APPENDIX I

REPORT OF THE FOURTH SESSION OF THE EXECUTIVE COMMITTEE OF THE COMMISSION FOR CONTROLLING THE DESERT LOCUST IN THE EASTERN REGION OF ITS DISTRIBUTION AREA IN SOUTHWEST ASIA

held in

Karachi, Pakistan

5 - 7 March 1969

INTRODUCTION

In accordance with the recommendation of the Fourth Session of the Commission for Controlling the Desert Locust in the Eastern Region of its Distribution Area in Southwest Asia, the Director-General of the Food and Agriculture Organization of the United Nations, at the kind invitation of the Government of Pakistan, convened the Fourth Session of the Executive Committee of the Commission from 5 to 7 March 1969 in Karachi.

The Session was opened by Mr. M. Yamin Qureshi, Joint Secretary, Ministry of Agriculture and Works, Pakistan, who, on behalf of the Government, welcomed the participants to the Session. He emphasized the importance of field research on locusts and, in particular, mentioned the existing opportunities because of the suitable targets available to intensify research on gregarious populations, which was not possible to undertake during the recession period. He hoped that all the participants had brought with them reports on the field research work carried out at the various research stations in the member countries of the Commission. He stressed the importance of coordination of field research at regional and international levels. He welcomed the initiative taken by FAO to convene a meeting of all the field research workers in Beirut at the end of the month. He hoped that the member countries of the Commission having field research stations would take full advantage of this meeting in order to discuss the programme within the region as well as to exchange views with the other research workers.

In reply Mr. Gurdas Singh, on behalf of the Director-General of FAO, welcomed the participants to the Session and thanked the Government of Pakistan for their kind invitation to convene this Session in Karachi and for the numerous facilities provided for the same. He informed that the FAO was very much interested in the field research on the Desert Locust. He emphasized the need for proper coordination of research work in the member countries of the Commission. He informed the Committee that a symposium had been organized by FAO and would be held in Beirut from 25 to 27 March 1969. He expressed the hope that the member countries of the Commission would fully utilize this opportunity and ensure proper representation.

In his capacity as Chairman of the Executive Committee, Mr. A. Soltani of Iran welcomed all the participants to the Session and emphasized the importance of the matters to be discussed. He hoped that the Committee would be able to prepare concrete proposals, in particular with regard to field research on locusts for consideration of the Commission at its Fifth Session.

Officers of the Session

Chairman: Mr. A. A. Soltani, Iran

Vice-Chairman: Mr. Heshamul Huque, Pakistan

The work of drafting the report was entrusted to the FAO Secretariat. Mr. Gurdas Singh and Mr. S. S. Pruthi of the FAO Secretariat acted as Technical Secretaries.

Acknowledgements

At the close of the Session the members of the Committee expressed their thanks to the Chairman for conducting the deliberations in a very tactful manner. The Committee wished to place on record their gratitude to the Government of Pakistan for the hospitality extended and the facilities provided.

PARTICIPATION IN THE SESSION

Members of the Executive Committee

Afghanistan

Mohammed Hassan Rahimi
Director, Plant Quarantine and Locust Control
Department of Plant Protection and Quarantine
Ministry of Agriculture and Irrigation
Kabul

India

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AGENDA

The Executive Committee adopted the following Agenda:

1. Opening of the Session
2. Adoption of the Agenda
3. Election of the Drafting Committee
4. Coordination of the Desert Locust Research in the Region
5. Advanced Training Fellowship
6. Election of the Chairman and Vice-Chairman of the Executive Committee for 1969
7. Any other business
8. Place and date of next Session
9. Adoption of the Report.

SUMMARY OF DISCUSSIONS

Coordination of Research

1. The Committee reviewed the field research work conducted on locusts in India, Iran and Pakistan, a summary of which is given in Annexe I.

2. The Committee took note of the following important research projects undertaken at the various locust field research stations and observed that results of practical significance had been obtained.

Bikaner (India)

(a) Anti-feedent qualities of neem (Azadirachta melia) kernel paste and green citrus fruit; effect of food on sexual maturation of locusts; deterioration of insecticide sprayed on desert soil; reaction of the Desert Locust to different types of light traps; fluctuation of locust populations in relation to ecology and meteorology.

Bhawani (Pakistan)

(b) Water absorption capacity of the Desert Locust eggs during different stages of development; partial starvation of hatchlings; effect of crowding and ionizing radiation on adults and fledglings and pathogenecity of organism isolated from the Desert Locust eggs.

Bandar Abbas (Iran)

(c) Development of research laboratories; rearing of locusts; light trap studies and ecological survey.

3. While considering the future plan of work, the Committee recommended the continuation of the existing projects with special emphasis on the following lines of work:

(a) Effect of different coloured lights in light traps along with indication of most appropriate period of the night for attracting locusts; effect of cold shock treatment on hatchability of eggs; effect of sub-lethal doses of insecticides, applied to the parents, on the progeny (eggs and hoppers) and determination on metabolites of insecticides applied.

(b) Determination of conditions for the flow of water into the eggs and various periods of drought exposure on the hatchability of eggs; use of different foods in starvation experiments; work on fluctuation in locust populations in relation to ecology and meteorology and role of two pathogens, viz. Bacillus subtilis and Dephtheriods in biological control of field populations.

(c) Further development of locust field research work with special reference to fluctuation of locust populations in relation to ecology and meteorology and relationship between the Desert Locust and the Moroccan Locust populations.

4. The Committee suggested that preliminary notes on neem (Azadirachta melia) kernel paste, feeding on citrus fruit and absorption of moisture by the Desert Locust eggs may be published in the Technical Series issued by FAO.

Fellowships

5. The Committee noted that there were two fellows: one from India, another from Iran receiving training in the United Kingdom, and two Afghans in Iran.

6. In view of the fact that all the present fellows had to continue for a considerable length of time, the funds already committed and proposed in the programme of work and budget for 1970 would not be enough to accept any new candidate for fellowship for the present. It was therefore agreed that during 1969 no candidate be selected for any further training, and the question of awarding further fellowships should be considered at the next Session of the Executive Committee in spring 1970.

