PN-AAZ-775

TEL AVIV UNIVERSITY אוניברסיטת תל-אביב
GEORGE S. WISE FACULTY הפקולטה למדעי החיים
OF LIFE SCIENCES ע"ש ג'ורג' ס. וייז
DEPARTMENT OF ZOOLOGY המחלקה לזואולוגיה

2 November 1987

Ms. R. Smith
Program Operation Assistant
CDR, AID
Washington, DC 20523
U.S.A.

Dear Ms. Smith

Herewith please find the annual report for grant no. C5-004 for 1986/87. It consists of two parts:

I. Malawi: A report is attached.

II. Israel: We concentrated on obtaining, rearing and studying parasitoids for introduction into Malawi and for use in Israel. Several shipments of Pakistani parasitoids have arrived from the CIBC in the U.K., but in spite of our efforts they have either arrived dead or did not last in our cultures for more than 5 generations. Following a discussion with Dr. Asher, Dr. Gerling contacted Dr. Waage of the CIBC and visited his lab during his stay in Europe, in September 1987, in order to hand-carry parasitoids to Israel. Unfortunately, this was not possible because of problems in the CIBC rearing facility but Dr. Gerling was promised that new efforts would be made to accommodate us with parasitoids.

Bemisia-cassava relationships were studied in Israel on several plants that were grown in a screened cage and out-of-doors. The results have shown that Bemisia was slow to establish on the cassava, and that at least 3 parasitoid species present in Israel attacked it. We have not yet determined which of these was introduced into Malawi in 1986, since we have not received material from Malwai for identification - to determine if introductions have taken hold.

The behavioral studies with one of the parasitoid species, Eretmocerus sp., have shown that the smell of the whitefly honeydew acts as an arrestant, preventing them from leaving the pest infestation site. More studies on the exact paramaters and possible utilizing of this finding are being concluded.

Parasite rearing: Rearing of the parasites is an important aspect of our project for utilization in Israel and for introduction into Malawi, and for learning how to multiply the insects most efficiently once they have been introduced into Malawi. Of the 2 genera with which we are dealing, Eretmocerus is the easier one to rear and, therefore, we did not spend much time on the improvement of its rearing techniques.

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RAMAT AVIV, 69978 TEL AVIV, ISRAEL, TEL. 03-420812 425518 רמת אביב, תל אביב, 69978 טל.

TEL AVIV UNIVERSITY אוניברסיטת תל-אביב
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Parasite rearing

Rearing of the parasites is an important aspect of our project for utilization in Israel and for introduction into Malawi, and for learning how to multiply the insects most efficiently once they have been introduced into Malawi. Of the 2 genera with which we are dealing, Eretmocerus is the easier one to rear and, therefore, we did not spend much time on the improvement of its rearing techniques. Instead, we worked on Encarsis which poses a problem, especially because of its characteristic to develop males at the expense of its own females (Heterenomous autoparasitism). This feature, which may cause stability and efficiency under field conditions, makes lab rearing more difficult because the emerging females go about and kill the yet unemerged progeny by laying male-producing eggs into them. This, in turn, creates a preponderance of males, and reduces the parasite population, when we want it to increase. Another point that has to be studied is the optimal number of females per infested host-plant leaf that we have to introduce into the rearing cages in order to maximize our parasite output and minimize labor output.

These studies are still in their midst and will continue throughout the project. However, preliminary results show that removal of the just-emerged females from the rearing cages improves the sex ratio of the cultures considerably. Presently, this is done manually, which is a labor-intensive and somewhat inefficient process. However, we are working on trapping and collecting techniques that will eliminate the necessity of hand-work in this phase. The optimization studies have also yielded some preliminary results. Whereas the most efficient production per female is at very low numbers of females per host insect, the overall production is higher when a larger number of females is introduced (Fig. 1). Consequently, we are now moving from the extreme cases of a few (less than 10) females per cage and those of many females (35) per cage to intermediate numbers of females.

Other factors, like the absolute host density and ambient conditions, have also great importance in the success of rearing and are monitored with the aim of standardizing them in a simple manner that can also be utilized under semi-field conditions like those in Malawi. So far we have been able to determine that moderately infested plants, in which whiteflies do not cover the leaf completely, are parasitized to a higher degree, and probably because they are covered with less honeydew, produce more parasite adults. Therefore, we are gearing our production of whiteflies for parasite culture to lower host numbers, by exposing them to ovipositing whiteflies for limited periods only.

Yours sincerely

Dan Gerling

Encl.

RAMAT AVIV, 69978 TEL AVIV, ISRAEL, TEL. 03-420812 425518 .טל .69978 קרית האוניברסיטה, רמת אביב, תל אביב

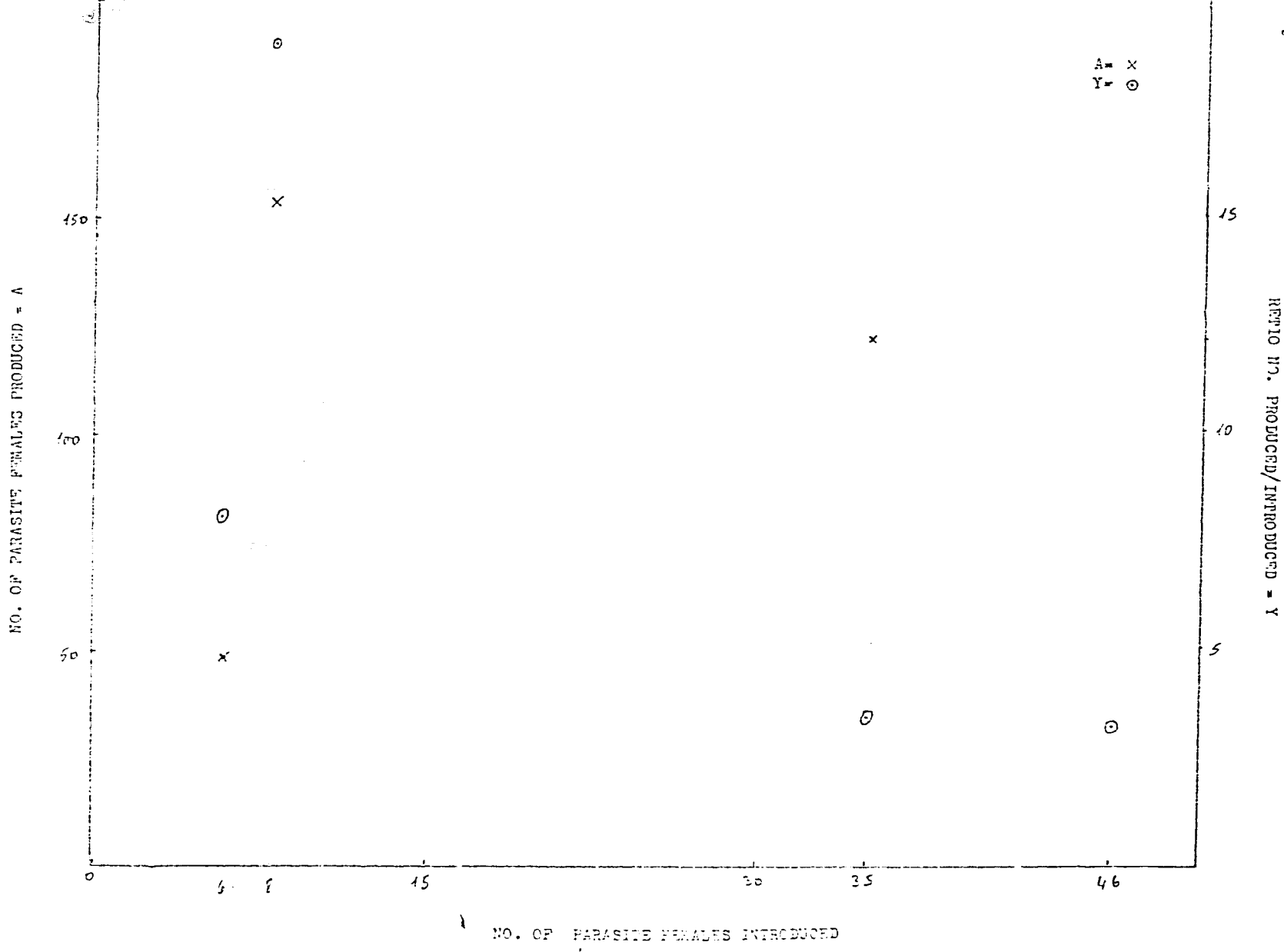

Fig 1. Relationship between No. of introduced parasites and output of rearing cages

Ref. No. CPR/1/7/2/69.

Makoka Agricultural Research Station,
Private Bag 3,
P.O. Thondwe,
MALAWI.

15 October 1987

Professor D. Gerling,
Tel Aviv University Research Authority,
George S. Wise Faculty of Life Sciences,
Department of Zoology,
Ramat-Aviv, 69978,
Tel Aviv,
ISRAEL.

The Chief Agricultural Research Officer,
P.O. Box 30134,
LILONGWE 3.

CC: Mr. A.J. Radi,
USAID,
P.O. Box 30455,
Capital City,
Lilongwe 3.

: Dr. D.C. Munthali,
Chancellor College,
P.O. Box 280,
Zomba.

: The Deputy Chief Agricultural Research Officer,
Bvumbwe Research Station,
P.O. Box 5748,
Limbe.

(Attention : Dr. G. Chapola)

4

Dear Dan,

AID-GRANT NO. PDC-5544-G-55-5093-00, C5-004
PROFESSOR DAN GERLING NO. 432-151-AGREEMENT
BETWEEN AID AND TEL AVIV UNIVERSITY "DEVELO
PMENT OF INTERGRATED MANAGEMENT METHODS"

Please receive the first report from the Malawi work on the above project. Work carried out by Dr. Munthali will appear in a later report.

Problems facing this project are outlined and I hope you will take immediate steps so that the availability of funds is in good time and in view of the difficulties faced, it is strongly recommend that the project should be extended to November, 1989. I also recommend that a further US $15,000 should be sent as soon as you get this report.

The Ministry is looking for a candidate to come for the training in Israel and you will be advised as soon as his name is known.

The best time for you to come here would appear to be between October and December when Bemisia populations are at their peak. This may also be an interesting period from the parasitoids and other natural enemies point of view.

I hope you had a nice sabbatical in Canada and Holland.

Best wishes to you and family.

