	Effective Swath Width (m)											
	7.5	10	12.5	15	17.5	20	22.5	27.5	32.5	37.5	42.5	47.5
	Coverage (hectares/min)											
100	1.3	1.7	2.1	2.5	2.9	3.3	3.8	4.8	5.4	6.3	7.0	7.9
110	1.4	1.8	2.3	2.8	3.2	3.7	4.1	5.0	6.0	6.9	7.8	8.7
120	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.5	6.5	7.5	8.5	9.5
130	1.6	2.2	2.7	3.2	3.8	4.3	4.9	6.0	7.0	8.1	9.2	10.3
140	1.8	2.3	2.9	3.5	4.1	4.7	5.3	6.4	7.6	8.8	10.0	11.1
150	1.9	2.5	3.1	3.8	4.4	5.0	5.6	6.9	8.1	9.4	10.6	11.9
160	2.0	2.7	3.3	4.0	4.7	5.3	6.0	7.3	8.7	10.0	11.3	12.7
170	2.1	2.8	3.5	4.2	4.9	5.7	6.4	7.8	9.2	10.6	12.0	13.4
180	2.3	3.0	3.8	4.5	5.3	6.0	6.8	8.3	9.8	11.3	12.8	14.3
190	2.4	3.2	4.0	4.8	5.5	6.3	7.1	8.7	10.3	11.9	13.5	15.0

1.4 The area which can be covered with one aircraft tank load is found by dividing the tank capacity, given either in litres of solution or kilograms of solid material, by the specified treatment density, in litres/hectare for liquid solutions or kilograms/hectare for solids as follows:

$$\text{Area (hectares)} = \frac{\text{tank capacity (litres)}}{\text{treatment density (litres/hectare)}} \quad \text{for liquids, or}$$

$$\text{Area (hectares)} = \frac{\text{tank capacity (kilograms)}}{\text{treatment density (kilograms/hectares)}} \quad \text{for granulars.}$$

When the area which can be covered with a tank load is known, the number of swaths which can be flown with one load can be found using the field length and effective swath width. Table D-2 shows the area in hectares covered in one swath depending upon the swath length, which can usually be taken as the field length, and the effective swath width.

Table D-2

Area Covered in One Swath

Swath Length (m)	Effective swath width (m)											
	7.5	10	15	20	25	30	35	40	45	50	55	65
	Area covered in one swath (hectares)											
250	0.19	0.25	0.38	0.50	0.63	0.75	0.88	1.0	1.13	1.25	1.38	1.63
500	0.38	0.50	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	2.75	3.25
750	0.56	0.75	1.13	1.5	1.9	2.25	2.63	3.0	3.38	3.75	4.13	4.88
1 000	0.75	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.5
2 000	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	13.0
3 000	2.3	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0	16.5	19.5
4 000	3.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	26.0
5 000	3.75	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	32.5

1.5 As an example, suppose that a material is to be applied with a solution density of 50 litres per hectare and that the tank will hold 550 L. The area which can be treated with one load is then 550/50 or 11 hectares. If the swath length is 750 m and the effective swath width is 10 m, the table shows that the area covered in each swath will be 0.75 hectare. Dividing the total area which can be covered with one tankful of solution, which is 11 hectares in this example, by the area in one swath, or 0.75 hectare, shows that 14.7 swaths can be flown with one load, Therefore, in order to prevent running out in mid-swath, the aircraft should return for re-loading after flying 14 swaths.

1.6 Calibration procedures for either liquid or granular applications involve flying the aircraft dispersing material across some type of collecting apparatus or containers placed perpendicular to its path. The collected material is then analysed to determine the effective swath width, density of deposit and swath characteristics. The various parameters of dispersal rate, nozzle location, aircraft speed, height of application, etc., can then be adjusted as necessary to produce the desired results. For reasons which have been previously discussed in Chapter 12, all calibrations should be made under conditions duplicating the actual field working conditions as closely as possible. Operators and pilots should be continually alert to factors which could cause a calibration to become inaccurate (e.g. system leaks, nozzle wear, clogged pipes or nozzles, moisture in granular materials, etc.). Calibrations should be re-verified any time such a change is suspected and periodically checked in any case.

2 - CALIBRATION OF LIQUID DISPERSAL SYSTEMS

2.1 The steps to be followed in calibrating a liquid spray system are generally as follows:

a) calculate the total flow rate required in litres of solution per minute using the specified treatment density in litres per hectare and the methods given in paragraph 1. Assume an effective swath width and aircraft speed as accurately as possible. The calibration procedure will verify them and corrections can be made as necessary;

b) using the nozzle manufacturer's specifications, select and install the correct number and size of nozzle tips to obtain the required flow rate at the system operating pressure;

c) operate the spraying system under pressure using water and a dark and easily visible dye. Find and rectify any leaks or obstructions which may be present;

d) make a trial run to determine effective swath width and swath characteristics. Use a solution as similar in volatility to the actual solution to be sprayed as practicable. Water and dye are generally satisfactory for water-based solutions. If an undiluted chemical or an oil-based spray is to be used, an oil solution may be preferable;

e) using the data from the trial run, correct the initial estimate of coverage to obtain the actual hectares per minute which the aircraft will treat at the speed, effective swath width and height used;

f) having an actual figure for the coverage, re-calculate the flow rate in litres of solution per minute and adjust the system accordingly. If the assumed swath width and speed estimates used in step a) above were reasonable, the change in flow rate required will be small and can generally be accomplished by adjusting the system pressure. If a large change is required, it will probably be necessary to change the size or number of nozzles used;

g) make a trial run to verify that the flow rate is actually as intended. To do this:

1) carefully fill the chemical tank either to the top or to some suitable index marked on the tank;

2) spray for a pre-determined length of time which will use up most of the material, but which will not run the tank dry while spraying;

3) making sure that the aircraft is sitting as it was when the tank was originally filled, refill it to the same mark; then

4) divide the litres of material sprayed by the number of minutes which it took. This determines the actual flow rate in litres per minute.

As a general rule, it will be necessary to fly the aircraft to do this. The pilot will then be totally responsible for starting and stopping the system at the correct time interval and for observing that all nozzles are spraying normally without leaks or stoppages. However, if the system is electrically or hydraulically driven, it may be possible to do this test on the ground with the system operating at normal pressure. Before this is done in practice, however, it is a good idea to verify that it is accurate by doing a test on the ground and one in flight and comparing the results; and

b) determine the amount of active chemical to add to the tank in order to obtain the correct solution. The number of hectares which can be covered with a tankful of solution can be calculated by the method of 1.4. Having this number and using whatever treatment density of active chemical in litres/hectare is specified, the amount of active chemical needed per full tank of solution is calculated by the formula:

Chemical/tankload (L) = hectares/tankload x treatment density (litres per hectare).

Using the previous example, the solution density to be applied was specified as 50 litres per hectare, the tank capacity was given as 550 L and it was found that one tankload would cover 11 hectares. Now suppose that the specified treatment density of active chemical per 50 litres per hectare of spray mix is 2 litres per hectare. Using the formula, the amount of chemical to be used per tankload in this case is:

Chemical/tankload = 11 hectares/tankload x 2 litres per hectare = 22 L per tankload.

2.2 Various types of ground equipment, having varying degrees of sophistication have been devised for use in calibrating spraying systems. One of the simplest involves the placing of individual sheets of paper or a strip of paper such as is used in business machines in a line perpendicular to the path of flight of the aircraft and then making a spray run across it using water and dye. The resulting dye pattern, while not very accurate for actual calibration of the deposit density or effective swath width at least allows an experienced person to estimate these. It will also reveal certain common problems with spray uniformity and swath characteristics, such as propwash effects, dripping nozzles and lofting of drops by wingtip vortices, quite well.

2.3 A very complete and portable spray calibration system has been recently developed in the United States by Oklahoma State University. It is an excellent example for illustration of the calibration process, since it provides devices which take each necessary item of data and process the data to obtain the complete calibration. (See Figure D-1.)

Annex 2

CAL. AG. AERO
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Tulare, CA 93274

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Joyce J. Brunson

Joyce J. Brunson
Owner

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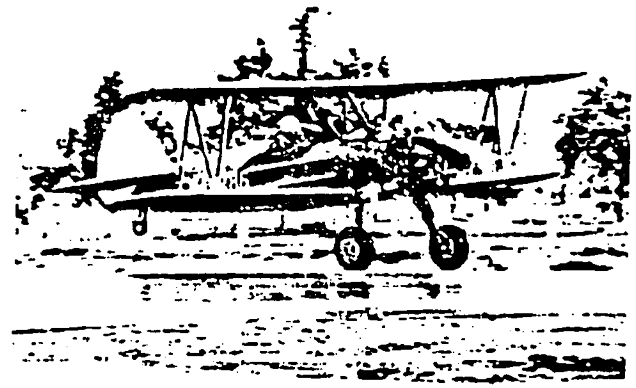

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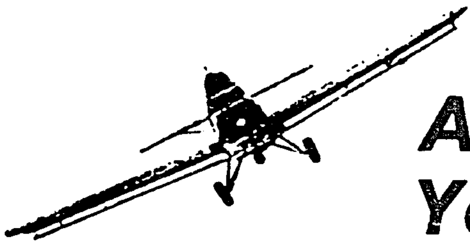

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Many Ag Operators and Ag Pilots consider the Stearman to be the best for basic experience.

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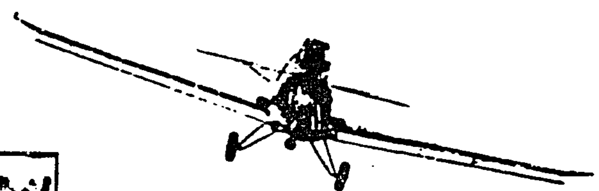

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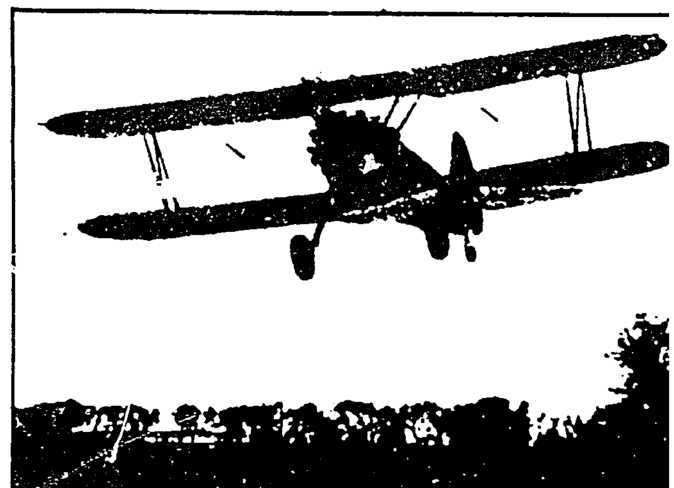


Arnold flagging for Paul in the Pawnee. There is no significance in the type of flag he is using.

Mister Stearman

by Brett Dickerson

"HOW DOES a person break into Ag Flying?" I doubt there are many pilots in the business today who didn't ask themselves that question at least once. To those of us who don't have a seat to inherit from Dad, the opportunities to secure that first spray job seem terribly limited.

The general consensus among the operators to whom I posed the above query was to either "get yourself a thousand hours of ag time and call me in the morning" or "go out and buy an airplane and start beating the bushes." As neither of these options appeared to be particularly viable, I was still searching for that elusive third alternative. Finally, a thirty-year veteran told me that my best chance of breaking in as a novice lay in attending an agricultural flying school.

It was because of this recommendation that I found myself sitting in a booth at "Lyle's" truckstop, listening to instructor Arnold Whisman outline the details of the Ag Pilot Training Course offered by Cal-Ag-Aero, an FBO ag service located in Tulare, California.

The goal of the course is basically two-fold: 1) to train the student in the specialized flying skills necessary to become a competent aerial applicator, and 2) to prepare the student to pass the written test required to obtain the California Apprentice Aircraft Pilots Pest Control Certificate.

If you were to ask the non-pilot what is required to become a crop duster, they would probably answer that all you need is an airplane and an individual with a propensity for self-destructive endeavors. The State of California, however, requests that ag pilots under their jurisdiction have a little more knowledge than merely that required for efficient spray runs. Before pilots can receive the Apprentice ticket, they must demonstrate adequate knowledge of the pesticides they will be working with and the effect these pesticides may have on non-target crops in the area or on people who may be exposed to the chemicals, be it your flaggers and loaders, or even the omnipresent spectators that seem to gravitate to such demonstrations of aeronautical expertise. Should such exposure occur, ag pilots must be familiar with the steps necessary to minimize its effects.

Cal-Ag-Aero accomplishes this task by utilizing five sample tests which the student takes, using an "open book" format. The student has access to all reference material required to correctly answer the test questions. Afterwards, Arnold reviews each question, offering whatever clarification or explanation is necessary to assure maximum understanding. The fifth sample test closely resembles the actual test the student will take for certification. Once you can handle this one, the real McCoy presents no problem.

Although a certain amount of book work is required in achieving any new flying skill, few would consider it the most enjoyable facet of the training process. Personally, I had been looking forward to getting my hands on the two-holer Stearman that

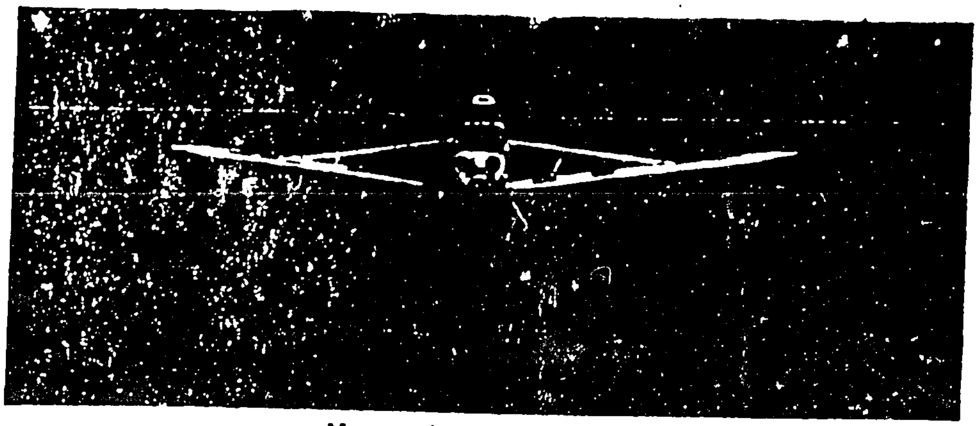
(continued on next page)

Arnold fires up the Stearman for me.

(Cal-Ag-Aero cont'd. from previous page)

Cal-Ag-Aero uses for the dual instruction portion of the flight training. For all intents and purposes, I had no taildragger experience prior to beginning the ag course, so I was anxious to add a new dimension to my somewhat limited flying skills.

It didn't take me long to realize how little all of those hours in 150's and 172's had prepared me for that big biplane. Forget the centerline. It was all I could do to keep up out of the weeds. Each lateral boundary of the runway was explored several times before the old bird finally took to the skies. (This wasn't any narrow ag strip either, folks ... 75 feet wide, at least.)



Me spraying in the Pawnee.

Once we were in the air, things settled down a bit and I could begin to work on getting the feel of the new airplanes. Using a stick in place of a control wheel felt a little odd at first, but once you become accustomed to it, it's a far more natural means of controlling the airplane. The first two lessons were primarily spent in gaining confidence with the unfamiliar machine. Lazy eights, Chandelles, steep turns, oscillation stalls and lots of touch and goes. Later, we were ready to move on to the actual ag flying portion of the training.

Simulated spray runs were the first order of business. The first few were done by Arnold so he could demonstrate the proper entry and departure angles and the correct altitude to maintain above the crop. Neopnyte that I was, I figured that the lower you could fly, the better job you could do, so I was working on trying to roll the wheels on the top of the alfalfa we were flying over. Arnold was quick to point out that it isn't necessary to come back with leaves hanging in the landing gear to be effective in your spray application. With this bit of information, I was able to concentrate on learning to consistently maintain an effective working altitude during the hundreds of simulated spray runs we would make during the course of the training.

As we progressed through the curriculum, we began working more complicated fields, learning how to deal with obstacles such as power lines, standpipes, trees and all the other things that seem to have been stuck in the ground for the sole purpose of complicating the lives of ag pilots the world over. "Feel" for the airplane becomes very important here, as maneuvering around some of these obstacles requires a degree of control precision that just isn't required in most of general aviation flying.

After completing 30 hours of dual instruction in the Stearman, I began ten hours of solo flights in a Piper Pawnee. This is the portion of the course which involves actual spraying. Arnold starts the student out with 50 gallons of water in the hopper. Each successive flight is made with an extra 10 or 20 gallons until the hopper is completely full. In this way, the student can progressively learn the performance degrading effects of heavier and heavier loads.

Graduation from the course requires at least one flight at maximum gross weight, which in the Pawnee meant filling the hopper with 150 gallons of water for a load weight of 1200 pounds. In spite of the fact that we had gradually built up to this weight, I was still surprised at the airplane's reluctance to move with the hopper filled. As it starts to lazily crawl forward, you begin to wonder if the tires are

(continued on page 12)

CAL-AG-AERO

Arnold Whisman (right) has 40 years of experience to share with his students.

FORMED 18 years ago by a group of Ag Aircraft Operators, California Agricultural Aeronautics, Inc. (Cal-Ag-Aero) has continually served the Ag Aircraft Industry as a training facility aimed at producing a good Crop Duster Trainee.

Arnold Whisman is Chief Flight and Ground Training Instructor with a background of 40 years in Ag Aviation, including nine years with Cal-Ag-Aero.

Whisman has been an Ag Pilot, Ag Operator and helped train numerous pilots prior to joining Cal-Ag. His experience covers General Aviation Training plus five years with the Army Air Corps Program from 1940 to 1945.

Cal-Ag-Aero believes the Ag Aviation Industry has an excellent future for the individual possessing good skills and desiring to continue learning. Retirements alone open up great possibilities for pilots entering the profession.

Cal-Ag-Aero utilizes a 220 HP PT Stearman and a 235 HP Pawnee.

All time in the Stearman is dual, sharpening up basic skills and techniques, and fulfilling a large portion of FAR 137 requirements. Simulated loaded conditions are given using restricted power for takeoffs, climbs and turnarounds.

Time in the Piper Pawnee is supervised solo, working from empty up to maximum hopper weight of 1200 pounds.

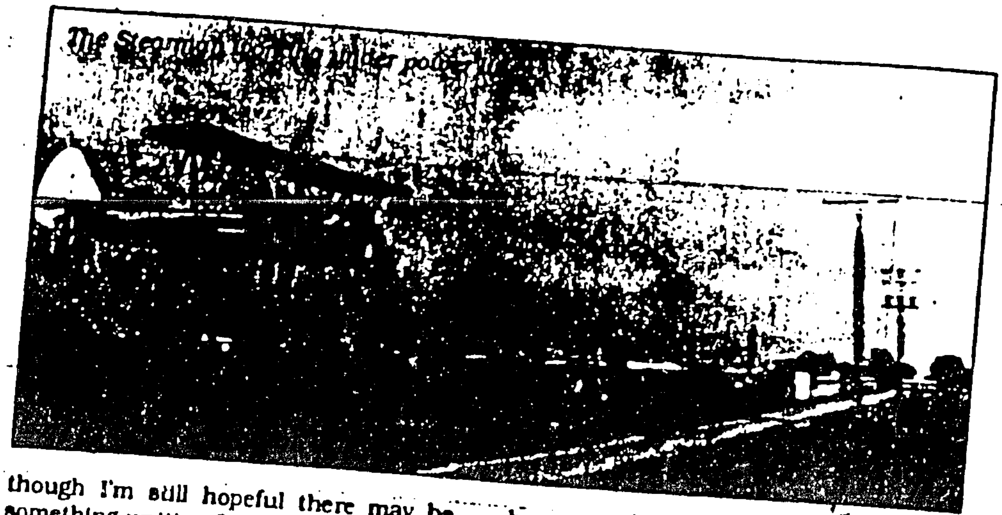
Ground school covers requirements of FAR 137 and most State and Federal regulations. Theoretical and practical instruction is given.

Using the theory that one needs to be better than "average," the course is intensive and demanding.

This school is approved by the FAA and the California Department of Education.

"SAFETY AND PROFESSIONALISM" is the motto of Cal-Ag-Aero. ■

(Cal-Ag-Aero continued from page 10)



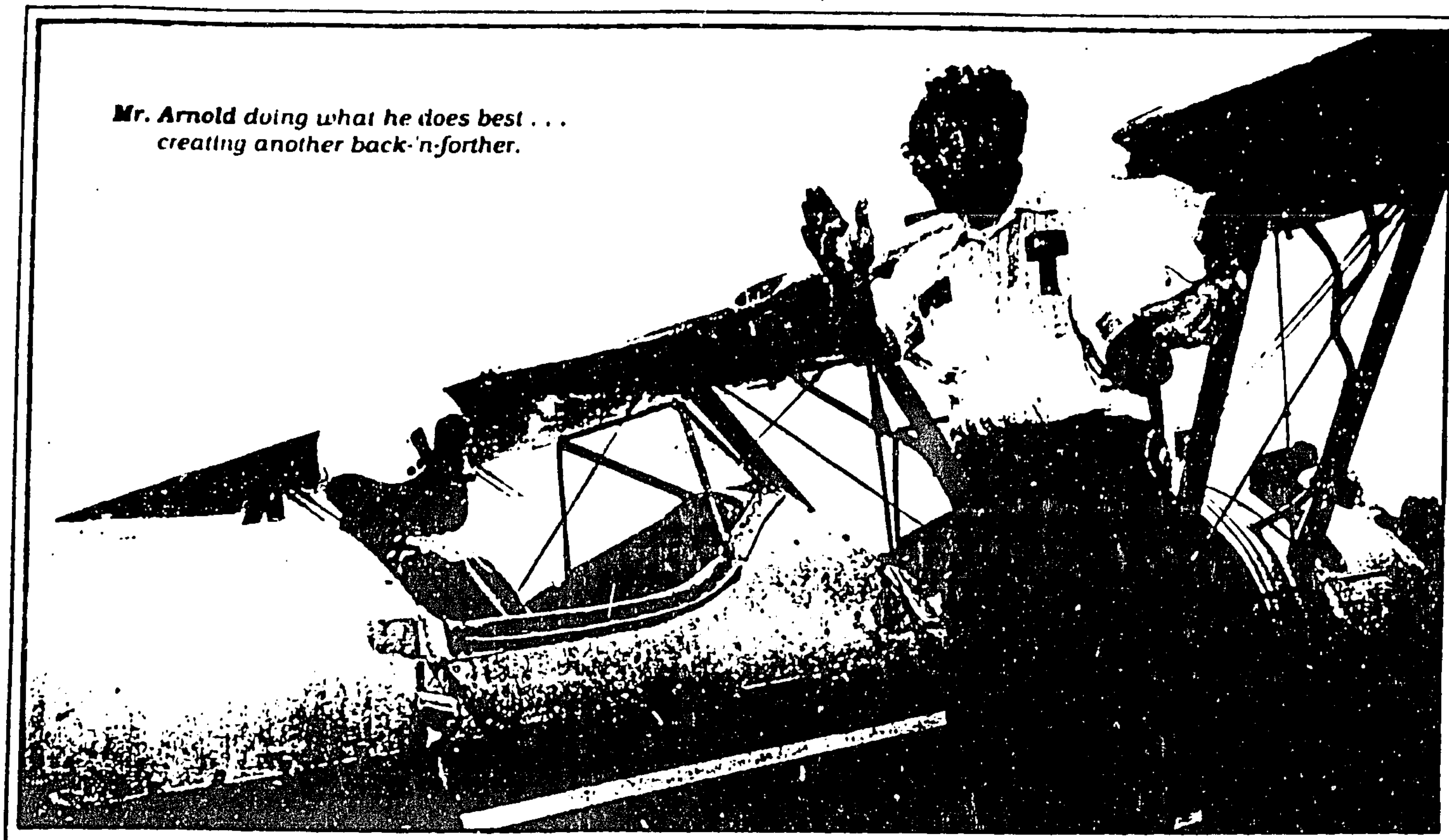
flat or maybe you left the parking brake on. Once it finally starts rolling, however, it accelerates quickly and soon the tail is up and you're flying away. It's a good lesson in the need to tailor the load to the existing conditions.

Throughout all the flights in the Pawnee, Arnold will act as flagman so that the student can gain experience in visualizing the imaginary line over which the airplane must be flown on each successive spray run. It also gives Arnold an excellent vantage point from which to observe the student's performance so that he may offer suggestions and advice during the post-flight critique.

Once the Pawnee flights are finished, the course is completed. Other pilots often ask me if I feel the course is worth the time and expense just to log another 40 or so hours. To be [illegible]est, I never know exactly what to tell t[illegible]. There is no question that it is far and away the most fun I have ever had in any flight training experience. I recommend that if they would like to enjoy a somewhat unique flying experience, then go and buy a couple of hours in the Stearman. It will enhance your flying skills and you'll have a helluva time in the process.