7. It was decided that FAO should invite nominations from the member Governments of the Commission for advanced training fellowships and put up such applications for consideration at the next annual Session of the Committee. At the same time arrangements should be made to nominate a new fellow from Afghanistan in place of Mr. Ajruddin Wais, who had to discontinue his studies for health reasons.

8. The following are the details of the duration and expenditure involved under the present fellowship programme:

Name	Country of origin	Country of training	Duration	Cost ($)	Actually incurred	Needed
Fellowships Awarded						
AHMED	Pakistan	U.K.	1966/67	4 277	4 277	complete
NOORZAI	Afghanistan	Iran	1966/71	23 925	9 925	14 000
WAIS	Afghanistan	Iran	1967/72	23 580	9 580	14 000
SAKET	Iran	U.K.	1967/70	12 710	8 710	4 000
GILL	India	U.K.	1968/71	12 790	8 790	4 000
		Total expenditure incurred		77 282	41 282	36 000
Fellowships in Process						
FAIZYAR	Afghanistan	Saudi Arabia	4-5 weeks	1 500	nil	1 500
MOAYEDI	Iran	Pakistan	6 months	2 500	nil	2 500
JARAHI	Iran	Pakistan	6 months	2 500	nil	2 500
		Total expenditure envisaged		82 782	41 282	42 500

Budget Allocation

1966	$ 20 000	
1967	$ 10 000	
1968 Supplementary	$ 10 000	
Allocation from Reserve Fund	$ 5 000	$ 45 000
Further provision needed		$ 37 782
to be met as follows:		
1969 approved budget allocation		$ 20 000
Balance to be met from unexpended surplus on other allocations as at 31 December 1968		$ 17 782

9. While reviewing the progress of the fellowship programme, the Committee decided that the fellowship award for advanced training (with the exception of Afghan Fellows studying in Iran) should not exceed three years. In case the period is to be extended due to certain special circumstances, the matter should be referred to the Commission for approval.

Chairman and Vice-Chairman of the Executive Committee 1969/70

10. The Executive Committee unanimously elected Pakistan and Afghanistan as Chairman and Vice-Chairman respectively for a period of approximately one year from March 1969 up to the time of the next annual Session of the Executive Committee.

DATE AND PLACE OF NEXT SESSION

11. It was decided that the next Session of the Executive Committee should precede the annual Session of the Commission, and the date and place would be decided by the Director-General of FAO. The Committee, however, observed that in view of the present locust situation a special session may be convened by FAO in consultation with the Chairman of the Committee at any time during the course of the year.

Annex I

A Summary of the Desert Locust Research Work carried out during 1968 and Future Plans

INDIA

Studies on the Ecology and Biology of the Desert Locust (Schistocerca gregaria Forsk)

(1) Behaviour of the Desert Locust swarms

Some observations on the behaviour of a loose mature swarm of the Desert Locust were recorded at Gosainsar (Churu district) on 30 and 31 July 1968. It was found that noon roosting went on at the base and middle of bushes such as phog (Calligonum polygonoides), khinp (Leptadenia spartium), booh (Aerua persica), sinya (Crotolaria burhia) and murant (Panicum turgidum) at air temperature 31.0°C, RH 70%, bush base 32.0°C, bush middle temperature 32.0°C. At 18.45 hours, the adults which were near the base of the bushes crawled into and under them. Locusts preferred soil near the base of bushes and dirt track for laying. Laying and copulation was observed between 21.00 and 21.15 hours, and maximum laying occurred at night; copulation was observed even in the middle of bushes. The average number of egg pods in the plain area as well as near the base of bushes was 2.4 pods per square foot (range 0-20 pods per square foot), near the base of bushes 3.3 pods per square foot and in the plain area 1.1 pod per square foot. The number of eggs per pod averaged 77, the range being 30 to 118. Crows and kites were found predating on the adults of the Desert Locust.

(2) Light trap studies of the Desert Locust

Light trap observations were continued and were conducted at a number of places in Rajasthan, using an Aldis signalling lamp, a mercury vapour lamp with 125-watt bulb and an ordinary petromax lamp (400/500 cp). It was observed that there was no consistent pattern in the behaviour. Similar results were obtained last year. An area of 3-4 km which showed no population in the afternoon survey attracted locusts when the trap was set in the evening, whereas the light trap set in an area where locusts were actually present or their incidence confirmed by the day surveys brought no locusts to light on the same evening. Amongst the attracted locusts mature females and males as well as immature ones were found. Biometrics were E/F 1.97 to 2.33, and F/C 3.11 to 4.22.

(3) Fluctuations in locust populations in Khara, Kanasar, Napasar, Udramsar (Bikaner district) in relation to ecology and meteorology

Areas within a radius of 4 km from the villages of Kanasar, Khara, Napasar and Udramsar of the Bikaner district were kept under observation for locusts during 1968. All the four sides of each village were surveyed for locusts in relation to vegetation and meteorology once a month during January, February and April to August 1968. Among the meteorological factors the air temperature, relative humidity, wind velocity and rainfall were kept in view while studying locust population. Light trap observations were also made with the mercury vapour lamp or petromax or Aldis signalling lamp for additional evidence on the presence or absence of locust population in the area surveyed during the day.

From the observations made during 1968 it was observed that influx of population or increase of locust population occurs after rainfall, especially within a fortnight of rainfall, and on very rare occasions population increased

a week ahead of the rainfall, which perhaps indicates the action of the fore-running depression of the converging winds.

(4) Laboratory observations on some aspects of the biology of solitarious Desert Locusts

A systematic and detailed study of the solitary Desert Locust in laboratory and semi-natural conditions as suggested by Albrecht was initiated in 1967 and continued during 1968.

Solitarious males and females of the Desert Locust numbering 62 (8 o + 54 ♀) were collected during the months of July to September from the field. Some of them were kept isolated and some crowded (4 to 5 females per cage of 18" x 18" x 18"). When the females showed external signs of maturity, sex-starved males were introduced into the females' cage three to four times, for a maximum duration of 5 hours at a time on different days. Only one female laid one egg pod (containing only 4 eggs) on 22 August 1968 in soil with 6.8% moisture and at 10 cm depth. Out of this egg pod only 4 hoppers emerged on 4 September 1968, the incubation period being 13 days at soil temperature varying between 32.0 and 37.0°C under natural conditions. All the hoppers were pale green and their weight at the time of emergence ranged between 5.9 to 9.3 mg (average weight being 7.35 mg), which is abnormally low compared to the average recorded by other workers - almost the double of this. These hoppers, however, survived only 20 days and during this period did not change much in colour; the duration of the first and second instars was 8 and 9 days respectively.