Yours Sincerely,

G.K.C. Nyirenda

Dr. G.K.C. Nyirenda
DEPUTY CHIEF AGRICULTURAL RESEARCH OFFICER

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AID-Grant,
No. PDC - 5544-55-5093-00,
C 5-004,
Prof. Dan Gerling,
Ref. No. 432-151.

Background: The Project was born out of a visit by Professor Gerling In February, 1984. After a short stay at Makoka and brief visit in the Shire Valley it was decided that a project to assess intergrated control of whitefly Bemisia spp. should be initiated. The project was acceptable to Malawi since:-

(a) Whitefly, (Bemisia spp.) occurs on a wide range of wild and cultivated plants and is a vector of virus diseases on sweet potatoes, cassava and tobacco but some of these have not been well documented.

(b) The population dynamics and species of Bemisia have not been studied. In addition the full range of Bemisia spp is unknown.

(c) It is known that Bemisia is a vector of African Cassava Mosaic virus but this has not been well documented.

(d) Natural enemies of Bemisia are unknown and it would therefore be important to establish the range of the indiginous natural enemies and have exotic enemies introduced in the country.

(e) Information gained on this pest with respect to cassava may be helpful in tackling similar problems on other crops.

Introduction:

The above project was supposed to have started in October, 1985 but because of technical problems, such as absence of the principal investigator from Malawi, delay in signing the agreement and making funds available has resulted in serious delays in starting the project.

Professor Gerling visited Malawi from 10 - 22 June 1986 to discuss the signing of the agreement and also to participate in planning what trials were to be done in Malawi.

Gerling, Nyirenda and Sauti travelled from Makoka to Mzuzu. On the way a preliminary survey of whitefly populations on selected fields was done. The survey also included checking on cassava green spider mites and mealybug. Professor Gerling returned to Lilongwe for discussions with the Chief Agricultural Research Officer on the signing of the agreement whereas messrs Sauti and Nyirenda proceeded to Karonga. During Professor Gerling's visit it was decided that in addition to field experiments, three surveys per year should be conducted to establish how widespread whitefly and African Cassava Mosaic Virus were in the country at different times. Trials to be run at Makoka and other sites in the country including those to be run by Dr. Munthali at Chancellor College were also planned. When these discussions were being held it was hoped that the agreement would be signed by August and trials would be in the ground by the end of 1986. However, it took sometime before the agreement was signed and thereafter no money was forthcoming from Israel. This is because money could not be issued to Makoka by Tel Aviv University without presentation of receipts or vouchers indicating what was spent. In Malawi work could not start because there was no money to spend. When a cheque finally arrived from Israel in March 1987 the money was not made available until 10 July 1987 (Departmental Expenditure Warrant No. 51/4/16/5/3 dated 2 July 1987.) As at 24 September 1987 expenditure on this account was

not being honoured because Liwonde Agricultural Development Division has bot been given the authority to honour expenditure on this account. Liwonde Agricultural Development Division (LWADD) are responsible for preparing payment cheques for all Makoka expenditures.

In reality work on this project cannot start until authority is given to LWADD. These then are an outline of the problems that have been encountered with the project. Professor Gerling and appropriate authorities in AID should note that unless a way is found on making the funds available other than on presentation of receipts or expenditure vouchers, this project is likely to fail. The long time factor involved between the presentation of claims to Israel, then Israel to U.S.A., then money to Israel and finally cheque to Ministry of Agriculture - to Treasury - back to Agriculture and finally to Makoka and LWADD several months will have elapsed. It would not be practical to utilize funds from other projects as these would suffer from lack of funds. A better and faster way of releasing these funds to Makoka should be identified. It is also strongly recommended that the project should be extended to November 1989 because of these difficulties.

FINANCIAL REPORTS

As a result of the difficulties above commitments were kept to a minimum and a limited amount of money was spent on labourers. More money has been commited on transport and allowances and materials in preparation of trials. A breakdown of expenditure is shown below. Paid vouchers are also enclosed for claim purposes. It would be appropriate that a further US $15,000 dollars should be sent without delay since this will take months before Makoka starts spending.

BREAKDWON OF EXPENDITURE

	K	T
Hire of vehicles (PVHO)	306	81
Public transport	67	12
Fuel and Lublicants	4318	69
Hotel charges	783	34
Allowances	4463	68
Materials		
Farm inputs and miscellaneous	672	92
Wages	379	58
TOTAL	K10882	14

PROGRESS OF SCIENTIFIC WORK

Principal Investigators:

Dr. G.K.C. Nyirenda -
Mr. R.F.N. Sauti - } Makoka Research Station, Private Bag 3, Thondwe.

Dr. D.C. Munthali - Chancellor College, P.O. Box 280, Zomba.

National Survey March - June 1987:

Objectives: The objectives of the survey were:-

(1) To establish how widespread whitefly is in the country and to detect any differences in the intensity in different ecological zones.

(2) To establish differences in distribution of different stages on the plant.

(3) To discover and collect parasites and other natural enemies of the whitefly.

(4) To establish the distribution of African Cassava Mosaic Virus and relate its occurance to ecological or topographical features or cultural practices in the different areas. This would assist in control of cassava mosaic virus.

(5) To identify the cassava germplasm and identify some tolerant varieties to ACMV that may be included in the research programme.

(6) To find out the role of cassava in the rural populations food supplies and economy.

Methodology:

Fields were sampled at approximately every 10 - 30 km along passable roads - usually main roads. At each field the owner was asked for the approximate date of planting the cassava, the variety planted, why the variety was chosen and why he grew cassava. In each field ten plants were selected (five plants across each diagonal). Two leaves were selected per plant from the top, middle and bottom. Adult whitefly were counted with minimum disturbance (Shaking of the selected plants). Any natural enemies such as adult parasitoids were also counted. Leaves were then removed and placed in paper bags marked with the name of the farmer and the relevant part of the plant where the leaves were picked, i.e. all top leaves from the same field went into one bag. Counting of nymphs, healthy and parasitised were on the same day or the first thing on the following morning. Parasitised nymphs were recorded by their appearance as yellow, black, brown or grey. This is because parasitoids could not be confidently identified to genus or species levels. However, it is most likely that the yellow parasitoids could mostly be Eritmocerus spp. and the black ones were largely Encarsia spp.

The percentage distribution of the African Cassava Mosaic Virus is shown in the map (Fig 1) and Table 1. The total number of fields scouted is shown and the percentage of fields clean of the total scouted is indicated (Table 1). In general African Cassava Mosaic Disease (ACMD) is high in low lying compared to high altitude areas. The majority of the low lying areas were in the rift valley. The low incidence of ACMD in high altitude areas may be a result of the disease not expressing itself fully although the plants may be carriers or it is because the whitefly population in these areas is free of the ACMV. This aspect may be partially answered by sending cassava samples which are apparently clean of the disease and those showing symptoms to the Crops Research Institute in Dundee, Scotland for screening. Whitefly adults from the high and low lying areas should be used to inoculate cassava and establish whether differences exist between the populations.

Distribution of Bemisia

The distribution of Bemisia spp in the country is shown in Table 2. Distribution on the plant is not shown but data is available. There is no obvious relationship between the population level of whitefly of both nymphs and adults and the incidence of ACMV. However, there may be some relationship after data has been closely analysed. There also seems to be no relationship between altitude and population levels of Bemisia.

NORTHERN REGION

1. Chitipa
2. Karonga
3. Rumphi
4. Nkhata Bay
5. Mzimba

CENTRAL REGION

6. Nkhotakota
7. Kasungu
8. Ntchisi
9. Dowa
10. Mchinji
11. Lilongwe
12. Salima
13. Dedza
14. Ntcheu

SOUTHERN REGION

15. Mangochi
16. Machinga
17. Zomba
18. Blantyre
19. Mwanza
20. Mulanje
21. Chiradzulu
22. Thyolo
23. Chikwawa
24. Nsanje

KEY

M % ACMV(African Cassava Mosaic Virus)

( ) % Fields Clean

Ma Part of Dowa District under Salima Agricultural Develop. Division.

Mb Part of Dowa District under Kasungu Agricultural Develop. Division.

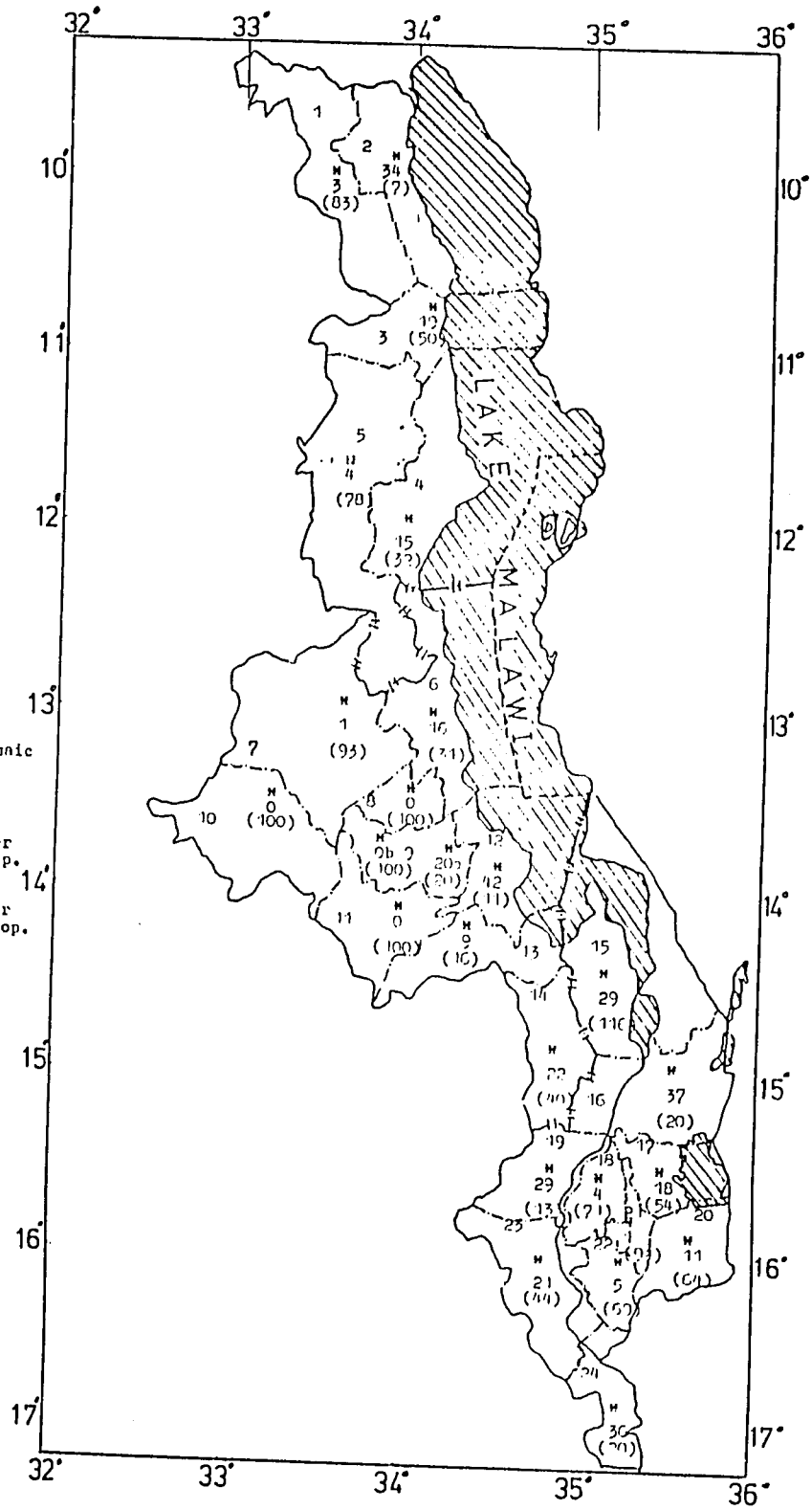

Table 1 : Distribution of African Cassava Mosaic Virus on Cassava in Malawi.