As to whether it is the key that opens the door to that first ag job, in my own case, it hasn't yet led to an actual spray job, though I'm still hopeful there may be something waiting for me down the road. However, this is a reflection on the state of the job market in agricultural aviation and not on the relative value of ag training, particularly that offered by Cal-Ag-Aero. I personally think their course of instruction is outstanding, particularly for someone who has a seat waiting for them upon graduation. Tulare, California is located in the southern San Joaquin Valley and there is an abundance of fields in the area which present nearly every flying situation a pilot may encounter once he or she goes to work.

The foundation of the course, however, is instructor Arnold Whisman. After serving as a civilian instructor during the war, he went into ag flying in 1946 and stayed in the business as both a pilot and eventually as an owner operator until 1976. He even served as a president of the California Agricultural Aircraft Association from 1975 to 1976. With almost 15,000 hours of ag flying to his credit, there is a wealth of knowledge and information he can pass on to the new pilot. True, 30 hours of dual in a Stearman and 10 hours in a Pawnee does not an ag pilot make, but it may make a difference in how successful that important first season is, and in the most extreme case, may determine if you are even around for the second. In this light, you can't put a dollar value on the importance of learning the ropes from an experienced ag instructor. ■



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THAT'S WHAT the brochure says . . . and that is what Mr. Arnold Whisman does. He does it in his 35th year of teaching and has taught Crop Dusters for the past 17, and every bit of that in a Stearman aircraft.

Now I ask you, "With whom had you rather log 35 hours of dual in a Stearman than with Mr. Whisman?"

Located within easy driving distance of Sequoia, Kings Canyon and Yosemite National Parks and the seashore, Arnold Whisman, at California Agricultural Aeronautical (Cal-Ag-Aero), is waiting to teach you. If you are a prospective student, how to do safe and efficient back-'n-forths.

Many ag operators and ag pilots consider the Stearman to be the best for basic experience . . . This magazine agrees with that.

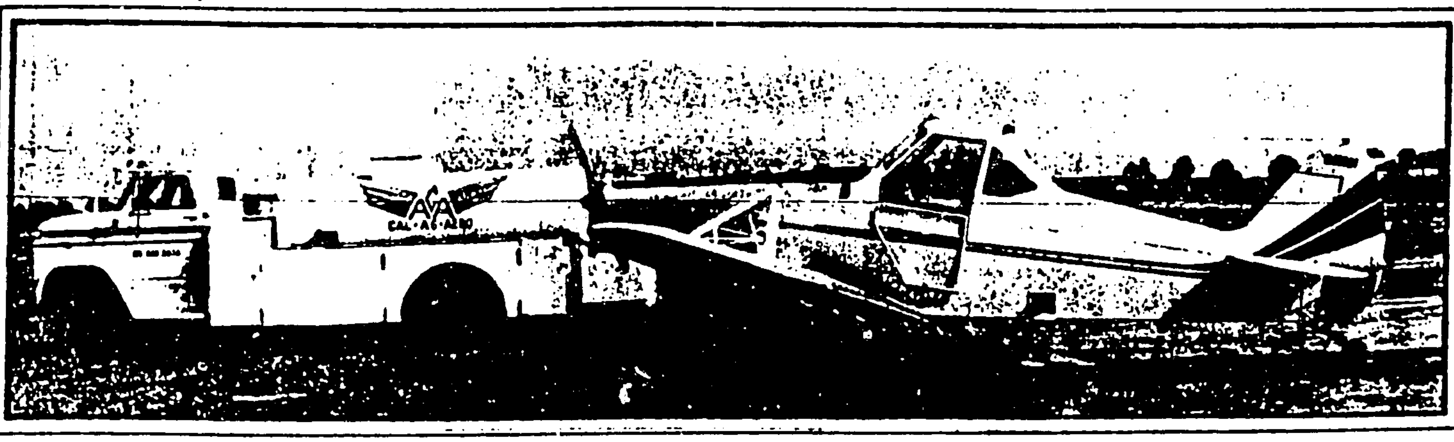
Cal-Ag-Aero courses include mandatory stalls, simulated ag swaths, plus working around trees and under wires. You will receive 35 hours dual in the Stearman and 15 additional hours solo (supervised) in a Pawnee 235, the aircraft you will most likely land your first job in.

You will receive training to qualify for the California Ag Pilot Apprentice Certificate and will be able to meet the requirements of FAR 137.

All you need is a commercial pilot's license, or have the written passed and have completed close to the commercial required flight experience, and Mister Arnold will tuck you under his experienced wing and get on with it.

This school is located on Mefford Field in Tulare, California.

We have received complaints about every ag pilot training school in the United States except two . . . Cal-Ag-Aero is one of these two. ■



You get your first back-'n-forth training in this Pawnee 235.

CALIFORNIA AGRICULTURAL AERONAUTICS, INC.

TULARE MUNICIPAL AIRPORT TULARE, CA.
Ph: (209) 688-0669 93274

A $100 registration fee must accompany this application, which will be credited towards tuition. The $100 registration is not refundable. Enrollment application must be filled in carefully and accurately and should be sent to CAL-AG-AERO prior to the student's arrival.

This is my application for admission to the following aviation programs

____ Private ____ Helicopter X Ag Flying ____ Instructor

____ Commercial ____ Multi-Engine ____ Intrument

____
(Indicate Title of Courses Desired)

NAME IBRAHIM GAMSO PHONE (Res.) ________ (Bus.) ________

PERMANENT ADDRESS P.O. Box 865 CITY NIAMEY ZIP ________

AGE 30 MARITAL STATUS YES SEX M

DATE OF LAST PHYSICAL 17 July 1986 CLASS (Type) FIRST

TOTAL FLYING TIME 1650 h + 49 h PILOT IN COMMAND 430 h

TOTAL FLYING TIME LAST YEAR 52 h SIM DUAL 30 h SOLO 22 h

TOTAL FLYING TIME IN TRICYCLE GEARED AIRCRAFT 7 h 45'

TOTAL FLYING TIME IN CONVENTIONAL GEARED AIRCRAFT 1642 h

TOTAL FLYING TIME IN AG AIRCRAFT NONE TYPE ________

NUMBER OF FLIGHT OR FLYING ORIENTED ACCIDENTS NONE
(Explain on Separate Sheet of Paper)

NUMBER OF FAA VIOLATIONS NONE
(Explain on Separate Sheet of Paper)

HAVE YOU EVER BEEN IN A STATE OR FEDERAL PRISON? NO

AVERAGE AMOUNT OF ALCOHOL CONSUMED PER DAY NONE

ARE YOU A REGULAR USER OF DRUGS OR MEDICATION? NO

Over

GIVE BANK REFERENCE _NONE_

TWO BUSINESS REFERENCES:

NAME ________ ADDRESS ________

NAME ________ ADDRESS ________

CHARACTER REFERENCES:

NAME ________ ADDRESS ________ OCCUPATION ________

NAME ________ ADDRESS ________ OCCUPATION ________

NAME ________ ADDRESS ________ OCCUPATION ________

MILITARY BACKGROUND _NONE_

DATES SERVED ON ACTIVE DUTY IN MILITARY SERVICES ________

BRANCH OF SERVICE ________ SERVICE CLASSIFICATION ________

DATE RETIRED OR SEPARATED FROM SERVICE ________

YEARS OF MILITARY SERVICE (active) SINCE AUGUST 5, 1964 ________

EDUCATION

HIGH SCHOOL _LYCEE AMADOU KOURAN DAGA_ GRADUATED YEAR _June 1978_
Name of school

COLLEGE ________ NOT GRADUATED ________
Name of school
YEAR _1980_

OTHER _AMERICAN FLYER'S ARDMORE USA_ DEGREE _COMM + IR + MULTI-ENG_

SIERRA ACADEMY OF AERONAUTICS _1986_
OAKLAND - USA _ATP_

REMARKS ________

NAME AND ADDRESS AND PHONE NUMBER OF CLOSEST LIVING RELATIVE:

MAHAMANE KONDO USAID NIAMEY-NIGER.

APPLICANTS SHALL PROVIDE TWO PHOTOSTATIC COPIES OF CURRENT FAA MEDICAL
TWO PHOTOSTATIC COPIES OF CURRENT RATING CERTIFICATES PRESENTLY HELD SUCH AS PRIVATE, COMMERCIAL, ETC.

I. UNITED STATES OF AMERICA

DEPARTMENT OF TRANSPORTATION — FEDERAL AVIATION ADMINISTRATION

THIS CERTIFIES IV. THAT

V. GAMBO IBRAHIM
AIR NIGER, P.O. BOX 865
NIAMEY NIGER NIGER

000001136

DATE OF BIRTH	HEIGHT IN	WEIGHT	HAIR	EYES	SEX	NATIONALITY VI.
09-22-57	69	150	BLACK	BROWN	M	NIGER

IX. HAS BEEN FOUND TO BE PROPERLY QUALIFIED TO EXERCISE THE PRIVILEGES OF

II. AIRLINE TRANSPORT PILOT III. CERT. NO. 2303046

RATINGS AND LIMITATIONS

XII. AIRPLANE MULTIENGINE LAND
COMMERCIAL PRIVILEGES
AIRPLANE SINGLE ENGINE LAND

XIII.

VII. SIGNATURE OF HOLDER

X. DATE OF ISSUE 09-12-86

VIII. X. ADMINISTRATOR

XI.

AC FORM 8060-2 SUPERSEDES PREVIOUS EDITION

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

MEDICAL CERTIFICATE First **CLASS**

THIS CERTIFIES THAT *(Full name and address)*

Ibrahim GAMBO
Air Niger, P.O. Box 865
Niamey, Niger

DATE OF BIRTH	HEIGHT	WEIGHT	HAIR	EYES	SEX
09-22-57	69	119	black	brown	male

has met the medical standards prescribed in Part 67, Federal Aviation Regulations for this class of Medical Certificate

LIMITATIONS: None

DATE OF EXAMINATION	EXAMINER'S SERIAL NO
17 July, 1986	01643-1

EXAMINER SIGNATURE

TYPED NAME Thomas Reich, M.D.

AIRMAN'S SIGNATURE

FAA FORM 8500-9 (10-73) SUPERSEDES PREVIOUS EDITION

CALIFORNIA AGRICULTURAL AERONAUTICS, INC.

TULARE MUNICIPAL AIRPORT   TULARE, CA.
Ph: (209) 688-0669   93274

A $100 registration fee must accompany this application, which will be credited towards tuition. The $100 registration is not refundable. Enrollment application must be filled in carefully and accurately and should be sent to CAL-AG-AERO prior to the student's arrival.

This is my application for admission to the following aviation programs:

___ Private   ___ Helicopter   _X_ Ag Flying   ___ Instructor

___ Commercial   ___ Multi-Engine   ___ Intrument

____
(Indicate Title of Courses Desired)

NAME DODO MAHAMAN LAMINOU PHONE (Res.)______ (Bus.)______

PERMANENT ADDRESS BP 865 ______ CITY NIAMEY ZIP ______

AGE 30 MARITAL STATUS Yes SEX M SOCIAL SECURITY NO. ______

DATE OF LAST PHYSICAL 01-20-87 CLASS (Type) 1st class

TOTAL FLYING TIME 1626.4 PILOT IN COMMAND 341.0

TOTAL FLYING TIME LAST YEAR 12.1 DUAL 6.9 SOLO 5.2

TOTAL FLYING TIME IN TRICYCLE GEARED AIRCRAFT 6.9

TOTAL FLYING TIME IN CONVENTIONAL GEARED AIRCRAFT 1619.5

TOTAL FLYING TIME IN AG AIRCRAFT NONE TYPE ______

NUMBER OF FLIGHT OR FLYING ORIENTED ACCIDENTS ONE
(Explain on Separate Sheet of Paper)

NUMBER OF FAA VIOLATIONS NONE
(Explain on Separate Sheet of Paper)

HAVE YOU EVER BEEN IN A STATE OR FEDERAL PRISON? NO

AVERAGE AMOUNT OF ALCOHOL CONSUMED PER DAY NONE

ARE YOU A REGULAR USER OF DRUGS OR MEDICATION? NO

Over

GIVE BANK REFERENCE NONE

TWO BUSINESS REFERENCES:

NAME ______ ADDRESS ______

NAME ______ ADDRESS ______

CHARACTER REFERENCES: NONE

NAME ______ ADDRESS ______ OCCUPATION ______

NAME ______ ADDRESS ______ OCCUPATION ______

NAME ______ ADDRESS ______ OCCUPATION ______

MILITARY BACKGROUND NONE

DATES SERVED ON ACTIVE DUTY IN MILITARY SERVICES ______

BRANCH OF SERVICE ______ SERVICE CLASSIFICATION ______

DATE RETIRED OR SEPARATED FROM SERVICE ______

YEARS OF MILITARY SERVICE (active) SINCE AUGUST 5, 1964 ______

EDUCATION

HIGH SCHOOL Lycee Amadou Kouran Daga
Name of school

GRADUATED YEAR June 1978

COLLEGE C.E.G Birni Zinder
Name of school

NOT GRADUATED ______

YEAR October 1969 (first year of entry

OTHER N.L.S Beek NETHERLANDS

DEGREE CPL + IR

REMARKS I finished my CPL + IR training in December 1980
I got a F27 type Rating in Feb 1981 and HS748 rating in march 1982.

NAME AND ADDRESS AND PHONE NUMBER OF CLOSEST LIVING RELATIVE:

KONDO SANI.M USAID NIAMEY NIGER

APPLICANTS SHALL PROVIDE TWO PHOTOSTATIC COPIES OF CURRENT FAA MEDICAL
TWO PHOTOSTATIC COPIES OF CURRENT RATING CERTIFICATES PRESENTLY HELD SUCH AS PRIVATE, COMMERCIAL, ETC.

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

MEDICAL CERTIFICATE FIRST CLASS

THIS CERTIFIES THAT *(Full name and address)*

Mahaman Laminou Dodo
B .P. 865
Niamey
Republic of Niger
West Africa

DATE OF BIRTH	HEIGHT	WEIGHT	HAIR	EYES	SEX
12/9/57	69"	115#	Blk	Brn	M

has met the medical standards prescribed in Part 67, Federal Aviation Regulations for this class of Medical Certificate.

LIMITATIONS: Holder shall wear correcting lenses while exercising the privileges of his airman certificate.

DATE OF EXAMINATION	EXAMINER'S SERIAL NO.
20 January 1987	11668-1

EXAMINER — SIGNATURE: James S Ceton M.D.
TYPED NAME: James S. Ceton M.D.

AIRMAN'S SIGNATURE: L. D.

FAA FORM 8500-9 (10-73) SUPERSEDES PREVIOUS EDITION

SAFETY IS NO ACCIDENT—IT MUST BE PLANNED!

PLEASE SIGN YOUR NAME IN INK ON ITEM VII. (SIGNATURE OF HOLDER)

CUT ALONG DOTTED LINE

I. UNITED STATES OF AMERICA
Department of Transportation – Federal Aviation Administration
XI.

THIS CERTIFIES IV.
THAT V. LAMINOU MAHAMAN DODO
AIR NIGER BP 865
999818216 NIAMEY NIGER

DATE OF BIRTH	HEIGHT	WEIGHT	HAIR	EYES	SEX	NATIONALITY VI.
12-09-57	69 IN	118	BLACK	BROWN	M	NIGER

IX. HAS BEEN FOUND TO BE PROPERLY QUALIFIED TO EXERCISE THE PRIVILEGES OF

II. AIRLINE TRANSPORT PILOT III. CERT NO 2366193

RATINGS AND LIMITATIONS

XII. AIRPLANE MULTIENGINE LAND

XIII.

VII. SIGNATURE OF HOLDER

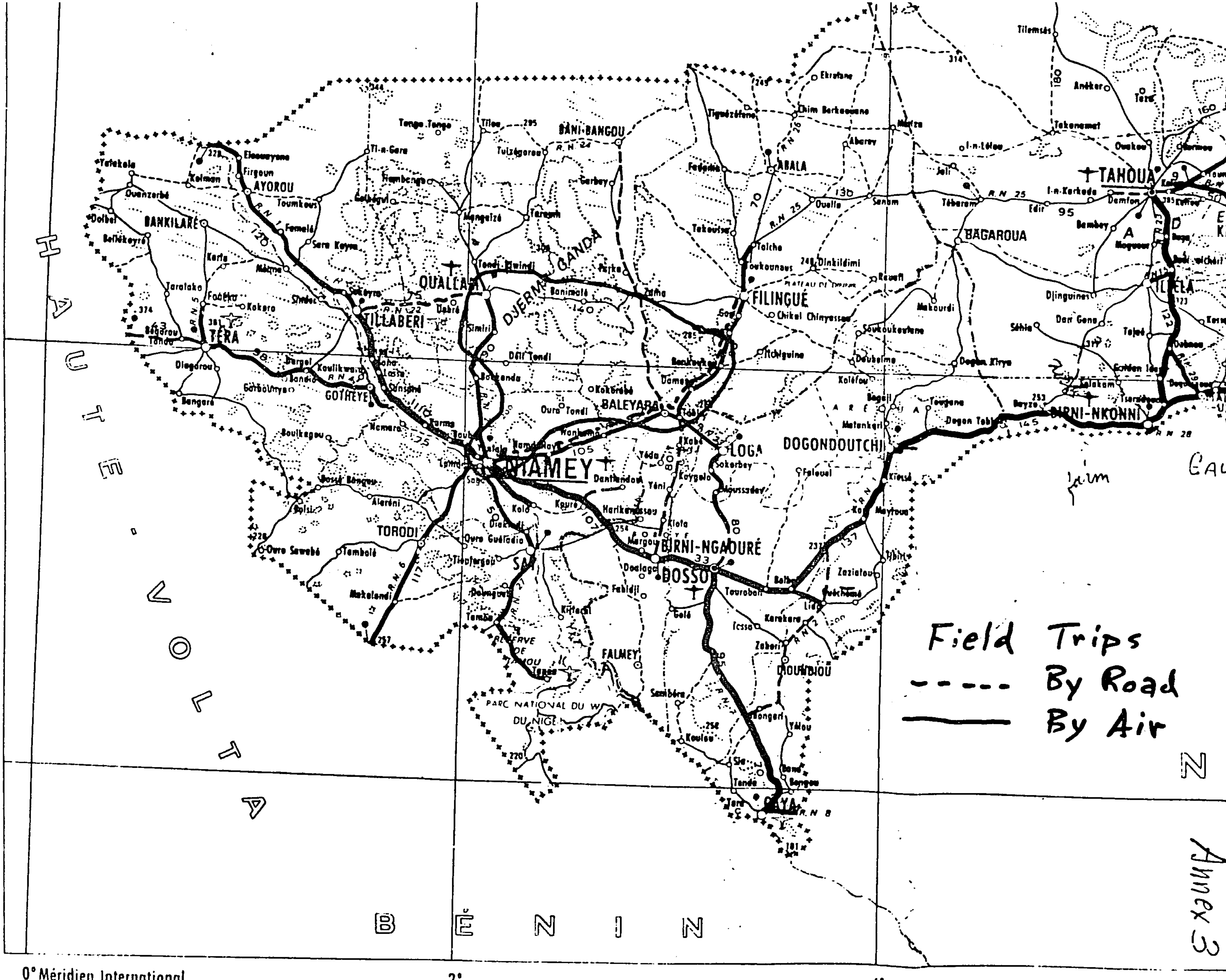
X. DATE OF ISSUE 12-11-85 VIII. x ADMINISTRATOR

CUT OR FOLD HERE

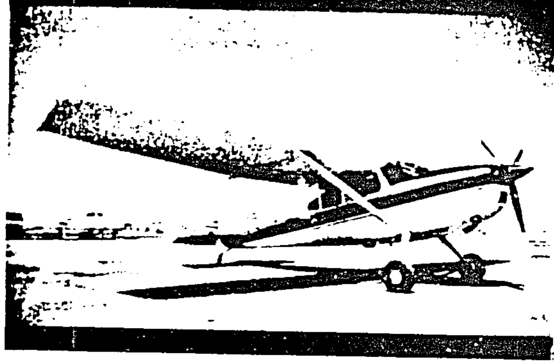
TO:

LAMINOU MAHAMAN DODO
AIR NIGER BP 865
NIAMEY NIGER

2366193 85610096
12-09-57 M 999818216


Field Trips
By Road
By Air
HAUTE VOLTA
BÉNIN
NIAMEY
TAHOUA
BAGAROUA
FILINGUÉ
ABALA
BANI-BANGOU
OUALLAM
TILLABERI
TERA
AYOROU
BANKILARÉ
GOTHEYE
DJERMA GANDA
BALEYARA
LOGA
DOGONDOUTCHI
BIRNI-NKONNI
BIRNI-NGAOURÉ
BOSSO
TORODI
SAY
FALMEY
DIOUNDIOU
GAYA
PARC NATIONAL DU W DU NIGER
0° Méridien International
2°
4°
14°
12°

Annex 3

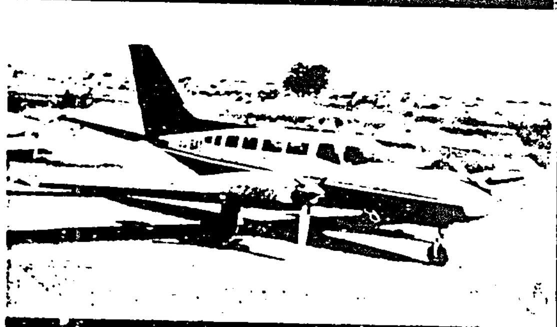


CESSNA 185

CESSNA 402

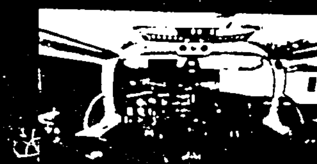
CESSNA 404

APPAREILS CLASSÉS TRANSPORT PUBLIC EXPLOITÉS AUX NORMES O.A.C.I.



Des voyages d'affaires confortables et rapides sur un paysage de safari...

... assurés par une équipe qui puise son expérience sur les routes du ciel africain...



La confiance et la sécurité offertes par l'équipement le plus moderne de l'aviation légère.

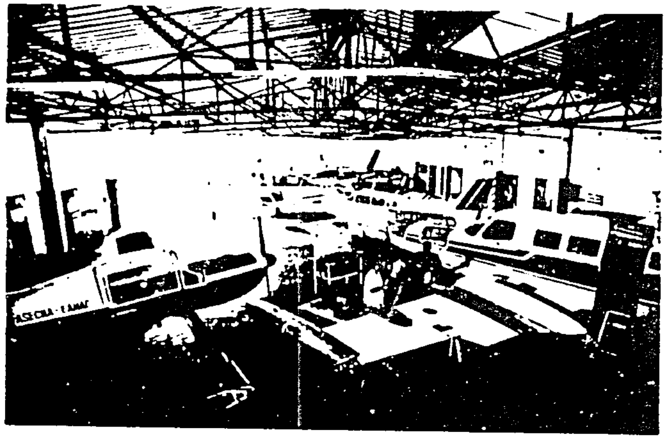
CONCESSIONNAIRE DES MARQUES

Cessna — Avions

LYCOMING — Moteurs

KING — Equipement électronique

VENTE ET ENTRETIEN DE MATÉRIEL AÉRONAUTIQUE, RADIO-NAVIGATION ET TÉLÉCOMMUNICATIONS.



UN ATELIER MODERNE AU CŒUR DE L'AFRIQUE

HYDRAULIQUE

HÉLICES

MOTORISATION

AVIONIC

Conception-Réalisation Françoise Quesnot Fernandes 42.60.67.10 - Photos : Michèle da Silva 42.60.05.85.

