MANAGEMENT OF SOME IMPORTANT INSECT PESTS OF GROUNDNUT

BY

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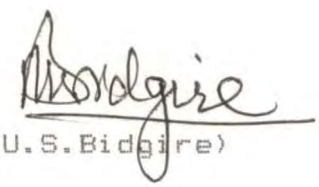
CANDIDATE'S DECLARATION

I, hereby declare that the entire work embodied in this dissertation or any part there of has not been previously submitted by me for a degree of any University



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CERTIFICATE - I

Shri Udhav Salbaji Bidgire has satifactorily prosecuted his course of research for the period of not less than four semesters and that the dissertation entitled **" Management of some important insect pests of Groundnut "**, submitted by him is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the dissertation or part thereof has not been previously submitted by him for a degree of any University.

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CERTIFICATE - II

This is to certify that the Dissertation entitled " **Management of some important insect pests of groundnut**", submitted by Shri.U.S.Bidgire to the Marathwada Agricultural University, Parbhani in partial fulfilment of the requirement for the degree of **Doctor of Philosophy** in the subject of **Agricultural Entomology** has been approved by the Student's Advisory Committee after oral examination in collaboration with external examiner.

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[U.S.Bidgire]

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INTRODUCTION

Groundnut, Arachis hypogea L. is one of the improtant oil seed crops cultivated in many tropical and sub-tropical countries. It is mainly cultivated for its seed which contains 50 per cent non drying oil and about 35 per cent protein (Anonymous,1975). Groundnut is second largest source of edible oil in the world next to soybean. The kernels which account for 70 to 80 per cent of weight of pods are utilized either for seed purposes or for oil extraction.

Nutritive value of groundnut is equal to that of milk and egg (Dhamdhare and Saxena,1969). Being leguminous crop, it can fix atomospheric nitrogen and improve soil fertility. Groundnut cakes have nutritive value and often used as manure and cattle food.

India accounts for 42 per cent of total acreage and 33 per cent of world production with an area of 7.17 million hectares (Anonymous,1976) under this crop, Occupying first position in production (Patel and Ramakrishna Rao,1965). At present it is taken on 8.67 million hectares touching production of 70.7 lakh tonnes in India (Anonymous,1993).

Groundnut, an important oil seed crop is attacked by a number of insect pests, therefore pest spectrum of groundnut is quite complex. The major pests attacking groundnut crop include , aphids, Aphis craccivora,leaf

hoppers, Empoasca kerri, red hairy caterpillar, Amsacta albistriga, thrips, Scirtothrips dorsalis, leaf miner, Aproaerema modicella and white grub, Holotrichia serrata.

In Maharashtra the crop mainly suffers from the attack of leaf hoppers, thrips and leaf miner. Infestation of jassids and thrips at early stage results in stunted growth and gradual death of plant, bringing about considerable reduction in the yield. Leaf-miner infestation proceeds in the middle of August, affecting the vitality and yield of crop. Besides groundnut, it attacks soybean severely in the region (Mundhe and Dabhade, 1980).

It is a well documented fact that food plants play a vital role in development, survival and reproductive potential of insects. The plant characters which interfere with normal physiology or feeding of insect affects adversely the biology of the pest (Painter, 1951).

Although, growing importance of this crop is being realised world over, little is known about ecology and population dynamics of the pests attacking groundnut.

A study of insect population requires perfect knowledge and understanding of aut-ecological parameters i.e. longevity, fecundity, developmental duration and sexratio which can be utilized as a basis for biological studies.

The losses worth Rs.350 crores per annum (Anonymous, 1975 b), 52.29 per cent (Singh and Rawat, 1981) and 15.87 per cent (Ghule and Jagtap, 1984) have been reported.

The field screening of cultivars against pest attack helps in evolving the resistant lines which can be incorporated in breeding programme.

Many insecticides have been tested for their efficacy against the pests of groundnut. However, the reports on use of plant products are scanty.

The present studies were therefore under taken by employing pest management tactics. The studies constituted,

1. Biological studies of leaf miner on different hosts.
2. Population dynamics of major pests of groundnut.
3. Assessment of crop losses in groundnut due to the pest complex.
4. Field screening of groundnut cultivars against major pests.
5. Efficacy of different insecticides and plant products against major pests of groundnut.

REVIEW OF LITERATURE

Chapter II

REVIEW OF LITERATURE

The present investigations were undertaken to study the biology of leaf miner, population dynamics of major pests of groundnut, assessment of crop losses due to major pests, field screening and efficacy of different insecticides against major pests of groundnut. The literature was reviewed pertaining to these aspects and presented here under the following heads.

2.1 Biology of Aproaerema modicella (Deventer) on different hosts.

2.1.1 Egg :

Pruthi (1957) studied the incubation of Aproaerema modicella. The average egg period of 2 to 3 days was reported (Nayar et al.,1976). Gujrathi et al.,(1973) recorded an incubation period of 3.0 days.

Kapadia et al.,(1982) reported that the egg period lasted for 6-8 days with an average of 7.45 days.Further, the incubation period of 5.30 days was reported by Lavekar et al.,(1992). Kalyansundram and Sundara Babu (1992) recorded egg period of 3.1 days on soybean and groundnut.

2.1.2 Larva :

Gujrathi et al., (1973) pointed out that leaf miner larva on soybean passed through four instars of 2 to 5 days duration,while Nayar et al.,(1976) reported 9 to 17

days larval duration of A. modicella.

Kapadia et al.,(1982) reported first, second and third larval instars of 7-14 (av 2.84), 4-9 (6.46) and 4-9 (6.46) days durations,respectively. Whereas total larval duration of leaf miner on groundnut varied from 14 to 23 days.

Lavekar et al.,(1992) observed that the larval stage passed through four instars. The larval period ranged from 8-11 days with an average of 9.16 days. The larva moulted three times during its life. Duration of first two instars was recorded as 2.0 days each. Whereas third and fourth instars were completed in 2.63 and 3.0 days, respectively on soybean. Kalyansundram and Sundra Babu (1992) reported larval period of 12.1 and 13.9 days on soybean and groundnut, respectively.

2.1.3 Pupa :

According to Gujrathi et al.,(1973) pupation occured generally in folded leaves and required 4 to 6 days as pupal duration. Nayar et al.,(1976) recorded 3 to 7 days of pupal duration on soybean.

Kapadia et al.,(1982) observed that the pupal period varied from 6 to 13 days (average 9.93) when leaf miner larva was reared on groundnut crop.

Lavekar et al.,(1992) reported that pre-pupal stage did not last for more than one day. But the pupal duration ranged from 5-8 days with an average of 5.96 days.Male pupal duration was slightly longer (6.17 days)

as compared to female (5.83 days). Pupal duration of 5.5 and 6.0 days on soybean and groundnut respectively, was recorded by Kalyansundram and Sundra Babu (1992).

2.1.4 Life cycle, adult longivity and fecundity of *A. modicella* :

Gujrathi *et al.*,(1973) found female of *A. modicella* capable of laying upto 259 eggs on soybean, The life cycle from egg to adult stage lasted for 16-22 days on soybean as against 15-28 days on groundnut in India and 25.26 days on groundnut in China.

According to Meheta and Verma (1968), leaf miner required 15 to 28 days for completion of its life cycle.

Nayar *et al.*,(1976) recorded an average of 181 eggs per female during its life time. Kapadia *et al.*,(1982) reported that single female moth of groundnut leaf miner was capable of laying 109.93 eggs during adult span of 7.27 days. The life span of adult male was 2-7 days (average 5.47) and of the adult female ranged between 2-7 days (average 2.27 days).

Lavekar *et al.*,(1992) studied the biology of soybean leaf miner and found that the pest completed its life cycle (egg to pupa within 21 to 22 days with an average of 21.66 days). Differences in life cycle of male and female were at most negligible. Longivity of female moth was 10.5 days whereas, it was 7.33 days in case of the male moth. The female moth laid an average of 131.25 eggs during its life time. Kalyansundram and Sundra Babu

(1992) observed that single female of leaf miner was capable of laying 67.3 and 61 eggs per female on soybean and groundnut, respectively.

2.2 Population dynamics of major pests on groundnut crop.

2.2.1 Seasonal fluctuation in population of insect pests :

Amin (1982) observed that under the field conditions at ICRISAT, Hyderabad, the populations of jassids remained low during hot summer months from April to June. The population of jassids gradually increased from first week of July and reached maximum in early September and remained at a low level during rest of the year on groundnut. Jassid population was affected by total rainfall as well as rainfall distribution and temperature. In 1978 season,the rainfall received was higher (1077 mm) and well distributed compared to the low rainfall of 572 mm in 1979.