The other female adults survived for varying periods, some dying after 5 days and others after 73 days (most of them after 30 days), during which period they did not show any external sign of any disease.

(5) Oviposition in the presence of different salts in the sand

Preferences of the laying females to soils containing different concentrations of sodium chloride, magnesium sulphate and calcium carbonate were studied by mixing molar solutions of sodium chloride, magnesium sulphate and about 0.8 M of calcium carbonate. Solutions were prepared separately by taking 21.06 g, 43.20 g and 30.00 g of sodium chloride, magnesium sulphate and calcium carbonate in each cc of distilled water and mixing them with coarse sterilized sand (3600 g each). Twelve tubes for each treatment and twelve tubes of distilled water plus sand (as control) were kept in three oviposition cages according to Latin Square design. Equal numbers of mature males and females were released in each of the three cages and food plant was hung from the roof of the cage. Observations recorded are tabulated below:

Table I

Oviposition in relation to presence of salts in the soil

Experiment no.	Sodium chloride		Magnesium sulphate		Calcium carbonate		Distilled water	
	False boring	Egg laying	False boring	Egg laying	False boring	Egg laying	False boring	Egg laying
I	24	nil	16	nil	12	1	16	nil
II	18	nil	9	nil	5	nil	6	nil
III	26	nil	33	1	7	nil	21	4
Total	68	0	58	1	24	1	43	4

From the above table it would appear that successful laying could take place in soils with magnesium sulphate concentration as high as 1 molarity. Some workers had observed that locusts rejected soils containing concentrations of sodium chloride higher than 0.5 molarity for laying. False borings were also noticed in sodium chloride, magnesium sulphate, calcium carbonate and distilled water. In these observations (i.e. in distilled water, plain soil) it was seen that the ratio between false boring to successful egg-laying was about 5:1. Others had recorded the ratio as 4:1 in ordinary soils in the open. In salty soils there was a great disparity, but false borings were no indication of unsuitability of soil or otherwise for egg-laying. Hatching occurred from the laying confirmed in distilled water and from magnesium sulphate, and none from the calcium carbonate tube, and the hoppers were normal. The work was in progress.

(6) Effect of low temperature on mortality, feeding and fledging

During 1967 experiments were conducted under laboratory conditions to confirm whether Desert Locust adults could withstand persistent low temperatures, and if so for how long and at what temperatures, and also with what after effects. It was observed that there was 100 percent mortality within 24 hours when the adults were subjected to temperatures ranging from -7.0 to -11.0°C, whereas at temperatures from -3.0 to -6.5°C 100 percent mortality occurred within 189 hours. Most of the individuals tested showed no marked effects of the low temperature and their fecundity was not affected. To see whether fifth-instar hoppers could also withstand continued low temperatures like adults, the following preliminary studies were made on fifth-instar hoppers.

Preliminary studies showed that when fifth-instar hoppers were continuously subjected to an average temperature of 3.5°C, 3.3% of the hoppers died after 43 hours, 20% after 114 hours, 36.6% after 138 hours, etc., and after 474 hours all the hoppers had died (percentage of mortality corrected by Abbott's formula). Faecal pellets voided by the hoppers kept in low temperatures were fewer (faecal pellet number in control at 31.0 and 37.0°C was 5.7 times more than at low temperatures), and there was no fledging. This seems to indicate that low temperature affects both the feeding capacity as well as growth factors in hoppers. Other low temperatures (including those that might naturally occur in the locust habitats) and their effects on the longivity as well as physiology of the hoppers were being studied.

(7) Effect of food plants on sexual maturation

Studies on the effect of food plants on sexual maturation of the Desert Locust were started on 3 September 1968 by introducing ten pairs of Desert Locusts, fledged on 2-3 September, in each of three rearing cages provided with booh leaves (Aerua persica), berseem leaves (Trifolium alexandrinum) and bajri leaves (Pennisetum typhoideum) separately. It was observed that hind wing colour became slightly yellow earlier in the case of locusts fed on bajri leaves (24 days) than on berseem (35 days) and on booh (not even in 119 days), but all the locusts died by 25 October 1968 in the case of bajri leaves (i.e. after 53 days), whereas on that date there were 9 and 14 live adults in the case of the berseem and booh cages respectively. Copulation and laying were observed 52 days and 59 days respectively after fledging in the berseem cage, whereas there was no fledging in the case of the booh cage even up to 31 December 1968, i.e. almost 4 months after fledging.

(8) Studies on the efficacy of neem kernel paste suspension as a deterrent to the Desert Locust

A recent recommendation of the Indian Agricultural Research Institute, New Delhi, that 0.1% neem seed kernel paste suspension sprayed on the plants could keep off the Desert Locust for a considerable length of time and should therefore be adopted as a locust control measure was given critical field and semi-field tests in addition to further laboratory assessment. It was found that apart from the various inherent drawbacks in adopting this as a control measure on a field scale, the suspension did not show any worthwhile residual repellency. Significant deterrent action was noticed for a maximum of 3 days. Even within those 3 days there was some feeding which gradually increased, and normal feeding was subsequently observed.

(9) Anti-feeding compounds in orange fruits; studies on the factors inhibiting the feeding on citrus fruits by Desert Locusts

An incident in Morocco in 1955 where a Desert Locust swarm that settled in an orange orchard defoliated the trees completely but did not damage the fruits gave rise to the query as to whether the orange fruit itself was in any way distasteful to the otherwise omnivorous Desert Locust and if so whether any anti-feeding compounds were present in its rind. Field trials were conducted with the Desert Locust and its reaction to orange (malta fruit) in situ in the Ganganagar district of Rajasthan was studied. It was found that the non-feeding of the Desert Locust was not due to any built-in anti-feedant, but to its inability to have a biting grip on a fruit which has a slippery and tough skin.