RÉSEAU SAGA AFRIQUE DE L'OUEST

Information - Réservation :

MAURITANIE

SAMMA
B.P. 258/278 - NOUADHIBOU - TÉL. : [222] 2263.23.64 - TÉLEX : 433 SAMMAR NDB

SOGECO
B.P. 351 & 378 - NOUAKCHOTT - TÉL. : [222] 522.02 - 527.40 - 522.58 - TÉLEX : 557 MAFRIC NKT

SENEGAL

SOAEM
53, BD PINET LAPRADE - B.P. 835 DAKAR
TÉL. : [221] 22.57.43 & 21.34.78 - TÉLEX : 508 & 3183 MAFRIC SG

SIERRA LEONE

UMARCO
7, COLLEGE ROAD, CLINE TOWN, PO BOX 417 - FREETOWN
TÉL. : [232] 50.348 - 50.730 - TÉLEX : 3218 MAFRIC SL

LIBERIA

UMARCO
LOT 21 A FREEPORT, PO BOX 1196 - MONROVIA
TÉL. : [231] 222.812 - 223.307 - 223.725 - 221.517 - TÉLEX : 4279-4453 MAFRICLI

COTE D'IVOIRE

SOAEM
ROND POINT DU NOUVEAU PORT - B.P. 1727 & 1477 - ABIDJAN 01
TÉL. : [225] 32.51.51 & 32.14.08 - TÉLEX : 23854 - 23855 - 23536 MAFRIC CI

MALI

SOAEM
RUE MOHAMED V - B.P. 2428 - BAMAKO - TÉL. : [223] 22.40.24 - TÉLEX : 404 MAFRIC BKO

BURKINA FASO

SNTB
B.P. 1192 OUAGADOUGOU - TÉL. : [226] 33.54.15 & 33.50.87 - TÉLEX : 5208 SNTB

GHANA

UMARCO
HARBOUR AREA - PO BOX 215 - TEMA - TÉL. : [233] 40.31/5 - TÉLEX : 2037 MAFRIC ACCRA

TOGO

SOAEM
Z.I. DU PORT AUTONOME - B.P. 3285 - LOMÉ
TÉL. : [228] 21.27.21 & 21.07.20 - TÉLEX : 5207 MAFRIC TO

NIGERIA

UMARCO
5, CREEK ROAD, PO BOX 94 - APAPA
TÉL. : [234] [1] 80.32.40 à 49 - 87.41.38 - 87.46.37 - 87.74.59 TÉLEX : 23494/21228 MAFRIC NG

COASTAL SERVICES
42/44 WAREHOUSE ROAD, PO BOX 97 - APAPA
TÉL. : [234] [1] 87.07.04 & 87.05.73 - TÉLEX : 21228 MAFRIC NG

NIGER

S.N.T.N.
B.P. 135 - NIAMEY
TÉL. : [227] 72.24.55 - 72.24.58 - 72.28.32 - 72.28.33 - TÉLEX : 5238 - 5338 - 5370

CAMEROUN

SOAEM
RUE ALFRED SAKER - B.P. 4057 - DOUALA - TÉL. : [237] 42.02.88 - TÉLEX : 5220 MAFRIC KN

TCHAD

S.T.A.T.
B.P. 100 - N'DJAMENA - TÉL. : [235] 20.24 - 20.25 - 38.98 - TÉLEX : 5230 KD MAFRIC

CENTRAFRIQUE

SOCATRAF
B.P. 1445 - BANGUI - TÉLEX : SHIPRCA 5258 RC

GABON

SOAEM
B.P. 72 - LIBREVILLE - TÉL. : [241] 70.28.30 - 70.28.31 - TÉLEX : 5205 GO

8, RUE DU LIEUTENANT DE VAISSEAU SERVAL - B.P. 518 - PORT-GENTIL
TÉL. : [241] 75.21.71 & 75.21.74 - TÉLEX : 8205 MAFRIC GO

CONGO

SOAEM
18, RUE DU PROPHÈTE ZÉPHIRIN LASSY - B.P. 874 - POINTE-NOIRE
TÉL. : [242] 94.10.18 et 94.10.17 - TÉLEX : 8214-8311 MAFRIC KG

TRANSNIGER AVIATION

RUE HENRICH LUBKE [FACE OFFICE DU TOURISME]
B.P. 10454 NIAMEY TÉL. : VILLE [227] 73.20.55
AÉROPORT 73.20.21 - TÉLEX : LOCAVIA 5250 NI

TRANSNIGER AVIATION

TRANSPORT À LA DEMANDE
TRAVAIL AÉRIEN
AFFRÈTEMENT-LOCATION
ATELIER DE MAINTENANCE

AVIATION

FILIALE GROUPE SAGA/SNTN

The Micronair Spray Pod System enables suitable aircraft to be converted for spraying within hours. Two completely self-contained spray pods are mounted on a standard underwing pylons and are controlled from a plug-in panel in the cockpit.

As the system is completely external to the aircraft, the installation does not disturb the cabin area which can be used for passenger or transport purposes whenever necessary.

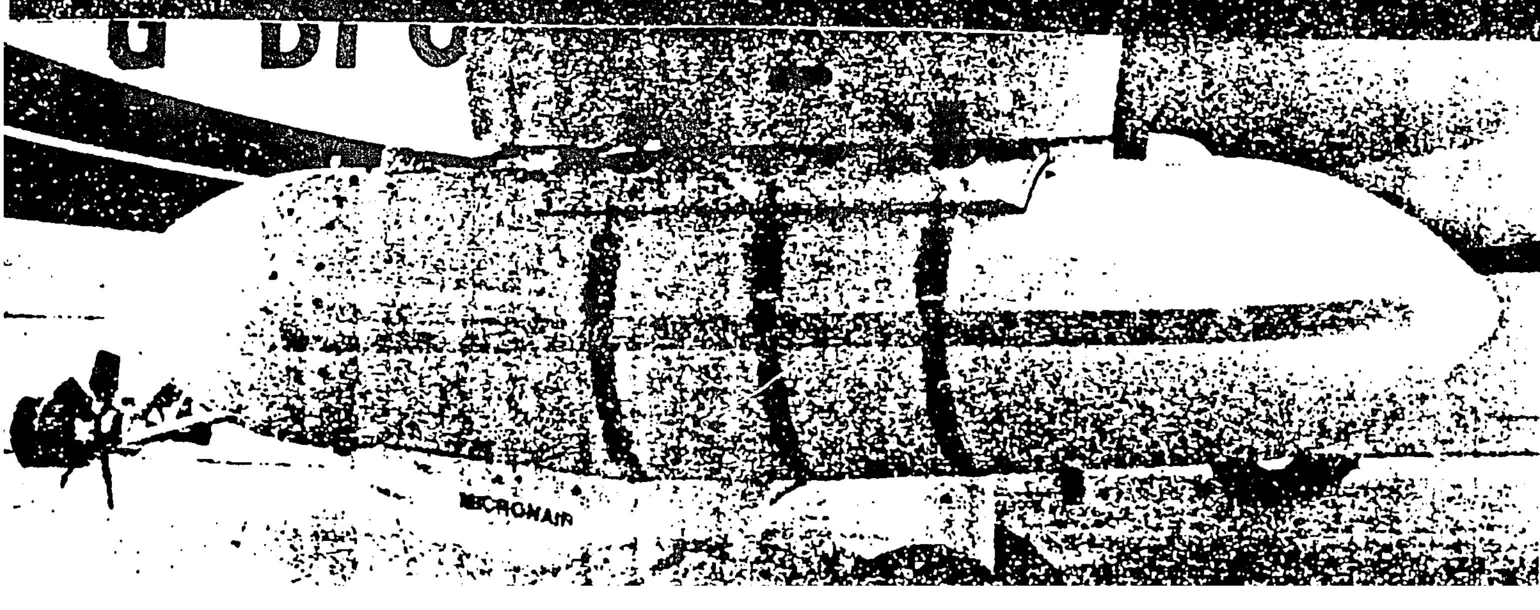
Ease of installation, combined with multi-role versatility of the aircraft makes the system ideal for a wide range of pest control tasks, especially when these are only required occasionally. At all other times the aircraft can be employed to its maximum advantage for transport or survey work.

SELF-CONTAINED SPRAY POD

SPECIFICATION

Dimensions:	Length 103 in. (2.6m) overall Diameter 18in. (0.5m)
Mountings:	Suitable for attachment to carriers with 14 inch mounting centres. NATO attachments can be used.
Capacity:	50 US Gallons (190 litres)
Weight:	Empty 128 lb (58 kg) Full 545 lb (248 kg)
Output:	Variable from 0-8 US Gallons/min (0-30 L/min)
Atomiser:	Micronair AU4000 capable of producing droplets of 50 - 500 microns diameter.

MICRONAIR (AERIAL) LIMITED
Bembridge Fort Sandown Isle of Wight PO36 8QS England
Telephone: Sandown (0983) 406111 Telex: 86448 MICAIR G Cables: Micronair Sandown England



DUFLO

AEROSPRAY SYSTEMS

NEW BREMEN, NEW YORK 13412

We're leading the aerial application industry to a promising new frontier, with the Micromist 900 Conversion. Think of spraying 90 acres/min. on only a few ounces of fuel. It's not just a dream. Duflo Aerospray Systems, Inc. has made it a reality.

The Micromist 900 is an idea whose time has come.

It's sleek, quiet, economical . . . above all, safe . . . Consider the possibility of losing one engine at gross weight, yet still being able to return to base losing nothing but time. You can do it with the Micromist 900 conversion.

The Micromist 900 is a money-maker for you.

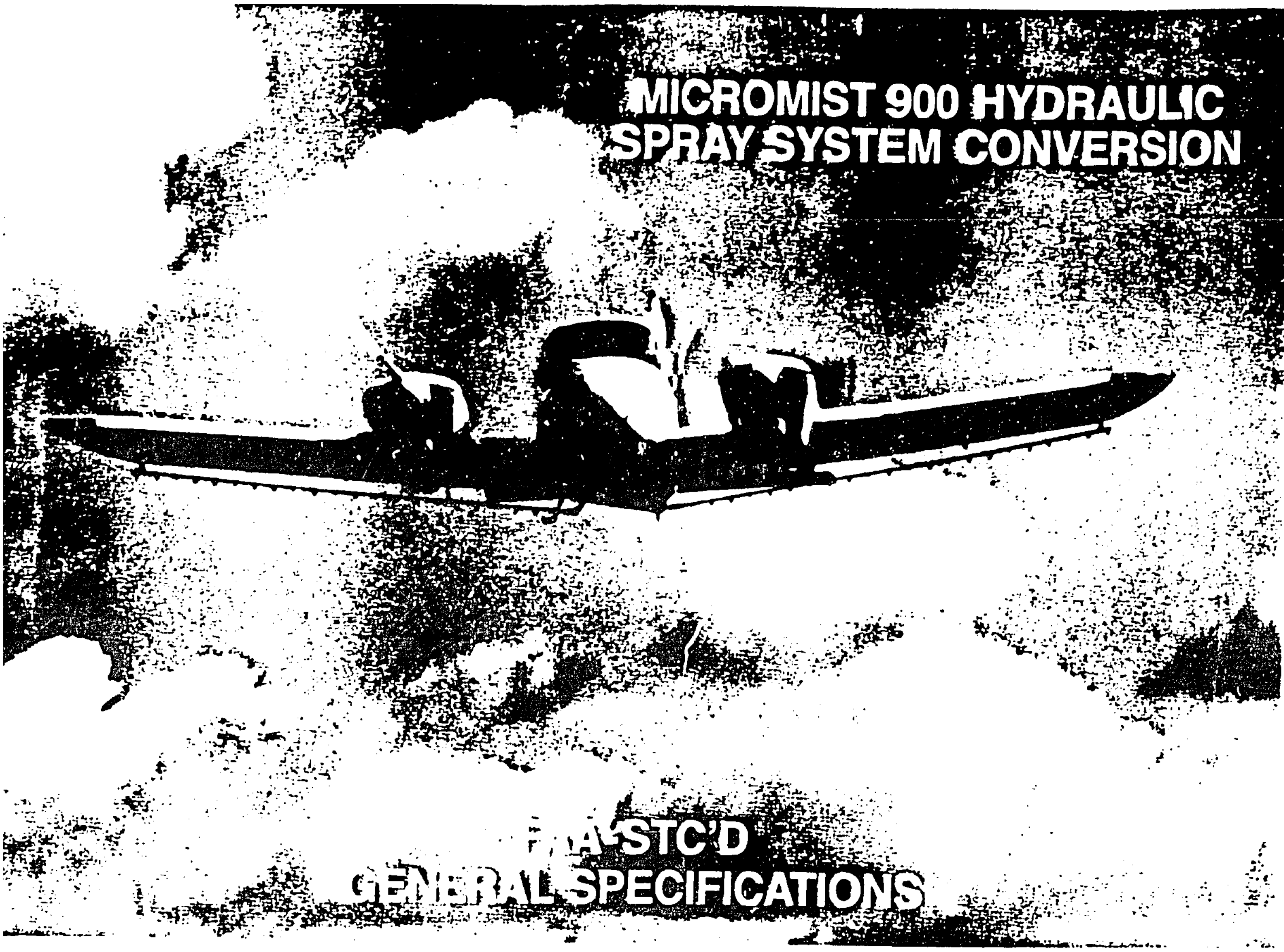
Lower application rates let you make money on ag, mosquito and forest insect control. Micromist 900 is the equivalent of 3 planes in 1, at about half the cost of today's ag equipment. A Micromist 900 can open new markets for you, work farther from base and handle larger jobs . . . all with unheard-of dependability and safety.

Best of all . . . a reliable, trouble-free spray system backed by the strongest protection plan in the ag industry.

ENJOY THESE ADVANTAGES

- **Efficiency**
  Extremely low drag factor. Entire spray system components mounted inside aircraft, leaving only streamline stainless steel booms and low profile heat exchanger outside.
- **Practical**
  Aircraft capable of spraying a swath width 60 ft.–400 ft. at speeds ranging from 100 to 180 mph. Rates can be varied from ½ oz. to 6 gals. per acre
- **Low Noise**
  Aztec has a very low outside noise level, compared to most ag aircraft . . . less than 85 decibels at 150 ft. AGL. Reduced cockpit noise level, due to additional sound proofing, reduces pilot fatigue and enhances communications.
- **Easy to Fly**
  Quick and light control response. Horizontal stabilator reduces pilot fatigue.
- **Safe**
  Twin engines provide all-important safety factor. Excellent visibility. Low stall speed.

"There's no comparison in mental stress flying a single engine, day in and day out, versus a twin. The noise level is low, the cockpit is clean and comfortable. Pilot fatigue is at the lowest possible level. If you get into trouble... the second engine buys time."



AIRCRAFT

Performance (Certified Gross Weights)

1. Speed	Power %	GPH	Miles/Gal.
175	70	26.2	6.6
167	65	24.7	6.8

NOTE: Compare miles/gallon with any other ag aircraft and see the Micromist 900 economy.

2. Stall Speed .... 62 MPH
3. VMC .... 80 MPH
4. Top Speed .... 212 MPH
5. Takeoff Distance .... 800 Ft.
6. Landing Distance .... 900 Ft.
7. Max Cruise Range @ 70% Power .... 1090 Miles
8. Single Engine rate of climb 275 Ft./Min. unloaded 500 Ft./Min.

Other Distinguishing Features

1. Fuel Capacity - 144 US Gals
2. Dependable Lycoming 250 HP Engines (2000 hr TBO)
3. Hartzell Constant Speed, Full Feathering Props

SPRAY SYSTEM

A. Performance

1. Speed (mph)	Swath (ft.)	Max Rate	Acres Per Min.
120	100	3.6 gals/acre	24.0
150	100	2.9 gals/acre	30.0
150	150	1.9 gals/acre	45.0
150	300	3.8 qts/acre	90.0
170	400	2.5 qts/acre	136.0

2. Droplet Range 30-1,000 Microns (VMD)
3. Spray Pressure Range 15-75 PSI
4. Spray Tank Capacity 190 U.S. Gals.

B. Operational Features

1. Fingertip control of entire system within cockpit
2. Electric spray control valve with recirculation mode
3. Injector syphon for positive nozzle shut off
4. Electronic "Spray on" timer
5. Adjustable "Spray on" amber light
6. Duplex filter/spray boom pressure gauge
7. Trouble-free hydraulic pump drive system
8. Streamline stainless-steel booms
9. "Panel mounted" gauges

C. Safety Features

1. Positive-trip emergency dump
2. Fully corrosion-proof and abrasion-resistant
3. Hydraulic system
   a) Low-level oil reservoir warning light
   b) Hydraulic oil temperature indicator
   c) Hydraulic pressure gauge
   d) High-pressure warning light

JUFLO
EROSPRAY SYSTEMS
EW BREMEN, NEW YORK 13412
TELEPHONE: 315/376-TWIN

TODAY'S ANSWER TO TOMORROW'S NEEDS

60

DUFLO AEROSPRAY SYSTEMS, INC.

NEW BREMEN, NEW YORK 13412 • 315/376-TWIN

March 3, 1987

Agrotors, Inc.
P.O. Box 578
Gettysburg, PA 17325
ATT. Carrol M. Voss

Dear Carrol:

The only question I have, Carrol, is how can a retired person be so involved in a foreign country such as Africa? I have heard a little bit about their problem and it appears that they're on the right track wanting to use smaller aircraft. Per your letter of February 11, 1987, please find enclosed a few Micromist 900 brochures. Inside you'll find some national reprints which further describes the Micromist 900 Spray System. The system was finally STC'd in January of 1986 and since that time has received much notoriety. It is a rugged, light weight system which allows the Aztec to fly with greater efficiency than ever before. From a dollar and cents standpoint we find the Aztec Micromist 900 equipped to be extremely versatile and efficient in the one gallon or less per acre range. Mile per gallon figures produce efficiency twice that of conventional ag equipment, making the Micromist 900 a far reaching aircraft. Installed Micromist 900 conversions fall around the $30,000 figure. All Piper Aztec models are candidates for conversions except for the turbocharged models. If you should like to evaluate one of these aircraft, Carrol, we would certainly welcome the opportunity at our facility in Upstate New York. Getting in the right seat, or making a few practice runs with the Micromist 900 Aztec, is the best way to understand the efficacy of the system. Application speed of 180 MPH, 1200 pounds of material, and fuel economy approximately 27 gallons/hour, says it all. The second question about availability in July, August, and September is a function of our mosquito season in the Northeast. In a normal season, we are pretty much finished by Mid-July and if so would be available for the following time period. Currently we have three Micromist 900 Aztecs ,they are in excellent condition and ready to work. In summation, the Micromist 900 equipped Aztec would do a splendid job at the 8 ounce/acre rate. Along with the proper people, a demonstration could be arranged at our facility. Appreciate your interest in Duflo Aerospray Systems and hope that you would call if we can be of any further assistance. Yes, we did miss you at Cornell this year; it was an excellent conference.

Sincerely yours,

Jeffrey T. Duflo

Jeffrey T. Duflo
President

DUFLO AEROSPRAY SYSTEMS, INC.
NEW BREMEN, NEW YORK 13412 • 315/376-TWIN

Dear Applicator:

Meet the Micromist 900 Aztec Spray Conversion. The first hydraulically driven internal delivery system designed and S.T.C.'d specifically for the Piper Aztec. The advantages of using the Piper Aztec are many. Low wing loading, high cruise speed, low stall speed, excellent fuel economy, and one of the best single engine performance ratings (475 ft/min) in the industry are just a few. It is an agile airplane with a respectable turn aroung time--18 seconds.

The Aztec has a comfortable margin between normal working speeds and stall speed (on average 90 mph). The visibility is excellent. With counter balanced stabilator (not found on conventional ag aircraft), control responses are light and quick. Low external noise enhances crew communications and reduces pilot fatigue. Optional 3 bladed propellers further improve takeoff acceleration and reduce cockpit noise levels. The Micromist 900 Aztec has the dependable 0-540 series Lycoming engines with TBO's of 2000 hours. Engine reserve totals for the Aztec run about $6.50/hour.

At the heart of the aircraft is one of the most innovative spray system designs available in the business. High tech plastics for low weight and 316 grade stainless steel combine to yield the ultimate in corrosion proof systems. Bromine resistance is over 40%, while in most ag aircraft 12% is considered maximum. Fiberglass spray tanks are safely secured to withstand a crash at an impact angle of 45 degrees fully loaded. All chemical hoses have a minimum burst rating of 6000 PSI. The electronic control valve and positive shutoff system is capable of eliminating all dribble. Controls are within reach of the pilot to further facilitate complete system operation. An emergency dump with positive trip pull, allows for total evacuation of the system and an additional 250 ft/min single engine climb.

Hydraulic drive means low aerodynamic drag, consistent and efficient fluid power-where and when you need it. All hydraulic lines are run through metal tubing to minimize chafing, have reusable fittings for in field repairs, and have a designed safety factor in PSI of at least 6:1. A special low drag heat exchanger and eliptical streamlined booms make the Micromist 900 the most aerodynamically sleek system found anywhere. Innovation through design makes the Micromist 900 a highly competitive sprayer with many safety factors not found on other Ag aircraft. For forest insect control, fire ant, ag work, and of course, mosquito control, we feel the Micromist 900 Aztec is truly an idea whose time has come.

The Micromist 900 Warranty is as follows:

Hydraulic System - 12 months or 250 hours, whichever comes first. This would cover pump, motor, all lines, and connections.

Spray System - (A) 6 months or 150 hours, whichever comes first. This would cover, filter bodies, all valves, hoses, pumps, and associated tubing.

(B) 12 months or 250 hours, whichever comes first. This would cover, the spray tanks against delamination as a result of Dibrom 14 (Naled). Spray booms also are included.

Purchasing a Micromist 900 can be done one of two ways:

1) You can purchase a ready to fly Micromist 900 equipped and taylored to your particular needs.
2) We can equip your Aztec with a Micromist 900 spray system.

Think you would like to fly a Micromist 900 Aztec? We believe it's the best way to show you the real story. Duflo Aerospray Systems is located in Northern New York, 50 DME north of the Utica VOR. If you're flying commercially, we would suggest Syracuse, NY for a destination.

Thank you for your interest in Duflo Aerospray Systems.
Enjoy the conference and your visit to Acapulco.

Sincerely yours,

Jeffrey T. Duflo

Jeffrey T. Duflo
President

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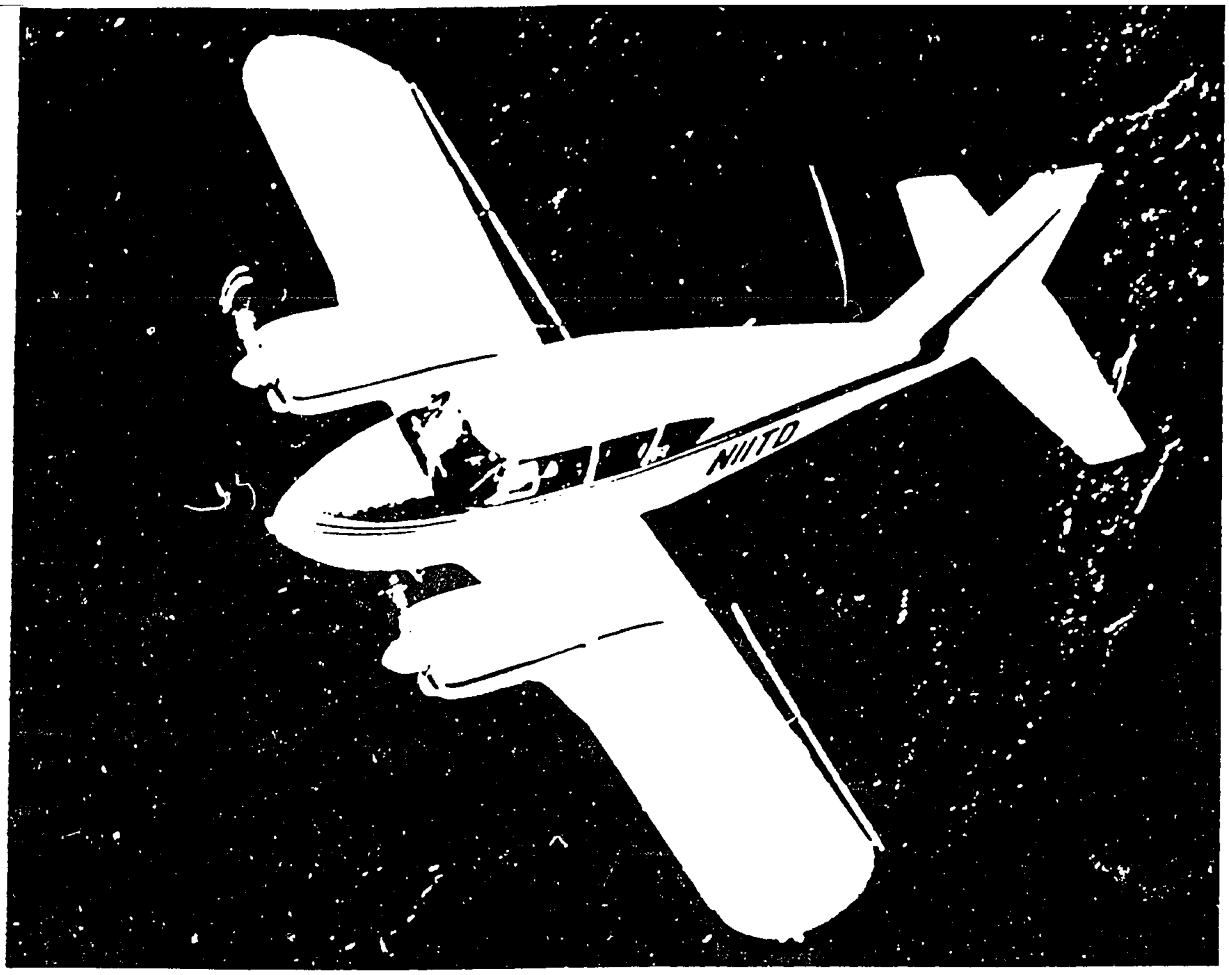
Agricultural Aviation

Volume 13 Number 3



Twin Engine Spraying is Back . . . Better Than Ever

by Karl E. Warm

As far as Jeff Duflo is concerned, his days of "low and slow" are over. He has replaced them with "fast and clean," and his 31-year-old company, Duflo Aerospray Systems, Inc, has made that change possible with the Micromist 900.

Duflo emphasizes that the development of the "900" spray conversion for the twin engine Piper Aztec came from the basic needs of his successful aerial application firm.