ADD	District	No. of field sampled	% fields clean	No. of plant	Mean % of ACMV
Karonga	Chitipa	18	83	180	3
	Karonga	28	7	280	34
		46	90	460	37
	ADD Mean	23	45	230	19
Mzuzu	Mzimba	18	78	180	4
	Nkhata Bay	22	32	220	15
	Rumphi	8	50	80	19
	ADD Mean	16	53	160	13
Liwonde	Machinga (Balaka, RiviRivi)	23	0	230	61
	Phalula	4	0	40	53
	Chingale	5	0	50	56
	Kawinga	7	57	70	6
	Liwonde	7	43	70	7
		46	100	460	183
	District Mean		20		37
	Zomba				
	Mpokwa	8	50	80	16
	Malosa	9	22	90	38
	Dzaone	9	89	90	1
	Total	26	161	260	55
	District Mean		54		18
	Mangochi				
	Namwera	19	84	190	2
	Rest	33	3	330	53
	Total	52	87	520	55
	District Mean		44		28
	ADD Total	124	348	1240	293
	Mean	41	39	413	29

Table 1: Continued Distribution of ACMV on cassava in Malawi

Blantyre	Blantyre	7	71	70	4
	Mwanza	15	13	150	29
	Chiradzulu	11	91	110	1
	Thyolo	13	69	130	5
Mulanje	Phalombe Project	19	32	190	16
	Mulanje project	7	43	70	20
	Total	26	75	260	36
	District Mean	13	37	130	18
	ADD Mean	12	64	144	11
Salima	Dowa	5	20	50	20
	Dedza/Ntcheu (Bilila, Golomoti, Mtakataka)	3	0	30	70
	Salima	19	11	190	42
	Nkhotakota	26	31	260	16
	ADD Mean	13	15	133	37
Ngabu	Nsanje	5	20	50	36
	Chikwawa	9	44	90	21
	ADD Mean	7	32	70	29
Kasungu8	Kasungu	14	93	140	1
	Mchinji	6	100	60	0
	Ntchisi	5	100	50	0
	Dowa	5	100	50	0
	ADD Mean	7	98	75	0.3
Lilongwe	Lilongwe	16	100	160	0
	Dedza	19	16	190	9
	Ntcheu	15	40	150	22
	ADD Mean	17	52	166	10
	Country Mean	16	60	174	19

Table 2: Distribution of *Bemisia* on cassava in Malawi

Based on ten plants

ADD	District	Nymphs	Adults
Karonga	Chitipa	19	5
	Karonga	36	12
	Mean	27	9
Mzuzu	Mzimba	25	6
	Nkhata Bay	25	10
	Rumphi	27	12
	ADD Mean	26	9
Liwonde	Machinga		
	(Balaka, RiviRivi)	290	72
	Phalula	96	21
	Chingale	279	34
	Kawinga	169	137
	Liwonde	254	56
	Mean	218	64
	Zomba		
	Mpokwa	3031	71
	Malosa	183	26
	Dzaone	400	76
	Mean	1205	58
	Mangochi		
	Namwera	189	9
	Rest	167	27
	Mean	178	18
	ADD Total	5058	529
	ADD Mean	506	53

Table 2: Distribution of *Bemisia* on cassava in Malawi (continued)

Blantyre	Blantyre	70	14
	Mwanza	69	30
	Chiradzulu	56	30
	Thyolo	70	12
	Mulanje		
	Phalombe Project	420	50
	Mulanje Project	168	15
	District Mean	294	33
	ADD Mean	112	24
Salima	Dowa	217	8
	Dedza, Ntcheu (Bilila, Golomoti, Mtakataka)	64	19
	Salima	86	20
	Nkhotakota	63	11
	ADD Total	430	58
	ADD Mean	107	15
Ngabu	Nsanje	37	7
	Chikwawa	97	63
	Mean	67	35
Kasungu	Kasungu	40	8
	Mchinji	49	3
	Ntchisi	41	9
	Dowa	179	9
	ADD Mean	77	7
Lilongwe	Lilongwe	175	19
	Dedza	127	19
	Ntcheu	76	15
	ADD Mean	126	18
	Country Mean	131	21

Distribution of parasitoids

The distribution of parasitised Bemisia nymphs excluding emerged ones in the country and over the plant are shown in table 3. Adult parasitoids have not been included but they are covered under Makoka trials.

In most cases parasitism was highest on bottom leaves followed by top leaves. This suggests that some of the top leaves sampled were mature. The few leaves with parasitoids usually scored high percentage parasitism. The frequencies of parasitism was lowest on top leaves.

Distribution of different parasitoid spp.

The percentage of each group of parasitoids commonly encountered is shown in table 4. In many districts yellow parasitoids (Eretmocerus spp?) had the highest percentage but in some areas black parasitoids (Encarsia spp?) had the highest percentage. Other parasitoids were rare. The parasitoids collected will be sent for proper identification to appropriate institutions. It should further be stated that these ratios may change with time. A number of predators were also found during the survey. A better picture will emerge if more surveys are done per year at different times.

Table 3: % Distribution of parasitoids on Bemisia in Malawi

ADD	District	Nymphs Top	Middle	Bottom	Total
Karonga	Chitipa	5	1	9	5
	Karonga	9	2	9	50
	ADD Mean	7	2	9	25
Mzuzu	Mzimba	0	1	13	7
	Nkhata Bay	75	12	15	14
	Rumphi	0	8	6	7
	ADD Mean	25	7	11	9
Liwonde	Machinga (Balaka, Rivirivi	4	2	4	3
	Phalula	8	1	10	4
	Chingale	0	7	14	9
	Kawinga	0	1	15	6
	Liwonde	0	5	17	9
	ADD Mean	2	3	12	7
	Zomba				
	Mpokwa	0	2	47	7
	Malosa	67	8	20	9
	Dzaone	18	5	19	10
	Mean	28	5	29	9
	Mangochi				
	Namwera	3	0	4	1
	(Chilipa, Nakumba and Central)	0	4	5	3
	Mean	1	2	5	2
	ADD Mean	10	4	15	6
Blantyre	Blantyre	2	8	15	10
	Chiradzulu	0	32	55	45
	Thyolo	0	3	9	16
	Mulanje	1	12	69	16
	Mwanza	2	4	18	18
	ADD Mean	1	12	33	21

Table 3: Continued % Distribution of parasitoids on *Bemisia* in Malawi.

ADD	District	Nymphs			
		Top	Middle	Bottom	Total
Salima	Dowa	100	1	3	3
	Dedza/Ntcheu (Bilila, Golomoti, Mtakataka)	0	13	10	12
	Salima	9	17	20	18
	Nkhotakota	13	7	9	7
	ADD Mean	31	9	11	10
Ngabu	Nsanja	0	3	3	3
	Chikwawa	7	9	28	10
	ADD Mean	3	6	15	6
Kasungu	Kasungu	0	5	26	11
	Mchinji	0	1	23	6
	Ntchisi	0	2	8	4
	Dowa	25	4	10	5
	ADD Mean	6	3	17	7
Lilongwe	Lilongwe	0	1	2	1
	Dedza	46	2	6	3
	Ntcheu	0	3	14	4
	ADD Mean	15	2	7	3
	Country Mean	13	6	15	11

Calculation of % parasitism on each plant part and all plant parts (Total):-

Plant Part:

$$\frac{\text{No. of parasitised nymphs on appropriate plant part} \times 100}{\text{Parasitised + healthy nymphs on appropriate plant part}}$$

Total:

$$\frac{\text{No of parasitised nymphs on all plant parts} \times 100}{\text{Parasitised + healthy nymphs on all plant parts}}$$

Table 4: - % of each category of parasitoids

ADD	District	Total No. Parasitoids	Percentage Yellow	Black	Others
Karonga	Chitipa	18	50	33	17
	Karonga	47	62	21	17
	Mean	33	56	27	17
Mzuzu	Mzimba	32	53	47	0
	Nkhata Bay	91	75	25	0
	Rumphi	17	47	53	0
	Mean	47	58	42	0
Liwonde	Machinga (Balaka, RiviRivi)	189	85	17	0
	Phalula	16	56	44	0
	Chingale	136	71	15	14
	Kawinga	71	90	10	0
	Liwonde	194	90	8	1
	Mean	121	78	19	3
	Zomba				
	Mpokwa	1776	91	2	7
	Malosa	198	79	12	9
	Dzaone	406	80	10	10
	Mean	793	83	8	9
	Mangochi				
	Namwera	47	28	51	21
	The rest	190	52	46	2
	Mean	119	40	49	11
	Mean	344	67	25	8
Salima	Dowa	29	93	7	0
	Dedza/Ncheu (Bilila, Golomoti, Mtakataka)	26	81	11	8
	Salima	365	88	9	3
	Nkhotakota	134	65	31	6
	Mean	139	81	15	4

Table 4: % of each category of parasitoids (continued)