(10) Contact toxicity of some insecticides to first-instar hoppers of the Desert Locust

Insecticidal trials were conducted at Jhajoo (Sri Kolayatji tehsil of the Bikaner district) to study the comparative contact toxicity of aldrin and malathion oil solutions against two-day old first-instar hoppers of the Desert Locust emerged from swarm layings. Malathion oil solution applied with the help of an Aspee Bolo motorized knapsack sprayer at 6.25 g and 12.5 g actual ingredient per acre gave 99.0% and 99.5% kill within an hour respectively, while aldrin oil solution applied at 12.5 g actual ingredient per acre gave 99.4% kill. Scope for reducing the quantity of the actual active ingredient per acre to get 99% kill was indicated. Further comparative trials would be undertaken in the next season.

(11) Relative toxicity of some insecticides as contact poisons to the adults of Chrotogonus sp.

To ascertain the relative contact toxicity of some insecticides like malathion, parathion, dichloroves, dieldrin, and endosulfan against adults of Chrotogonus sp., experiments were conducted in the laboratory using Potter's tower.

The order of toxicity of insecticides to the adults of Chrotogonus sp. computed on the basis of LD 50 values was found to be: malathion, parathion, dichloroves, dieldrin, endosulfan. Malathion, parathion and dichloroves were found to be 1.76, 1.16 and 1.03 times more toxic than dieldrin, respectively. Endosulfan was found to be less toxic than dieldrin, being 0.023 times as toxic as dieldrin, the most widely used locusticide.

(12) Assessment of the loss of the insecticide from the sprayed desert soil

To get a rough estimate of the natural loss of insecticides from the desert soil in different months, the following method was tried. A unit area was sprayed with a fixed quantity of colourless kerosene oil into which an accurately weighted quantity of waxoline red had been mixed, and the resultant colour was compared with the Munsel book of colour. Different dilutions of this were prepared and the resultant colours and strengths noted. Known quantities of soil samples from the sprayed area were mixed with colourless kerosene oil and the colour compared with known strength, or dilutions were made until the colours matched known strengths and colours. During October, November and December 1968 0.1% waxoline red in kerosene oil at 625 litres per hectare was sprayed over the sand dunes, and it was found that there was loss of 55-58%, 72-80%, 86-92% and 100% one day, three days, seven days and ten days respectively after application. These trials could be repeated in spring and summer months when the weather factors in the desert would be different.

(13) Mapping and analysis of past locust populations in relation to weather

Studies to correlate locust activity with meteorological data were initiated, and a case study of the July/October 1965 atmospheric disturbances leading to solitary concentrated breeding in the Phalodi-Bikaner area was made.

Desert Locust population and rainfall data of the Bikaner and Phalodi zones for 1965 and monthly percentages of occasions when rainfall preceded or succeeded population by a week during July/October over the entire scheduled desert area were worked out. Charts showing locust population and rainfall were prepared. For critical study 40 localities - 10 in each month from July to October - bearing maximum locust population were selected. Such localities near to these having received rainfall on earlier dates and which might have influenced the influx of population were found out, tabulated, and a map was prepared. No definite conclusions on the pattern of reaction of locusts to the rainfall have been possible as yet.

(14) Studies on biometrics and eye-stripes in the Desert Locust

Adults

(a) Morphometrics of 522 adults of the Desert Locust collected at random during 1968 were studied. Their phase status by E/F and F/C ratios was calculated and compared with similar data of 206 adults of a 1967 population (Santara, Barmer).

Whereas the transiens population had remained almost the same, there was a slight exchange of the gregarious and solitary population positions between the first two and the last two sets, by both F/C and E/F ratios.

(b) Desert Locusts numbering 659 collected from the scheduled desert area during 1968 and another set of 1 318 collected in 1967 from an area in the Barmer district were analysed on the basis of their eyestripe number and sex.

The comparative study of eyestripes and sex proportions seemed to indicate that the September/October 1968 population was apart from the 1967 or May/August 1968 populations, the last two being nearer to each other. The May/August 1968 population was comparatively more inclined towards gregaria.

Hoppers

Phase sensitivity of colour in fifth instar hoppers of Desert Locust

The following nine body parts of 226 hoppers of the fifth instar were measured and analysed for assessing the phase sensitivity of colour: width of head at the ocular region (O), width of head at the genal level (C), length of pronotum at Keel (P), height of pronotum (H), width of pronotum at constriction (M), length of wing-pad (Wp), width of wing-pad (W-p), length of elytron pad (Ep) and length of hind femur (F).

Table II

Colour and sex of hoppers studied for phase sensitiveness

Colour of hoppers	No. of specimens examined			Density
	Males	Females	Total	
green	33	50	83	solitary
fawn	54	18	72	solitary
yellow	35	36	71	crowded

According to the Munsell Book of Colour, the green ranged between 5 Gy:8/4 to 5 Gy:8/6, fawn 7.5 YR:8/4 to 10 YR:8/4, and yellow (gregaricolour) 7.5 Y:8/8 to 7.5 Y:8/10. All these hoppers were 5-eyestriped. The ratios of the various body parts were worked out and the data were statistically analyzed.

The significance of phase differences in respect of mean dimension, to see the extent of sensitivity, were summarized as under:

Body Parts

Males: the mean value of all the nine body parts studied were very significantly lower in yellow (gregaricolour) than in fawn, but the mean value of "P" was significantly lower in fawn than in green.

Females: the mean value of all the nine body parts studied in fawn was significantly lower than green and significantly higher than yellow.

Ratios

Males: the mean value of P/O, P/C, H/C, M/C, Wp/C, Wp/Wp', F/C and Wp'/F ratios were very significantly lower in yellow than in fawn. The mean value of fawn colour P/C ratio was significantly lower than green, but the reverse was the case for C/O ratio.

Females: the mean value of P/O, P/C, H/C, Wp/C, Wp/Wp', F/C and Wp/F ratios were significantly lower in yellow than fawn, but the mean values of P/C, H/C, M/C and F/C ratios was significantly higher in green than in fawn.