Author Karl Warm is the Micromist 900 project manager. For more information contact Duflo Aerospray Systems, Route 812, New Bremen NY; 315-376-2155.

"We needed an aircraft that could operate safely in remote areas and that the FAA would allow over congested areas. We required speed for range, power to carry a respectable load, and single engine performance for safety. The Aztec has all three," says Duflo.

Designing and developing a spray system that takes full advantage of the Aztec's performance, clean lines and high cruise speed, high lift wing and low stall speed, is the main ingredient in the Micromist 900 story.

During the late seventies the Duflos began an intensive program to minimize all parasitic drag on their airframe. The most complex undertaking was the development of a hydraulically driven spray dispersal system. The advantage of a hydraulic spray system is an overall cleaner airframe, increased fuel economy, more reserve power at working speeds, and better single engine performance.

The use of corrosive chemicals, resulted in the need to design structural components that could survive such wear and tear, day in and day out, season after season. "We have spent years in research," says Duflo, "locating and designing the most corrosion resistant components and materials in use today."

In the aerial application business there is no story if you can't make money with your equipment. In their thirty years in the ag aviation business, the Duflo's have flown Super Cubs to Ag-Cats. The increased productivity of the Micromist 900 led to a phase out of ag singles and to upgrade to other Aztecs. This significant change is one reason Duflo Spray Chemical is one of the most successful ag operations in the Northeast.

"Initial investment and total operating cost of a Micromist 900 is less than most 300-400 horsepower ag singles," says Duflo. A standard Micromist 900 comes with full IFR equipment, dual nav/coms, and a second seat. Two Lycoming 0-540, 250 horsepower engines, with a 2000 hour TBO, power the spray aircraft.

Outstanding Performance

"Useful load of the Micromist 900 exceeds a 450 or 600 horsepower Ag-Cat and that's without overloading the aircraft," notes Duflo. Outstanding performance at certificated weights means safety. At gross weight the single engine rate of climb is 275 feet per minute, dumping the load increases this to 500 feet per minute. The power off stall speed is 70 miles per hour, standard ferry speed exceeds 175 miles per hour. Working speeds can range from 120-160 miles per hour at 50-65 percent power settings. "It's nice to have the throttle back and spray, a rarity with conventional ag aircraft," Duflo mentions. "And we have obtained the safety and reliability that turbines are trying to sell, without the penalty of a high initial investment and high operating cost."

With Duflo technology and innovation at work, reliability extends beyond the aircraft and includes the spray system itself. "The system works only as hard as the load placed on it," explains Duflo, "If you were to run the centrifugal pump after running out of spray, not much is going to happen because there is no load on the pump." Pump examina-

DUFLO MICROMIST 900 AZTEC SPRAY CONVERSION

Specifications

Engines	Two Lycoming 0-540
Horsepower	250 at 2575 RPM
Time Between Overhaul	2000 hours
Propellers	Hartzell Constant Speed Full Feathering
Standard Empty Weight	3300 lbs
Gross Weight	5200 lbs
Spray Tank Capacity	190 gal
Fuel Capacity	144 gal
Wing Span	37 ft
Wing Area	207 sq ft
Length	27.6 ft
Height	10.3 ft

Performance*

Cruise 75% power @5200 lbs	182 mph
Working Speed	120 mph - 170 mph
Top Speed @S.L.	212 mph
Stall Speed flaps up, power off @5200 lbs	72 mph
Stall Speed flaps down, power off @5200 lbs	62 mph
Rate of Climb @5200 lbs	1500 ft/min
Single Engine Rate of Climb @5200 lbs	275 ft/min
Takeoff Distance @5200 lbs	800 ft
Landing Distance @5200 lbs	900 ft
Fuel Consumption 75% power	28 gal/hr
Fuel Consumption 65% power	24 gal/hr
Max Cruise Range @70% power	1090 miles
Min Control Single Engine Speed	80 mph
Single Engine Service Ceiling @5200 lbs	6000 ft

* *Performance figures denotes flight testing for Supplemental Type Certification*

Performance of Spray System

Droplet Range	30-1,000 microns (VMD)
Spray Pressure Range	15-75 PSI
Spray Pump Max Output	86 gal/min

Speed (mph)	*Swath (ft)*	*Max Rate*	*Acres/min*
120	60	6.0 gal/acre	14.4
120	100	3.6 gal/acre	24.0
150	100	2.9 gal/acre	30.0
150	150	1.9 gal/acre	45.0
150	300	3.8 qts/acre	90.0
170	400	2.5 qts/acre	136.0

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tions after three years of use have shown negligible wear.

The design life of the system is exceptionally high. This can be verified by the Micromist warranty, which exceeds industry standards by over 1200 percent.

Innovation and well-planned engineering can be seen in the installation of the system as well. From the pilot's fingertip control of the entire spray system, to the quality and esthetics of the system, the word to describe it is *clean*. "Except for the spray booms everything is on the inside. People don't even realize that this is an ag plane," remarks Duflo.

Duflo engineering is evident in the design of the hydraulics that drive the spray system. System efficiency is 94 percent. Again, this means reliability and it makes the Micromist 900 a versatile, high performance spray system.

An Ideal Sprayer

The Micromist 900 is an ideal forest and mosquito sprayer. It is also competitive in crop care work where lower volume rates are now being used. Application rates can be varied from ½ ounce to 6 gallons per acre. Spray pressures are adjustable from 15 to 75 PSI, and swath widths range from 60 to 400 feet. Spray tank capacity is 190 gallons.

"For the applicator working only crops," says Duflo, "a Micromist 900 on the line is a money maker because it can help him diversify his operations, expand and work beyond the range of his competitors, and still be used in his everyday work."

Duflo Aerospray has received Supplemental Type Certification for the Micromistmist 900. It is the first hydralically driven internal system STC'd for twin engine Piper Aztecs.

"All parts of the Micromist 900 will be manufactured under FAA-PMA for quality assurance," states Duflo, "We can service a customer by either converting his Aztec or delivering a complete ready-to-go Micromist 900."

Duflo's recommendation to customers is to use his company's experience in selecting Aztecs, and save considerable time and money by ordering a ready-to-work Micromist 900. "We have a complete maintenance facility, so a person can have a Micromist 900 delivered around his specifications and needs." Delivery time is within four weeks.

Duflo Aerospray Systems say they have today's answers to tomorrow's needs. The Micromist 900 can open new markets for applicators, or efficiently work a present market by taking on larger jobs. The Duflo goal of high productivity, low operating cost and initial investment, reliability and safety makes the "900" a system whose time has come. A system that will be a tough one to beat.

DUFLO MICROMIST 900 SPRAY DISPERSAL EQUIPMENT

Standard Equipment

- Streamline stainless steel booms
- Stainless steel dry brake coupler - male and female - side loading
- Stainless steel plumbing
- 190 gallon corrosion proof spray tank - externally vented
- Electronic spray timer*
- Duplex filter/spray boom pressure gauge*
- Adjustable amber "spray on" light*
- Hydraulic temperature gauge*
- Hydraulic low level light*
- Hydraulic high pressure warning light*
- Direct drive hydraulic pump
- Electric spray control valve with recirculation mode
- Spray on/off switch mounted on control yoke
- Manual spray system on/off valve located near fuel console
- Low profile - low drag hydraulic heat exchanger
- Stainless steel positive trip emergency dump assembly
- Fingertip control spray pressure adjustment located on fuel console
- Two inline spray filter assemblies
- Direct drive hydraulic motor/centrifugal spray pump
- Adjustable injector syphon for positive nozzle shutoff

* *Panel mounted gauges and instruments*

Optional Equipment

- Rear Partition (Sound Proofing)
- Spray System Cover (Sound Proofing)
- Brass dry brake coupler

AVIATION IN AGRICULTURE WORLDWIDE

AG-PILOT INTERNATIONAL

- Ag Pilots
- Ag Aircraft Owners
- Chemical Dealers
- Consultants

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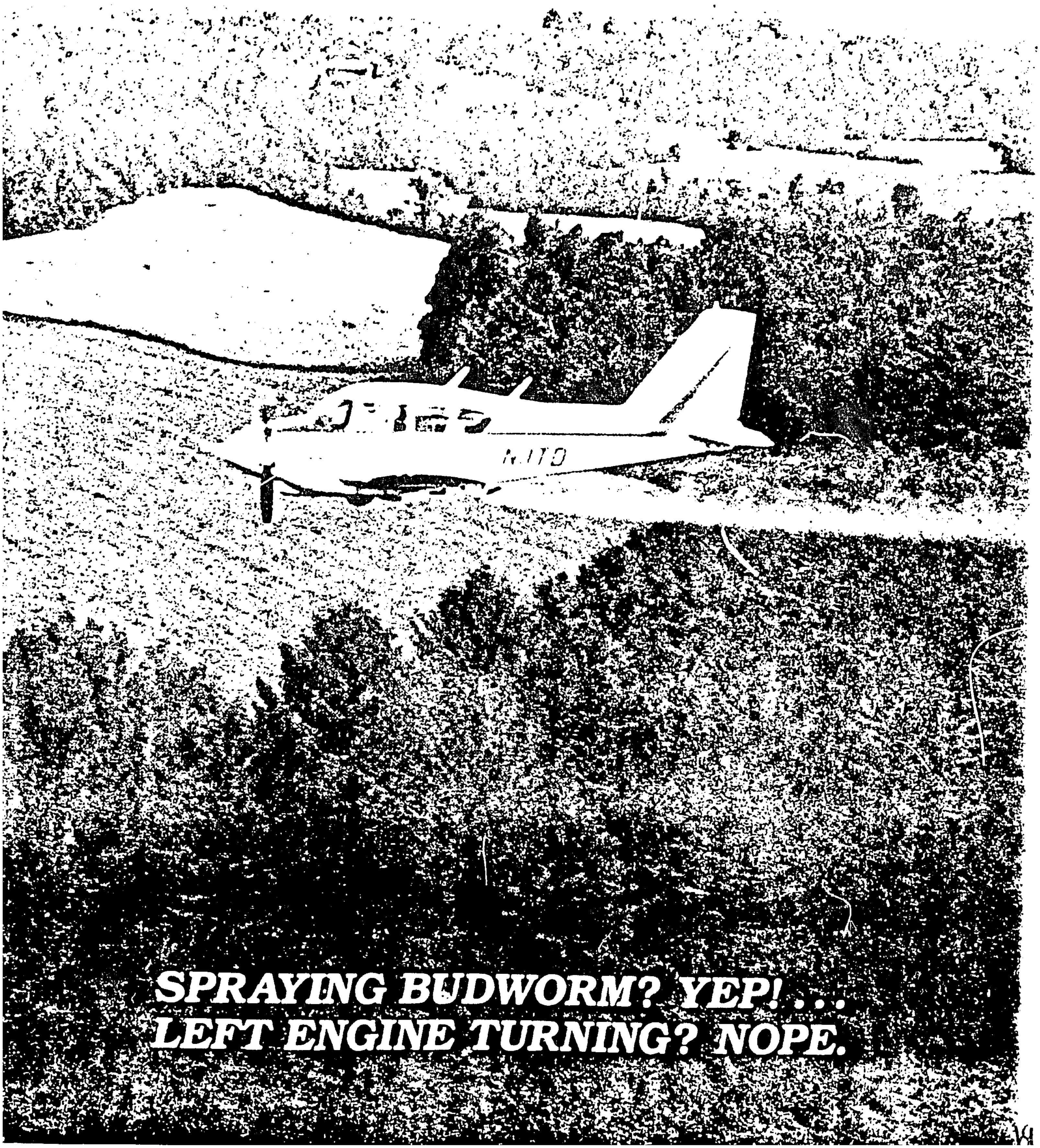
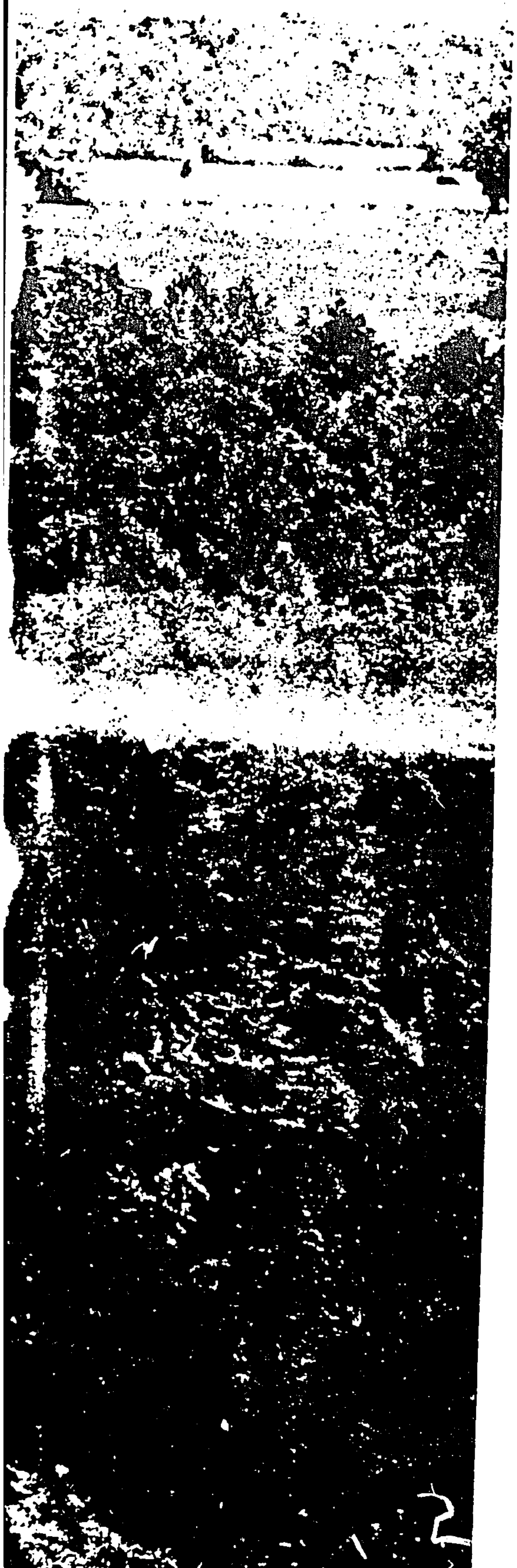


by Karl E. Warm

When Piper Aircraft introduced the Aztec line at the turn of the sixties, they were after a growing twin market of business executives and charter operators. For Tom Duflo to look at a shining new Aztec, costing twice what most sprayers were in those years, and see a sprayer that could catapult his business to the heights of being the largest aerial applicator in the Northeast is beyond most people's imagination.



TOM DUFLO is founder of Duflo-Spray Chemical, Inc. and his son JEFF DUFLO is President of the family corporation. The Duflos have been in the ag spray business for thirty years. In 1962, Tom Duflo was the first on record to convert an Aztec to an ag sprayer. In the subsequent years, his two singles on the line were phased out and replaced with Aztecs. The Duflos have designed the most technologically advanced spray system on the market for their Aztecs. The conversion is called the Micromist 900 and is the first such spray conversion to receive STC approval for an Aztec.

The development of the Micromist 900 is more of an evolution that spans the 23 years the Duflos have used Aztecs. "Our off-season means testing and developing, whether it's with chemical formulations, nozzles, or system design," says Jeff Duflo. The Duflos have established themselves as innovators in the ag industry. In addition to the design and development of the Micromist 900, they have improved chemical formulations under experimental permits which have directly resulted in current labeling.

Duflo innovation and technology in the Micromist 900 has been a remarkable achievement. "Our goal," says Tom Duflo, "is simplicity and reliability because that means safety and profits. With the Micromist 900, we have achieved the reliability that the turbines are trying to sell without the penalty of high initial investment and operating cost. It's safe, and it's a money making unit."

The engines are the time tested 250 hp Lycoming 0-540's. Says Tom Duflo, "The 0-540's can easily see their 2000-hour TBO without a top." The Duflos have owned low and high horse ag singles and have found the total operating cost of the Micromist 900 to be comparable to a 300-horse single.

"Not only can you compare operating cost," says Jeff Duflo, "the initial investment is less than most 300 or 400 horse ag singles and you get full IFR equipment, dual nav/coms and a second seat with the Micromist 900."

The two main factors that make the Micromist 900 a success are the reliability of the system and the aircraft speed. The Duflos have spent 23 years in cleaning up the airframe for some very important reasons. Explains Jeff Duflo: "The flaps-up stall speed of the Micromist 900 is 70 mph. The 75 percent cruise speed at working weights is 175 mph. Our normal working speed ranges from 120 mph to 160 mph and that's at 50 to 65 percent power settings. A clean airframe allows a safety margin between stall and flying speed with either excess power or speed. The range between stall and cruise speed in the Micromist 900 is greater than most ag planes can fly. Fuel economy is better than 300 horse singles and twice that of 450 and 600 horse singles. We average 7.0 miles per gallon."

"My primary reason for moving into a twin ag aircraft was safety," says Tom Duflo. "There is no comparison in mental stress in flying a single engine day in and day out versus a twin. The noise level is low, the cockpit is clean and comfortable. Pilot fatigue is at the lowest possible level."

"If you get into trouble," continues Tom, "the second engines buys time." At normal working weights with 150 gallons of material and three hours of fuel, the Micromist 900's single engine rate of climb is 275 feet per minute. Dumping the load increases the single engine rate of climb to over 500 feet per minute. Since the Micromist 900 has STC approval, the single engine climb rates have been extensively tested.

Cleaning up the airframe meant designing a hydraulic spray system. This turned into a monumental task. Says Tom Duflo: "We set up a test bench and spent two years evaluating different combinations until we hit on a design that not only works, but is 94 percent efficient." An advantage of the Duflo hydraulic system is that the system works only as hard as the load placed on it. At spray pressures of 20 to 40 PSI, the system is operating between 30 to 50 percent of system capacity. Application rates can be varied from one-half ounce to six gallons per acre.

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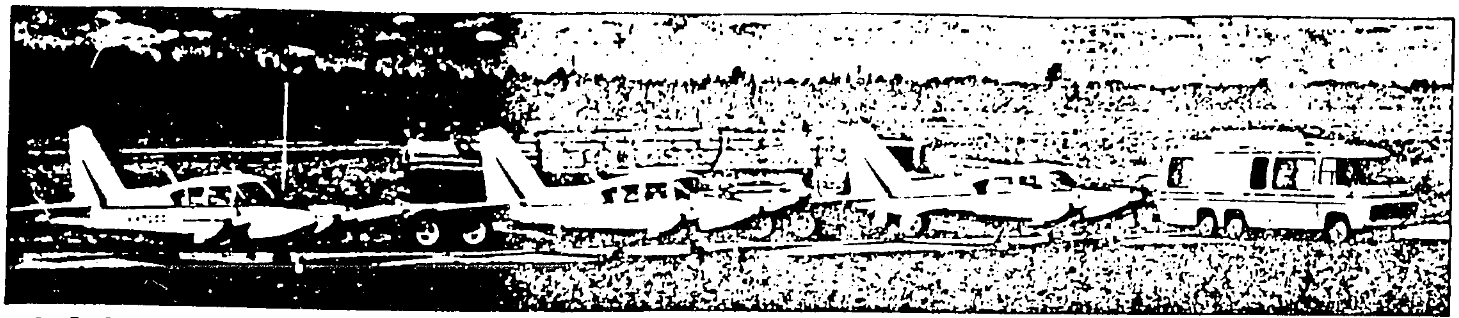

Duflo-Spray Chemical's three Aztec/Micromist 900 Conversions, GMC Motorhome (mobile office), and International Transtar Tanker (Nurse Tank). Total production capability is 450 acres per minute.

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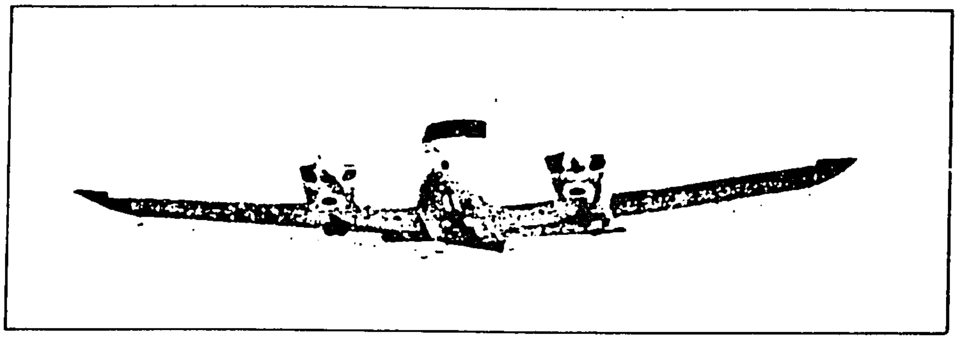
"Within the cockpit, we have fingertip control of the entire spray system," says Jeff. The gauges and instruments are all panel mounted. System performance can be monitored by the pilot, and any abnormality be easily detected. An electronic timer provides for precise metering and partitioning of loads. For night operations, a "spray on" light is incorporated.

"This industry can be divided into three distinct categories," states Jeff, "Agriculture, Forest, and Biting Insects." Versatility of the Micromist 900 keeps the Duflos working in all three areas. For agricultural crops, the Micromist 900 is used in the care of wheat, corn, alfalfa, and Christmas trees. Forest work includes the control of spruce budworm, gypsy moth, and forest tent caterpillars. For biting insects, the Duflos have received worldwide attention for their work in mosquito and blackfly control.

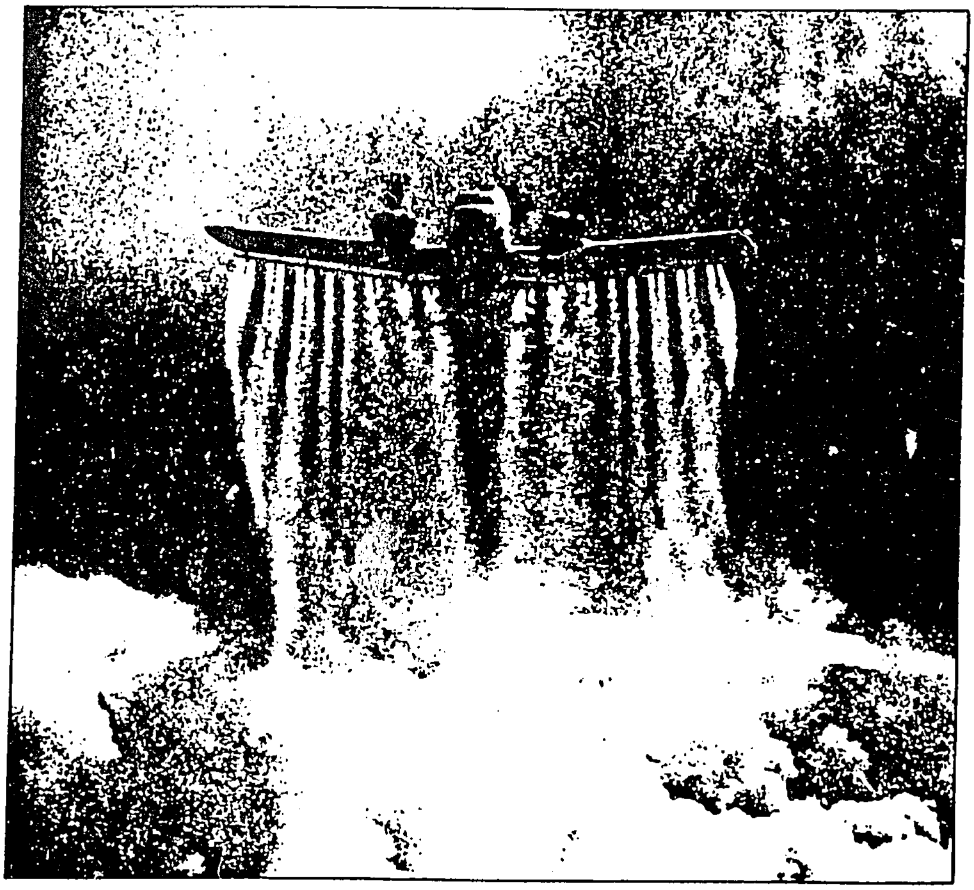
There is no doubt the Micromist 900 is an ideal mosquito sprayer. In agreement is Don Menard, Director of the Cameron Parish Mosquito Abatement District in Creole, Louisiana. Their 79 Aztec F Model has been converted into a Micromist 900 Sprayer, Duflo's first customer conversion. "We are very pleased with the system and performance of the airplane," says Menard. "We had a lot of problems with the bolt-on systems currently found on today's market."

The Micromist 900 is designed to handle the most corrosive of chemicals. "We use a lot of Dibrom," says Jeff Duflo. "There is no need of flushing the system during the season, unless we change chemicals for another job. We have a corrosion test lab with a sample of the wettable components soaking in straight Dibrom. They've been there for four years showing no sign of deterioration. The Micromist 900 is also designed so that when the system runs out of spray, there's no chemical left in the tanks and lines, and only about a cup left in the stainless steel dump."