Khan and Raodeo (1987) studied the seasonal incidence of A. modicella on groundnut. The pests was active from early June until the end of December with 5 population peaks.

Kenchaiah and Porte (1989) conducted field surveys to determine major pests of groundnut. Average aphid population during kharif and rabi season was moderate (16.25 per cent) and low (1.5 per cent), respectively. The maximum incidence of aphid population on groundnut

was recorded between July and September. Jassids were recorded at low level (1.15 per cent) on groundnut during both the seasons. The Gelechid, A. modicella was recorded as serious pest of groundnut (above 25 per cent) in Karnataka in both the seasons. Incidence of thrips in general remained between 1 and 15 per cent throughout the survey period.

2.2.2 Incidence of insect pests of groundnut and its relation to weather parameters :

Lokgiswaran et al.,(1982) studied the incidence of leaf miner, A. modicella on two varieties of groundnut i.e. TMV-7 and TMV-16 in relation to weather factors and reported that in both the varieties, morning relative humidity percentage showed a significantly negative correlation while the maximum temperature and minimum temperature showed significantly positive association with the incidence, which in turn exibited a negative correlation with the yield. From the coefficient of determination, it was found that 83 % variation was contributed by percentage relative humidity and maximum temperature incase of TMV-7 variety and 90 per cent by maximum and minimum temperature incase of TMV-10.

They further studied the influence of weather factors on the infestation of groundnut leaf miner and its influence on yield of TMV-7 and TMV-10 varieties. In both these varieties maximum and minimum temperature exibited a negative correlation with infestation. The

infestation exhibited a negative correlation with yield. Among the two varieties TMV-7 was more affected for the same unit of variation in weather factors of infestation (Logiswaran et al.,1982).

Ghule et al.,(1989) studied the effect of meteorological factors on out break of leaf miner on groundnut cultivar JL-24. The heavy precipitation followed by break of monsoon and increase of sunshine hours were observed to be favourable for multiplication of the pest. However, continuous rainfall and lesser sunshine hours were not favourable for its build up. Significantly positive and negative correlations were observed between the pest incidence and sunshine hours and relative humidity, respectively. Pooled analysis of three years data revealed that increase in relative humidity, minimum,maximum temperature and intensity of rainfall were responsible for decrease in population of leaf miner of groundnut. However, pest intensity increased due to increase in sunshine hours and maximum temperature.

2.3 Assessment of crop losses due to insect pests in groundnut.

2.3.1 Methods and techniques in general for assessing crop losses :

Techniques for assessment of losses due to pests have been out lined by several workers (Pradhan,1964; Judenko,1965,1972; Smith,1967; Strickland and Bardner,

1967; Krishnaiah,1980; Veeresh,1980, Kulkarni,1983 and Suryawanshi,1986).

2.3.1.1 Comparison of yields from a mechanically protected pest free crop with naturally infested crop :

The ideal method for estimating crop loss would be to compare yields under pest infested and pest free conditions. Attempts were made by several workers to get the pest free plots by different methods as indicated below.

a) Cage studies :

Technique involving cages is useful for studying the infestation of specific pest while eliminating others and in critical experiments to establish the relationship between insect intensity and yields. Cages of great varieties were used either to exclude or contain pest infestation (Judenko,1965), to cover a portion of field or plant (Smith,1967 and Krishnaiah, 1980), to prevent the oviposition (Raw and Loety,1957) or to cover the soil to prevent the entrance of insect into soil (Bardner and Griffiths,1967).

b) Artificial removal of pests :

Hand picking is usually employed to remove the pests from small areas (Judenko, 1938, Judenko et al., 1952). Prasad (1963) used this method for assessing the loss in cabbage plant by imported cabbage worms Pieris rapae L. The same method was adopted by Sheshu Reddy

(1973) to estimate loss in red gram due to Heliothis armigera.

c) Chemical treatments :

Voluminous literature in economic entomology contains many examples of comparisons of treated and untreated insect population and the effect on crop yield. Indeed, popular technique of crop loss assessment is by using pesticide. In this, an attempt is made to protect the experimental crop by pest control schedule known for a particular pest and the yield of such crop is compared with one which has been exposed to normal insect infestation. Though, pesticides can not give true estimate of losses from specific pests, this method has been adopted by several investigators. Hunter (1924) estimated losses in cotton due to Anthonomus grandis using this method.

Le-clerg (1971) suggested paired plot technique and multiple treatments experiment to know the increment of loss per unit, increase of pest intensity and the competitive or interaction effect of more than one pest on yield loss. Suryawanshi and Pawar (1980) used the paired plot technique for estimating losses due to aphids in safflower. Krishnaiah (1980) suggested the randomised block design instead of paired plot technique incase the programme aims at assessing the loss at different crop stages or due to more than one pest. Kulkarni (1983) and Suryawanshi (1986) modified the

method suggested by Le-clerg (1971) and used Factorial and Randomised Block Design, respectively instead of paired plot to work out losses in cotton and okra.

2.3.1.2 Comparison of naturally infested plants with naturally uninfested plants :

Pradhan (1964) described that, the plants from the same field are examined for the degree of infestation and their individual yields are determined.

Judenko (1972) suggested an analytical method of calculating loss based on comparison of yield from two sets of plants that are precisely identical in all respects, except that one is unattacked and the other is attacked by specific pest. The economic loss was calculated employing the formula.

$$\text{Co-efficient of harmfullness (C)} = \frac{a - b}{a} = 100$$

Where,

a = Mean yield per uninfested plant

b = Mean yield per infested plant

$$\text{Percentage of economic loss (L)} = \frac{c \times p}{100}$$

Where,

p = Percentage of plants infested and expected yield in the absence of pest.

$$(W) = \frac{100\ (ACT)}{100 - L}$$

Where,

ACT = Actual yield.

The economic loss (Los) = W - ACT.

2.3.1.3 Average amount of damage caused by individual pest :

This method was utilized by Pradhan and Peshwani (1961) to assess the losses caused by Hieroglyphos nigroleptus (Roliver) in maize and by Plusia orichalacea F. in cauliflower by Basu and Chatterjee (1969).

2.3.1.4 Subjective estimates of yield loss :

Estimates of losses over large areas are often made from the opinions of farmers and extension workers. This method may be useful when damage is heavy.

Although, none of the foregoing methods and techniques of assessing losses give unequivocal results.

2.3.2 Crop loss assessment techniques and losses caused due to major pests on groundnut :

Khan and Hussain (1965) reported that aphids are capable of reducing yield upto 40 per cent. Palaniswamy and Ramchandran (1978) suggested that complete protection from the pests infesting groundnut increased yield to the extent of 36 to 92 per cent in South India.

Tejkumar (1979) recorded 55 to 65 per cent loss in groundnut yield due to major pests.

Senapati and Patnaik (1980) reported 29 per cent reduction in yield due to thrips S. dorsalis. Singh and Rawat (1981) estimated 52.29 per cent avoidable losses to pest complex in groundnut. Anonymous (1982) reported

that losses in yield of groundnut pods due to pest complex were 21.9 per cent at Jalgaon (Maharashtra), 29.7 per cent at Chiploma (Orrisa) and 83.2 per cent at Vridhachalam (Tamil nadu). Jagtap and Ghule (1984) reported that losses in the Phule Pragati, a bunch variety of groundnut averaged to 15.87 per cent due to Aphis crassivera and Aproaerema modicella with benifit ratio 1:4.25 using spray of 0.05 per cent dimethoate, 0.20 per cent carbaryl and 0.05 per cent monocrotophos.

Upadhyay (1984) estimated the maximum avoidable loss of groundnut pod yield to the tune of 21.97 per cent in untreated control, when compared with plot treated with 0.05 per cent monocrotophos. Bhalani et al.,(1985) studied the assessment of damage caused by larvae of Aproaerema modicella to leaves of 7 cultivars of pigeonpea which ranged from 27.5 to 34.6 per cent in the resistant cultivars T-15-5 and UPAS-120, respectively.

Shivasubramanian and Palaniswamy (1986) estimated the yield losses in groundnut caused by A. modicella, E. kerri, Caliothrips dorsalis, and Frankliniella schultzei. Pod yield were significantly higher in plots sprayed with 0.075 per cent monocrotophos than untreated plots. The loss in pod yield was 48.5 per cent in 1983 as compared with 19.62 in 1984.

Patil et al.,(1992) conducted an experiment to findout losses in the yield of groundnut caused by pest complex could be seen. They noted average loss in dry pod yield of groundnut (JL-24), to the tune of 26.50 per

cent during kharif seasons of 1985 to 1987.