These studies seemed to indicate that there was a close association between different colour patterns and biometric values. Higher values were seen in hoppers that were green (solitaricolour), lower values in yellow (gregaricolour) and intermediate values in fawn - i.e. colour could be used as another measure for differentiating phase in the normal/naturally occurring fifth-stage hopper population.

Programme of Work for 1969

(1) Studies on the biology of locusts, their incubation period, larval period and percentage of natural mortality under different soil and temperature conditions.

(2) Oviposition reactions to soils containing different concentrations of various salts (chemicals).

(3) Studies on the biology of grasshoppers like Oedeleus senegalensis, Poecilocerus pictus, Hieroglyphus nigroreplotus, Acrotylus sp., the tree locust (Anacridium sp.) and the Bombay locust (Patanga succincta).

(4) Effect of prolonged low temperature and pressure on adults and hoppers.

(5) Light trap studies to be continued to corroborate and clarify results obtained so far.

(6) Case studies of correlation of swarm movements with meteorological phenomena.

(7) Phenology of certain desert plants in the Bikaner district.

(8) Toxicological studies of some newer insecticides against hoppers and adults of the Desert Locust.

(9) Studies on the natural depletion of some insecticides sprayed/dusted on soil/vegetation.

(10) Determination of relationship between the size and weight of locusts as fledglings and when fully grown (FAO Fourth Symposium, Cairo).

(11) Phaseology of locust populations during 1969 in relation to various biomorphic discriminators.

(12) Biotic control factors studies.

IRAN

Bandar Abbas Desert Locust Field Research Laboratory

In addition to the equipment supplied by the Food and Agriculture Organization of the United Nations, the Government of Iran procured further equipment such as an incubator, cages, meteorological instruments, etc.

Rearing: in order to prepare for field investigations, rearing work was started during 1968 when 50 pairs of adult locusts and five tubes containing egg-pods were transferred from the Pests and Diseases Research Institute, Evin, Teheran, to Bandar Abbas.

A technical officer was posted at Bandar Abbas who was trained in rearing, and the work commenced in November/December. Egglaying started in the first week of December. A Stevenson screen was fixed at the field laboratory and meteorological observations were recorded.

Locusts were reared in oviposition and rearing cages in the room. The sand used for oviposition was sterilized in the oven for two hours at 200°C. Since there is no temperature control room, each cage was fitted with a 60 watt electric bulb. The humidity at Bandar Abbas varied from 45 to 85%, and that was considered suitable for locusts. Therefore no special measures were taken to control it. The locusts were fed on Cynodon dactylon grass, which was supplemented with cabbage leaves and wheat bran. It was proposed to grow wheat at the site for feeding.

Light Traps: during November/December light traps were used. Although a number of other insects were attracted by light, no locust was observed.

Survey of Southern Iran: an extensive survey of southern Iran starting from Gwadur up to the Khusistan area, covering about 8 000 km, was conducted from 3 August to 2 September 1968 to study the locust population. No locusts were observed anywhere except in the Dashtiari area near Chah Bahar and the Aliabad area near Iranshahr, where the population was also very low. The area in general was very dry. The locusts were observed in a henah field in Aliabad and a sorghum field in Dashtiari. In the Dashtiari area two locusts were also found in Capparis on the dunes.

Future Plans: as soon as sufficient stock is built up, insecticidal trials and other experiments will be started. It is also proposed to test the efficacy of BHC oil solution and Accothion 96% vis-à-vis dieldrin oil solution both in the laboratory and under field conditions. A study of the relationship between the Desert Locust and Moroccan Locust populations in Iran will also be made.

PAKISTAN

1. Role of soil salinity in the developing eggs of the Desert Locust

Soil salinity affects the development of Desert Locust eggs when water absorption capacity of the eggs is reduced. Water absorption by the eggs in normal soil is about 142% of their initial weight. When the salt (sodium chloride) concentration is 1.5% the eggs complete their development without going into quiescence, and the quantity of water absorbed is about 24%, which is the minimum for completing uninterrupted development. When the salt concentration is further increased, the embryos enter into a quiescent stage after developing up to late anatrepsis. At 2.4% concentration an equilibrium is created in the osmotic pressure between the egg contents and the surrounding medium. Any further increase beyond this concentration causes a loss in the initial weight of the eggs, rendering them nonviable. Eggs incubated in salt solutions of 0.9 to 1.2% concentration yield typical solitaricolour hatchlings.

2. Survival of the Desert Locust eggs under unfavourable conditions

When the water supply for the developing eggs of the Desert Locust is inadequate the embryos enter a stage of quiescence after developing up to late anatrepsis stage. These eggs remained viable for more than 125 days and resumed development when adequate water was provided. This means that the eggs can tide over the unfavourable subdry period and hatch after the rains.

3. Studies on the threshold of embryonic development in Desert Locust eggs

When incubated at 15.5°C, Desert Locust eggs enter into quiescence in the very early embryonic stage. This quiescence can be terminated by bringing the incubation temperature to the optimal range (30-35°C). The quiescent eggs remained viable for a period of 84 days. When quiescence was induced in the very early embryonic development all the hatchlings from the solitary as well as the gregarious eggs were black. This quiescence also helps the eggs to tide over the unfavourable temperature below the threshold of embryonic development (16°C).

4. Water absorption capacity of Desert Locust eggs

Solitary eggs, which are lighter in weight, absorb more water (192.8%) than gregarious eggs (142%), with the result that the final weight of the solitary hatchlings is more than that of the gregarious ones when incubated under similar conditions. Solitary eggs may thus produce gregarious hatchlings in one single generation when an ample supply of water is available for the developing eggs.

5. Effect of water logging on Desert Locust eggs

If freshly laid eggs remain completely immersed in water for 24 hours there is no adverse effect on their further development. However, longer immersion may result in bursting of the egg-shell. On the other hand it is always fatal during the entire period of blastokinesis. Again during the Kata-trepsis stages immersion is not harmful, even when the egg chorion is dissolved.

It is claimed that there are air spaces in the chorion which supply oxygen to the developing embryos (Hartley, 1961). Since the eggs survived immersion even after the chorion was dissolved, the role of air spaces in the chorion becomes doubtful. Finally, during the hatching process immersion causes suffocation and death to the vermiform larvae.