The Duflos point out that the Micromist 900 is not the answer to all of ag aviation needs. "But," says Tom Duflo, "we do feel that a second or third aircraft on the line should be a Micromist 900. Although I could make more money with one Micromist 900 than with two singles."



Head on view — right engine feathered.



Dramatic illustration of the Micromist 900's clean lines. Notice symmetry of vortexes.

"I don't like to call myself an operator," continues Tom, "but rather a contractor, and a contractor must fulfill the terms of his contract and deliver, in order to renew it."

In the files of Duflo-Spray Chemical is a letter from a Senior Forester, supervisor of a recent forest contract. He states: "We were most pleased with every aspect of your company's operation. The thorough study of topographic maps and aerial reconnaissance before each mission, the near perfect calibration, swath width, and uniform small droplet size achieved, and the rapid and clean turnarounds were all indicative of a company that is concerned with the quality of work they perform."

In meeting the needs of today's ag spraying, it appears that Duflo Aerospray Systems, Inc. of New Bremen, New York may have found the answers to tomorrow's needs. ■

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MEMORANDUM

DATE: March 17, 1987

FROM: Charles Kelly, USAID/Burkina

SUBJECT: Grasshopper/Locusts Emergency Program Planning Visit to Niger

TO: Tim Knight, Africa Division, OFDA

Attached please find the Trip Report and backup material on the OFDA financed Grasshopper/Locusts Emergency Program Planning visit to Niger which took place from March 5 to 13, 1987. The main elements of the report have been transmitted to OFDA by cable from Niamey.

USAID/NIGER GRASSHOPPER CONTROL PROGRAM

OFDA ASSISTANCE AND PLANNING MISSION

1987 OPERATIONS PLAN BACKGROUND

MARCH 13, 1987

INTRODUCTION

This report has been prepared as the result of an OFDA funded technical assistance and planning mission to USAID/Niger on the 1987 Grasshopper and Locust Control Program. The mission team was composed of Carrol Voss (AgRoters, Inc.), Aerial Operations Specialist and Charles Kelly (USAID/Burkina), Emergency Operations Specialist. The team was in Niamey March 6 to 13, 1987, met with GON Crop Protection Service (CPS) personnel, donor representatives, commerical air operators and undertook both ground and aerial inspection of potential grasshopper infestation areas.

The objective of the OFDA mission was to assist USAID/Niger in reviewing GON proposals for assistance to counter grasshopper infestations during the 1987 crop year. The review focused on:

- the training of GON personnel for aerial spraying,
- the requirements for developing adequate operational procedures for aerial operations,
- the technical, material, manpower and funding requirements for aerial treatment in 1987, and
- the acquisition of accurate information on the magnitude and location of grasshopper and locust infestations for early warning and control activities.

Before the arrival of the OFDA team a decision had been made in concertation with the GON that USAID assistance would be focused on aerial treatment activities. The team did not review in detail overall GON plans for pest management or specific donor assistance for the control of grasshopper and locusts through village based activities or other ground treatment programs.

This report is intended to document the findings of the OFDA team and assemble the documentation and information collected during the mission. The report presents the recommendations of the team in terms of an appropriate US assistance to Niger in 1987. Procedures and actions required of USAID/Niger for the implementaiton of the proposed assistance program are also detailed.

CROP PROTECTION SERVICE CAPACITY FOR AERIAL OPERATIONS

The OFDA team met with several donors, CPS staff, commercial air service operators and reviewed reports on the 1986 control program to assess the operational experience and capacity of the CPS to undertake aerial spraying activities. The team found the CPS has had considerable experience in aerial spraying and has been involved in aerial control programs on a constant basis during at least the past 6 years.

The CPS first acquired aircraft for spraying in 1968 (possibily through Title II food assistance local currency funding) and currenlty has two Cessna Ag Truck spray aircraft and one Cessna 185 modified with a belly tank for spraying. One of the Ag Trucks was purchased in 1986 under a USAID Ag. Setor Support Grant. All aircraft use Microair sprayers.

Based principally on information and comments on the 1986 grasshopper/locust control program, the OFDA team arrived at the following conclusions about the aerial treatment capacity of the CPS.

1. The CPS was able to accomplish an impressive amount of aerila spraying despite severe operational limitations.

2. Due to a need to maximize the area treated, CPS spraying operations may have used application methods which were not environmentally.

3. Because of a need to maximize the area treated, and because of weak management systems and target identification, aircaraft may have been operated in an unsafe manner.

4. A significant improvement in aerial treatment capacity can occur in the near term through improved management, operations procedures and target identification.

5. Improved collection, transmission and use of data on grasshopper/locust infestations is feasable and required to improve the quality and effectiveness of aerial operations.

6. The expected outbreak of grasshoppers and locusts in 1987 will exceed the capacity of the 3 CPS aricraft to control, even with improved management. Additional aircraft for spraying may be required during August and September.

FOCUS OF USAID ASSISTANCE

In view of the past assistance which USAID has provided to the CPS in the area of aerial treatment and the ongoing or poroposed assistance from other donors, a decision was made to have USAID assistance focus on improved aerial treatment and associated requirements. This decision was reached based on consultations with the GON and has their approval.

Based on the policy decision to focus on aerial operations, the OFDA team developed a set of funding recommendations for support by USAID. These recommendations are intended to accomplish three objectives:

1. Improve the immediate and medium term capacity of the CPS to conduct efficient and safe aerial treatment operations.

2. Implement an appropriate system for the accurate identification of grasshopper and locust infestations which require aerial treatment.

3. Assure the CPS has adequate means and materials at its disposal to mount an aerial responds to the expected level of greasshopper and locust infestations in 1987.

Based on these considerations, a CPS biannual operations outline and promised and proposed assistance from other donors, a portfolio of assistance activities was developed. The OFDA team was also aware that it is not possible to predict the magnitude and impact of grasshoppers and locusts for the coming season during the period of the work in Niger. The portfolio outlined below is meant as a preliminary planning and funding document, and should be revised and up dated as the rainy season progresses and the grasshopper/locust situation becomes clearer.

USAID GRASSHOPPER CONTROL ASSISTANCE PORTFOLIO

Improved Aerial Operations

Pilot Training:

The OFDA team concurres with USAID/Niger that two former Air Niger pilots be trained in the US as agricultural treatment pilots. Both canidates for training were interviewed by Carrol Voss and have FAA certifications (see Annex). The training of the pilots will cost an estimated $ 30,000 and can be accomplished before mid-July. This is less expensive that the alternative of having one USAID financed pilot for 4 months (June - September) and an additional USAID financed pilot for two months (August - September) as a releif and backup pilot.

Training in the US will ensure the pilots have adequate theoretical and supervised practicial experience in correct spray procedures. This type of training is not possible in Niger and is more advanced and appropriate than the training originally proposed by the French CPS pilot. The pilots should leave for the US by early April, to ensure adequate time for appropriate training.

Before agreement by USAID to the training, adequate assurances should be secured from the trainees and GON that the pilots will be engaged by the GON for aerial operations by the CPS and will

Any Action / How do we ensure this? Do we write into some of contract?

remain in Niger. Contracting for the training should be handled by OFDA and AID/W, although paperwork delays should be avoided to the greatest extend possible.

Additional Pilot

Only one pilot is currently available to the CPS. A second pilot is required for the period of June and July to operate the second spray aircraft. An additional pilot will be provided by the French in August and September. USAID should finance the cost of the second pilot (est. cost: $34.000) and ensure an adequate overlap with the two returning pilots in July.

Experienced aerial treatment pilots are hard to come by in West Africa. It is possible that either USAID or the French will not be able to find a accceptable pilot for the positions required. By an early recruitment of a pilot for Niger, chances will be better for finding a good pilot and avoiding a late rush for less qualified personnel.

The CPS has already requested Transniger identify a pilot for the 1987 season. USAID can either contract directly with Transniger for a pilot or execute a grant with the GON for the pilot.

If the Nigerien pilots are not available for operations this year, USAID/Niger should request funding for a two month extension of the initial two month contract spray pilot. In addition, a USAID should contract for an additional sprva pilot for the August - September period to provide a relief/backup pilot for the intense operations period of August - September.

~~GON~~ would Niger accept an american pilot to fill the slots of additional pilots & back up pilots.

The work load during the late season will be significant, with pilots operating up to 10 hrs. per day. The limiting factor during this period will be pilot fatigue, rather than aricraft maintanence, which will be assured under the Transniger contract. Prudent managment and safe operating procedures require a backup pilot for this period.

If the Nigerien pilots are unavailable, the cost of the additional 4 person/months of expatriate pilots will be $ 68.000. This is bewtween $ 30.000 and $40.000 more than the estimated cost of training the two Nigerien pilots in the US.

Aerial Operations Unit

The OFDA teams believes it is essential to the effective operation of the spraying program in 1987 and in the future for the establishement of an aerial operations unit within the CPS. This unit would have adequate resources to field and sustain the aircraft which are currently operated by the CPS.

To accomplish the estalbishment of the unit and ensure imporoved management of operations in 1987, the OFDA team proposes three actions be taken:

1. A design for an Aerial Operations Unit be developed in consultaiton with the CPS and the French CPS pilot.

2. Training of CPS staff be complete in aerial operations and use of aircraft for spraying and survey work via the AFR/DEO training program, and

3. A advisor be made available to the CPS for the period of June to September to assist and work with the CPS on managing aerial oeprations.

Cost of the advisor will be approximately $ 35.000 through a PSC. Alternative sources are PASA or RASA personnel from the US Forest Service or USDA/Plant Protection. The advisor would also be responsable for the day to day managment of the USAID aerial operations assistance to the CPS.

Sam looking for RSSA

The operations unit design could be accomplished by the OFDA Regional Disaster Advisor at no cost to the grasshopper program. The AFR/DEO training will be centrally funded and is planned to take place in Niamey in May.

Aircraft Maintanence

In 1986, flight time was reduced by the need to return aircraft to Niamey for routine maintanence. Timely and adequate maintanence is important to ensure aircraft are operational as much and as safely as possible.

The OFDA team recommends USAID execute a contract with Transnier, the authorized Cessna representative in Niger, for the periodic maintanence of the CPS aircraft during the May to September period. This contract would include the services of two mechanic's aids for up to 3 months (July - September) to accompany aircraft during field operations.

Based on an expected total of 600 hrs of flight time for the three CPS aircraft, approximately $ 12.000 will be required for routine maintanence, based on standard Transniger prices. The two mechanic's aids will cost approximately $ 6.000 for the three months of field assistance.

Aircraft Tenders

In the past, the CPS aircraft have operated without support vehicles to provide basic camping equipment, tools and food for the pilot. This situation has placed unnecessary burdens on pilots in view of the isloated nature of most of the loactions from which treatment is undertaken.

The OFDA team proposes that fuel and operating costs for two CPS vehicles be funded through a grant of $ 5.000 to the CPS to provide for chase vehicles for the CPS aircraft. The same vehicles will also serve as transport for the Transdniger mechanic's aids.

France will be providing the camping and other equipment to be carried in the trucks. Canada will provide pesticide and fuel pumps to be carried by the trucks in support of the aircraft.

Fuel

Based on 1986 performance and USDA standards, it is expected the CPS aircraft will treat approximately 200,000 Ha. during the 1987 season. Using data from 1986 and standard fuel consumptionm tables, approximately 75,000 liters of fuel will be required for the CPS planes at a cost of $ 62,000. The FED has pledged up to 18,000 ECU through FAO against the expected fuel needs. The balance of $ 44,000 is proposed to be met from USAID funds.

The funding for the fuel costs should be available in June and incremental funding would be appropriate. The funds can be disbursed through a Purchase Order with Mobil against justification of flight time and use rates provided by CPS. The fuel will be purchased and placed in barrels by Mobil. Lots of up to 5,000 liters could be requested at one time.

Additional Aircraft

Based on 1986 performance and USDA standards, the three CPS aircraft will not be able to fully handle the infested areas expected in August and September. It is estimated that an additional capacity to treat up to 150,000 Ha. will be required. This will require one additional aircraft for 60 days or two aircraft for 30 days. Actual aircraft requirements will depend on the development of the 1987 season.

The cost of the additional aircraft will be approximately $ 110,000, including pilot, mechanic, fuel, ferry charges and per diem, for 300 hrs. of spraying. The additional aircraft can be contracted through one of a number of specialist firms.

A boiler plate contract is being developed for grasshopper control aircraft. Competitive bidding should be encouraged to reduce costs. Funds for the additional aircraft should be available by late May to permit adequate time for contracting. It is recommended assistance be requestred from REDSO for the contracting, as well as cabled suggestions from USAIDs in Burkina, Mali and Senegal, all of which have had experience with contracting for aircraft.

Survey/Data Collection

Helicopter

The OFDA Team recommends USAID rent a light turbine helicopter for up to 200 hrs of flight time during July - September for survey and -- where justified -- spraying. The helicopter will be principally used for the identification and definition of grasshopper and locust infestations to permit appropriate aerial and ground treatment and assist in rational decision making.

Ideally, the helicopter will work in close cooperation with one or more spray aircraft. Personnel will need to be trained in helicopter use for survey work (AFR/OEO training). A functional system of operations coordination will also need to be developed for the effective use of the helicopter and planes. It is also suggested that the OFDA Regional Disaster Advisor based in Burkina undertake a TDY in Niger to assist in the start-up of the helicopter operation.

The helicopter will also provide confirmation of and additional information for the FAO/UNDP Early Warning Project to be started in April (see below).

The cost of the helicopter is estimated to be $ 240,000 for the 200 hrs. of operation, including crew, fuel, per diem and ferry costs. Funding for the contract should be available by May to permit adequate time for efficient contracting (bids and review of qualifications).

USAID/Burkina will be procuring a helicopter earlier in the season than Niger. Savings could develop from sharing the helicopter or requesting more than one helicopter from the chosen contractor.

OCLALAV Support

Due to financial problems, the OCLALAV teams to monitor and respond to locusts in the north of Niger are not operational at present. In 1986 the CPS funded the OCLALAV teams in the north as part of their response to the locust outbreaks.

In recognition of the significant threat which locusts can have in Niger and other countries in the region, the OFDA team proposes funding be made available through a grant to the CPS for the basic operation of the OCLALAV personnel for monitoring activities.

This funding, amounting to $ 15,000, will be used to support the basic fuel and field operating costs of the OCLALAV teams over a 6 month period, beginning in April. Normal USAID accounting procedures will be use to track the use of the funds, which are to be used only for monitoring activities. If there is the need for treatment, additional funding should be requested and a detailed operations plan developed.

Radios

There is a need for a multi-channel HF (long distance) radio to be installed in each of the CPS aircraft. These radios are required for required for operational communications between rural air bases and Departmental or Niamey offices. The HF radios are also important as a saftey factor if an aircraft breaks down.

is forced to make an emergency landing or encounters some other emergency situation.

The HF radios should cost no more than $ 2.000 each and can be procurred by OFDA and air freighted to Niger. The radios should be procurred and installed as soon as possible.

Additional HF radios (10) are to be provided under the FAO/UNDP Early Warning Project, scheduled to start in April. These radios will complement the exisiting HF radios in Zinder (OCLALAV) and Diffa.

There is also a need for VHF (short distance) radios for ground to air communications during aerial spraying and with the ground support for each plane. With three aircraft, which already have VHF radios, an additional three radios are required for the ground support and one each for field operations. The ground support radios can also be used for field (spraying) operations.

It is understood that at least 12 VHF radios are currently in Sudan awaiting disposition. OFDA has been requested to air freight 6 of these radios to Niger for use in the 19876 control program.

Insurance

Insurance for the CPS aircraft and pilots, at a cost of $ 185.00, was originally included in the USAID/Niger request for assistance sent to AID/W. On review of this request in AID/W it was noted that insurance is not normally paid by USAID, as the U.S. Government normally self-insures. If insurance is noramlly required for the CPS, then this is more in the nature of a recurrent cost factor, and should be programmed into the non-disaster budget of the CPS.

Based on discussions with the CPS the OFDA team does not believe it necessary for USAID to fund this cost. The CPS has funds available within its budget allocation which are adequate to cover insurance costs.

In addition, only one of the three CPS aricraft needs to be insured at this time. Insurance for the other two aircraft expires in September and October. If any insurance costs were to be paid in the future, they should only cover the actual period inwhich the aircraft are in use for emergency operations.

FAO/UNDP EARLY WARNING PROJECT

This project is intended to provide an early warning of possible grasshopper infestations based on rainfall data and the Agrhymet model for O. Senegalensis. If the FAO/UNDP project does not begin as planned, USAID should consider specific activities to address the ojectes set out in the project. As this project is only planned for 6 to 7 months of operation, USAID may wish to consider funding for a continuation of the project from medium term AFR/DEO funds.

INSECTICIDE REQUIREMENTS

The OFDA team did not review the insecticide situaiton in Niger. USAID/Niger should review with the GON and other donors the insecticide stock and condition situation in the near future. Some insecticides used against grasshoppers and locusts deteriorate over time. Care should be taken to avoid using out dated or decomposed insecticides.

AFR/DEO, in coordiantion with Desk Officers, is developing a set of pesticide use waivers for the grasshopper/locust control effort. Pending the transmission of the terms of these waivers to the field, care should be taken to ensure no USG assistance is used to contribute to the use or application of insecticides which have not recently (this year) received AID/W approval for use against grasshoppers or locusts in Niger.

MISSION MANAGEMENT

USAID/Niger should establish a specific system for managing the emergency grasshopper/locust control assistance. Funding in the order of $ 500,000 will be made available to USIAD/Niger over the next 5 months with the expectation these funds will be fully obligated, expended and accounted for by December, 1987. In addition to this project implementation and management load, USAID/Niger will face constant requests for information and reporting from AID/W.

The managment of the 1987 emergency program can occur through one of two systems. USAID/Niger can assign full time management of the program to a DH or senior PSC, who will be responsable for the complete management of the program. This person would draw on other staff within USAID/Niger, but would not delegate any major task or responsability involving the program. The person would coordinate directly with other donors and the CPS, as well as undertake frequent field travel. Although functionally the person would report to a Senior Staff, operationally, the person would need frequent and direct access to the D. Director or Director.

Alternatively, program responsabilities could be staffed out to various Offices within USAID/Niger under the coordination of the Mission Disaster Relief Officer or D. Director. This approach has the advantage of spreadding the load, although it also has the risks of specific actions being lost within offices or falling between different staff responsabilities. The "Working Group" approach may be appropriate for a Mission the size of USAID/Niger, but would require frequent group meetings and direct oversight by the MDRO or D. Director.

The OFDA Team discussed the management and manpower issue

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with USAID/Niger Staff and was advised that the Mission was not able, under the current funding limitations, to ensure adequate staff would be available to support and properly manage the proposed grasshopper control program. Based on discussions on resolving this problem, it appears that a PSC hired locally, at a cost of $ 15,000 for 8 months (salary, per diem, misc) would resolve many of the management issues brought up by USAID/Niger. Given severe O.E. limitations, this PSC would have to be funded by AID/W (OFDA or AFR/DEO).

The contractor would be responsable for day to day management and tracking of the project assistance. This would include coordination with the GON and other donors, prepartino routine reporting cables and memos, procurement and administrative support related to grants and contracts and general management and tracking of USAID assistance and contractor activities. A limited amount of field travel would be required.

OPERATIONS PLAN

There is a need for an Operations Plan for the 1987 grasshoppper/locust control, both on the part of USAID/Niger and the GON. The present report provides much of the necessary information required for USAID/Niger's plan, but additional work needs to be done on defining specific assistance, timing and preparing funding documents.

The Bi-Annual Funding Request from the CPS is not adequate for the 1987 control operation. It does not provide adequate detail on the disposition of GON assets for the program, GON and Donor funding and assistance activities, implementation plans for the different phases of the program or an indication of the priority with which the grasshopper/locust situation is viewed by the CPS or the GON.

While all these elements may be self-evident from coordination meetings and bilaterial discussions, experience in 1986 demonstrated (as in the case of Senegal) that considerable confusion and disagreement can develop if the objectives and methods of the control program are not clearly stated and presented. As an example, at present USAID has major differences with the manner in which the application rates of insectices are calculated based on tradition in the Sahel. Once we begin providing assistance for aerial application, we must assure our standards are being met. This will result in a direct conflict with personnel involved in the spraying program and probably at least one other donor. Planning, both within USAID and between donors can minimize or prevent such problems from developing.

From the documents reviewed, it is not clear that either the CPS or the GON view the grasshopper/locust problem as urgent. From brief conversations with the French and EEC representatives, one also senses a lack of urgency or immediate need in dealing with the possible problem in 1987. Although it may not be tasteful. USAID/Niger may have to light some fires to ensure we are not the only organization ready for the 1987 season.

FEWS

The FEWS Project data collection and reporting system can be used by USAID/Niger to reduce it's reporting workload and improve the definition and evaluation of grasshopper/locust infestations. Procedures need to be worked out with the FEWS representative on how he and the Mission can work together on the reporting process.

Given the software available to the FEWS Project in Niger and the type of information to be generated by the FAO/UNDP Early Warning Forject and the helicopter surveys. it will be possible to generate fairly accurate maps of the location of reported grasshopper and locust infestations. expected infestations and areas treated. The FEWS Project person in Niger should be consulted on this possible collaboration as well.

ANNEXES

The annexes to this report contain information on:

- Calibration of Aerial Pesticide Application
- Nigerien Pilot Information (spray pilot trainees).
- Information on Spray Pilot Training School.
- Working Notes by C. Voss on Flight Training. CPS Aircraft. Application Calculations for 1987. Improvements in Aerial Operations. Pilot Safety.
- Fuel and Aircraft Equipment Available in Niger.
- Fees and Rates for the Niamey Airport.
- Transniger Aviation Maintanence Rate Sheet.
- Transniger Aviation Information on Brittian Normand Islander with twin 50 gal. Micronair pods.
- Field Trip Map: Ground and Air.
- Government of Niger. Crop Protection Service Biannual Plan
- FAO/UNDP Grasshopper Early Warning System for Niger: Project Description (in French).
- Niamey 8616 (86): USAID/Niger Assistance Proposal for Grasshopper Control. 1987.
- Persons Contacted.

PERSONS CONTACTED

Crop Protection Service

J. Moudour. Director
B. Barkire. Deputy Director
G. Lanson. Pilot

French Cooperation

G. Bossy

European Development Fund

F. Rohde

FAO

T. Lindquist

CIDA Plant Protection Project

G. Baillargeon

Transniger Aviation

A. Daoud. Director

US Mission/Niger

Ambassador Bogosian
R. C. Coulter. D. Dir. USAID
E. Gibson. ADO. USAID
K. Mullally. D. ADO. USAID
M Kondo. Proj. Assist.. ADO. USAID
D. Maxwell. GDO. USAID
D. Tunley. DRO

MEMO

March 13, 198[illegible]

TO: USAID/Niger

FROM: L. Kelly

SUBJECT: Use of initial $25,000 in funds from OFDA.

The initial $25,000 in emergency funds from OFDA can be used for the following activities:

1. Funding of operating costs for the OCLALAV teams to monitor and survey the migrant locust situation in the north of Niger. This funding should be approximately $10,000, with additional funding as the season progresses. The funding can be through a LBGA to the CPS. The same document will be used to cover a number of activities within the CPS over the coming months.

More detailed budget and information on the operation of the OCLALAV teams should be secured from the CPS before funding. As well, a requirement for periodic reporting should also be included.

2. A reserve of $10,000 should be made for the possible funding of the purchase and shipment of the 3 HF and 6 VHF radios. Even if AID/W pays for these radios, allow for some money to pay shipping charges and customs fees (not taxes) at the airport.

3. On OFDA's approval, the remaining $ 5,000 can be used to hire and partially fund the contract for the PSC Admin Assistant. This should be only done once OFDA has approved this line item.

4. If the occasion arises, and using the funds reserved for # 2, you may want to consider funding part of the cost of aircraft rental or flight time in CPS aircraft to assist in the locust survey in the north.

The purpose of the $25,000 is to permit USAID to react quickly to immediate needs with a maximum amount of flexibility. If the need is immediate, then the funds should be used and AID/W (OFDA) advised. If the need is long term (beyond tomorrow), then OFDA should be advised of the intended use of the funds and asked for concurrence.

OFDA is flexible on the use of all disaster funds, but does not generally support the use of this type of funding for administrative support of programs within USAID. They believe the funds should be used for immediate relief and response. Having [illegible] the USAID management of the aid is a developmental problem.