Shetgar et al. (1992) conducted a trial to find out the yield losses due to foliage pests of groundnut. Pooled the results and recorded 40.34 per cent loss in pod yield due to foliage pests of groundnut.

2.4 Screening of groundnut varieties/cultivars to major pests :

Lewin et al.,(1971) tested the resistance of ten varieties against pest complex of groundnut. The suspectibility to Bioloba subsecivella was greatest in two bunch varieties. In these leaf-lets infested by Gelechid averaged to 12.3 per cent as compared to 7.0-8.7 per cent in spreading and semispreading varieties.

Young et al.,(1972) screened 872 peanut entries to identify germplasm resistant to tobacco thrips. Slightly moderate resistance was shown by 50 entries. The resistance of 98 varieties of groundnut to leaf miner larvae of B. subsceivella, which cause severe damage in irrigated crop was evaluated by Rao and Sindgi (1974). The infestation percentage ranged from 16.04 to 38.19 and were less than 17 per cent on M.S.-11, G.N.-1024 and No-127.

Deshmukh et al.,(1984) screened CGS-101, along with ICG-5037 (NCAC-2154) and ICG-8109 (NCAC-17011) in advanced screening trial against leaf miner and recorded least leaf miner damage nearly 82 to 93 per cent less than check Phule Pragati. CGS-101 hold good promise for

leaf miner resistance also in addition to jassids.

Campbell et al.,(1987) reported the results of studies on the resistance of groundnut to insect pests from Thailand, North Carolina and Philippines. Variety GP-NC-343 was resistant to complex of insects at all three locations and crosses containing this variety including GP-NC-343 x NC-7 and GP-343 x NC-1736, were resistant to thrips, leaf hopper and defoliators. Local cultivars except NC-6 were susceptible to the insect pests.

Ghule et al.,(1988) screened 193 ICRISAT entries of groundnut for resistance to gelechid, A. modicella. The infestation ranged from 20-53 to 95.48 per cent. Among the entries none was resistant. However, 18 were moderately resistant by 21 to 40 per cent. The entries ICG 7758 and 8322 were promising with 20.53 and 21.3 per cent infestation, respectively as against 61.35 per cent in JL-24 and 95.48 per cent in ICG-693, which were highly susceptible. Ninety entries were moderately susceptible (41 to 60 per cent) and 85 highly susceptible (above 61 per cent).

Mahadevan et al.,(1988) screened 300 groundnut entries for resistance to the gelechid, A. modicella. ICGS-50 recorded the lowest damage and larval population and the highest pod yield (3000 kg/ha). This genotype also exhibited resistance against Spodoptera litura and H. armigera.

Mahadevan et al.,(1989) evaluated 155 genotypes of groundnut for the resistance of A. modicella. Eight groundnut entries (ICG-10361, 9212, 1458, 1989, 10383, 8555, 10558 and ICG-87177) were partially resistant compared to the two control varieties JL-24 and VR-11. The entries ICG-10361 and 9219 gave highest pod yield of 12.6 and 12.1 gm per plant and emerged as resistant to the attack.

2.5 Efficacy of different insecticides against major pests of groundnut :

2.5.1 Efficacy of different insecticides against leaf miner :

Kapoor et al.,(1975) reported that fenitrothion 0.05 per cent, carbaryl 0.2 per cent and ethyl parathion dust were effective in giving spectacular mortality of first and second instar larvae of Stomoptryx subsecivella. None of these chemicals were effective against the full grown and third instar larvae and pupae on soybean crop.

Urs et al.,(1976) evaluated eleven newer insecticides against groundnut leaf miner. Of the various chemicals used, quinalphos spray gave best control. The insecticides in order of their efficacy were dimethoate (92.72), ethyl parathion dust (90.06), formothion spray (89.20), carbaryl dust (87.07), malathion dust (66.32), disulfotan granules (64.68), carbofuran granules (64.63) and endosulfan spray (60.19).

Sangappa and Ali (1977) studied eleven insecticides for control of S. subsecivella , on groundnut on the basis of mean percentage of leaves damaged, the yield and net profit per hectare, monocrotophos proved best compound followed by dimethoate, leptophos, carbaryl and phosphamidon.

Palaniswamy and Ramchandran (1978) observed that dichlorovas 0.05 per cent applied 30 to 60 days after sowing was the most effective in reducing population (77.2 per cent) with increased yield (960 kgs/ha). The other insecticides, dicrotophos and fenitrothion gave 74 per cent pest reduction and over 940 kgs pod/ha.

Sadakatulla et al.,(1978) tested 12 insecticides and 3 antifeedants for the control of S. subsecivella on groundnut. The results indicated that sprays containing either phosalone at 0.05 per cent or dichlorvas at 0.1 per cent applied 30 and 50 days after sowing were most economical.

Khan and Raodeo (1979) reported that sprays of 0.05 per cent quinalphos, 0.05 per cent dichlorvas, 0.06 per cent monocrotophos, 0.04 per cent chlorfenvinphos and 0.02 per cent phosphamidon applied at 550 litres per hectare provided effective control of the leaf miner S. subsecivella on groundnut.

Khan and Raodeo (1979) tested the effectiveness of soil applications of granules of 4 systemic insecticides at rates equivalent to 2.5 kg a.i./ha to control the

natural infestation of S. subsecivella on groundnut. All compounds namely dimethoate, carbofuran, disulfotan and phorate gave significant larval control one week after treatment.

More effective control of S. subsecivella on soybean was obtained with application of fenitrothion 0.05 per cent, monocrotophos 0.05 per cent and fenthion 0.07 per cent recording 82.55 per cent , 81.82 and 77.17 per cent mortality, respectively. (Mundhe and Dabhade,1980).

Logiswaran and Rao (1982) tested five insecticidal sprays against A. modicella on groundnut and obtained best results with 0.05 per cent phosphamidon. The yield averaged to 2.00 kg/plot in the treatment as compared with 0.95 kg/plot in untreated control. 1.41 kg for 0.05 per cent dimethoate, 1.66 kg for 0.05 per cent demeton methyl, 1.32 kg for 0.075 per cent formothion and 1.75 kg/plot for 0.05 per cent monocrotophos, were recorded.

Logiswaran and Rao (1982)b reported that two foliar applications of the synthetic pyrethroids viz.fenvalerate and permethrin at 0.15 kg a.i./ha controlled the leaf miner incidence effectively followed by bendiocarb 80 WP at 1.5 kg a.i./ha.

Radhakrishanan et al.,(1982) tested the effectiveness of spray containing 25 per cent fenvalerate applied at 250, 500 and 750 ml/ha 20 and 35 days after sowing against A. modicella on groundnut and concluded that the best economic return was obtained from 2 foliar

applications of 25 per cent fenvalerate at 250 ml/ha.

Radhakrishnan and Mohanan, (1983) studied the effectiveness of seed treatment of groundnut in controlling A. modicella with isophenphos at 20, 40 and 60 g/kg seed and the treatment proved quite effective which gave 100 per cent control of the pests even in lowest dose, 20 days after sowing.

Samalo and Parida (1983) reported that monocrotophos 0.05 per cent offered good control of major groundnut pests, including leaf miner, when crop was sprayed 30 and 55 days after sowing and gave maximum net return of Rs.2137/ha.

Shivasubramanian and Palaniswamy (1983) observed that among the chemicals tested, fenvalerate 0.01 per cent recorded highest yield (2225 kg/ha) coupled with lowest infestation index (1.10) and highest mortality of leaf miner (95.2%). However, the highest cost benifit ratio of 1:6.52 was recorded by carbaryl 0.2 per cent compared to 1:3.49 by fenvalerate.

Logiswaran et al.,(1984) tested isofenphos against A. modicella and reported that seed pelleting proved more effective than soil treatment, protecting the crop for 30 days. Foliar sprays gave even better results and 2 applications at 750, 875 or 1000 ml toxicant per hectare on 30th and 45th day after sowing attained good insect control and increased yield.

Rajput et al.,(1984) observed that spray application of emulsifiable concentrate of 0.05 per cent monocrotophos, quinalphos, methomyl or acephate at 500 litres spray solution/ha or dust applications of 1.5 per cent quinalphos or 2 per cent methyl parathion at 20 kg/ha were most effective treatments in reducing larval population of A. modicella in groundnut. The spray treatment of 0.05 per cent quinalphos gave highest yield (9.41 q/ha).

Markar et al.,(1985) reported that the permethrin chlorfenvinphos, monocrotophos, phosphamidon, quinalphos and methyl parathion recorded more than 93 per cent larval mortality of A. modicella and statistically significant yields over a mixture of BHC, carbaryl 0.2 per cent and malathion 0.05 per cent. Highest yield of 12.82 q/ha was recorded in monocrotophos treated plots.