From the above it may be seen that water logging is fatal to the developing embryos only during particular stages of development, and even then not always.

6. Water regulation mechanism in the eggs of Acrididae

During the study of embryonic development in the eggs of Acrididae it was observed that during blastokinesis a few specialized cells of the serosa - called hydropyle cells - get detached from the yolk sac and adhere to the hydropyle. This mass of cells is known as the "posterior serosal patch". It has been observed that shortly after the formation of this patch the weight of the egg becomes constant, indicating that the pores of the hydropyle are closed, thereby cutting off any further water supply to the embryo.

7. Pathogenic organisms in Desert Locust eggs

Two pathogens, Bacillus subtilis and Dephtheriods, have been found to infect Desert Locust eggs during early developmental stages in the laboratory, thereby causing heavy mortality. When healthy eggs were infected with these isolated organisms one hundred percent mortality of the eggs was observed.

8. Effect of partial starvation on the hatchlings of the Desert Locust

Varying quantities of food ranging from one eigth of initial body weight to plentiful supply were provided to the hatchlings, and completely starved hoppers were also kept under observation. The results showed that the quantity of food available per day regulates the duration of the first nymphal stage considerably. As the quantity of food is increased there is a decrease in the duration of the first stage. Food equal to one quarter initial body weight per day enables the hoppers to survive and successfully moult to the second stage, but one eigth of the initial body weight of food per day prolongs the duration and the hoppers fail to moult and finally die. Starved hatchlings lived up to a maximum period of ten days under laboratory conditions.

Mortality due to cannibalism and natural causes increased with the decrease in the food supply.

9. Effect of crowding on wild solitary Desert Locusts

When solitary adults were crowded, until laying they usually turned yellow and laid a greater number of egg-pods as compared to gregarious stock. The number of eggs per pod also was more than in the gregarious ones. The hatchlings which usually emerged were mostly intermediate and black and a few were green, but all the hatchlings showed gregarious behaviour.

10. Effect of ionizing radiation on the blood cells of Desert Locusts

At a dose of 1 Kr the blood cells or the haemocytes became irregular and the wall of the nuclei either got ruptured or disintegrated.

11. Effect of ionizing radiation on fledglings of the Desert Locust

It was observed that when the fledglings of either sex of Desert Locust were subjected to a dose of 1 Kr and reared under laboratory conditions, they failed to show any sign of maturity and died after about forty-five days.

12. Studies on the life history of Cyrtacanthacris tatarica

Eggs: in the laboratory the females of Cyrtacanthacris laid 132-167 eggs per pod and the average number of egg-pods laid by one female was three.

Incubation: when the eggs of Cyrtacanthacris tatarica were incubated at a temperature of 31°C the minimum incubation period recorded was 24 days. It was observed that the eggs from the same pod hatched in three batches. The first

batch hatched after 24 days, the second ten days later, and the remaining eggs did not hatch at 31°C but hatched when they were subjected to a lower temperature.

Hopper stage: in the case of the males there were 6-7 nymphal instars, whereas in the females there were always one or two instars more than in the males. The duration of each nymphal instar is as follows:

Instar	Male	Female
I	6-7 days	7-8 days
II	7-8 "	8-9 "
III	8-9 "	9-11 "
IV	9-10 "	9-10 "
V	9-10 "	9-10 "
VI	9-10 "	7-8 "
VII	10-11 "	9-10 "
VIII	-	6 "
Total duration	58-65 days	64-72 days

Hopper colouration: striking colour polymorphism was observed in the hoppers of Cyrtacanthacris tatarica. Up to the third stage all the hoppers from an egg-pod were green. However, during the fourth stage colour variation became visible, and when they reached the fifth stage it became quite prominent. The hoppers may be fawn, grey and green with all the intermediate colourations. It was interesting to observe that these different colourations, once acquired by the hoppers, were maintained throughout their later immature life. However, the adults from all these different coloured hoppers were of the same colour.

Adult life: the females are larger in size and heavier in weight than the males.

Maturation period	10 days
Preoviposition period after mating	4 days
Egg-pod laid after	14 days
Maximum number of egg-pods/female	3

Future Programme of Desert Locust Research in Pakistan

1. Quantitative estimation of phase characters of hatchlings from eggs of solitary and gregarious parents, particularly under different incubation conditions.
2. Further investigation on the role of soil moisture in the developing eggs.
3. Effect of sub-lethal doses of gamma radiation on the embryonic development and haemolymph of the Desert Locust.
4. Effect of gamma radiation on the fecundity/sterility of Desert Locusts.
5. Investigations on the gregarization and displacement of the locust in the field.
6. Effect of low temperature on the survival of eggs, hoppers and adults.
7. Behaviour of solitary Desert Locusts in their natural habitat.
8. Studies on the causes of migration of solitary locusts.
9. Studies on life histories of Cyrtacanthacris tatarica, Locusta migratoria and Anacridium rubrispinum, which are usually found in the same locality in which solitary Desert Locusts exist.

APPENDIX II

TRUST FUND NO. 123

Statement of Accounts as at 31 December 1967

(expressed in US $ equivalent)

Receipts			US $
Balance brought forward from 31.12.66			87 897.61
Sums received in 1967 from:	India	27 000.00	
	Iran	25 125.00	
	Pakistan	16 699.93	
	Afghanistan	2 750.00	71 574.93
			159 472.54

Obligations 1967	Cash Expenditure	Unliquidated Obligations	
Personal services	300.00	-	
Supplies	-	500.00	
Equipment	-	-	
Travel	3 045.54	-	
Contractual services	62.13	-	
Grants and subsidies	10 298.82	19 819.34	
	13 706.49	20 319.34	
Project servicing costs	1 644.78	2 403.32	
	15 351.27	22 722.66	38 073.93
Unobligated Cash Balance			121 398.61
Unliquidated obligations			22 722.66
Cash balance as at 31 December 1967			144 121.27

Project Servicing Costs			
5% on supplies and equipment	-	25.00	
12% on personal services, travel, contractual services, grants and subsidies	1 644.78	2 378.32	4 048.10

APPENDIX III

TRUST FUND NO. 123

Statement of Accounts as at 31 December 1968 (provisional)

(expressed in US $ equivalent)