Blantyre	Blantyre	27	70	19	11
	Mwanza	131	70	23	7
	Chiradzulu	425	88	11	1
	Thyolo	42	74	26	0
	Mulanje				
	Phalombe Project	3068	95	5	0
	Mulanje Project	9	56	44	0
	District Mean	1539	76	24	0
	Mean	432	76	21	4
Ngabu	Nsanje	5	100	0	0
	Chikwawa	99	76	24	0
	Mean	52	88	12	0
Kasungu	Kasungu	71	31	54	15
	Mchinji	18	28	55	17
	Ntchisi	8	37	50	13
	Dowa	50	32	68	0
	Mean	37	32	57	11
Lilongwe	Lilongwe	28	29	61	11
	Dedza	87	43	56	1
	Ntcheu	52	40	52	8
	Mean	56	37	56	7
	Country Mean	143	62	32	6

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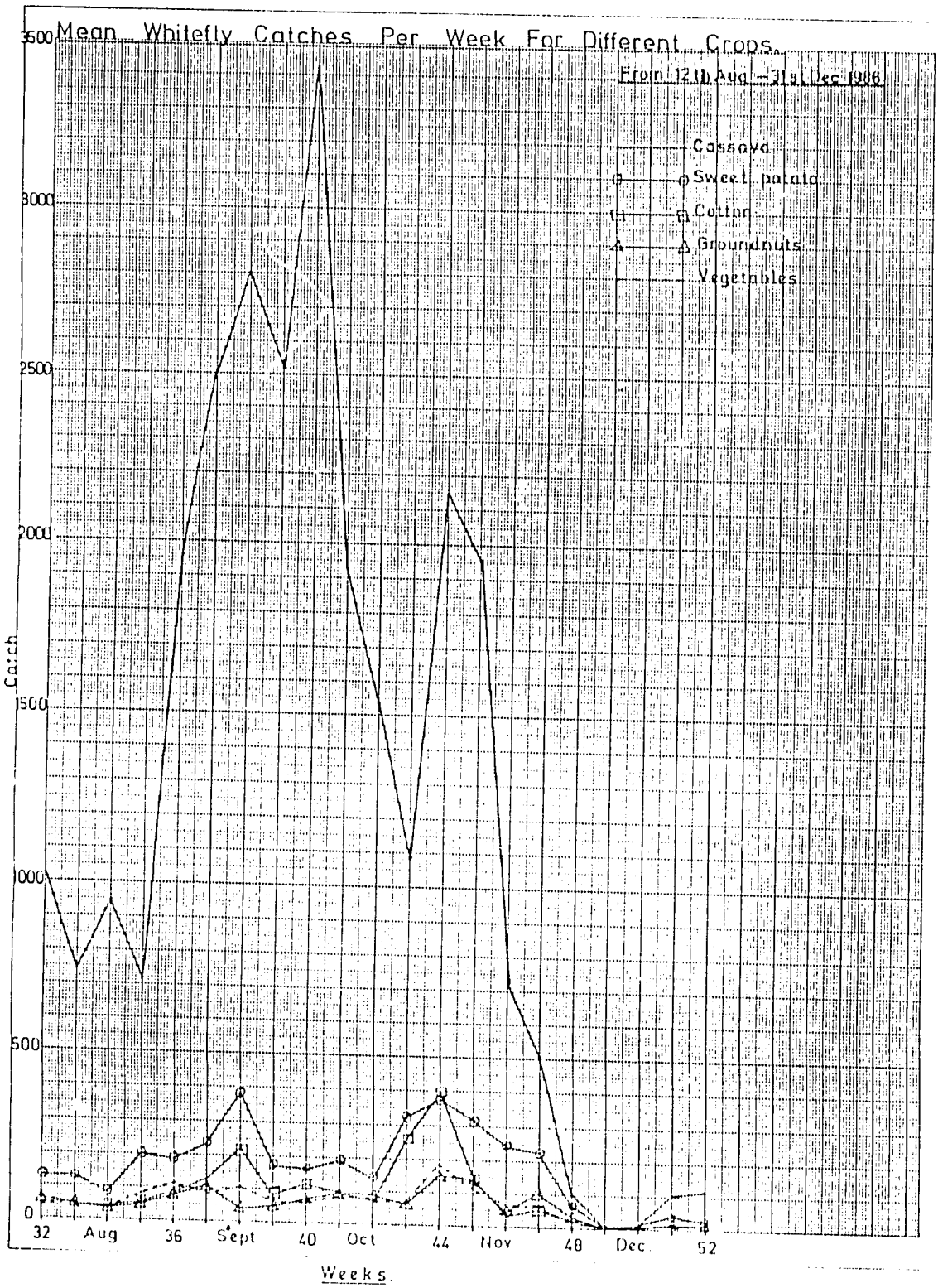
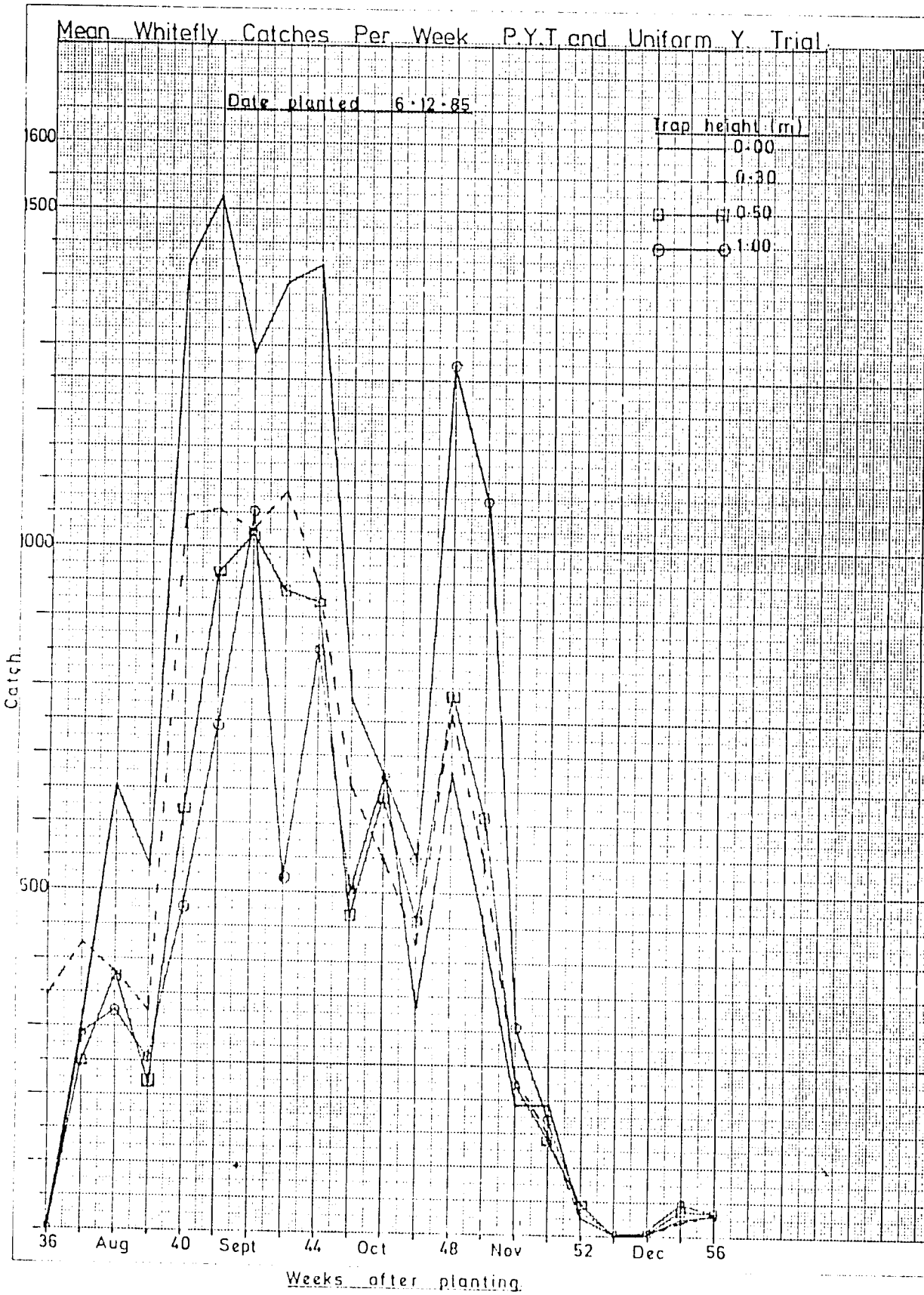
TRAPPING TRIALS

A number of traps were sited in different crops to establish the movement of Bemisia adults in selected crops. Normally four yellow traps were put in each crop. However, in addition to these traps extra traps were put in different cassava trials. These included placing traps at different heights in preliminary and uniform yield trials. These were replicated 3 - 4 times.

Catches of adult Bemisia in different crops are shown in Fig 2. Catches in cassava plots were highest followed by sweet potatoes. Catches in cotton were largely on an old site where cotton had been planted but uprooted and such catches should represent an open ground. The main characteristic is that in all crops there was a dramatic drop of catches in the second week of December. This may have coincided with the onset of continuous rains. This trial will be repeated in a modified form.

Catches of Bemisia at different trap heights are presented in Fig 3. Up to the end of October the trap on the ground had the highest catches. This was followed by the trap at 0.30m between August and September. After the middle of October the trap at one metre above the ground caught the highest number of Bemisia adults and that on the ground caught the lowest numbers. During the month of August to September, most of the cassava lost leaves and therefore the attraction to the ground may have been helped by within the crop wind movements. After September cassava had more leaves, mainly on the upper plant parts. The Bemisia was attracted to the leaves for oviposition sites.


Mean Whitefly Catches Per Week For Different Crops.
From 12th Aug – 31st Dec 1986
Cassava
Sweet potato
Cotton
Groundnuts
Vegetables
Catch
3500
3000
2500
2000
1500
1000
500
0
32
Aug
36
Sept
40
Oct
44
Nov
48
Dec
52
Weeks


Mean Whitefly Catches Per Week P.Y.T and Uniform Y. Trial.
Date planted 6·12·85
Trap height (m)
0·00
0·30
0·50
1·00
1600
1500
1000
500
Catch
36
Aug
40
Sept
44
Oct
48
Nov
52
Dec
56
Weeks after planting

SCOUTING TRIALS.

Distribution of different Bemisia stages on the plant

This was established by using two techniques. In the first technique counts of eggs, nymphs and adults were made on a number of plants in the field. Normally six plants were scouted and counts of eggs, nymphs and adults were made on three leaves from the top, middle and bottom of the plant, representing nine leaves per plant. In the second technique counts were made in the laboratory using a binoculor microscope and discs were cut from three lobes of each leaf using a size 10 cork borer. Only eggs and nymphs both healthy and parasitised were counted.