Annex I

CROP PROTECTION SERVICES DEPARTMENT, THE GAMBIA, GRASSHOPPER EGG-PODS SURVEY

20 - 30, JANUARY, 1987 — 1987 GRASSHOPPER CAMPAIGN PREPARATION - NATIONAL FIGURES

DIVISIONS	NO. OF SAMPLES	TOTAL EGG-PODS	MEAN NO. EGG-PODS
Western	60	162	2.7
Lower River	60	135	2.25
North Bank (East)	60	59	0.98
North Bank (West)	60	70	1.17
MacCarthy Island (South)	60	62	1.03
MacCarthy Island (North)	60	45	0.75
Upper River (South)	60	9	0.15
Upper River (North)	NOT ACCESSIBLE - NO FERRY SERVICE AT BASSE		
NATIONAL TOTALS	420	542	8.88
NATIONAL MEANS	52.5	67.75	1.11

Annex I

1987 GRASSHOPPER CAMPAIGN

GRASSHOPPER EGG POD SURVEY

Team

Village

Date of Sampling

Division

Description of site	Sample No.	Number of Pods/m^2 Red	Black	Grey	Brown	Total No. of Pods/m^2
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	Total					
	Mean					

A - Upland under tree — other than rice

B - Rice field

C - Bush near rice field

Annex 2

Entomological Overview Of Grasshoppers In The Gambia George Cavin- Consultant

A large number of grasshopper species exist in Gambia, but only the following five are considered of major economic importance: Kraussaria angulifera, krausella ambile, Cataloipus fuscocoerulipes, Zacompsa festa and several species of Hieroglyphus. Oedaleus senegalensis exists in Gambia, but is not considered a major pest species. Rainfall in the Gambia generally approaches or exceeds the tolerable level (1000mm) for O. senegalensis reproduction and development. Soil types are also generally not applicable in the riverine flood zones and rainfed swamps.

First generation O. senegalensis that are produced in the Gambia upon reaching the adult stage, migrate northwards, while adults of the third generation do not return to the Gambia until late fall when most cereal crops have been harvested.

Of the five grasshopper species of major economic importance in Gambia, four are considered major pests of cereals (rice, millet, sorghum and maize) while Zacompsa is principally found in grasslands and bush type vegetation. Of the cropland species Kraussaria and Krausella are generally found to hatch in close association with cereal crops. Kraussaria is generally found in the upland cereals, while Krausella is found in both lowland and upland cereals. Farmer applied treatments are most effective against these species.

Cataloipus generally breeds in the grasslands and forested areas and migrate from there, rather short distances, into the upland cereal crops.

Hieroglyplius generally lays its eggs in the soil cracks in the rainfed swamps. They hatch shortly following the early rains. As the water rises they move out in advance of the rising waters and invade the upland rice. Hieroglyphus is reportedly a good swimmer. In its early stages of development it is difficult to control due to problems of water contamination with pesticides. Except for ground applications by trained CPS personnel, treatment must be generally withheld until they have moved out of the rainfed swamps and into upland areas particularly the plantings of upland rice.

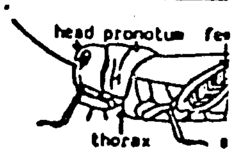
Thus, it becomes an almost insurmountable task for the individual farmer, who lacks mechanized equipment, to protect his cereal crops from severe damage by Cataloipus and Hieroglyphus in outbreak level populations. These two species are prevalent in the western and lower river divisions, the area where most aerial treatment occurred in 1986.

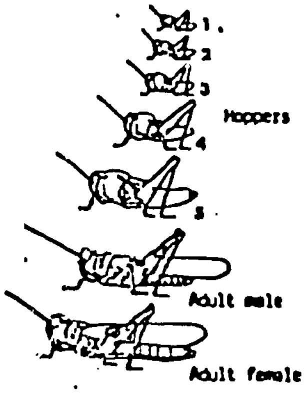
Hatch is initiated by the onset of the summer rains which may start in the eastern part of the country by mid-May and progress west. If the rains come late the entire country receives rains simultaneously, resulting in a more uniform but more widespread grasshopper hatch.

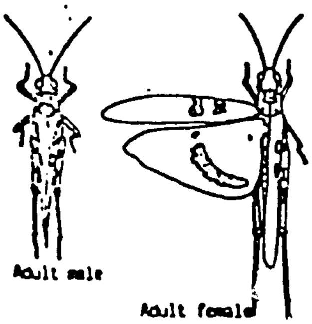
The economically important grasshoppers of Gambia have multiple generations. Usually 3 generations occur between May and early December. Early season control against the first generation is the most effective means of eliminating crop damage and preventing recurrence for the following year. Kraussaria can be expected to hatch about 2 to 3 weeks earlier than Catalopius. Although their habitats are generally dissimilar some overlapping can be expected, and must be considered when scheduling treatment.

At least two months can be needed to preposition insecticides, particularly farmer applied matterials. Distribution should be completed in the east by mid-May and by mid-June in the central and western parts of the nation.

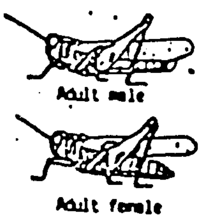
IDENTIFICATION CHART OF THE MAJ

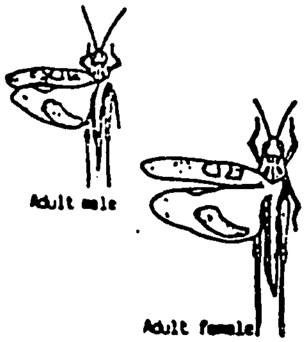






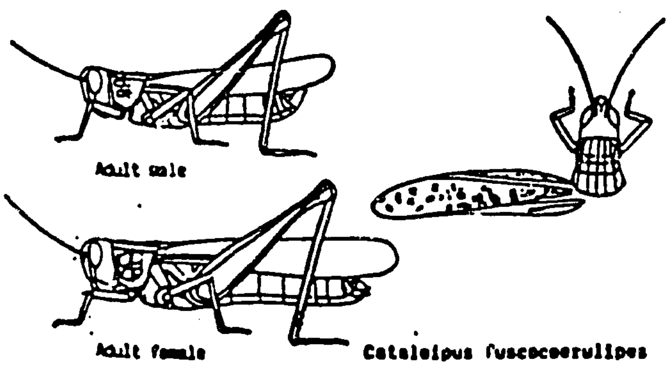
Oedaleus senegalensis



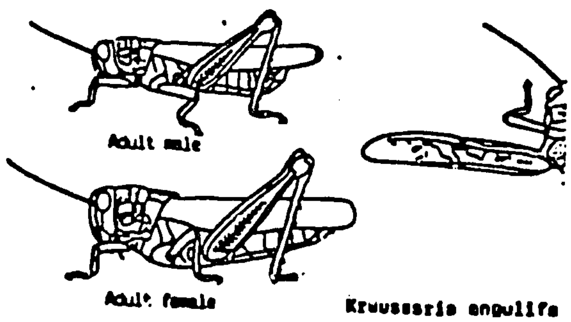


Oedaleus nigeriensis

Cataloipus fuscocoerulipes	Colour Green/Brown. Size 5 - 7 cm On sides pronotum 4 light rather regular spots On top pronotum 2 light parallel stripes Posterior end of pronotum rounded
Kraussaria angulifera	Colour Brown/Green. Size 4 - 6 cm On sides pronotum 4 light irregular spots Top pronotum with ridge, no parallel stripes Posterior end pronotum angular
Krausella amabile	Colour Yellow. Size 2 - 3.5 cm Sides of head and thorax grey/blue with black patterns Black vertical lines on pronotum Black line on elytra
Hieroglyphus africanus	Colour Yellow/Green with black patterns. Size 3.5 - 8 cm Furrows of pronotum black, joined on the top Black spots on hind femurs and tibia near their joint Posterior end of pronotum angular
Hieroglyphus daganensis	As <u>Hieroglyphus africanus</u> except: Furrows of pronotum black but only anterior ones joined on top Posterior end of pronotum rounded
Zonocerus variegatus	General body colour black and yellow with red spots. Size 3.5 - 5 cm Elytra Yellow/Green Hind wings pink with blackish base and grey/blue apex
Oedaleus senegalensis	Colour Yellow. Size 3 - 3.5 cm Pronotum marked with a darkish X Posterior end pronotum rounded Two dark spots on elytra
Oedaleus nigeriensis	As <u>Oedaleus senegalensis</u> except: Posterior end pronotum angular Dark spots on elytra and smokey crescent on hind wings slightly larger
Zacompta festa	Size 2 - 3 cm Black spots on head, pronotum, thorax, elytra and interior and exterior sides of the hind legs, giving the insect a black appearance
Chrotogonus senegalensis senegalensis	Colour Brown. Size 1.5 - 2 cm Seen from above lozenge or rhombus shaped Head rather rough Posterior end of pronotum angular

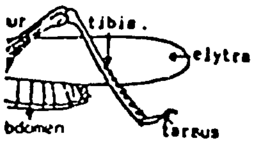


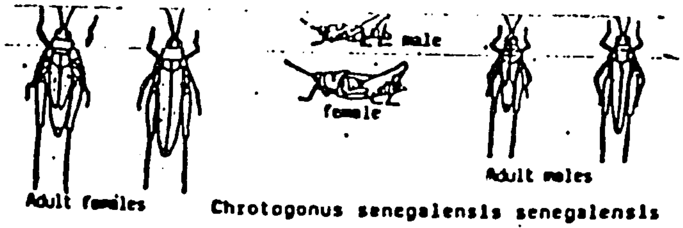
Cataloipus fuscocoerulipes



Kraussaria angulifa

ƆR GRASSHOPPER SPECIES OF THE GAMBIA

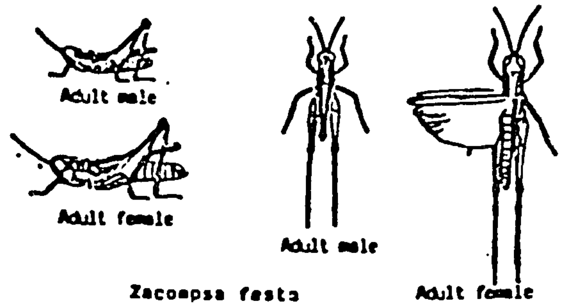




Chrotogonus senegalensis senegalensis

Elytra with small brown spots
Brown line on outside of hind femurs
Tibia of hind legs violet/blueish, with small spikes

Hind tibia not violet, with large spikes

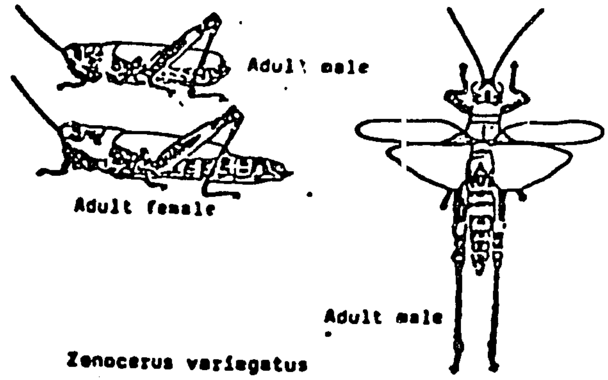


Zacompsa festa

Tip of elytra and hind wings with smokey spots
Black spots on inside and outside hind femurs
Body covered with fine hairs

Black spots on hind tarsus
Two forms:- Macropterous: wings covering entire abdomen
- Brachypterous: under developed wings not covering entire abdomen

Black pattern on thorax more pronounced
No black spots on hind tarsus, smaller spots on hind femur and tibia

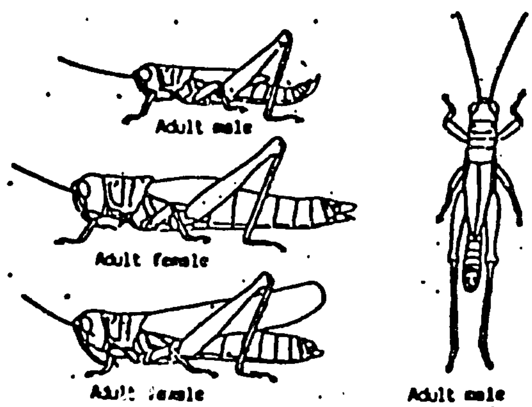


Zonocerus variegatus

Hind wings yellow at base and with smokey crescent
Dark spots on hind femurs

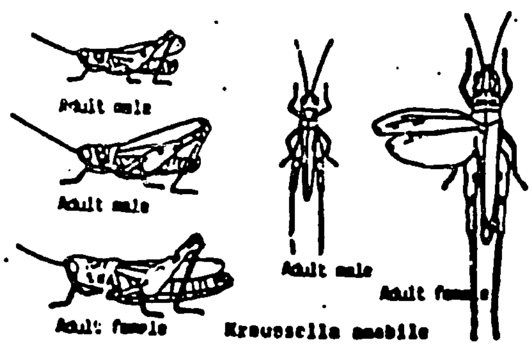
Less dark spots on hind femurs
Interior side hind femurs and tip hind tibia red/orange

Tip of hind wing smokey

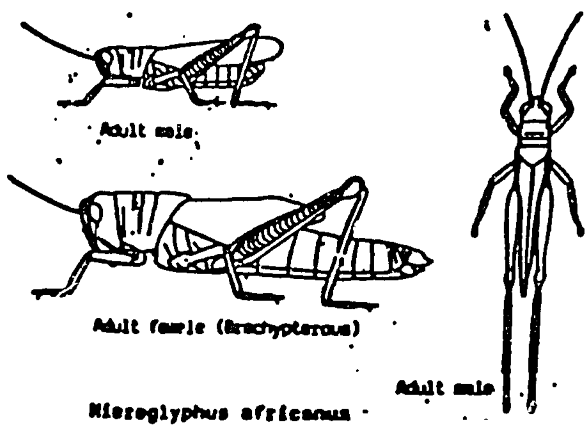


Mieroglyphus daganensis

Two forms:-Macropterous: wings covering entire abdomen
-Brachypterous: under developed wings not covering entire abdomen



Kraussella amabile



Mieroglyphus africanus

By A.A.Laurense/FAO.1987.Based on:M.Launois:Practical manual of identification of the principle locusts and grasshoppers of the Sahel.

Background And Recommendations For Phase I

George Cavin - Consultant

A three pronged control approach appears sensible against the initial generation.

1. Treatment by farmers to their own infested crops using hand applied dusts, liquid spray and baiting. Multiple applications may be required as the season progress. CPS mobil teams should supplement the farmers' efforts in treating the cultivated areas.

2. Baits applied by CPS power blowers to field boundaries and accessible forest and grassland.

3. CPS liquid sprays should be applied by motorized units to accessible grasslands and forest lands, Aircraft spraying could be applied to those areas that cannot be reached by the CPS teams.

The 1984/85 Gambian Agricultural Statistics list the following hectarage cultivated with crops susceptable to grasshopper infestation in the Western, Lower River and North Bank Divisions.

Early millet	10,940 has.
Late millet	5,330 has.
Sorghum	1,770 has.
Maize (corn)	3,080 has.
Upland rice	1,999 has.

Swamp or deep paddy rice was not included as being threatened from grasshopper attack.

The three Divisions had the highest incidence of grasshoppers in 1986 and the initial 1987 egg survey shows a mean 2.7 egg pods per sq. meter in the Western, 2.25 Lower River and 1.075 in North Bank. Numbers per meter^2 are progressively less moving eastward. Three egg pods per meter^2 are generally considered an outbreak condition. Areas of less than 1 pod per m^2 may have pockets of heavy infestation but overall the population can be expected to be less than economic level.

If we assume that the infested area in 1987 will be comparable to 1986 we can project that 53% of the susceptible cereals will be infested (CPS calculations for September 1986 or 12,253 has.). Points one and two above are the strategies recommended for treating the cultivated areas.

However, the size of the area of infestation outside the cropland could exceed cropland by a multiple of 10 if the goal is to contain the first generation as completely as possible, aircraft may be needed to supplement the CPS teams in the treatment of forest and grasslands.

Liquid insecticide requests are sufficient to treat in excess of 400,000 hectares. Equipment presently available to apply this liquid insecticide has a capacity for treatment of about 40,000 has. throughout a 120 day treatment. Thus the request for additional equipment (vehicle mounted mist blowers, motorized knap-sack sprayers, manual knap-sack sprayers and exhaust nozzle sprayers) matches closely the request for liquid insecticide. However, if a portion of the request for liquid insecticide is earmarked for aerial application then the equipment projections are excessive.

The Gambia Government is expected to arrange for the waiver of all taxes duties and fees on fuels, pesticides, equipment and materials etc which are directly involved with the survey and control of grasshoppers in The Gambia.

ORGANIZATIONAL PROPOSAL

The Gambia grasshopper survey and control effort could be organized in the following fashion:

- Steering Committee Chairman, Amadou Taal, Permanent Secretary, Ministry of Agriculture.

  The Steering Committee would be made up of the representative donors and the chairman. Their function would be to review the country plan, determine needs, set broad policy guidelines and solicit funds and assistance from their respective capitals.

- National Coordinator Mr. B. B. Trawally

  The National Coordinator who will have responsibility over the entire Gambia Grasshopper Control Program. This individual will report directly to the Director, Crop Protection Services.

- Gambia Technical Task Force The Task Force is chaired by the Undersecretary, Ministry of Agriculture. Galandou Gorre N'Diaye, Chairman

  The Technical Task Force may be composed of the following:

  Director of Agriculture, Sankung Janneh
  Director of Crop Protection Service, D.C.A. Jagne
  Director, Medical and Health Services
  Principal Extension Aids Officer
  Ministry of Water Resources and Environment
  ADPII Coordinator, Ministry of Agriculture
  Radio Gambia Representative
  National Coordinator, Grasshopper Campaign
  Chief Mechanical Engineer

The Technical Task Force will implement the plan of action as approved by the Steering Committee. It will handle the day to day operation of the grasshopper survey and control effort but will seek guidance from the Steering Committee on matters of policy.

Notes From The Steering Committee Meeting Of March 20, 1987

Chairman Amadou Taal reviewed the responsibilities of the steering committee and the technical task force and the position of the national coordinator in running the grasshopper control campaign. He explained the two phase strategy. If ground treatment is effective they will not need the aerial treatment but need to have equipment available. He expressed the need and invited donor participation to help supply the chemicals, vehicles and equipment required for 1987.

The CPS requirements were discussed from sheets passed out. Due to the lack of availability of propoxur 2% dust it was decided to add that 45,000kg requirement to malathion 2% dust.

The need for placing orders before the end of March was indicated and the technical task force will meet Monday, March 23 to finalize requirements. The donor group will then have an opportunity to review the CPS plan and requests.

I presented the following brief discussion regarding our observations.

"Mr. Chairman Amadou Taal and members of the steering committee. I believe that we all realize that there are no experts where natures calamities are concerned. We take the known facts and start working to do what has to be done.

Our consultant team felt that you have well qualified people in the Ministry of Agriculture and the Crop Protection Service.

I will not go into detail on the species of grasshoppers here and their characteristics. This is explained in the brief report that we brought. The important point is that these grasshoppers hatch and grow in and adjoining to the cultivated areas. They are not migratory so that a major effort on ground treatments early would have a good percentage of control. To secure early generation reduction the following should be considered. Farmers treating their own crops; the CPS control teams applying dust and spray to adjoining areas; and the application of bait around the edges of the fields to prevent movement into cultivated areas.

To prepare for this effort a two week training program will be starting the first of April to teach the trainers or supervisors to go out and check out farmers on the safe handling and application of insecticides and how to properly use hand application equipment.

With normal rains anticipated by mid May and early June the grasshopper hatch and treatment programs should be under way in June. From observations and egg pod surveys it is thought that the same areas in mid to western Gambia will have a heavy infestation again this year.

CPS will be in charge of the control phases from their Yundum headquarters. For assistance Mrs. Aleda Laurense has been posted to assist by FAO from the IPM project. It is also contemplated that another entomologist and a logistician be secured for several months to help. To facilitate their work and to improve communications it is suggested that an office be secured in Banjul to serve as a communications center. This would provide ready access to all donor parties and others connected with the program.

With the best of ground control efforts it still may be necessary to plan on a limited use of aerial spraying with small aircraft. Plans for such a contingency are currently being discussed.

We appreciate this opportunity to present some of our views which mostly coincide with the current CPS plan of attack".

FIRST MEETINGS OF THE 1987 GRASSHOPPER CAMPAIGN

STEERING COMMITTEE

Date: 19th March 1987

Venue: Ministry of Economic Planning & Industrual Development Conference Room

Representatives

1. A. Taal, Permanent Secretary Ministry of Agriculture (Chairman)
2. G. Gorree Ndiaye, Under Secretary, Ministry of Agriculture
3. B.B. Trawally, Coordinator 1987 Grasshopper Campaign (Secretary)
4. Tom Hobgood, USAID/Banjul U.S.A.
5. Ralph Conley, USAID/Banjul - U.S.A.
6. Dr C.M. Voss, Consortuim of Int'e Crop Protection U.S.A.
7. Bart Tuiker, E.E.C. Deplegate
8. Pierre Proter, E.E.C. Adviser
9. Tesema Negash, World Food Programme Banjul
10. Dr F.M. Roda, F.A.O. Representative - Banjul
11. Ms Alida Laurense, F.A.O. Associate Expert - Banjul
12. Robin E. Poulton, Action AID/TANGO
13. Alistair McKinzie, British High Commission - Banjul
14. Dodou C.A. Jagne, Director Crop Protection Service
15. Sankung K Janneh, Director of Agriculture
16. Dr S.B.K. Quartey, Director Animal Health and Production
17. Momodou Mambouray, Chief Mechanical Engineer Ministry of Agriculture
18. B. Manneh, Principal Extension Aids Officer

Agenda

1. Briefing of the steering committee members on the 1987 grasshopper campaign
2. Any other matter

Minutes

The Chairman Mr Amadou Taal welcomed the delegates to the 1987 Campaign and

The Chairman Mr Amadou Taal welcomed the delegates to the 1987 campaign and made a succinct analysis of roles of the National Task Force and The Steering Committee. He welcome the U.S. delegation whose arrival was very timely as it coincided with the time the Country Task Force was preparing the country plan of action for 1987. The Chairman expressed his appreciation of the efforts played by the 1986 steering committee chairman Dr. F.M. Reda (FAO Representative) in his dauntless efforts in mobilizing donors to assist the Gambia in combating the grasshopper outbreak last year.

Steering Committee

The aims of the steering committee according to the Chairman are to review policy by discussing with donors with the view to solicit funds for implementing the country plan. National needs are discussed at the country Task Force level and donors are brought together to exchange ideas and define commitments. The steering committee, is an important arm of the campaign effort as the success of the ground teams would partly depend on the timely availability of inputs. The steering committee is the advisory body to the Minister and it could request through the Permanent Secretary if the Minister could attend some of its sittings. The steering committee he reiterated had played a major role in the success of the 1986 campaign.

Task Force

The National Task Force is responsible for the day to day operations of the campaign and it consist of the Crop Protection Service, Department of Agriculture and various other departments. It is chaired by the Under Secretary Ministry of Agriculture. The Crop Protection Service is the implementing department and the task force is responsible for assisting the C.P.S. and the campaign coordinator.
In implementing the Programmes. The task force will meet weekly to review the activities, of the CPS especially the grasshopper campaign. The task force will comprehensively review the campaign requirements logistics etc and advice the steering committee on the campaign's needs.

The campaign coordinator and Director of Crop Protection are both members of the Task Force and the steering committee. All policy issues will be tabled before the steering committee who will advice the Ministry accordingly. The steering committee can also give instructions to the task force where it deems it fit. The steering committee has direct access to the campaign coordinator since he is a member of the steering committee.

The Campaign Coordinator is responsible for the entire campaign programme in consultation with the Director of Crop Protection Service. Where the coordinator has ideas that could not be solved at the departmental level he has the right to bring his proposals to the Task Force for review. All proposals brought to the steering committee will have been already reviewed by the task force. The Task Force has already done some ground work that would be finalized on Monday the 23rd March 1987. Donors will be given copies of this plan. Realistic estimates will be done by the 27th of March 1987. The Crop Protection Service has already made some effort in the area of materials, equipments and chemicals etc required.

Funding.

The Chairman in retrospect expressed satisfaction on the level of participation by the Gambia Government and the donors in the 1986 campaign. He once again expressed his appreciation of their contributions, in the absence of which the campaign would have been a failure.

He said he was cognizant of the desire the international community has in helping to avert a disaster in Gambia Agriculture due to pests and hence he hoped they would once again manifest their committment to this ideal by give a strong support to the 1987 grasshopper campaign.

He believes that at the steering committee level, the degree of commitments could be found out. It would be through the steering committee that each donor would be involved so as to avoid duplication of efforts.

He informed the delegates that the Gambia Government would be responsile for local expenses in the campaign such as self allowance, etc. Donor support, he emphasised would be welcomed in those inputs that have a foreign exchange component.

Campaign At Field Level

For the actual operation at the field level of the campaign, a clear strategy would be needed, The task force and the USAID, will work out a time bound plan of action. Already a training programme for 30 senior field staff who would be full time in the campaingn is scheduled to be held at the Freindship Hostel- from March 30th to 10 April 1987.

The CPS has already prepared a draft plan of action which after review by the task force will be available to all steering committee members.

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Campaign Strategy

The campaign will be in two phases. The first will aim at controlling the grasshoppers through mobile ground teams. The success of the ground teams i.e. their ability to maintain the pest densities below the economic injury level, will determine the policy decision to introduce agricultural aircraft in the second phase.

Phase I however does not rule out aerial application (depending on species appearance and generation interactions). The CPS and Department of Agriculture staff, under the direction of the campaign coordinator will constitute the ground teams. Simultaneously the ground teams will work side by side with farmers brigades which are estimated to constitute 5000 farmers in each agricultural circle.