Receipts			US $
Balance brought forward from 31.12.67			144 121.27
Sums received in 1968 from:	Afghanistan	2 750.00	
	India	27 000.00	
	Iran	25 014.59	54 764.59
			198 885.86

Obligations 1968	Cash Expenditure	Unliquidated Obligations	
Supplies	10 663.40	39 951.18	
Equipment	1 169.43		
Travel	5 525.78	6 054.68	
Contractual services	247.88		
Grants and subsidies	10 937.97	32 820.97	
	28 544.46	78 826.83	
Project servicing costs	2 597.04	6 662.64	116 630.97
5% on supplies and equipment	591.64	1 997.56	
12% on other items	2 005.40	4 665.08	
	2 597.04	6 662.64	
Unobligated cash balance			82 254.89
Unliquidated obligations			85 489.47
Cash balance as at 31 December 1968 (provisional)*			167 744.36

* The final position will not be known until the accounts for 1968 have been closed and audited, which will be about mid-April 1969.

APPENDIX IV

TRUST FUND NO. 123

Statement of Contributions from Participating Governments as at 31 December 1968 (provisional)

Country	Annual	Contributions due (US $)	Amount paid (US $)	Balance outstanding
Afghanistan	1965	2 750.00	2 750.00	-
	1966	2 750.00	2 750.00	-
	1967	2 750.00	2 750.00	-
	1968	2 750.00	2 750.00	-
India	1965	27 000.00	26 965.55	-
	1966	27 000.00	26 987.04	-
	1967	27 000.00	27 000.00	-
	1968	27 000.00	27 000.00	-
Iran	1965	25 000.00	25 000.00	-
	1966	25 000.00	25 125.00	-
	1967	25 000.00	25 014.00	-
	1968	25 000.00	-	25 000.00
Pakistan	1965	16 700.00	16 699.93	-
	1966	16 700.00	16 699.93	-
	1967	16 700.00	-	16 700.00
	1968	16 700.00	-	16 700.00
	Total	285 800.00	227 491.45	58 400.00

APPENDIX V

TRUST FUND NO. 123

Budget expressed according to FAO Expenditure Codes

Code		Para. Ref.no.	1970	1971	1972	1973	1974	Total
1	PERSONAL SERVICES							
	Short term experts	7	1 000	1 000	1 000	1 000	1 000	5 000
	Casual labour	4	2 000	2 000	2 000	2 000	2 000	10 000
2	SUPPLIES AND MATERIALS							
	Insecticides	6	24 000	24 000	24 000	24 000	24 000	120 000
	Other supplies	4	2 000	2 000	2 000	2 000	2 000	10 000
3	PROPERTY AND EQUIPMENT							
	Control equipment Transport " Radio " Survey " Reserve "	5	1 000	1 000	1 000	1 000	1 000	5 000
4	TRAVEL AND TRANSPORTATION							
	Sessions of Commission	7	4 000	4 000	4 000	4 000	4 000	20 000
	Regional Officer	7	4 000	4 000	4 000	4 000	4 000	20 000
	Consultants	5	2 000	2 000	2 000	2 000	2 000	10 000
	Survey teams	4	6 000	6 000	6 000	6 000	6 000	30 000
	Coordination	4	2 000	2 000	2 000	2 000	2 000	10 000
	POL, transportation	4	4 000	4 000	4 000	4 000	4 000	20 000
5	CONTRACTUAL SERVICES							
	Translation, printing	5	1 000	1 000	1 000	1 000	1 000	5 000
	Transportation	6	1 000	1 000	1 000	1 000	1 000	5 000
	Incidentals	7	1 000	1 000	1 000	1 000	1 000	5 000
6	GRANTS AND SUBSIDIES							
	High level fellowships	8	5 000	5 000	9 000	6 000	5 000	30 000
	Short term "	8	4 000	4 000	nil	3 000	4 000	15 000
7	PROJECT SERVICING COSTS							
	5% of $ 27 000-$ 1 350 14% of $ 37 000-$ 5 180	9	6 530	6 530	6 530	6 530	6 530	32 650
8	UNALLOCATED	10	920	920	920	920	920	4 600
			71 450	71 450	71 450	71 450	71 450	357 250

APPENDIX VI

SURVEY AND CONTROL POTENTIALS IN THE MEMBER COUNTRIES OF THE COMMISSION

1968/1969

AFGHANISTAN

The FAO Locust Officer, provided under the Expanded Programme of Technical Assistance, continued to assist the Anti-Locust Service of the Department of Plant Protection and Quarantine. He has since been transferred to Teheran and left Kabul on 19 January 1969.

Title and full address	Department of Plant Protection and Quarantine Ministry of Agriculture and Irrigation Kabul, Afghanistan
President	Mr. Abdullah Faizyar
Director, Locust Control and Plant Quarantine	Mr. Mohammed Hassan Rahimi
Technical staff	23
Administrative staff	4
Transport and general service staff	28
Number of outposts	5

Transport

Land Rover	4
Mitsubishi jeep	6
Toyota Land Cruiser	2
Dodge power wagon	2
Heavy trucks	3

Equipment

Hand dusters	414
Power dusters	13
Exhaust nozzle sprayers	10

Insecticides

BHC dust 12%	414 tons
Aldrin 20%)	79 gallons
Aldrin 30%)	

Wireless sets	10

(Note

BHC dust and hand dusters are also available in the northern provinces, and can be moved to the Desert Locust breeding areas in case of emergency)

INDIA

India has a permanent Locust Warning Organization as a wing of the Directorate of Plant Protection, Quarantine and Storage in the Ministry of Food, Agriculture, Community Development and Cooperation, Government of India. The details of the Organization and the control potential available within it by way of transport, insecticides, equipment and aircraft are given below:

Title and full address	Directorate of Plant Protection, Quarantine and Storage, N.H IV Faridabad (Haryana) Telegram: PROTECTION, New Delhi
Director	Dr. Sardar Singh Plant Protection Adviser to the Government of India and Director, Locust Control
Assistant Director (Locust Control)	Mr. J. S. Gill
Deputy Locust Entomologist in charge Locust Sub-Station Jodhpur (Rajasthan)	Mr. K. R. Bhatia
Deputy Locust Entomologist (Headquarters)	Mr. Jaswant Singh
Officer in charge Field Station for Investigations on Locusts	Mr. M. V. Venkatesh
Other technical personnel	131
Senior administrative and transport staff	22
General service staff	160
Number of locust outposts including circle and zonal headquarters in the scheduled Desert Locust areas	32 (four locust outposts were opened temporarily for a period of three months)