Field counts

Results from a uniform yield trial are indicated in Fig 4. The most preferred oviposition site for Bemisia was on top leaves with the bottom leaves having the fewest eggs. Nymphs were found in almost equal numbers on the middle and bottom leaves. Fewer nymphs were found on top leaves possibly because all eggs did not hatch or because it was difficult to detect the small nymphs that had just hatched. Adults were distributed evenly on all leaves irrespective of their position on the plant.

The overall distribution of eggs and nymphs as counted under a binoculor microscope are presented in Fig 5. These confirm the findings in the field. If these results are confirmed in future scouting for different stages will only be made from leaves most likely to give reliable results for the particular stage i.e. top and middle leaves for eggs, middle and bottom leaves for nymphs and middle leaves for adults.

Eggs, Nymphs and Adults of Bemisia on Leaves of Uniform Yield Trial at Makoka 1986/87 Season

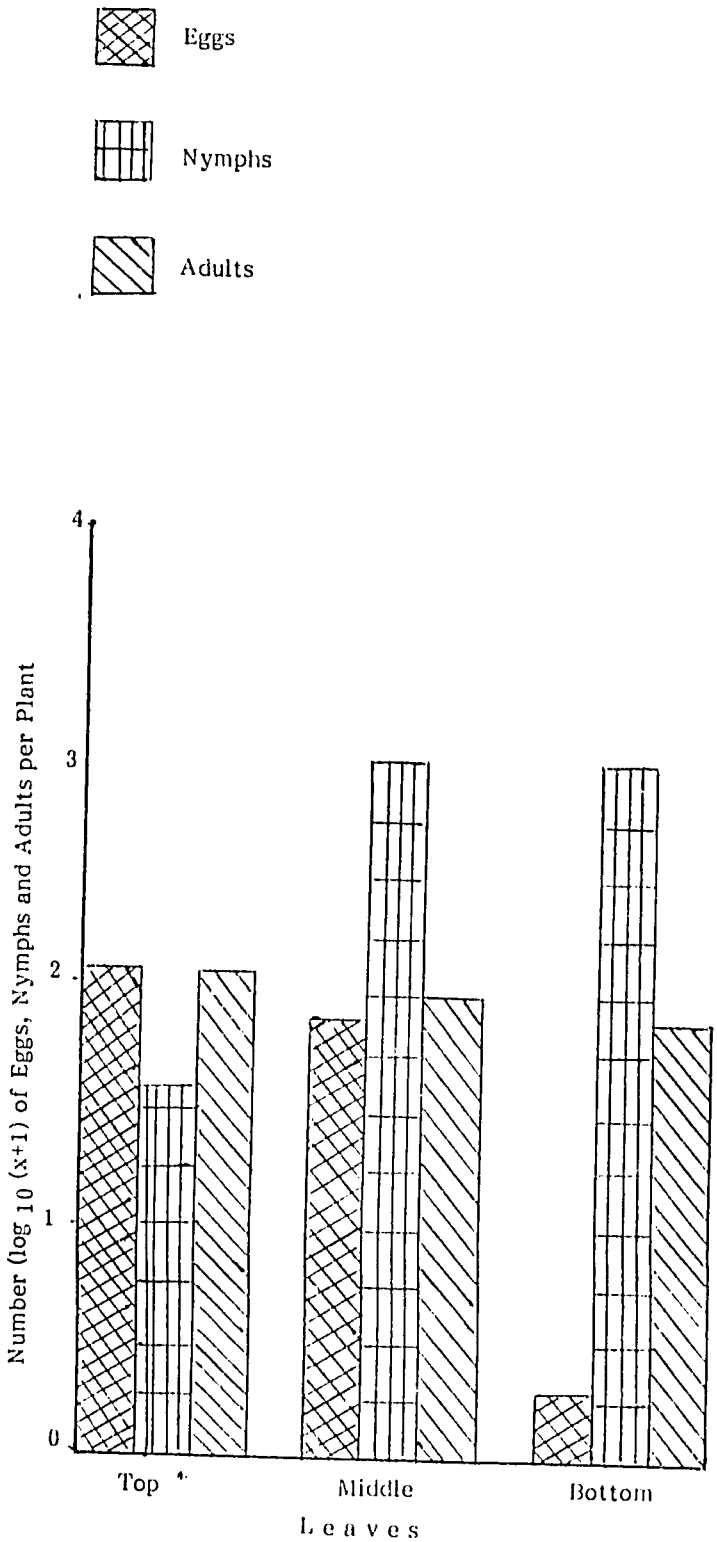
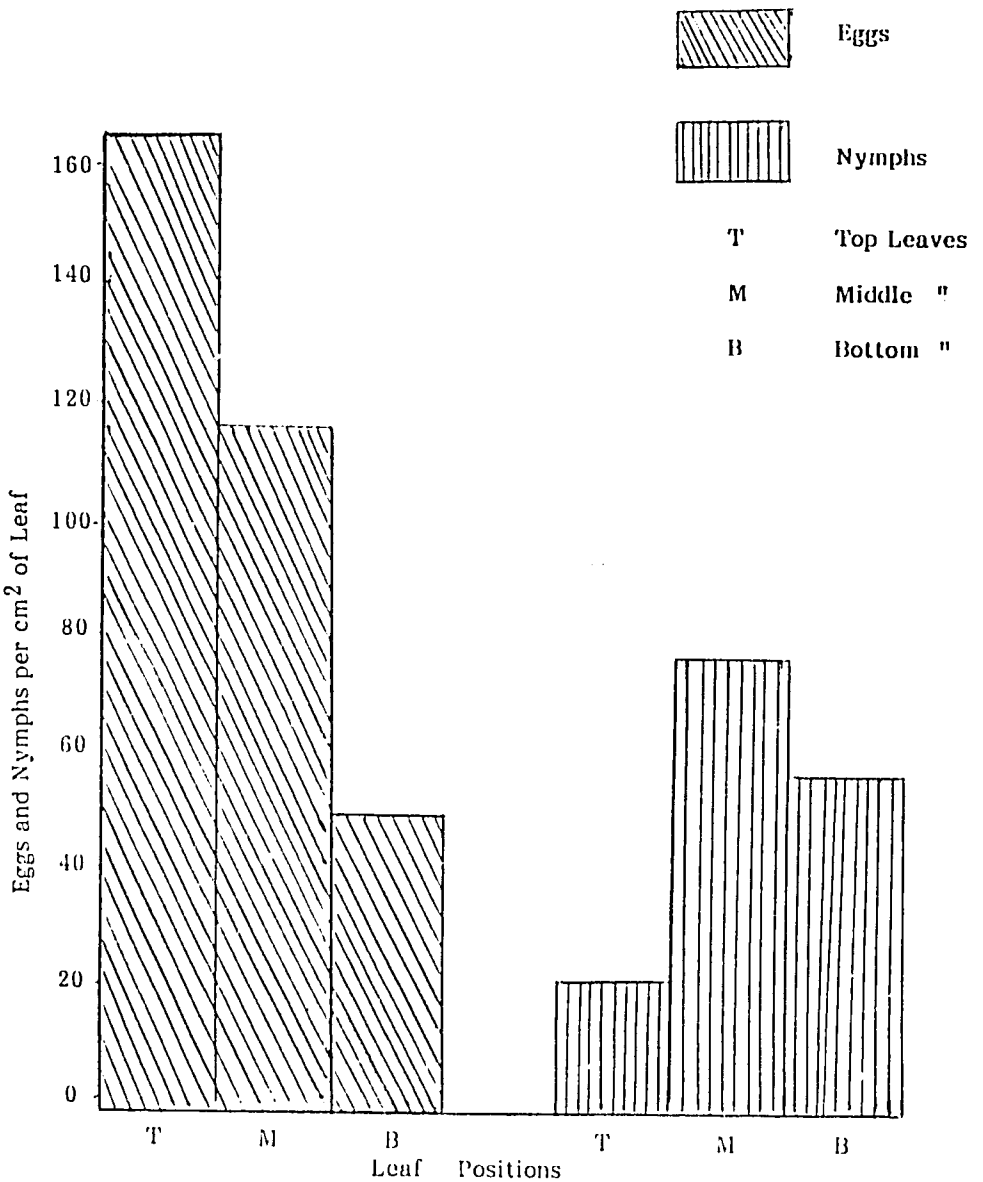


Figure .Whitefly Eggs and Nymphs on Four Cassava Varieties of Chitembwere, Gomani, Mbundumali and Kachamba from Top, Middle and Bottom Leaf Positions

Cassava Variety Trial at Makoka 1986



Distribution on some varieties

Eggs and nymphs were counted on the most common varieties grown in the country and grown at Makoka in a variety trial. Similarly counts were also made on some varieties commonly grown around Makoka. These local collections were also grown at Makoka from which population counts of Bemisia were made.

Oviposition on different varieties commonly grown in Malawi is indicated in Fig. 6 and the number of nymphs on the same varieties is also shown in Fig. 7. Fig.7 also shows the total level of parasitoids on all varieties combined.