Rajput et al.,(1985) studied the efficacy of synthetic pyrethroids and newly introduced insecticides against A. modicella on groundnut and observed that all 12 insecticidal treatments were significantly superior in controlling pest. Permethrin was the most effective treatment recording maximum yield of 10.54 q/ha .

Singh and Singh (1985) tested the effectiveness of several insecticides against A. modicella infesting soybean. On the basis of larval mortality, quinalphos at 0.05 per cent, fenvalerate at 0.01 per cent and monocrotophos at 0.04 per cent were more effective against pest, which also gave higher yield.

Srinivasan and Rao (1985) reported that quinalphos 1.5 per cent was the most effective treatment among the insecticidal dusts tested against larvae of A. modicella.

In further studies Jagtap et al.,(1986) broughtout two spray applications of 0.2 per cent carbaryl, 0.05 per cent quinalphos, 0.01 per cent permethrin, 0.01 per cent cypermethrin, or 0.01 per cent fenvalerate at an interval of 21 days reduced the infestation of groundnut by A. modicella. Fenvalerate was the most effective treatment which killed 93.13 per cent of larvae and gave pod yields upto 2341 kg/ha.

Ghule et al.(1987) obtained good control of the gelechid A. modicella on groundnut with monocrotophos 0.05 per cent, carbaryl 0.2 per cent, 0.1 per cent, quinalphos, 0.05 per cent and parathion methyl 0.02 per cent.

Ghule et al.,(1987) screened dusts and concluded that two applications of carbaryl,HCH mixture at 21 days interval were more effective and reduced pest population by 88.84 per cent, 48 hours after treatment.

Bhushan et al.,(1988) tested the efficacy of aldicarb against insect pest of groundnut including Cicadellid, Empoasca kerri and found that application of apdicarb at 2.25 kg a.i./ha, 15 and 30 days after sowing gave the maximum protection from all pests for 60-80 days.

Das (1988) reported that monocrotophos and quinalphos at 0.5 kg a.i./ha were most effective against leaf miner among the five insecticides tested for their efficacy.

In other trial, the plots treated with cypermethrin @ 40 g a.i./ha gave higher yield.

Murthy et al.,(1988) tested the efficacy of 0.01 per cent cypermethrin, 0.05 per cent deltamethrin, 0.04 per cent monocrotophos, 0.05 per cent quinalphos and 0.15 per cent carbaryl alone and in combination for control of gelechid on groundnut. They observed that cypermethrin or deltamethrin with carbaryl, cypermethrin with monocrotophos and monocrotophos alone were effective against A. modicella. Higher yields were obtained from the mixtures of cypermethrin + carbaryl (1275 kg/ha) and deltamethrin + carbaryl (1183 kg/ha).

Shrivastava et al., (1988) reported that monocrotophos 0.04 per cent was the most effective treatment followed by demeton-s-methyl at 0.03 per cent and dimethoate at 0.03 per cent amongst insecticdes tested against soybean leaf miner.

Jesudasan et al.,(1989) achieved the greatest level of control with cartap 0.025, 0.500, 0.750 and 1 kg a.i./ha compared with chlorpyriphos and monocrotophos at 0.180 and 0.360 kg a.i./ha. Application of cartap at 1 kg a.i./ha gave the lowest infestation level (4.24 per cent) and highest yield (347.5 kgs/ha).

Muthiah and Hussain (1991) found that monocrotophos effectively controlled leaf miner on groundnut, with minimum leaf-let damage and greater pod yields than other insecticides tested.

Rajagopal and Gowda (1992) evaluated granular insecticides and found isofenphos 5 G at 2 or 5 kg a.i./ha, carbosulfan 10 G at 4 kg a.i./ha and phorate 10 G at 4 kg a.i./ha were more effective in suppressing A. modicella infestation than chlorpyriphos 10 G at 1.00 and 2 or 4 kg a.i./ha. These treatments also gave increased pod yields over other treatments including control.

2.5.2 Efficacy of different insecticides against sucking pests :

Harding (1961) rated trithion, methyl trithion, ethion, SD-4002, DDT, taxophene and parathion as most effective treatments for control of thrips on peanut at 1,1, 0.5, 0.25,1.5, 1.5 and 0.5 lbs a.i./ha respectively.

Thimmaiah and Panchabhavi (1973) obtained the significant control of thrips on groundnut by carbofuran seed treatment at 4 per cent level and disulfaton 5 per cent granules over check. All treatments except aldicarb 10 per cent and dimethoate 5 per cent gave significantly higher yields over check.

Saboo and Puri (1978) ascertained efficacy of quinalphos against sucking pests. They observed no

incidence of leaf hopper in the plots treated with quinalphos 350 g a.i. per hectare spray, treatment 350 g a.i./ha dust, 250 g a.i./ha dust were found to be significantly superior in reducing incidence of thrips after 10 days. The plots treated with quinalphos 350 g a.i./ha dust registered the highest pod yield of 4379 kg/ha.

Logiswaran and Rao (1982) carried out the field tests of insecticides in three seasons and established that two foliar applications of bandiocarb 80 WP at 1.5 kg a.i./ha were the most effective chemicals in controlling the jassids.

Samalo and Parida (1983) studied the effectiveness of various plant protection measures against thrips, Cicadellids and aphids and observed that spray applications of a combination of 0.05 per cent monocrotophos and 0.225 per cent of the fungicide chlorothaloml 30 and 55 days after sowing protected the crop against these pests and gave maximum net returns of Rs. 2137/ha.

Thakkar et al.,(1984) evaluated 4 insecticides recommended for control of A. craccivora. Dimethoate 0.025 per cent and demeton-s-methyl gave significantly higher yield and offered good protection from the aphid. Sirisingh and Pitak (1987) observed that five applications of monocrotophos to groundnut at 0.2, 0.1 and 0.025 kg/ha at 2 weekly intervals reduced the population of Scirtothrips dorsalis from 120 to 20

insects/20 hills. Bhushan et al.,(1988) found that application of aldicarb at 2.25 kg/ha, 15 and 30 days after sowing gave the maximum protection from all pests for 60-80 days, including Cicadellids, Empoasca kerri.

Das (1988) studied the efficacy of endosulfan, quinalphos, monocrotophos, phosalone, dimethoate and chlor-pyriphos (all at 0.5 kg a.i./ha) and carbaryl and chlorfenvinphos at 2 and 0.7 kg a.i./ha against the groundnut pest complex. It was noted that the number of thrips and leaf folders were not reduced significantly by any treatment. The highest yield was obtained from plots treated with endosulfan followed by those treated with monocrotophos, phosalone and carbaryl.

Murthy et al.,(1988) tested the effectiveness of 0.01 per cent cypermethrin,0.005 per cent deltamethrin, 0.04 per cent monocrotophos, 0.05 per cent quinalphos and 0.15 per cent carbaryl alone and in combination for control of S. dorsalis and other pests on groundnut. Cypermethrin or in combination with monocrotophos or quinalphos and deltamethrin with monocrotophos or quinalphos and deltamethrin with monocrotophos or carbaryl gave good control of S. dorsalis and F. Schultesci, highest yield was obtained with the treatment mixtures of cypermethrin and carbaryl (1275 kg/ha) and deltamethrin and carbaryl (1183 kg/ha).

MATERIALS AND METHODS

Chapter III

MATERIALS AND METHODS

The present investigations were undertaken to study the population dynamics of major pests of groundnut, biology of leaf miner, Aproaerema modicella, assessment of crop losses due to major pests of groundnut, field screening of varieties/cultivars of groundnut against thrips, jassids and leaf miner and efficacy of insecticides against major pests of groundnut. The material used and methods followed during the course of experimentation are described here under.

3.1 Field experiments :

The field experiments were conducted at Sorghum Research Station, Marathwada Agricultural University, Parbhani. The city has subtropical climate, where the mean annual rainfall is about 828.28 mm, mostly during June-September. The mean maximum temperature ranges from 28.7 °C during December to 41.2 °C in May. The minimum temperature varies from 11.32 to 25.77 °C in winter and summer, respectively. The mean relative humidity ranges from 30-90 per cent. The experiments were laid out on black cotton soil having medium fertility and good drainage. Fields were well prepared by giving one ploughing and two harrowings to bring the soil to proper tilth. The crop was fertilized with 20 kg N and 40 kg P_2O_5 per hectare,as basal dose only. The seed of groundnut variety JL-24 (Phule Pragati) a bunch type

variety which matures in 110-120 days, was obtained from Oil Seeds Research Station, Latur. Seeds were sown by dibbling 2-3 seeds per hill in a row spacing 30 cm apart by keeping 10 cm distance between plants. One hoeing and three hand weedings were done to keep the plots free from weeds. The crop was grown under protective irrigation.