Transport

Light vehicles	71
Heavy vehicles	70
Tractors	8
	149

Insecticides

BHC 10% dust	1 352.36 metric tons
BHC 50% W P	5.13 metric tons
Lindane 25% W P	2.46 metric tons
Lindane 20% E C	842 litres
Aldrex 30% and 40%	2 742 litres
Dieldrin 50% W P	3.25 metric tons
Dieldrin 10% and 20% solution	46 037 litres

Ground machinery

Power sprayers	55
Hand sprayers	30
Power dusters	182
Hand dusters	9 555
Exhaust nozzle sprayers	19
Flame throwers	6

Wireless sets 54

Spray aircraft

(a) Government

Beavers	7

(b) Private

Piper PA-18A (USA)	1
Piper Pawnee (USA)	3
PZL.101 (Polish)	6
AN-2M (Russian)	1
Bumble-bee (Czech)	1
Helicopters	11
	30

Note: for cultivated areas, States maintained a large stock of power and hand operated equipment for locust and plant protection work.

IRAN

The Ministry of Agriculture has established a locust service under the Plant Protection and Quarantine Organization on a permanent basis. The southern, south-eastern and south-western provinces have been divided into three regions, and there are six permanent locust outposts. Six auxiliary outposts were established during 1968.

Title and full address	Plant Protection and Quarantine Organization Ministry of Agriculture Government of Iran Teheran, Iran
Director General	Mr. M. Ayazi
Other technical personnel	27
General service staff	30
Number of permanent outposts	6
Number of auxiliary outposts	6

Transport

Light vehicles	115
Heavy vehicles	7

These vehicles are located in the locust breeding areas. More vehicles can be mobilized in case of need.

Insecticides	tons
BHC	60
Aldrin	92
Dieldrin	45
Bran	947
Spray aircraft	
Piper Cubs	24
Ground machinery	
Power sprayers	1 010
Hand sprayers	822
Hand dusters	49
Exhaust nozzle sprayers	50
Wireless sets	

Note: in addition to the above, budget has been sanctioned for the following and their purchase is being arranged:

Laboratory equipment for Bandar Abbas	(incubator etc.)
Wireless sets	6
Light and heavy vehicles	75
Exhaust nozzle sprayers	50
Dieldrin	37.5 tons
Bran	500 tons
Camping equipment	

PAKISTAN

In Pakistan locust control is the joint responsibility of the Central and West Pakistan Governments. The Central Government maintains a permanent locust warning organization, a shock force for locust control, conducts research and fulfils international obligations. The details of staff and other available resources with the two organizations are given below:

Title and address	Central Government	Provincial Government
	1	2
	Department of Plant Protection, Ministry of Agriculture and Works, Government of Pakistan, Malir Halt, Karachi-27	Deputy Director of Agriculture (Locust Control), Dept. of Agriculture, West Pakistan, Lahore
Director	Mr. Heshamul Huque	
Other technical staff	67	73
Administrative and general services staff	197	108

	(Central Government)	(Provincial Government)
Transport		
Light vehicles	42	50
Heavy vehicles	7	5
Insecticides		
Aldrin 40%	1 800 gallons	50 tons
BHC 12%	60 549 lbs	100 tons
BHC 50%	5 300 lbs	-
BHC 1%	1 216 lbs	-
BHC 5%	-	132 tons
BHC 15% (Acrodel)	17 370 gallons	-
Dieldrin 20%	33 205 gallons	100 tons
Diazinon	45 gallons	-
Spray aircraft		
Beaver	10	-
Ground machinery		
Power sprayers	98	93
Hand sprayers	51	382
Power dusters	2	29
Hand dusters	27	219
Bait mixer	1	11
Exhaust nozzle sprayers	44	55
Wireless sets	29	-

SUMMARY

	Afghanistan	India	Iran	Pakistan Central Govt.	Pakistan Prov. Govt.	Total
Staff						
Technical	23	131	27	67	73	321
Non-technical	32	182		197	108	549
Transport						
Light vehicles	-	71	115	42	50	278
Heavy vehicles	17	70	7	7	5	106
Tractors	-	8	-	-	-	8
Insecticides						
Dust & powder m/tons	414	1 363	60	30	382	2 249
galls	79	ltr 2 742	gls	35005	-	
Oil solution	-	ltr 46 037	tons	137 gls 17370	-	
Emul.concentrate	-	ltr 842	tons	26 -	-	
Diazinon	-	-	-	gls 45	-	45
Technical materials	-	-	-	-	-	-
Bran m/tons	-	-	947	-	-	947
Aircraft	-	30	24	10	-	64
Power driven ground machinery	13	237	1 010	100	122	1 482
Hand driven ground machinery	414	9 610	921	123	667	11 735
Wireless sets	10	54	16	29	-	109

FAO Reserve of Insecticide

Bandar Abbas:

Dieldrin 20% - 2 000 gallons
BHC in oil - 12 000 gallons

Karachi:

Dieldrin 20% - 4 000 gallons

APPENDIX VII

LIST OF WORKING PAPERS

PL:SWA:5/1	The Desert Locust Situation during 1968/69 and Forecast
PL:SWA:5/2	Report of the Fourth Session of the Executive Committee
PL:SWA:5/3	Programme of Work and Budget for 1970/74
PL:SWA:5/4	Accounts for 1967 and 1968
PL:SWA:5/5	Survey and Control Potentials in the Member Countries of the Commission 1968/69
PL:SWA:5/6	Locust Situation in Pakistan during 1968/69
PL:SWA:5/7	Desert Locust Survey and Control Activities carried out in Pakistan during 1968
PL:SWA:5/8	Desert Locust Situation in India during 1968
PL:SWA:5/9	Report of Desert Locust and Measures Taken in Iran - January 1968 to March 1969