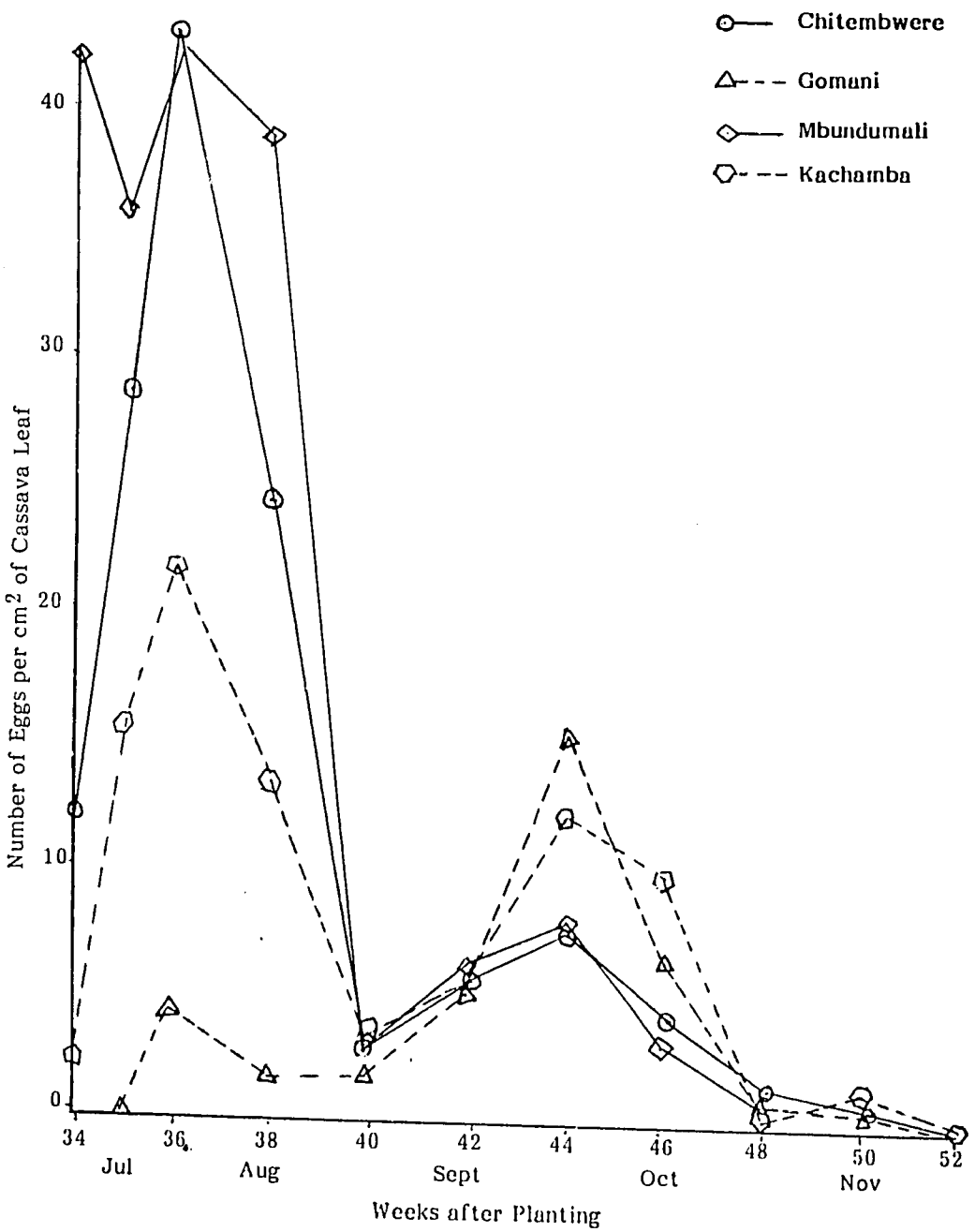
The high oviposition on Chitembwere and Mbundumali may reflect the fact that these varieties had their leaves intact in July and August. Between September and October oviposition was highest on Gomani followed by Kachamba. As all varieties had leaves this suggests that Gomani was the most attractive variety for oviposition and Kachamba was next in line. Later trials will follow this up. The trial will be planted late to ensure that leaves are present all the time and establish the actual oviposition preferences for Bemisia with regard to the four varieties. The pattern of nymphs followed closely the pattern of eggs on different varieties indicating that survival of Bemisia nymphs was not affected by the variety.

The oviposition and nymphs on varieties locally grown around Makoka are shown in Table 5. Oviposition was highest on Abiti Sumani and Kamchanya respectively but lowest on Pirigodo followed by Magaligawo and Nyasungwi. Kamchanya and Magaligawo had the highest number of nymphs followed by Magaligawo and Mpwapwa B and A. Kithekele and Abiti Sumani had the lowest nymph levels.

Distribution of parasitoid pupae on different plant positions in relation to Bemisia nymphs.

Whitefly Eggs on Four Cassava Varieties from Top, Middle and Bottom Leaf Positions

Cassava Variety Trial at Makoka 1986



Whitefly Nymphs and Parasitoids on Four Cassava Varieties from Top, Middle and Bottom Leaf Positions

Cassava Variety Trial at Makoka 1985/86 Season

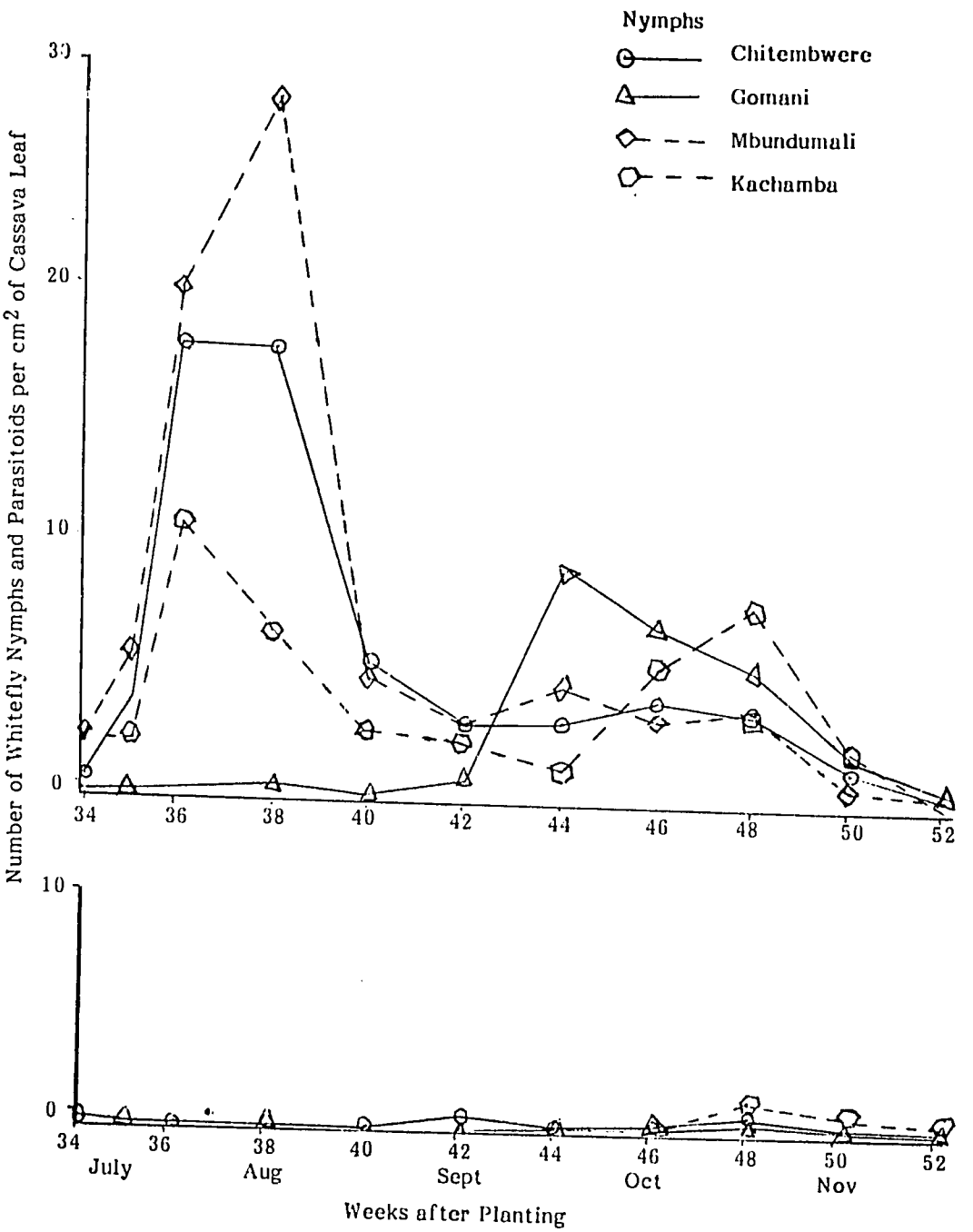


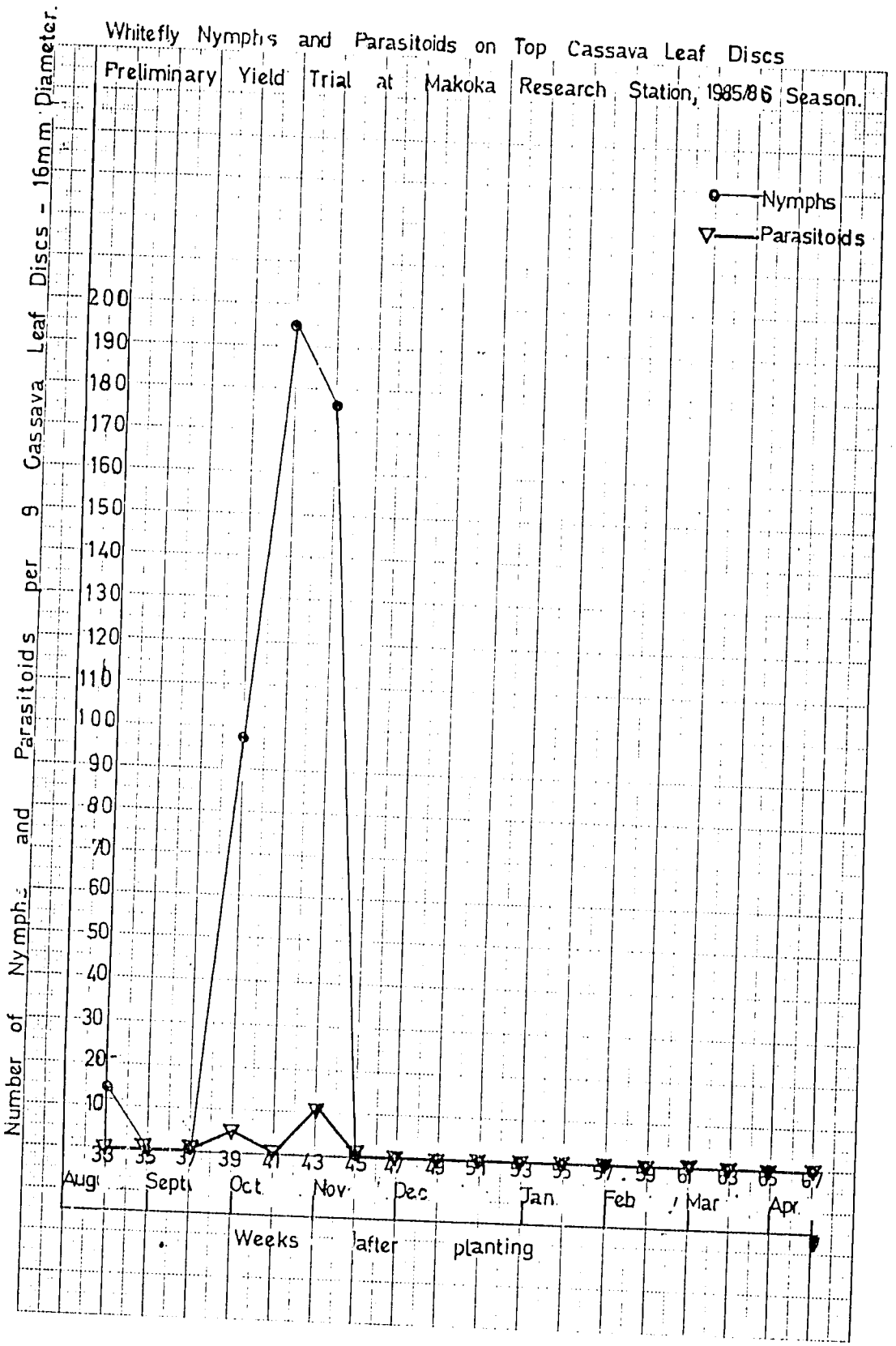
Table 5 *Bemisia tabaci* (Whitefly) Population on Cassava Local Variety Collections at Makoka 1986/87