If the ground teams and farmer brigades cannot suppress the grasshopper populations below the economic injury level, then phase II would set in. Phase II will be characterised by aircraft intervention in those areas where ground teams could not effectively control or penetrate due to physical constraints, such as forest. (For the purpose of this excerciso, temporary landing strips have been earmarked with the view to reduce the Ferrying Time of the aircraft).

After making an exhaustive explanation of the modus operandi of the 1987 campaign, the chairman made complements to the FAO Representative who single handedly chaired all the 1986 steering committee meetings. FAO contribution, he reaffirmed, was highly significant in 1986.

On taking the floor, Dr Reda, sent his compliments on his own behalf and on behalf of all the representatives of The International Community. He assured the Gambia of the full support of the FAO and the International Community on this important issue in national development. He said the international community has put their confidence in FAO for the grasshopper campaign hence FAO (Rome) will solicit for any assistance the Gambia may need for this campaign. He said the grasshopper issue is under comprehensive review and the prelimenary strategies for control are being discussed. He hopes there discussions would result in donations either through bilateral aid or through FAO.

On this note he made a verbal request if the chairman could accept two letters regarding the appointment of a Regional Coordinator in the person of Mr Alieu Njie (Senegal). He would be respohsible for overseeing the regional activities for the whole of West Africa in the 1987 campaign. The second letter regarded the appointment of Mrs Alida Laurence (Former IPM Associate Expert to the 1987 grasshopper campaign. She would be attached to the CPS and will work directly under the campaign coordinator.

As Yundum is the base headquarter of the campaign coordinator a.. technical assistants would automatically be attached there. Their job will be principally as technical support staff whose proposals will pass through the coordinator for discussion with the director of CPS and the Task Force. They have to work closely with the coordinator with the view to cummulatively obtain the targeted objectives of the campaign.

The director of CPS Mr D.C.A. Jagne said he would welcome any technical assistance in the form of logistics experts, emtomologist etc who would assist the coordinator during the campaign in the form of technical advise.

The chairman reminded the delegates of the urgency of the situation as time was against us. It was estimated that it would take 60-90 days for shippments to arrive (i.e. May-June). The FAO Representative therefore urged that the exact requirements should be made as soon as possible so that purchases could be made early. He informed the meeting that the Propoxur (insecticide) was not available in the International market hence alternatives should be indicated in the requirements.

Mr Robin Poulton the Action Aid representative vehemently indicated that since it was an immergency immediate action should be taken at this meeting since indications of the requirements were already presented in the meeting by the CPS Director. There was a general agreement oto this proposal but other donors had reservations to this method and would rather like to have the final countr- plan and requirements from the task force. The FAO Representative indicated that there requisitions would have to be proocessed and sent to donors for review Everything must be done in the proper administrative perspective.

The Under Secretary reminded the delegates that a supplementry comprehensive egg-pod survey for the entire country is in progress and this would give a better idea of the real grasshopper risk situation. This would also assist the donor in determing the level of commitment they would pledge for the campaign. He informed the delegates that Annex I of the paper presented by Mr D.C.A. Jagne were only indicative figures; realistic figures will be made after the task force meeting on Monday the 23rd March 1987.

Looking through Annex 1, the FAO representative observed that under section 6 (camping equipments) items mentioned there could be purchase before the 15th April as FAO has US $20,000 for this purpose. He therefore recommended that this should be deleted from the list of requrements intended for donocondideration. He reemphasized however that orders should be made before the 15th of April.

A similar observation was made for section 9 (Protective clotting, equipment and drugs) of Annex 1.

On the question of fuel the FAO representative said that this fell under local expense. The delegate from the British High Commission Mr McKunzie said that the fuel in the Gambia was from British Aid to the Gambia, he therefore could not see how Britain could fund the fuel requiments of the campaign.

The Director of CPS reminded the meeting that fuel constituted a major constraint in the 1986 campaign. In fact he reemphasized it was through the draught relief fund that the campaign coordinator was able to get fuel for the progr... He therefore made a solemn appeal that fuel should be considered for donor supp... for the 1987 campaign. The fuel allocation for CPS are very limited and ca... meet the campaign requirements. Had it not been for the UNDP in 1986 th... campaign would not have had fuel.

At this juncture Mr B Manneh, Principal extention aids officer requested th... chairman to suspend the discussion on issues which in real sense shou... discussed at the task force level. The chairman reminded the delegates ... items in Annex I were simply indicators and the task force will meet to furnish the donors of the actual requirements.

Dr C.M. Voss was introduced to the steering committee by Tom Hobeggod of the USAID. He said the US team had prepared a preliminery report which he req... the chairman for permission to present. Tom informed the meeting that the ... Team consisted of 2 entomologists, a logistics expert and a personel of the Foreign Diaster Relief Office. Dr voss the meeting was told, would be in The Gambia till the end of March and would render any assistance to the Task Force upon request.

A training programme has been arranged in connection for the training of trainers in this campaign. It is scheduled to begin on March 30th till 10... April 1987.

On communication Mr Hobgood said the US Team recommended that the campaign h... a command centre (control centre) that would have adequate communicatio... This they envisage would increase the frequency of contact between the com... centre and field teams. They have observed that CPS Yundum has inadequate communication links and hence an alternative command centre could be in Banjul as this would be nearer the Gamtel Headquarters. Dr Voss advised that if aerial application was perceived to be necessary, then materials such as

ULVS and aviation fuel should be in stock in advance of the aircrafts.

On this note the chairman indicated that estimates of the quantities could be made by the task force. With regard to a command centre the chairman said that the CPS is the implementing agency and hence if improvements in communication have to be made, they have to be at Yundum. He said the technical staff should all works under the coordinator at CPS headquarters in Yundum. He said the communication needs of the CPS especially for the campaign will be discussed at the technical committee meeting of the task forc Mr McKinzie of the British High Commission expressed concern over the effect of the pesticides on the activities of the MRC and ITC and asked the charirman what was being done in this area. On this the coordinator Mr Trawally informc Mr McKinzie already the MRC has been asked to submit maps of their experimenta sites. Such maps will assist both the ground teams and the Pilots during the campaign. These areas would be designated as No PESTICIDE SPRAY ZONES. The ITC has not yet contailed the CPS on this matter.

As a final note, the chairman reminded the delegates of the urgency of the situation and hence urged that the campaign requirements should be submitte as soon as possible for donor review so that orders could be placed as soo as possible.

The chairman said the technical committee will be the group to advice all field ground teams on what should be done, this group he reiterated will work directly under the campaign coordinator Mr Trawally at the CPS headquarters Yundum. On the communication issue he said the task force will look into the issue.

The chairman expressed his appreciation of the response to this first meetin and of the steering committee and hoped that donor support will be strong th year as of last year.

The meeting was adjourned sine die.

Mr B.B. Trawally

Secretary
Steering Committee
1987 Grasshopper Campaign
The Gambia

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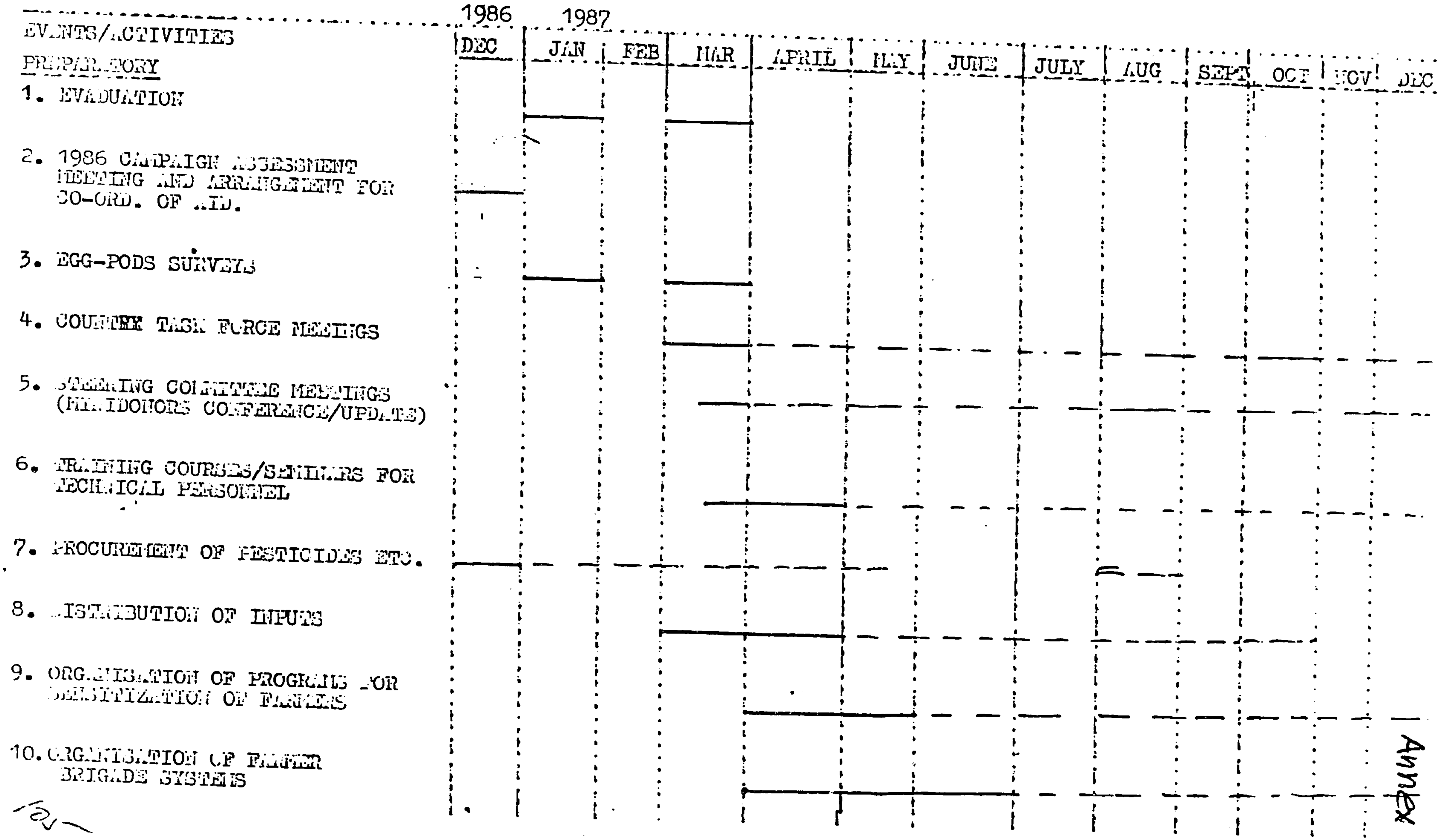
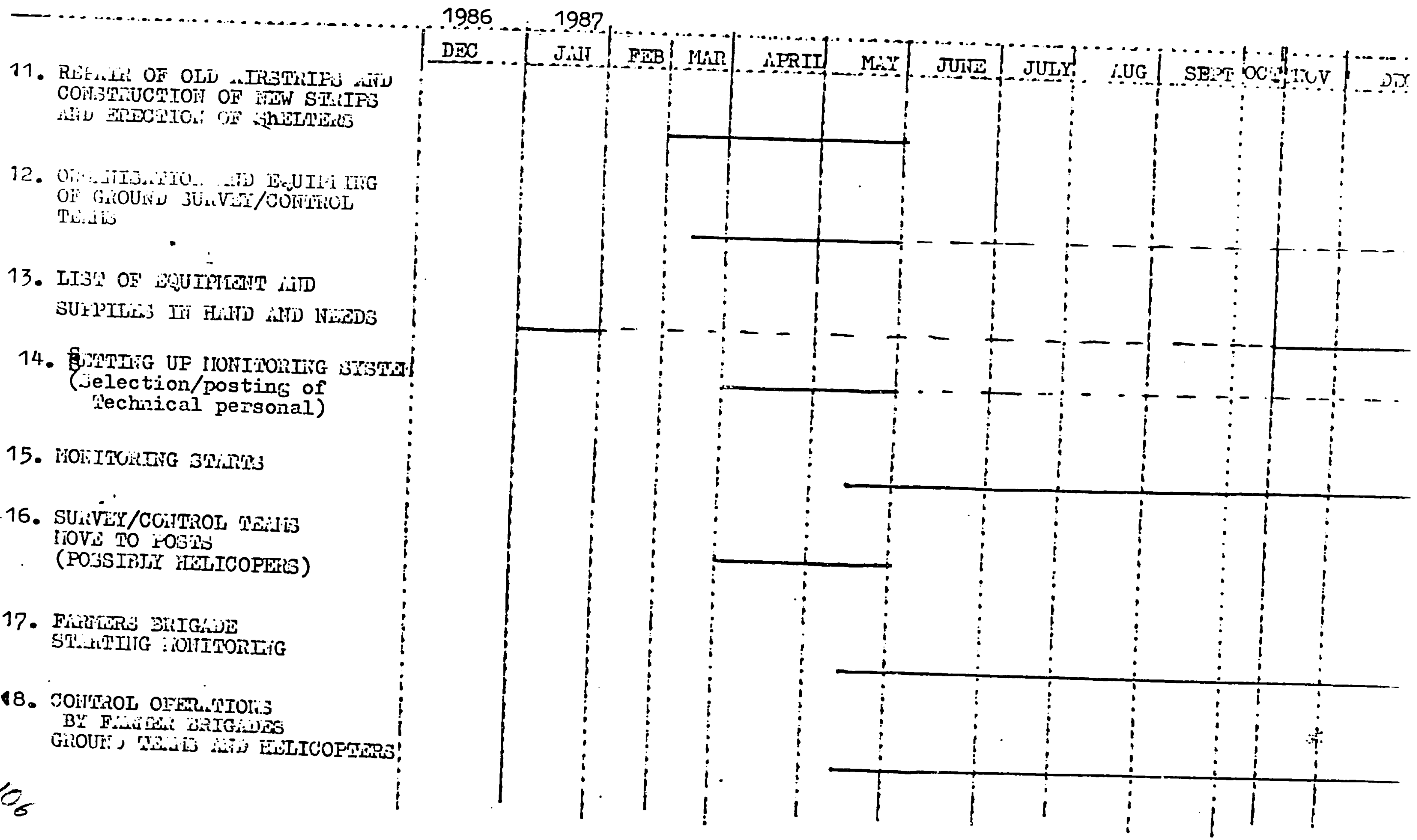
TIMING OF EVENTS



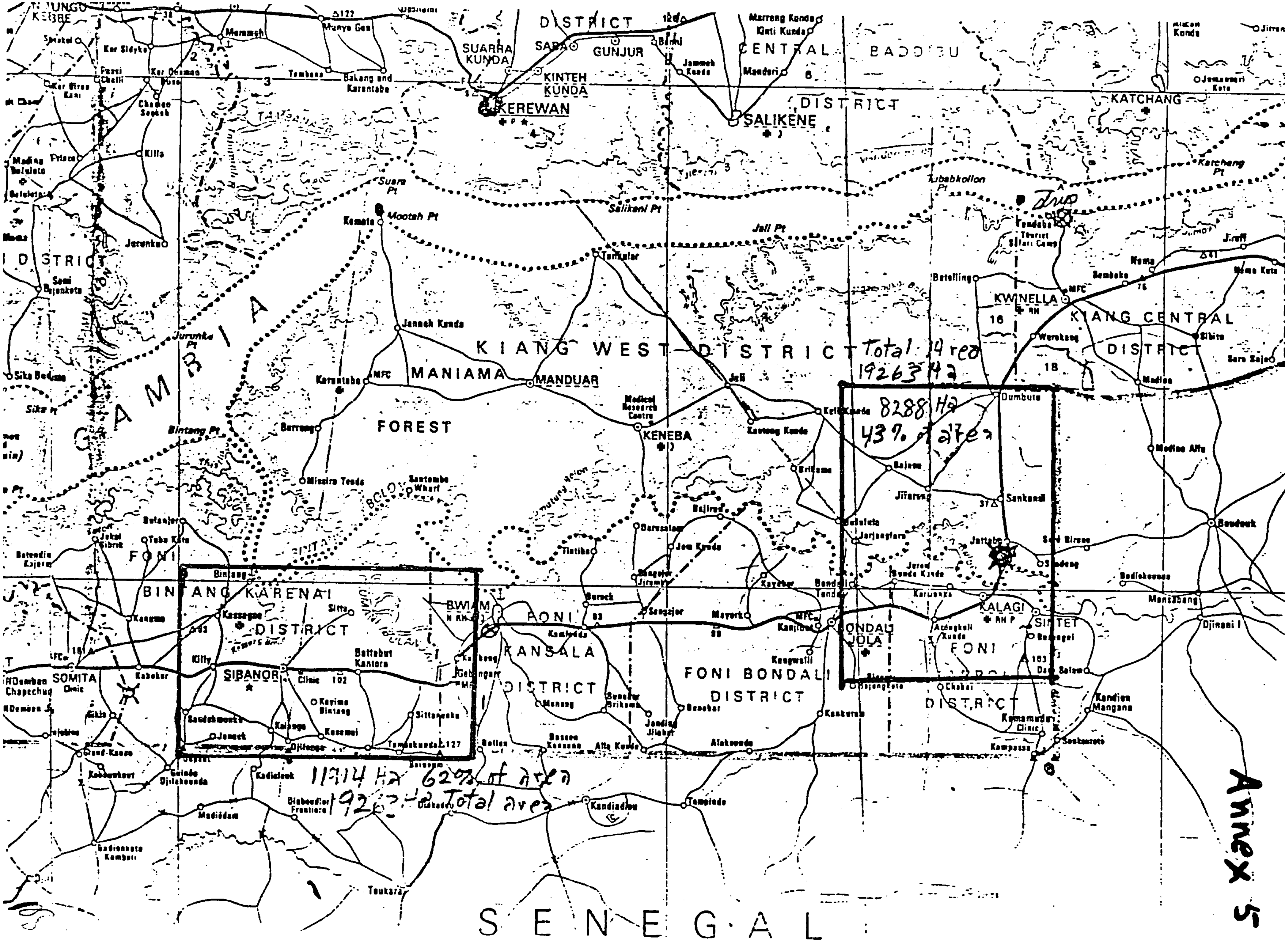
Annex 4


1986
1987
DEC
JAN
FEB
MAR
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
11. REPAIR OF OLD AIRSTRIPS AND CONSTRUCTION OF NEW STRIPS AND ERECTION OF SHELTERS
12. ORGANISATION AND EQUIPPING OF GROUND SURVEY/CONTROL TEAMS
13. LIST OF EQUIPMENT AND SUPPLIES IN HAND AND NEEDS
14. SETTING UP MONITORING SYSTEM (Selection/posting of Technical personal)
15. MONITORING STARTS
16. SURVEY/CONTROL TEAMS MOVE TO POSTS (POSSIBLY HELICOPERS)
17. FARMERS BRIGADE STARTING MONITORING
18. CONTROL OPERATIONS BY FARMER BRIGADES GROUND TEAMS AND HELICOPTERS

PHASE I

	1986	~~1987~~ 1987											
	DEC	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
19. (Additional Support)													
20. APPRAISAL OF SITUATION DURING PHASE I IN PREPARATION FOR PHASE II													
21. ALLOCATION OF ADDITIONAL FUNDS AND CONTROL RESOURCES IN EMERGENCY													
22. PHASE II OPERATIONS													
23. MOPPING UP OPERATIONS													
24. APPRAISAL PHASE II/EVALUATION CAMPAIGN.													

Annex 5


DISTRICT
SUARRA KUNDA
SABA
GUNJUR
CENTRAL BADDIBU
KINTEH KUNDA
KEREWAN
DISTRICT
SALIKENE
KATCHANG
GAMBIA
DISTRICT
KIANG WEST DISTRICT
MANIAMA
MANDUAR
FOREST
KENEBA
KWINELLA
KIANG CENTRAL DISTRICT
Total Area 19263 Ha
8288 Ha 43% of area
Dumbute
Jattaba
KALAGI
SINTET
BONDALI JOLA
FONI
DISTRICT
FONI BONDALI DISTRICT
KANSALA DISTRICT
BWIAM
BINTANG KARENAI DISTRICT
SIBANOR
SOMITA
FONI
11914 Ha 62% of area
19263 Ha Total area
Mootah Pt
Saliken Pt
Jali Pt
Tubabkollon Pt
Karchang Pt
Jurunku Pt
Bintang Pt
Tendaba
Kandiadiou
Toukara
SENEGAL

65 66 67 68 69 370000mE 71 72 73 16°10' 74 75 76 77 78

ƆRS Project No. 635-0203-01

ɪ by the Office of Remote Sensing, South Dakota State University, for the ɔnt of The Gambia, with funding from the U.S. Agency for International ɪent.

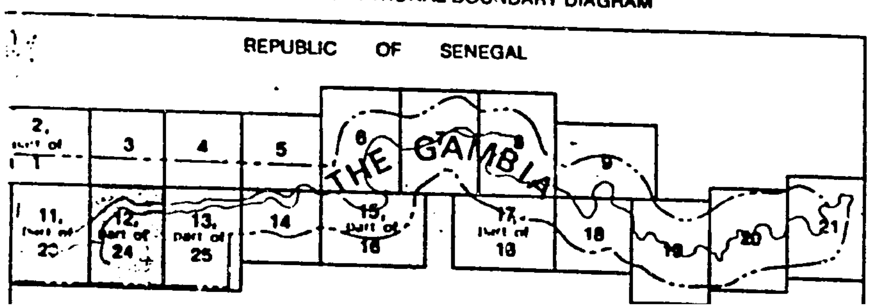
from interpretation of 1:50,000 scale Markhurd black-and-white aerial ɔhs collected in 1982 and from compilation of available documents.