3.1.1 Population dynamics of major pests of groundnut :

A plot of 10 x 10 meter was sown in kharif seasons of 1988 and 1989 at Sorghum Research Station, M.A.U., Parbhani. The variety,JL-24 was used. The observations were recorded at weekly intervals from five quadrates of 1 x 1 meter each on population of jassid nymphs, thrips as well as larval count of leaf miner.

3.1.1.1 Method of recording observations :

The details of observations recorded during experimentation are given below.

3.1.1.1.1. Population of sucking pests :

Counts of jassid nymphs and thrips were taken at weekly interval from three compound leaves (one each from top, middle and bottom) on all plants from five quadrates commencing from apperance of the pest to the harvest of the crop. The data on number of jassids and thrips were analysed statistically after transforming them using 'Poisson' formula $\sqrt{x + 0.5}$

(where x is the number of insects recorded)

3.1.1.2 Infestation of leaf miner :

The weekly observations were taken on all plants from five quadrates after germination. Actual larval count per plant was recorded. The data on number of larvae per plant were transformed using Poisson formula before statistical analysis.

3.1.1.3 Correlation studies :

The correlation between groundnut pest complex (jassid, thrips and leaf miner) and weather factors were worked out as per method given by Panse and Sukhatme,(1967).

3.1.2 Assessment of crop losses due to major pests of groundnut :

Popular technique of crop loss assessment using pesticides suggested by Le-Clerg (1971) was followed with some modifications in statistical design to suit the requirements of the present investigation i.e. instead of adopting paired plot, randomised block design was used to calculate the losses due to major pests of groundnut.

The field trials were laid out during the kharif season of 1988 and 1989 in randomised block design with five treatments and four replications. The gross and net plot were 3.00 x 4.00 and 2.40 x 3.80 meter. The trials comprised of following treatments.

T_1 – Carbofuran 3 G @ 1 kg a.i./ha at time of sowing to protect the crop during vegetative stage.

T_2 – Carbofuran 3 G @ 1 kg a.i./ha at the time of sowing to protect the crop during vegetative stage. + Lambdacyhalothrin 0.004 per cent a.i. to protect the crop during reproductive stage.

T_3 – Monocrotophos 0.05 per cent a.i. 45 days after sowing to protect the crop during reproductive stage (one spray only).

T_4 – Monocrotophos 0.05 per cent a.i. based on pest population from germination to harvest (four sprays).

T_5 – Untreated (control) throughout the growth period.

3.1.2.1 Method of recording observations :

Observations on five randomly selected plants were recorded in each net plot. The observations on sucking pests and leaf miner were under taken as per the procedure described earlier. In addition, count of leaf miner infested leaves was taken. Mean leaf miner infestation in the treatment was worked out by

$$\text{Per cent infestation} = \frac{\text{No.of leaves infested by leaf miner larvae}}{\text{Total number of leaves}} \times 100$$

3.1.2.2 Biometerical observations :

Observations on number of pods and the yield per plant from net plots were recorded seperately at harvest.

3.1.2.3 Yield and yield components :

The crop was harvested at the end of season and produce obtained from each net plot was dried and weighed separately.

3.1.2.4 Method used for assessing crop loss :

Judenko (1972) expressed the percentage yield loss per plant by giving the co-efficient of harmfulness (C):

$$C = \frac{(a - b) \times 100}{a}$$

Where,

a = Mean yield of unattacked plants

b = Mean yield of attacked plants

The losses in various parameters were calculated accordingly. The per cent loss was calculated by comparing the various treatments to the treatment that gave maximum protection and increase in yield. In such treatment, the avoidable loss was considered as nil.

3.1.2.5 Statistical analysis :

The data were statistically analysed by standard 'Analysis of variance' method (Panse and Sukhatme,1967

and Snedecor and Cochran,1967). The null hypothesis was tested by 'f' test of significance to know whether the observed treatments effects were real or not. For significant treatment effects, the appropriate standard error (S.E.) and critical difference (C.D.) at five per cent level of probability were calculated for comparison the treatment means.

3.1.2.6 Pooled analysis :

A simple technique of analysis of variance may not be valid under two different seasonal conditions if the error variance in the season is not of the same order and interaction (treatment x season) significantly different. Therefore, pooled analysis of two years data was carried out as per method described by Panse and Sukhatme (1967).

3.1.3 Efficacy of different insecticides against major pests of groundnut :

The experiments were laid out in kharif season of 1988 and 1989 in randomised block design with ten treatments and three replications using JL-24 variety. The gross and net plot sizes adopted were 3.0 x 4.0 and 2.4 x 3.8 m, respectively.

The treatments were as under :

T1 - Carbofuran 3 G @ 1 Kg a.i./ha + monocrotophos 0.05 per cent a.i.

T2 - Phorate 10 G @ 1 Kg a.i./ha + monocrotophos 0.05 per cent a.i.

T3 - Monocrotophos 0.05 per cent a.i.

T4 - Lambdacyhalothrin 0.004 per cent a.i.

T5 - Cartap 0.1 per cent a.i.

T6 - Indiara 1 per cent.

T7 - Neemark 1 per cent.

T8 - Triazophos 0.05 per cent a.i.

T9 - Ethofenprox 0.05 per cent a.i.

T10 - Control (Untreated)

The details of insecticides used in the above trial are given in Table 1.

3.1.3.1 Methods of recording observations :

Observations were recorded on the nymphal population of jassid, thrips and leaf miner larvae per plant on five plants, selected randomly. The counts were taken, one day before and one and seven days after the sprayings.

3.1.3.2 Yield data :

The yields of dry pods were recorded from each experimental net plot after harvest.

3.1.3.3 Statistical analysis :

The data were statistically analysed adopting standard analysis of variance method given by (Panse and Sukhatme,1967). Treatment variance was compared with

variance to test the null hypothesis at P = 0.05 level.

3.1.3.4 Pooled analysis :

Pooled analysis of the data for two years was carried out as per method given by Panse and Sukhatme(1967)

3.1.4 Field screening of cultivars/varieties against major pests of groundnut :

The experiments were conducted in kharif season of 1988 and 1989, in randomised block design with fourteen treatments and two replications. The plot size was 90 cm x 3 meter with the row spacing of 45 x 15 cm. The details of the treatments are as under.

T1	-	LGS-10	T2	-	ICG-5030
T3	-	ICG-2271	T4	-	GBFDS-273
T5	-	ICG-1363	T6	-	ICG-49
T7	-	ICG-10718	T8	-	ICG-134
T9	-	ICG-9559	T10	-	ICG FDRS-33
T11	-	9/136-2187	T12	-	TMV-2 (S.C.)
T13	-	SB XI- (LC)	T14	-	JL-24 (N.C.)

3.1.4.1 Method of observations :

The observations were recorded weekly on the population of jassid nymphs, thrips and leaf miner as per the procedure outlined earlier.

3.1.4.2 Yield data :

Yield of dry pods was recorded from each cultivar/ variety after harvest.

3.1.4.3 Pooled analysis :

Pooled analysis of two years data was carried out as per Panse and Sukhatme(1967)except for the yield.

3.2 Laboratory studies :

3.2.1 Biological studies of leaf miner on different hosts :

3.2.1.1 Rearing technique of leaf miner :

The initial culture of leaf miner A. modicella was procured from infested field of groundnut and soybean in the month of August 1990. The larvae were fed until pupation and pupae collected were kept in a plastic container for adult emergence. Sexing was done in the pupal stage (Lavekar et al.,1992).

The newly emerged male and female moths (1:1) were introduced in a large sized plastic container. Live plants of groundnut and soybean were maintained in plastic jars for egg laying. Their tops were tied with muslin cloth and food was served through dipped cotton swabs 5 per cent honey solution. Every day fresh plant was placed for egg laying. Old plants were removed and kept under observation till hatching. Later, first instar larvae were transferred into individual plastic container with fresh leaves of the host plants i.e. groundnut and soybean. The food was changed on alternate

day until pupation. The rearing was continued for a generation and nucleus culture was maintained on host plants. From third generation onwards culture was used for laboratory investigations. All the laboratory experiments were conducted in the Department of Entomology, Marathwada Agricultural University, Parbhani at 27 ± 2 °C temperature.