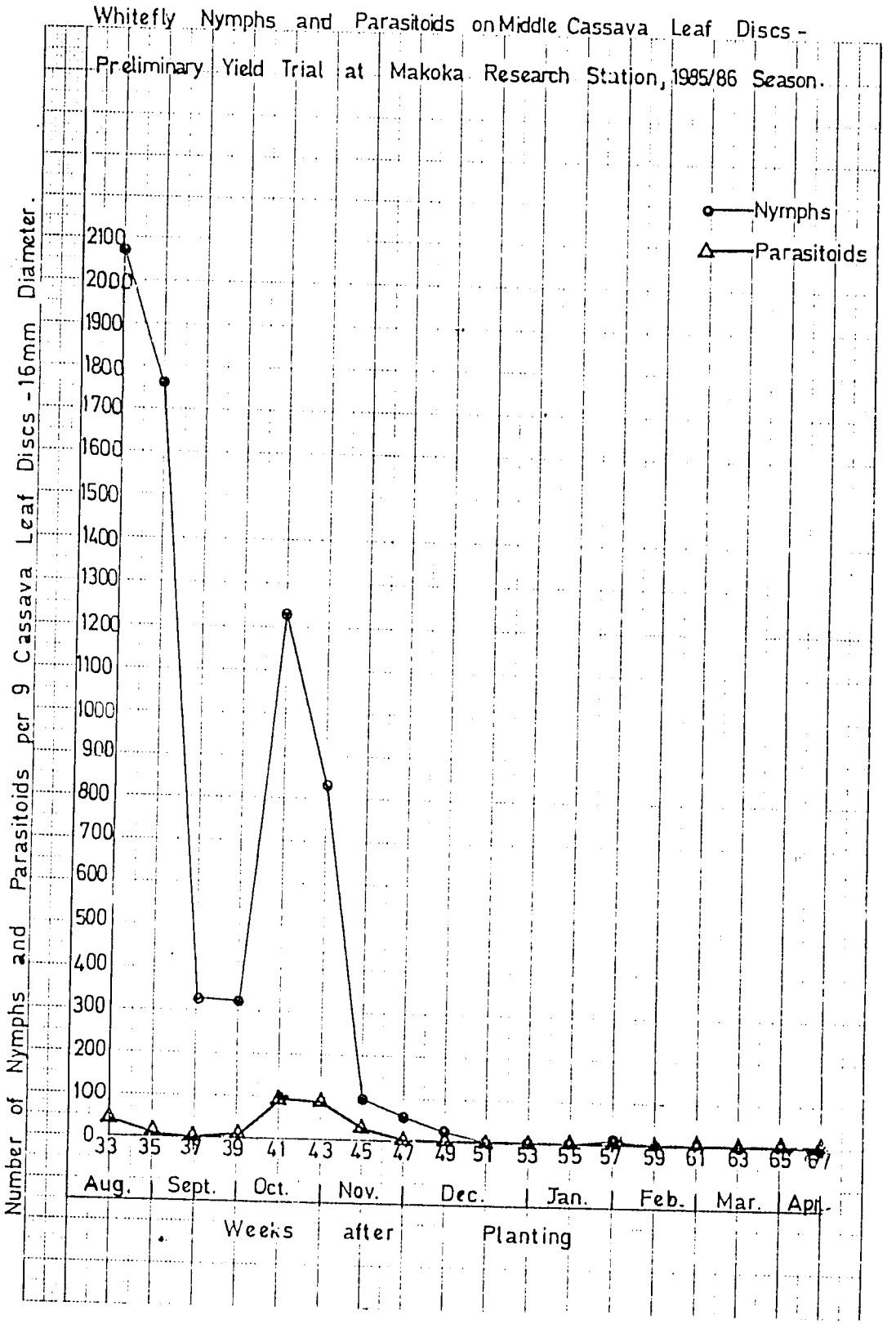
EGGS

VARIETY	DECEMBER	JANUARY	FEBRUARY	MARCH	MEAN	NO/CM^2
Apiti Sumani	4	0	12	4	5.00	0.092
Birigodo	0	0	0	1	0.25	0.005
Ipwapwa 1A	0	0	6	2	2.00	0.037
Kithekele	0	0	4	4	2.00	0.037
Magaligawo	0	0	2	2	1.00	0.018
Mpwapwa 2	1	0	5	5	2.75	0.051
Nchilingano	0	0	9	1	2.50	0.046
Namchanya	0	0	19	0	4.75	0.088
Ipwapwa 1B	3	0	9	1	2.50	0.046
Nyasungwi	0	0	5	0	1.25	0.023
Pachamba	0	0	NR	NR		0
Mean	0.636	0	6.600	2.00		
Nymphs						
Apiti Sumani	5	0	3	1	2.25	0.041
Birigodo	7	2	3	0	3.00	0.055
Mpwapwa 1A	0	0	5	11	4.00	0.074
Kithekele	0	1	4	1	1.50	0.028
Magaligawo	0	1	7	3	5.25	0.097
Mpwapwa 2	2	0	7	3	3.00	0.055
Nchilingano	4	9	8	5	6.50	0.120
Namchanya	10	0	10	4	6.00	0.111
Ipwapwa 1B	4	1	6	7	4.50	0.083
Nyasungwi	5	2	4	2	3.25	0.060
Pachamba	0	0	NR	NR	0	0
Mean	3.36	1.45	5.70	4.70		

NR - No Records taken

Records from the preliminary yield trial are presented in Fig 8 - 11. Parasitism was very low on top and middle leaves Figs 8 and 9. On bottom leaves parasitism was high and parasitised nymphs were more than healthy ones between November and December Fig 10. On local varieties this principle becomes even clear with parasitism on middle leaves remaining constant at zero. This is because the nymphs are still young and parasitised pupae could not be detected (Fig 11). On the other hand parasitised pupae were very high on bottom leaves and kept the Bemisia population low between December and March (Fig 11 and 12). The results suggests that for a reliable record of parasitism samples should be collected from bottom leaves and certainly not from top leaves. It is at the bottom and middle leaves where Bemisia pupae are found. Parasitoid on individual local collection varieties are presented in Table 6. Parasitism was lowest on Abiti Sumani, Nyasungwi and Mchilingano and highest on Kithekele and Mpwapwa 1B. There seems to be no obvious relationship between nymph levels and parasitism. This is mainly because results include samples from top leaves where parasitoids could not be detected. Figure 12 also suggests that Bemisia build up may be kept in check by parasitoids helped by factors such as rains.


Whitefly Nymphs and Parasitoids on Top Cassava Leaf Discs
Preliminary Yield Trial at Makoka Research Station, 1985/86 Season.
Nymphs
Parasitoids
Number of Nymphs and Parasitoids per 9 Cassava Leaf Discs - 16mm Diameter.
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
Weeks after planting


Whitefly Nymphs and Parasitoids on Middle Cassava Leaf Discs - Preliminary Yield Trial at Makoka Research Station, 1985/86 Season.
Nymphs
Parasitoids
Number of Nymphs and Parasitoids per 9 Cassava Leaf Discs - 16mm Diameter.
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.
Weeks after Planting

Whitefly Nymphs and Parasitoids on Bottom Cassava Leaf Discs - Preliminary Yield Trial at Makoka Research Station, 1985/86 Season.