SCALE 1:50,000

FEET 5000 0 1

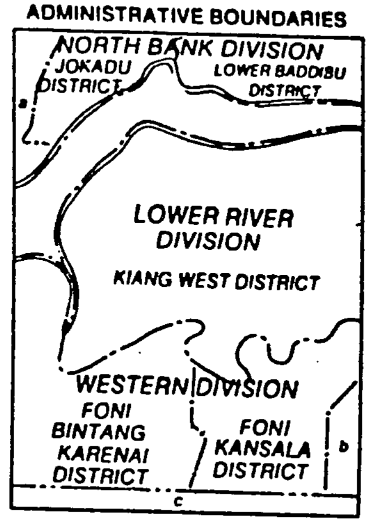
METRES 1000 0 1 2 3

SHEET INDEX AND INTERNATIONAL BOUNDARY DIAGRAM



WHERE INTERNATIONAL AND OTHER BOUNDARIES ARE SHOWN ON THIS MAP THEIR DELINEATION MUST NOT BE CONSIDERED AUTHORITATIVE. ALIGNMENTS MAY BE GENERALISED TO CLARIFY THE EXISTENCE OF A BOUNDARY

ADMINISTRATIVE BOUNDARIES



a UPPER NIUMI DISTRICT
b FONI BONDALI DISTRICT
c REPUBLIC OF SENEGAL

ORS OFFICE OF REMOTE SENSING
neering & Environmental Research Center

Agency for International Development

2, 24 (part of)

Main Road, with Bridge
Secondary Road, with Culvert
Other Road or Track
Town or Village
Boundaries – International
Boundaries – Divisional
Boundaries – District
KEREWAN .... Divisional Headquarters
KANIFING .... District Headquarters
Telegraph or Telephone Line
Power Line
▲ .... Trigonometrical Station
Bench Mark
× .... Wells: Rural Water System
o .... Wells: Hand-Dug Wells Construction Programme
▲ .... Wells: Saudi Sahelian Programme
Watercourse
Telephone Exchange
Telephone Kiosk
⚓ .... Wharf Town

RAINFED AGRICULTURE: Upland and Colluvial Soils

[illegible]	Current agriculture, intensive cultivation (Groundnuts, millet, sorghum, rice, maize)
Af	Fallow fields, non-intensive cultivation (Groundnuts, millet, sorghum)
O	Plantations (*Gmelina arborea*, mainly)
L	Non-intensive cultivation in palm groves (Groundnuts, rice, millet, vegetables)

SWAMP AND IRRIGATED AGRICULTURE: Alluvial Soils

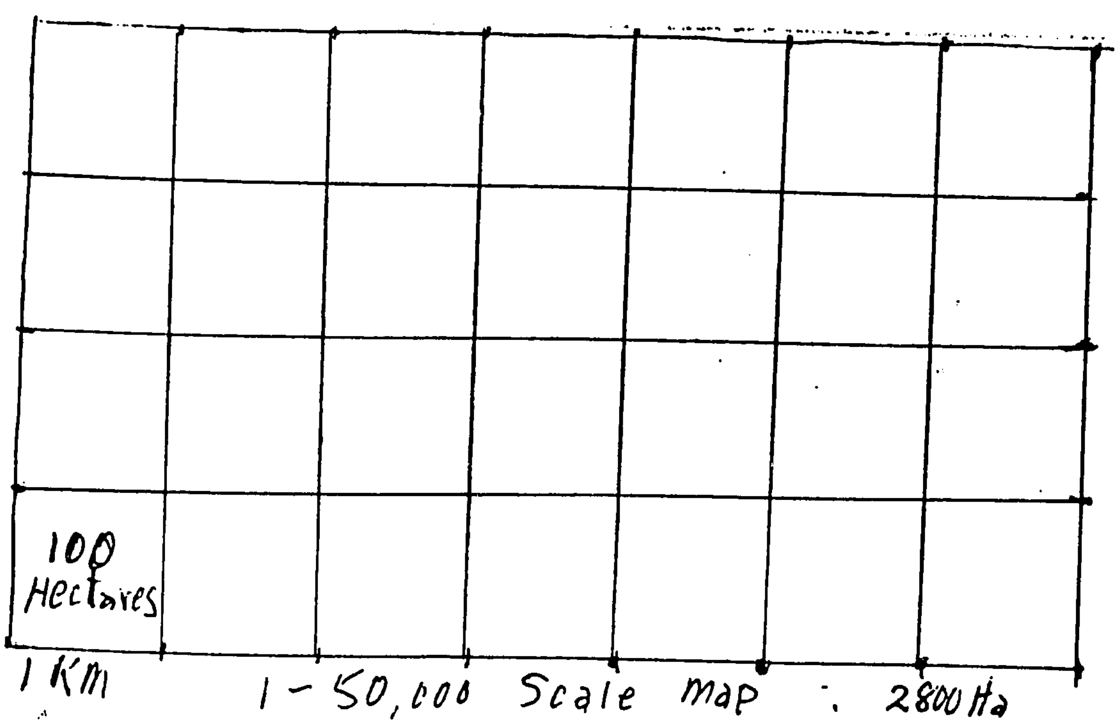
Ar	Swamp rice
Ari	Irrigated rice, bananas (limited in area)

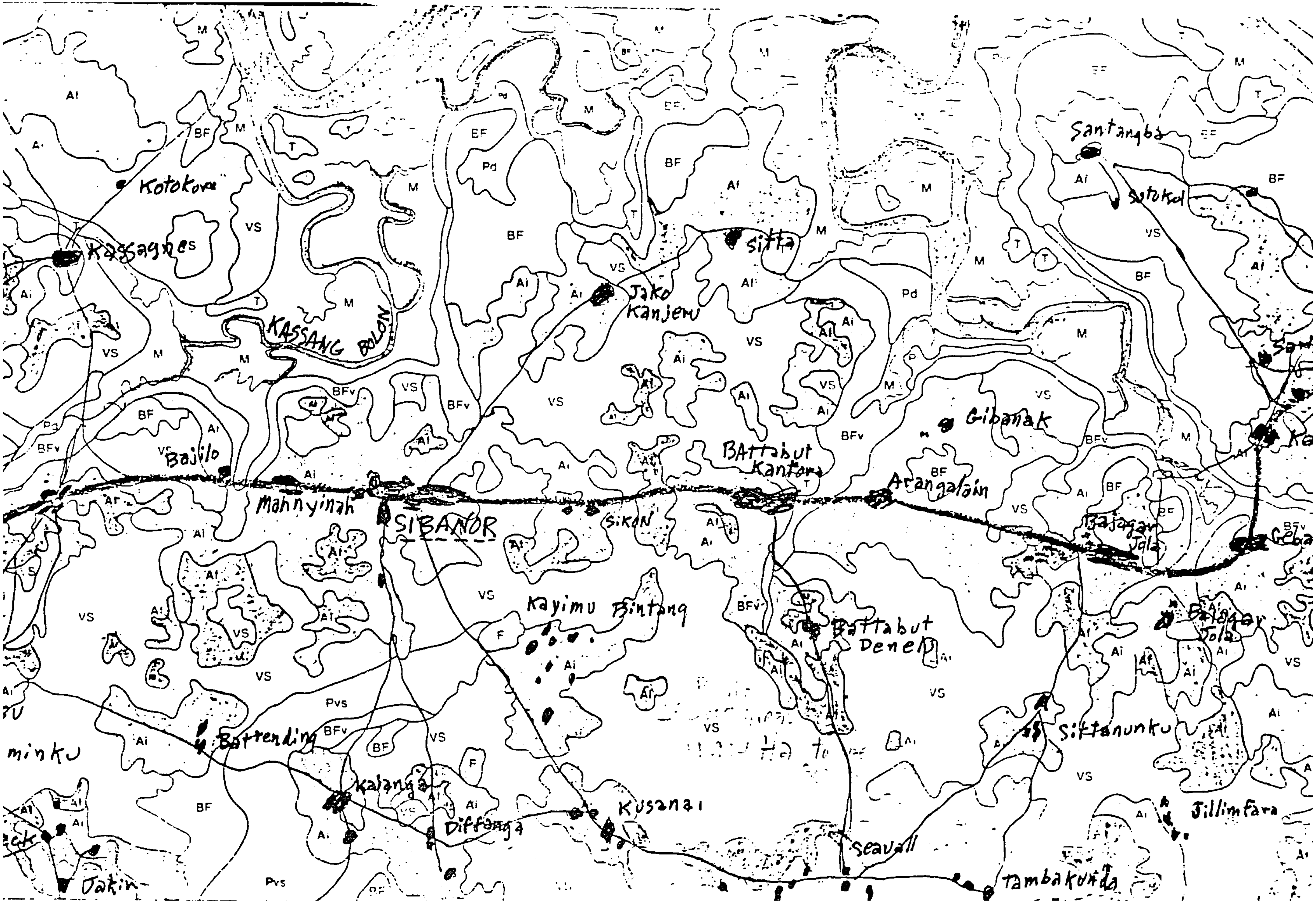
NON-AGRICULTURAL AREAS: Upland and Colluvial Soils

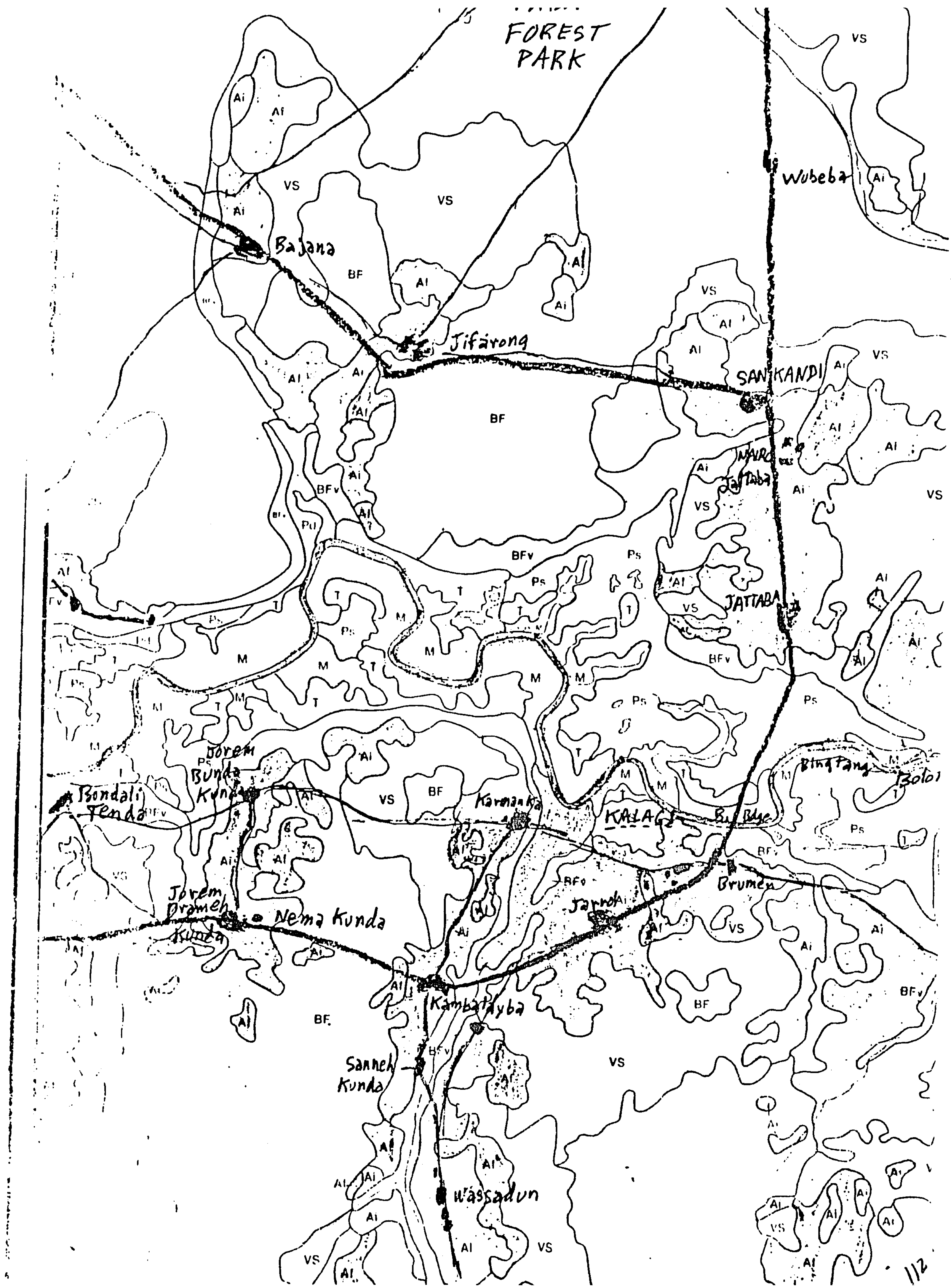
VS	Shrub and tree savannas (including old fields)
B	Savanna woodlands
BF	Savanna woodland/woodland transition
F	Woodlands
BFv	Riparian and fringing savanna woodlands and woodlands
G	Gallery forests

NON-AGRICULTURAL AREAS: Alluvial Soils

M	Mangroves
T	Barren flats
Ps	Herbaceous steppes
Pd	Grass savannas
Pvs	Shrub and tree savannas
Pb	Savanna woodlands
Pf	Woodlands




Kotokora
Kassagnes
KASSANG BOLON
Jako
Kanjeru
Sifta
Santangba
Sotokoi
Bajilo
Mahnyinah
SIBANOR
Sikon
Battabut
Kantora
Arangalain
Gibanak
Bajagar
Jola
Kayimu Bintang
Battabut
Deneh
Battending
Siftanunku
Jillimfara
Kalanga
Diffanga
Kusanai
Seavall
Tambakunda
Dakin
minku


FOREST PARK
Wubeba
Bajana
Jifarong
SANKANDI
JATTABA
Jorem Bunda Kunda
Bondali Tenda
Karmanka
KALAGI
Bingtang Bolon
Brumen
Jorem Drameh Kunda
Nema Kunda
Jarrol
Kambatayba
Sanneh Kunda
Wassadun
VS
BF
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Ai
Ps
Pu
T
M
Al

Annex 6

Communications, (Agrhymet) Robert Herald - Consultant

The Crop Protection Service presently has no working communication system, and nothing which can be expanded upon; it does however use the Gamtel when available, and Gamtel is in the process of improving its equipment. The Agrhymet however, does have a communication net and has agreed that it could work with CPS on its need for communications.

Agrhymet presently has working tranceivers at Basse, Bansang, Georgetown, Yundum and Banjul; stations are established at Jenoi, Sapu, Kan-ur and Kerewan, but are in need of small generators, which would supply power. All stations are available for 24 hour service, though Basse, Bansang and Georgetown are the only ones open 24 hours now.

It is felt that when all stations are on the air that a good basic radio net exists. To enhance this basic net it is suggested that additional matching tranceivers be acquired to supplement where additional coverage is desired, or where emergency needs dictate. These tranceivers should be either stationary or mobil. Refer to the attached map for station locations.

The radios used are;

Model SR-206 SSB

Single side band tranceiver with 6 channels made by:

Scientific Radio System
367 Orchard St.
Rochester N.Y. U.S.A.

The channels now in use, which are crystalized are;

1. 5853
2. 4778.5
3. 3820.0
4. 3207.0

If additional tranceivers are ordered they should be ordered complete with;

1. Correct crystals, ref supra.

2. Suitable mast antennas for ground stations.

3. D.C. converter if necessary for mobil and/or accessories.

4. Automatic antenna tuners.

5. Suitable auto antenna if for mobil unit.

6. Auto vibration mounts and dust covers for mobil.

All purchases should be coordinated with AID/Washington communications experts.

LOGISTIQUES FINDING Robert Herald - Consultant

This report is intended to portray the general feeling of the OFDA team regarding the present capability and needs of the grasshopper campaign in the Gambia, as of this date. Team members have during the past several days had meetings with AID officials and members of the Gambian CPS, and with the FAO.

In country organization

First, I will discuss the organization of the Country Plan and its progress. I am told by D.C.A. Jagne, Director, Crop Protection Services that the National Steering Committee has been formed and has regular weekly meetings, the next of which will be 3-19-87, next Thursday. The Steering Committee is made up of the Gambian Minister, the donor nations, the FAO, and other appropriate parties. Mr. D.C.A. Jagne assured me that he had secured and hired a highly qualified and capable Project Coordinator, an administrator in the person of Mr. Tarawali, whom he anticipates will be confirmed by Steering Committee in the Thursday meeting of 3-19-87. The country plan will be ready for presentation at the next steering committee meeting and will contain a plan for consideration by the committee, and comprehensive list of equipment and materials needed for the 1987 campaign.

A technical task force should be empowered as soon as possible to meet weekly and carry the task and duties eminating from the steering committee and such other duties and task as may be necessary to achieve the goals of the campaign.

Policy

Basic policy to be followed by the steering committee during the upcoming campaign should be discussed and agreed upon during the first several meetings of the year, taking into consideration the recommendations eminating from the FAO general meeting in Rome (December of 1986). These policy guidelines then will be used as a basis from which to plan and project time schedules, equipment and supplies, needs as well as personnel and coordination needs. By following such a sequence we hope to keep the sequence of happenings in logical order.

All tasks should be specifically assigned and monitored with deadlines set for accomplishment.

The OFDA team has sugested that D.C.P.S. (Jagne) should adopt the command center concept to effectively centralize the receipt, accumulation and distribution of all campaign information, and direction.

Initially the command center, which is under the direct guidance and control of the Project Coordinator, will coordinate survey efforts and training along with preparatory logistics needs and planning; then follow right on into the first phase which is ground application of pesticides, the next phase would be dictated by the condition, as the season is followed through to its completion. The Project Coordinator would cause to be kept all kinds of related information for collection, accumulation and recording of information for future reference.

Control techniques

Mr. D.C.A. Jagne expressed that he had organized the farmers and his CPS people in such a way as to be able to secure reliable and timely reports of conditions in the countryside, and thus be in a position to take timely and appropriate action.

Mr. D.C.A. Jagne expressed that he would like some help in two areas of concern; that of communications, and some technical assistance in entomology, during the first phase of the campaign. Mr. Jagne seemed to feel that at least during the first phase of the campaign it would be desirous to have an entomologist present in Gambia.

A logistics expert should be retained to work in tandom with the project coordinator and assist in all logistics matters.

Logistiques - communication

The Crop Protection Service presently has no working communication system, and nothing which can be expanded upon or otherwise utilized. Agrhymet however, does have a communication net and has agreed that it could work with CPS on need for communications. The needs to put the net up in shape would be at least four or five small generators and a base station for CPS Project Coordinator, plus any new out station radio that CPS may need to establish; for instance maybe an additional station or two in the lower River and Western Division's. Agrhymet presently has working tranceivers at Basse, Bansang, Georgetown, Yundum, Banjul; with Jenoi, Sapu, Kau-ur, Kerawan established but in need for generators. The Agrhymet presently utilizes a UHF single side band radio made by scientific radio systems.

Aircraft

In the event it becomes necessary to request aircraft to be brought in for control in phase II it is suggested that operators be prepared to come in with as nearly a complete operation as possible; that is to say don't expect to find parts or maintenance or equipment or oil in Banjul. In short the operator should come in with a turn key operation. There is a good runway at Banjul which is ready for use. Bwiam and Tendaba are in need of repair, and five more suitable sites have been identified if more fields are needed. Airfield information will be forthcoming.

Be advised that the only fuel available in Banjul is Jet A-1.

Annex 7

THE REPUBLIC OF THE GAMBIA

Ministry of Agriculture
Central Bank Building
Banjul The Gambia

Ref:MA/3303/Vol.5/(11-CGN/NYT)

25th March, 1987

GRASSHOPPER CAMPAIGN

The proposed indicative figures for the grasshopper campaign put out by the Department of Crop Protection Services have been revised by the Technical Task Force. The present submission details the global national requirements for an effective grasshopper campaign.

The requirements are based on a total area of 300,000 ha, 110,000 of which is crop land and 190,000 forest area for the first phase. Thirty per cent of the forest area (57.000ha) will be spot sprayed during the first phase in order to contain migration of grasshoppers from the forest area into the crop lands. For Phase II an area of 125,000 ha is earmarked, 20,000 ha of which will be covered by ground teams.

The equipment needs have been worked out based on the provisions for 9 phytosanitaryposts and 29 surveillance posts.

G. Gomez Gaye
For: Permanent Secretary

Dr. F.M. Reda, FAO Representative
Mr. M. Luboga, UNDP Resident Rep.
Mr. T. Nagash, WFP Representative
Mr. P.Protar, EEC Delegate
Mr. A.W McKenzie, British High Commission
Mr. R. Conley, USAID
Mr. Lui Kinfent, Chinese Embassy
Dr. H.A.B N'jie Director, Medical Services
Mr. S.K. Janneh, Director of Agriculture
Mr. D.C.A Jagne, Director of C.P.S
Ms. Amie Joof-Cole, Radio Gambia
Mr. B.Mannoh, Prin. Ext. Aids Officer
Mr. O. Fye, Princ. Env. Officer
Dr. S.B.K Quartey, Director A:H & P
Mr. Robin E. Poulton-Director Action Aid
Mr. Lamin Dibba, TANGO

c.c P.S.M.W.R & E
P.S.M.H.L.& S.W

GRASSHOPPER CAMPAIGN 1987

CATEGORIES	DESCRIPTION	NATIONAL REQUIREMENTS	GAMBIA GOVT. CONTRIBUTION	LEFT OVER 1986	IN STOCK	DONOR ASST. REQUIRED
1. Vehicles	Unimogs	7	5	5(Major) (Repairs) (Needed)		7
	Landrover Pick-Ups	9	7			2
	Pick-Up 4WD	9	7			2
	Station Wagon 4WD	9	7			2
	Trucks 5 Tonner	4	4			-
	Motocycles	30	-			30
2. Pesticides	Propoxur 2% dust	35,000 kg	5,000kg.)	30,000kg.)		
	Malathion 2% dust	~~390~~ 394 tons	4,000kg.)		95 tons	780 tons dust
	Fenitrothion 3% dust	~~390~~ 446 "	56,000kg)			
	Malathion 50% EC	~~28,000~~ 30,000 lts)	2,000lts)		4,000L	56,000 litres
	Fenitrothion 50% EC	~~28,000~~ 30,000 lts)	2,000lts)			
	Malathion 91% ULV	~~53,000~~ 59,400 lts)		6,400lts)	9,100L	106,000 litres
	Fenitrothion 98% ULV	~~53,000~~ 55,700 lts)		2,700lts)		
	contingency	~~5%~~ 10% dust EC UCV				dust 234 tons EC 16,800 Litres UCV 31,800 Litres

CATEGORIES	DESCRIPTION	NATIONAL REQUIREMENTS	GAMBIA GOVERNMENT CONTRIBUTION	LEFT OVER 1986	IN STOCK	DONOR ASSISTANCE REQUIRED
3: Application Equipment	Vehicle Mounted Dusters	18	6	–	6	12
	Vehicle Mounted Mist Blowers	18	2	–	2	16
	Motorised Knapsack Sprayers	1,000	143	–	143	857
	Manual Knapsack "	800	403	–	403	397
	Manual Knapsack Dusters	800	300	–	300	500
	Motorised ULV Sprayers	500	–	–		500
	Pesticide Pumps	100	–	–		100
	Plastic Funnels	200	–	–		200
	Dust Bellows	1,600	–	300	300	1,300
	Spark Plugs	24,000	–	–		24,000
	Carburetor Repair Kit	200	–	–	–	200
	Magneto Repair Kit	800	–	–	–	200
	Leather Covers (Bellows)	300				800

CATEGORIES	DESCRIPTION	NATIONAL REQUIREMENTS	GAMBIA GOVT CONTRIBUTION	LEFT OVER 1986	IN STOCK	DONOR ASSISTANCE REQUIRED
4. Radios	Radio Telephones					
5. Refuelling Equipment	Vehicle refuelers aircraft refuelers					
6. Camping Equipment	Camp beds	480				480
	Sheets	960				960
	Blankets	480				480
	Mess chests	40				40
	Filters (lar e)	40				40
	Plastic jerry cans (water)	40				40
	Shower buckets	40				40
	Ferry cans (oil)	60				40
	Mosquito nets	480				60
	Metal buckets	80				480
	Medical kits	40				80
	Fire extinguishers	9				40
7; Aircrafts	Fixed wings planes	150 Flight hrs				9
	Helicopters	100 Flight hrs				150 Flight
8; Landing strips	Yundum	1				100 "
	Bwiam	1				
	Tendaba	1				
	Njau (proposed)					
	Mamoud Fana	1				
	Basse	3				
	Jar Kunda (proposed)					

CATEGORIES	DESCRIPTION	NATIONAL REQ	GAMBIA GOVT CONTRIBUTION	LEFT OVER 1986	IN STOCK	DONOR ASST.
9 Protective clothing, equipment & drugs	Jumpsuits	1,200	500		500	700
	Plastic jackets	600				550
	Plastic aprons	600				600
	Raincoats	600				600
	Hose (rainboots)	1,000	110			990
	Respirators (dust masks)	5,000				5,000
	Catridges	5,000				
	Goggles or face masks	5,000				5,000
	Atropin ampoules	2,000		96	96	1,904
	Kerodex 7 Barrier Cream	2,000		100	100	1,900
	Contrathion	360		180	180	180
	Rubber boots	500	20		20	700
	Gloves	300				
10 FUEL	Petrol	45,000 l.	10,000 l.	-	10,000 l.	35,000 l.
	Diesel	10,000 l.	5,000 l.	-	5,000 l.	5,000 l.
	Motor engine oil	600 g.	100 g.	.	100 g.	500 g.
	Empty drums	150	40	-	40	110
11 Miscellaneous	Bath towels	480				480
	Hand towles	480				480
	Milk Cartons	900				900
	Vulcanising Kits	40				40
	Toilet soap (tablets)	12,000				12,000
	Soap power (Pkts)	12,000				12,000

Annex 8

Ground Baiting
Rice Bran - Carbaryl bait 5%

Item	Amount	Cost	Donor
Carbaryl sevin-4-oil	3000 U.S. Gal. (11,400 L.	$36,900	U.S.
Shipping (Carbaryl)		$ 5,000	U.S.
Diesel fuel	6000 Gal. U.S. (23,000 L.)	$ 5,400	-----
Rice Bran	100 MT	-------	T.G.
In Country Transport	$1 U.S./Ton Mile	$10,000	-----
Labor (mixing and bagging	400 man days	$10,000	-----
Burlap bags - with stenciled precaution statement	2000	$ 5,000	U.S.
Misc. - safety equip., tarps, shovels, rakes, back pack sprayers, bag sewing needles etc.		$ 2,500	U.S.

Annex 9

Costs - Air Application - 1986

1986 Donors Listing

Chemicals cost

Fenitrothion	FAO	6,000L	$51,000
	China	5,000L	50,000
	FRG	700L	100,000
	$11.17/liter	18,000L	$201,000
Malathion	$7.56/gal.	20,884 gallons	$158,000

Some diazinon was used but have no cost.

EEC plane	77,800 ha. @ 1/4 liter fenitrothion/ha.	=	19,450L
	X $11.17/L	=	$217,256
Canadian planes	90,740 ha. @ 1/4 liter fenitrothion	=	22,685L
	X $11.17/L	=	$253,391
U.S.A. planes	79,170 ha. @ 8oz/acre	=	18,000 gals.
	X $ 7.56/gal.	=	$158,000
	1986 approximate cost of chemicals		$628,647

Aircraft cost

EEC plane	-	$ 90,000
Canadian planes	-	177,000
U.S.A. planes	-	223,000
		490,000

Total 247,710 hectares.

Approximate $2.00 hectare application

Annex 10

Approval of airstrip by Village Chief

Seyfo

Babab .L. Sagnia

Kankuntou Village

Foni Kansala District ,

Western Division

Rep of the Gambia ,

19/3/87

Sir,

I authrise the bearer my uncle Abdou Sagnia Of Kankuntou Village lead you to the side and you can use any size of Land that you may requare, the land use to be an air POrt for somse time . the land is aur reserve land, thank you very much for your inclination may allah help .

Your GOOD FRIEND.

SEYFO BABA.L.SAGNIA (KANKUNTOU VILLAGE)

SIGN BY SEYFO ....

FONI KANSALA
GAMBIA