3.2.2 Biological studies of leaf miner on groundnut var. JL-24 and soybean var. PK-472 :

In order to study the biology, 100 larvae of first instar (0-12 hours) were removed from the plants of groundnut and soybean and were reared individually in plastic boxes. Observations on hatching, larval period, pre-pupal period, pupal period, successful adult emergence, fecundity as well as longevity of adult, i.e. male and female and mortalities of life stages were recorded daily. For determining the age specific fecundity, the total number of adults emerged on a particular day were transferred to separate plastic jars for egg laying. The live host plants were maintained in the container and the adults were released for oviposition, the number of eggs laid per female was recorded.

Table 1 : Details of insecticides used.

Sr. No.	Commom name of the insecticide	Trade name	Formu-lation	Chemical name	Source of supply
1.	Carbofuran	Furadon	3 G	2-3-Dehydro-2,2-diethyl-7 benzo furanyl methyl carbamate.	Rallis India Limited,Bombay.
2.	Phorate	Thimet	10 G	0,0-diethyl-S-(ethylthio)methyl) phosphorodithroate.	American Cynamid Company, Bombay.
3.	Monocrotophos	Nuvacron	36 SC	Dimethyl phosphate of 3-hydroky -N-methyl US crotonomide.	Ciba Giegy of India Ltd.,Bombay
4.	Lambdacyhalothrin	Karate	5 EC	---	ICI India Limited, Madras.
5.	Cartap	Padan	50 SP	S-S-(2-(dimethylmino)tri methylene bis (thio carbamate) hydro chloride.	Coromandal Indag Products India Pvt.Ltd. Madras.
6.	Triazophos	Hostathion	40 EC	1-phenyl-1-2-4-Trizoyat-3-(0-0-diethyl thiono phosphate).	Hoechst India Limited, Bombay.
7.	Ethofenprox	Trebon	10 EC	2-(4-ethoxy phenyl) 2-methyl propyl 3-phenoxy benzyl ether	Coromandal Indag Products India Pvt.Ltd., Madras.
8.	Indiara	--	--	---	Herringer Bright Chemical Pvt.Ltd., Pune.
9.	Neemark	--	0.03 EC	Azadirachtin	West Coast Herbochem Pvt.Ltd.,Bombay.

RESULTS

Chapter IV

RESULTS

The present investigations were carried out for management of major pests of groundnut. The results obtained are presented under the following heads.

4.1 Biological studies of leaf miner on different hosts.

4.2 Population dynamics of major pests of groundnut.

4.3 Assessment of crop losses in groundnut due to the pest complex.

4.4 Field screeing of groundnut cultivars against major pests.

4.5 Efficacy of different insecticides against major pests of groundnut.

4.1 Biological studies of leaf miner on groundnut and soybean :

The biology of leaf miner was studied on groundnut and soybean during the year,1989.

4.1.1 The egg :

Observations on the eggs taken both in the laboratory and the field, revealed that female moths laid the eggs singly or in groups of two or three on the lower side of leaves and also on twigs over the growing points. The egg looked rectangular, which remained embedded in the leaf tissues. The freshly laid egg was

white in colour. Before hatching the egg turned light brown and distal tip acquired dark brown colour.

4.1.1.2 Egg period :

Persual of the data presented in Table 2 revealed that the egg period varied from 5 to 6 days on both the hosts i.e. groundnut and soybean. No significant differences in the egg period were observed. The mean egg period, varied from 5.46 to 5.52 days, on groundnut and soybean, respectively.

4.1.2 The larva :

The neonate larva was light green which turned dark green after attaining full growth. The head and prothoracic plate was black. Pink brown to violet patches were noted on dorsum of fourth and fifth abdominal segments.

Table 2 : Egg period of A. modicella on groundnut and soybean.

Sr. No.	Host plant	Egg duration in days			S.D.
		Minimum	Maximum	Mean	
1.	Groundnut	5	6	5.46	0.51
2.	Soybean	5	6	5.52	0.50
	Mean	5	6	5.49	--

The data on larval period presented in Table 3 indicated that the larval period ranged from 13-15 days amd 8-10 days on groundnut and soybean, respectively. Whereas, mean, larval period was 14.20 and 9.00 days on groundnut and soybean, respectively.

Table 3 : Larval period of A. modicella on groundnut and soybean.

Sr. No.	Host plant	Larval duration in days			S.D.
		Minimum	Maximum	Mean	
1.	Groundnut	13	15	14.20	0.67
2.	Soybean	8	10	9.00	0.76
	Mean	10.5	12.50	11.6	--

4.1.3 The pupa :

Full grown larvae pupated in leaf folds of the host plant. The pupae were light brown to brown in colour. The pre-pupal stage lasted for a day.

Table 4 : Pupal period of leaf miner on groundnut and soybean.

Sr. No.	Host plant	Pupal duration in days			S.D.
		Minimum	Maximum	Mean	
1.	Groundnut	5	7	5.73	0.79
	Male	5	7	5.57	
	Female	5	7	6.12	
2.	Soybean	5	8	6.56	0.79
	Male	5	9	6.30	
	Female	5	8	6.66	
	Mean	5	7.5	6.14	--

The data on pupal period presented in Table 4 revealed that pupal duration fluctuated from 5 to 7 and 5 to 8 with an average of 5.73 and 6.56 days on groundnut and soybean, respectively.

Pupal duration of male and female ranged from 5 to 7 days with an average of 5.57 and 6.12 days on groundnut, where as it ranged from 5 to 9 ans 5 to 8 days with an average of 6.30 and 6.66 days on soybean.

4.1.4 The life cycle :

The data compiled on life cylce in Table 5 revealed that leaf miner completed its life cycle within 24-29 days with an average of 26.46 days on groundnut,under the laboratory conditions. Whereas, it ranged from 21-23 days with an average of 22.08 days when reared on

Plate No.1 : Larvae of Aproaerema modicella.

Plate No 1 : Pupae of Aproaerema modicella.

soybean. The differences in the life cycle of male and female adults were negligible on both the host plants.

Table 5 : Development period from egg to adult emergence of leaf miner on groundnut and soybean.

Sr. No.	Host plant	Development period in days			S.D.
		Min.	Max.	Mean	
1.	Groundnut	24	29	26.46	1.64
	Male	24	28	26.00	
	Female	24	29	26.87	
2.	Soybean	21	23	22.08	0.75
	Male	21	23	22.03	
	Female	21	23	22.13	
	Mean	22.5	26.00	24.27	

4.1.5 The adults :

The moths of leaf miner were small in size and dark brown fringed hairs were present on the inner and outer margins of hindwings. Two white specks were present in the centre of forewing close to the costal margins.

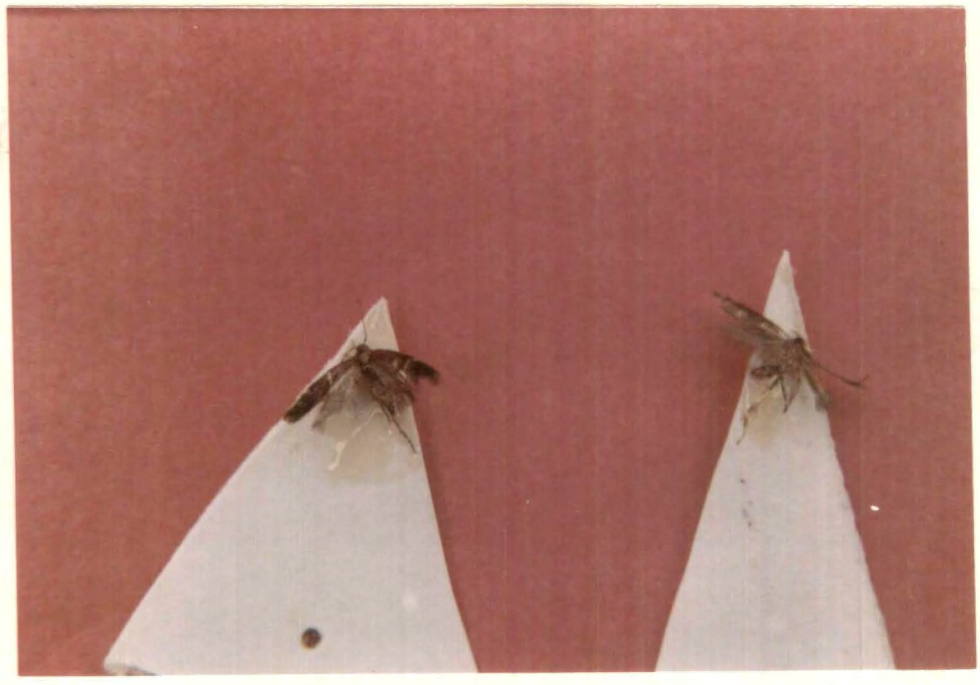
Table 6 : Longivity of male and female moths of leaf miner on groundnut and soybean.