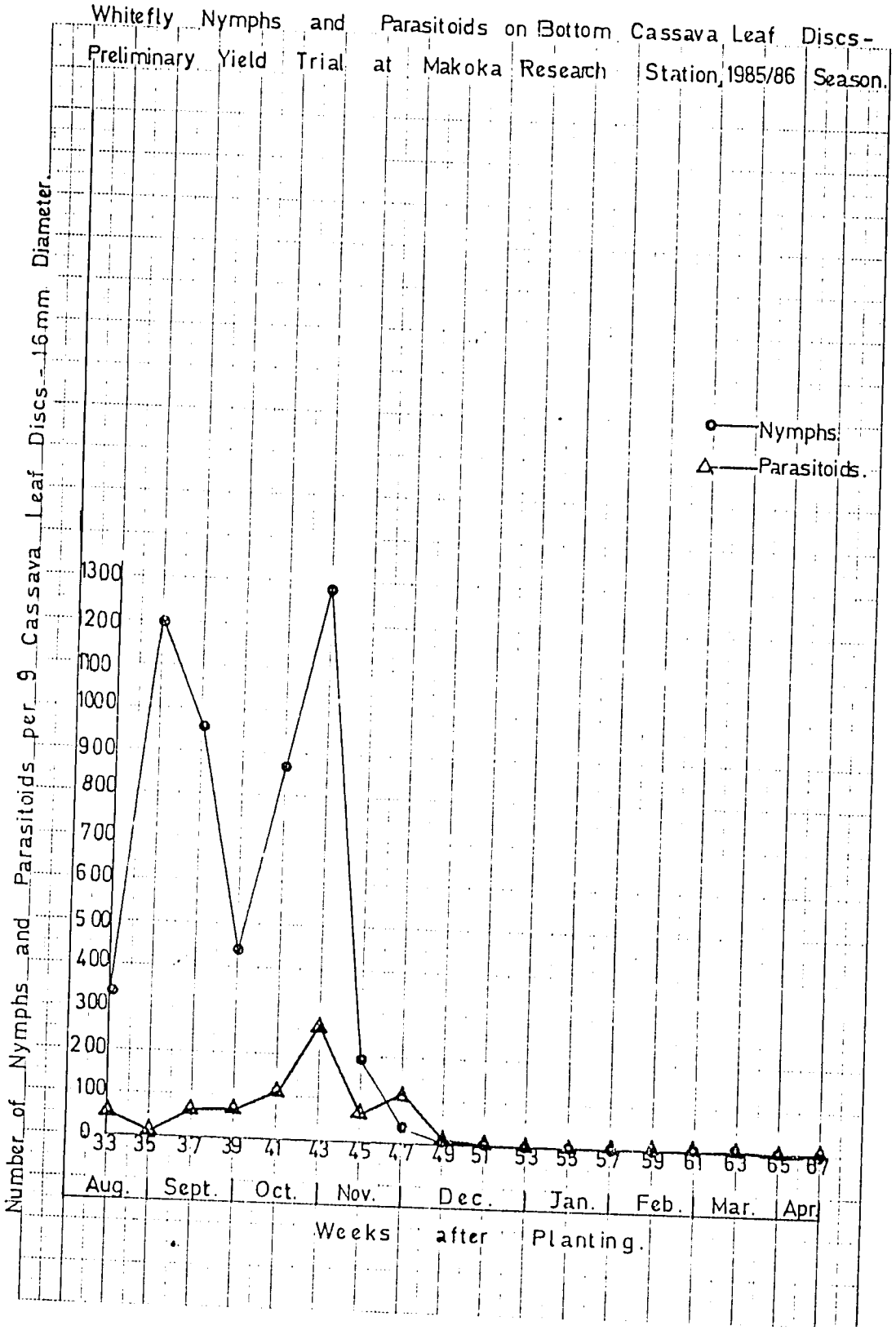
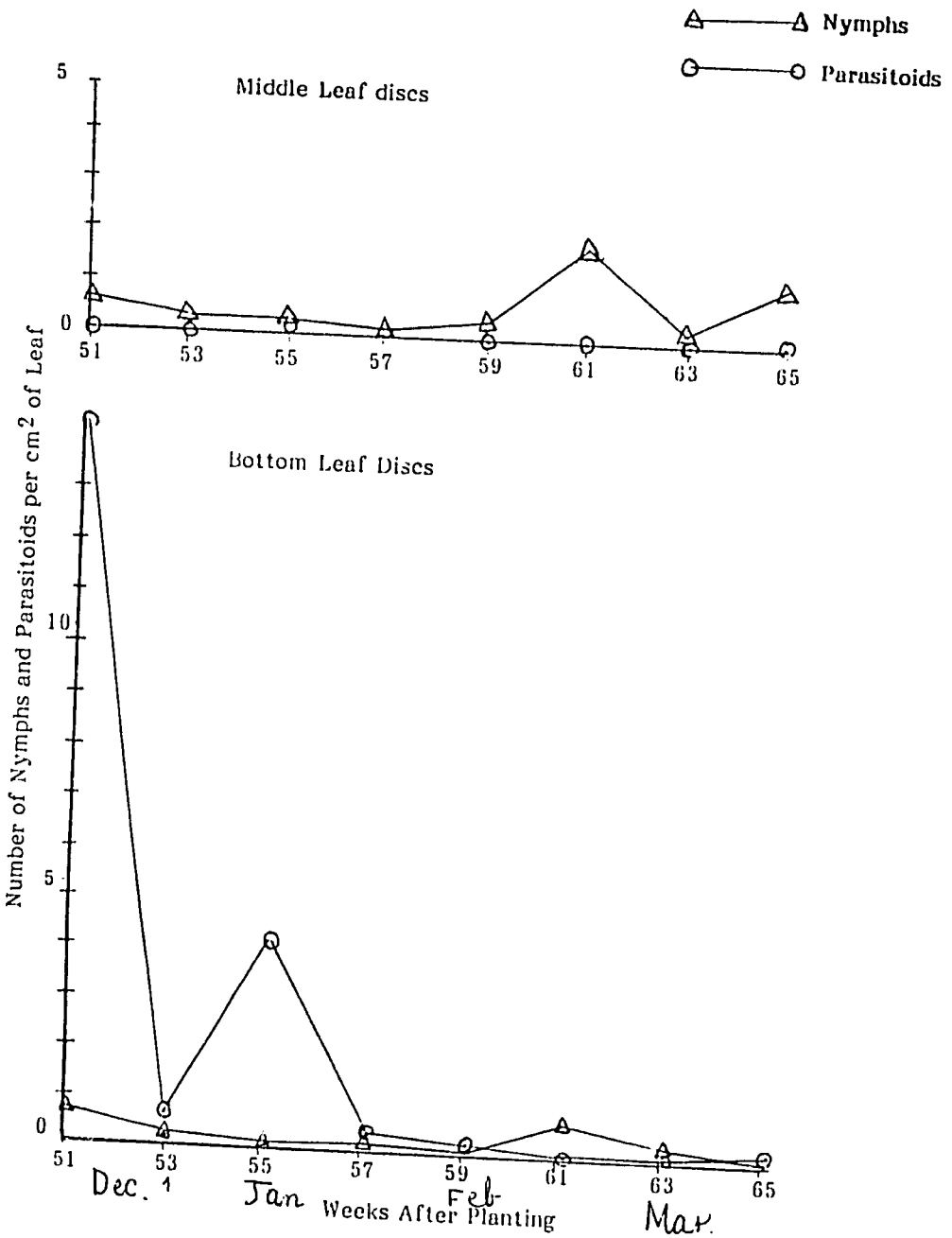


Fig 11 Whitefly Nymphs and Parasitoids on Cassava. Local Variety Collection Makoka 1986/87 Season



Whitefly Nymphs And Parasitoids On Cassava - Local Variety Collection.

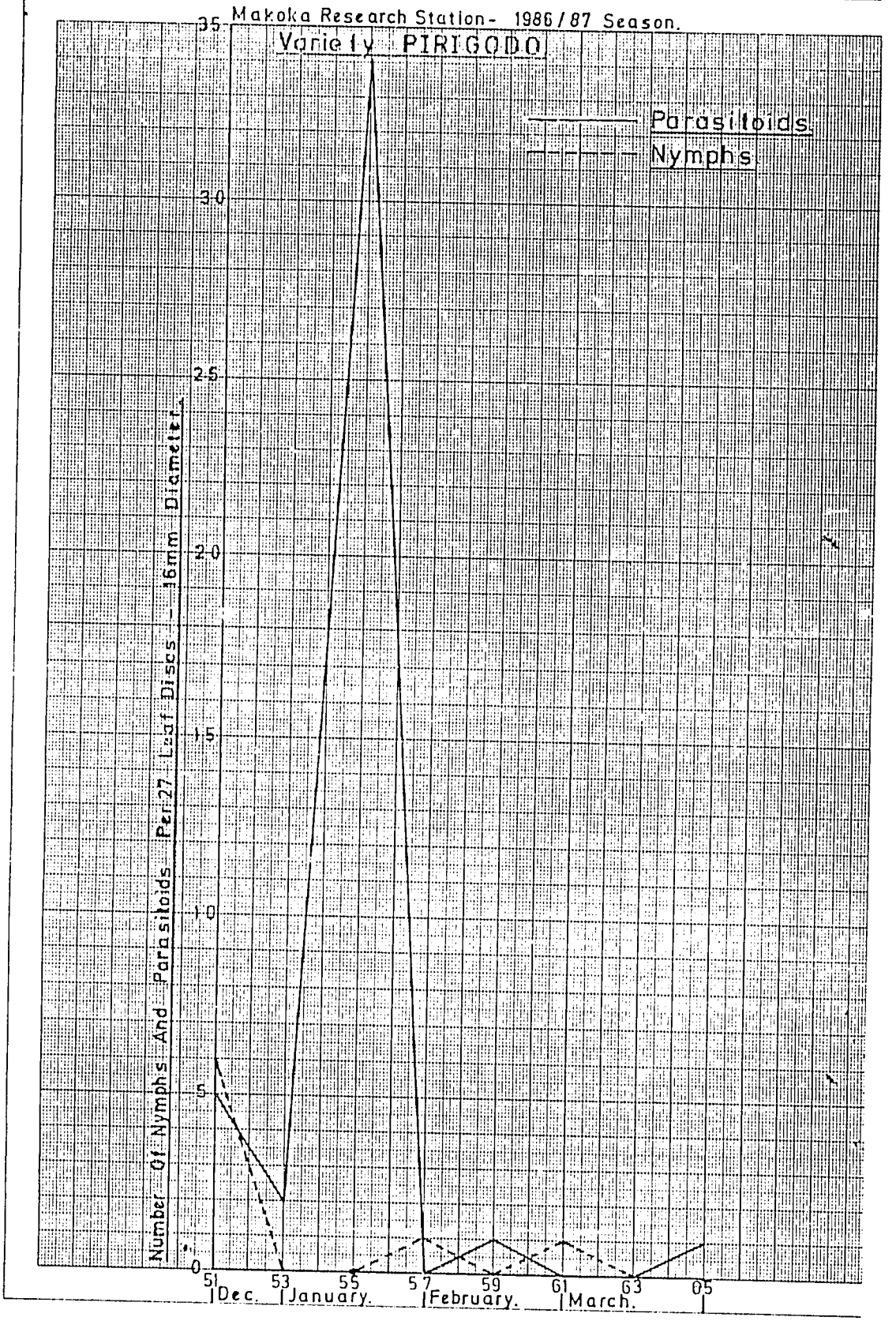


Table 6 Parasitoid Population on Cassava Local Variety Collections at Makoka

1986/87

Variety	Dec	Jan	Feb	Mar	Mean	No./cm^2
Abiti Sumani	1(3)	0(2)	0	0	0.250(1.250)	0.005(0.023)
Pirigodo	5(2)	0(32)	1	1	1.750(8.500)	0.032(0.157)
Mpwapwa 1A	0(20)	0(6)	0	5	1.250(6.500)	0.023(0.120)
Kithekele	29(26)	2(6)	0(3)	0	7.750(8.750)	0.143(0.161)
Magaligawo	11(19)	0(7)	0	0	2.750(6.500)	0.051(0.120)
Mpwapwa 2	6(6)	0(3)	0(1)	0	1.500(2.500)	0.028(0.046)
Mchilingano	0(19)	2(15)	0	0	0.500(8.500)	0.009(0.157)
Kamchanya	4	0	2	0	1.500	0.028
Mpwapwa 1B	21(51)	0(3)	0	0	5.250(13.500)	0.097(0.249)
Nyasungwi	1(3)	0(2)	0	0	0.250(1.250)	0.005(0.023)
Kachamba	2(32)	0(6)	NR	NR	1.000(19.000)	1.000(19.000)
Mean	7.273(16.455)	0.364 (7.455)	0.300 (0.400)	0.600		

* ( ) emerged

NR NO Records taken