Sr. No.	Host plant	Duration in days		
		Minimum	Maximum	Mean
1.	Groundnut-Male	5	8	6.03
	Female	6	10	9.15
2.	Soybean- Male	4	9	6.73
	Female	5	10	9.50

Perusal of the data on longevity of adults presented in Table 6, revealed that the longevity of female moth ranged from 6-10 days with an average of 9.15 days, whereas male moth recorded shorter life span in the range of 5-8 days with an average of 6.03 days on groundnut. The female longevity recorded on soybean ranged from 5 to 10 days with an average of 9.50 days and that of male moth ranged from 4 to 9 with an average of 6.73 days.

Table 7 : Fecundity of female leaf miner on groundnut and soybean.

Sr. No.	Host plant	Egg laid by female		
		Minimum	Maximum	Mean
1.	Groundnut	80	187	106
2.	Soybean	85	198	146
	Mean	82.50	192.5	126



It was evident from Table 17 that the oviposition on groundnut ranged from 80 and 187 eggs with an average of 106 eggs, whereas it ranged from 85 to 198 eggs with an average of 146 eggs on soybean. The sex ratio of 1:1.46 in groundnut and 1:1.50 in soybean were observed.

4.2 Population dynamics of major pests of groundnut.

Population of jassids, thrips and leaf miner were recorded on kharif groundnut grown during 1988 and 1989 seasons.

4.2.1 Incidence of jassids during kharif 1988 :

Data pertaining to the population of jassids recorded on groundnut crop during 1988 are presented in Table 8 and depicted in Fig.1.

Incidence of jassids (1.13 jassids/three leaves) was first noted in the second week of July (28th meteorological week). It continued upto the fourth week of October (43rd meteorological week). Maximum population (2.94 jassids/three leaves) was recorded during second week of August (32nd meteorological week) and reached to its minimum from the first week of October.

4.2.1.1 Incidence of jassids during Kharif 1989 :

The data on population of jassids on groundnut crop are presented in Table 9 and represented in Fig.1.

Incidence of jassids (0.31 jassids/three leaves) was first noticed in the first week of August (31st meteorological week) during 1989. Incidence of jassids

Table 8 : Population of Empoasca kerri recorded on groundnut crop during kharif 1988.

Month	Meteorological week	No.of jassids/ three leaves	Temperature °C		% Relative humidity		Sunshine hours	Wind/ speed km/hr	Rainfall (mm)	No.of rainy days
			Max.	Min.	Mor.	Even.				
July	28	1.13	31.02	23.71	82.71	59.42	1.7	7.3	4.48	6
	29	2.22	28.71	21.80	83.85	70.14	3.9	12.00	26.67	7
	30	2.48	29.87	22.24	92.28	64.28	2.2	11.3	14.52	6
August	31	2.79	28.95	22.14	88.25	69.28	0.7	9.8	0.68	2
	32	2.94	32.34	23.48	82.00	49.00	53	7.9	1.00	2
	33	2.79	31.35	22.95	86.00	60.00	4.7	7.7	11.62	4
	35	1.83	29.54	23.48	90.87	72.14	2.0	7.6	27.37	5
September	36	1.29	30.41	23.57	90.28	58.57	5.2	7.2	19.82	3
	37	1.23	31.20	23.57	85.57	50.28	7.7	5.2	1.55	3
	38	0.99	29.45	23.05	9,185	64.00	5.5	7.0	19.65	6
	39	1.20	31.07	23.10	88.14	64.42	7.3	7.9	14.91	5
October	40	0.36	32.75	20.92	89.85	62.42	6.3	8.8	3.1	4
	41	0.51	30.57	17.18	76.00	42.42	9.7	5.3	0.0	0
	43	0.45	32.76	14.76	68.00	27.14	11.3	4.6	0.0	0

Fig. 1. Population of jassids recorded

on groundnut crop during 1988 & 1989.

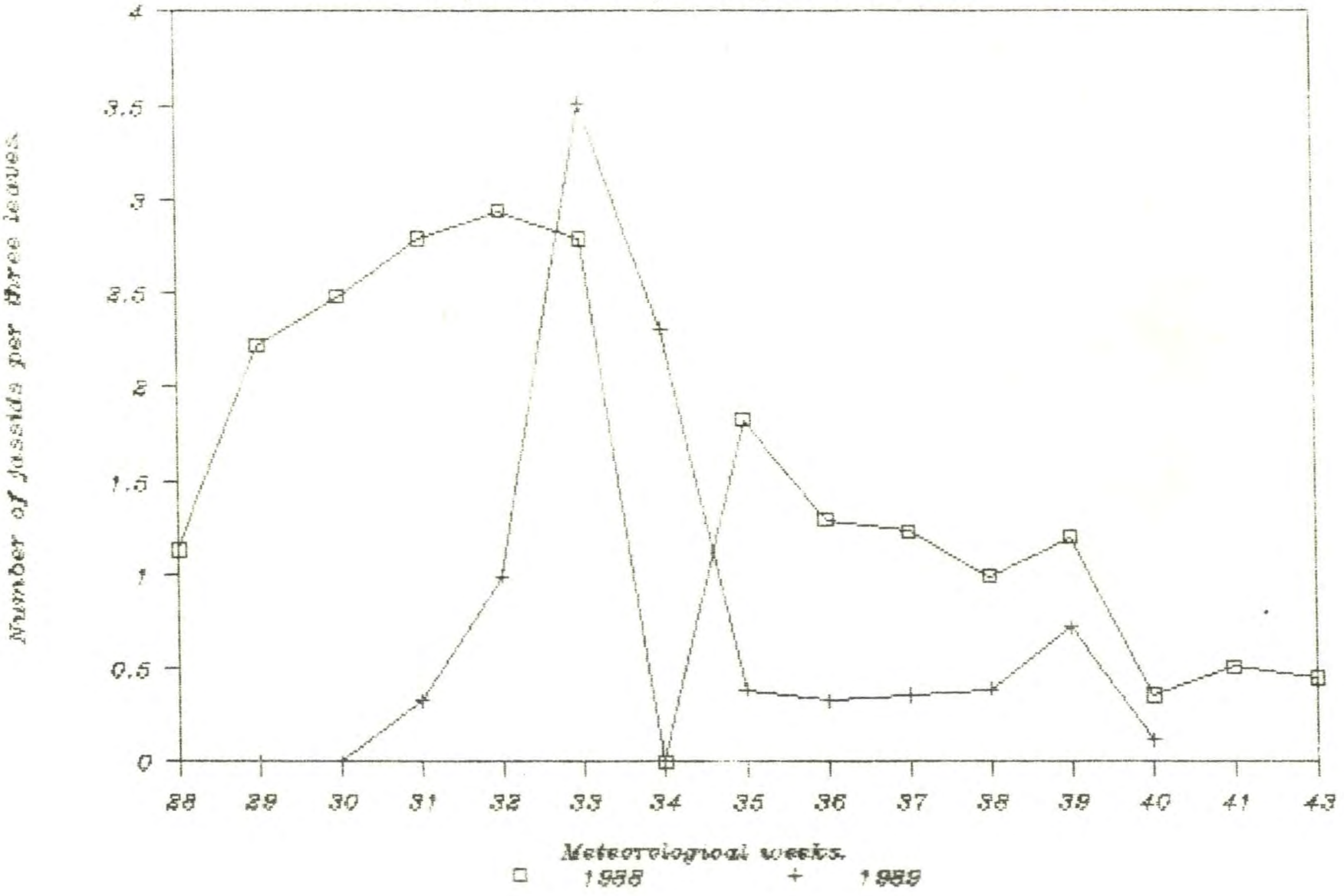


Table 9 : Population of Empoasca kerri recorded on groundnut crop during kharif 1989.

Month	Meteorological week	No.of jassids/ three leaves	Temperature °C		% Relative humidity		Sunshine hours	Wind/ speed km/hr	Rainfall (mm)	No.of rainy days
			Max.	Min.	Mor.	Even.				
August	31	0.33	30.72	22.0	84.8	57.8	6.0	13.6	0.17	1
	32	0.99	28.94	21.92	87.85	75.85	1.8	14.5	1.87	4
	33	3.51	29.14	21.05	91.28	3.6	12.8	29.25	29.25	4
	34	2.31	27.92	22.22	91.77	76.57	2.9	11.0	9.7	6
	35	0.39	29.34	21.12	89.85	72.28	5.0	10.5	25.95	3
September	36	0.33	30.90	21.12	86.71	59.71	8.0	6.5	0.00	0
	37	0.36	31.52	21.78	87.42	64.24	5.7	10.0	3.08	3
	38	0.39	32.80	22.50	85.28	61.71	8.1	5.0	2.17	1
	39	0.72	31.80	22.27	93.28	62.57	7.9	5.6	4.48	4
October	40	0.12	32.81	20.20	87.00	43.14	7.7	4.4	1.14	1

continued upto first week of October (40th meteorological week) and reached its peak (3.51 jassids/three leaves) during third week of August (33rd meteorological week) and minimum (0.12 jassid/ 3 leaves) in the first week of October (48th meteorogical week).

4.2.2 Incidence of thrips during kharif 1988 :

The data on population of thrips recorded on groundnut crop are presented in Table 10 and depicted in Fig.2.

Perusal of the data revealed that the incidence of thrips (1.68 thrips/3 leaves) started from third week of August (33th meteorological week). Maximum population (1.68 thrips/3 leaves) was observed during the same week and in subsequent weeks the population started declining. It was minimum (0.40 thrips/3 leaves) in the first week of October (40th meteorological weeks).

4.2.2.1 Incidence of thrips during kharif 1989 :

Population of thrips recorded on groundnut crop during 1989 are presented in Table 11 and represented in Fig.2.

Population of thrips (9.75/3 leaves) commenced from third week of August (33th meteorological week) and continued upto third week of September (38th meteorological week).It was maximum in middle of August.

Fig.2 Population of thrips recorded on

groundnut crop during 1988 and 1989.

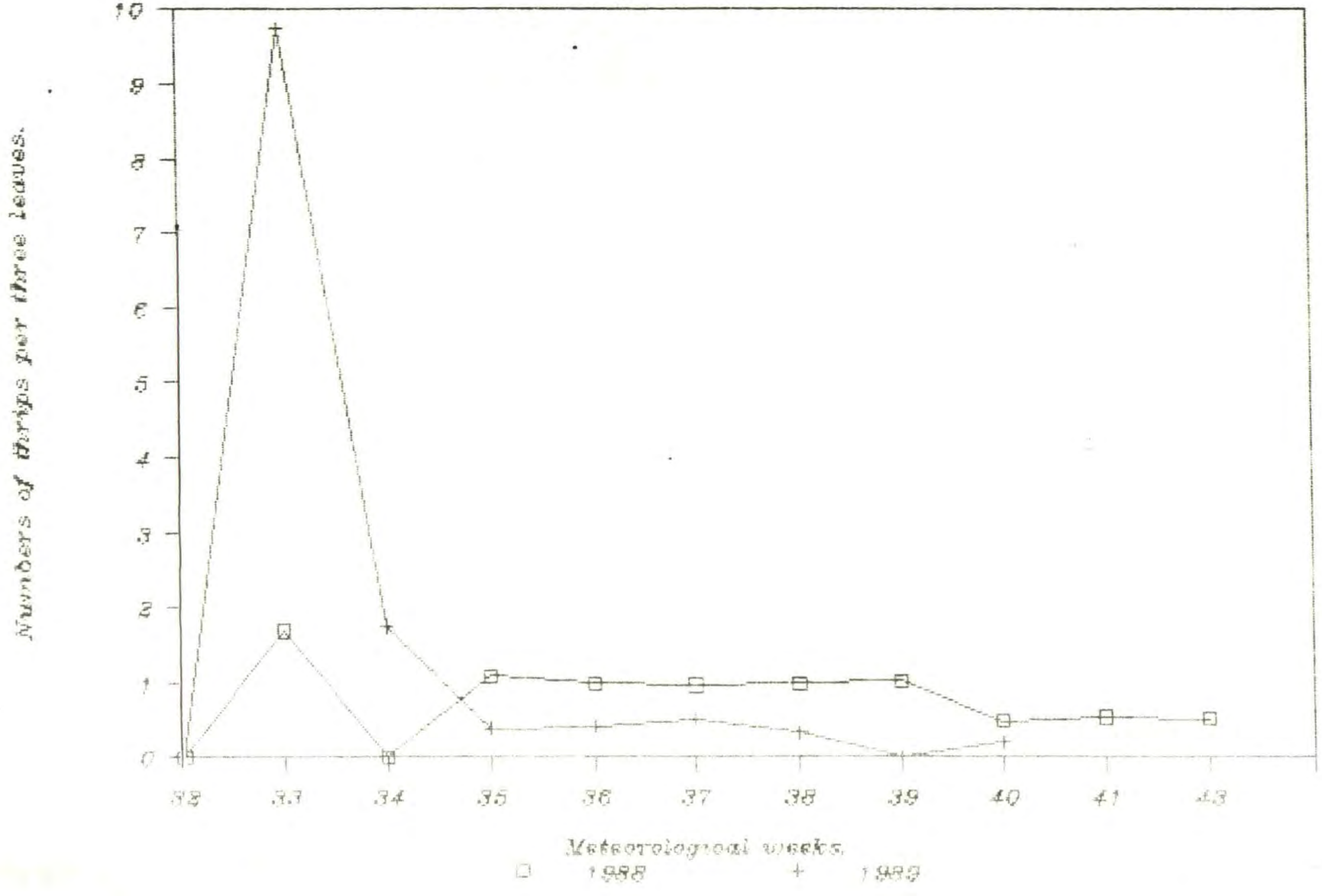


Table 10 : Population of Scirtothrips dorsalis recorded on groundnut crop during 1988.

Month	Meteorological week	No.of thrips/ three leaves	Temperature °C		% Relative humidity		Sunshine hours	Wind/ speed km/hr	Rainfall (mm)	No.of rainy days
			Max.	Min.	Mor.	Even.				
August	33	1.68	31.35	22.95	86.00	60.00	4.7	7.7	11.62	4
	35	1.08	29.54	23.48	90.71	72.14	2.0	7.6	27.37	5
September	36	0.99	30.41	23.57	90.28	58.57	5.2	7.2	19.82	3
	37	9.96	31.20	23.57	85.57	50.28	7.7	5.2	1.55	3
	38	0.99	29.45	23.05	91.85	64.00	5.5	7.0	19.65	6
	39	1.02	31.07	23.10	88.14	64.42	7.2	7.9	14.91	5
October	40	0.48	32.75	20.92	89.85	62.42	6.3	8.8	3.10	4
	41	0.54	30.57	17.18	76.00	42.42	9.3	5.3	0.00	0
	43	0.51	32.78	14.67	68.00	27.14	11.3	4.6	0.00	0

Table 11 : Population of Scirtothrips dorsalis recorded on groundnut crop during 1989.

Month	Meteorological week	No.of thrips/ three leaves	Temperature °C		% Relative humidity		Sunshine hours	Wind/ speed km/hr	Rainfall (mm)	No.of rainy days
			Max.	Min.	Mor.	Even.				
August	32	0.00	28.84	21.92	87.85	75.85	1.8	17.5	1.87	4
	33	9.75	29.14	21.05	91.28	72.28	3.6	12.8	29.25	4
	34	1.75	27.92	22.12	91.71	76.57	2.9	11.0	9.7	6
	35	0.39	29.34	21.12	89.85	72.28	5.0	10.5	25.94	3
September	36	0.42	30.90	21.12	86.71	8.0	6.5	0.0	0.00	0
	37	0.51	31.52	21.78	87.72	64.14	5.7	10.0	3.08	3
	38	0.33	32.80	22.5	85.38	61.71	8.1	5.0	2.17	1
	39	0.00	31.80	22.24	93.28	65.57	7.9	5.6	4.48	4
October	40	0.20	32.81	20.20	87.00	43.14	7.7	4.4	1.14	1

4.2.3 Incidence of leaf miner during the kharif 1988 :

The data on population of leaf miner on groundnut crop are presented in Table 12 and depicted in Fig.3.

During the year 1988, the population of leaf miner (0.60/plant) was first noticed in the last week of July (30th meteorological week) and continued upto second week of September.Maximum population (1.15 larvae/plant) was observed in middle of August (33th meteorological week).

4.2.3.1 Incidence of leaf miner during kharif 1989 :

Population of leaf miner recorded on groundnut crop during 1989-90 are presented in Table 13 and in Fig.3.

Population of leaf miner (0.30 larvae/plant) started appearing from the second week of August (32nd meteorological week) little later as compared to kharif season of 1988. (1.80 larvae/plant) was recorded in the fourth week of August (34th meteorological week), whereas it was lowest (0.08 larvae/plant) in the second week of September (37th meteorological week).

4.2.4 Relationship between weather parameters and pests of groundnut :

The relation between weather parameters and different pests of groundnut was studied. Path analysis was performed to study the correlation, combined effect as well as direct and indirect effects of weather parameters on incidence of different pests of groundnut during kharif seasons of 1988 and 1989.

Fig.3 Population of leafminer recorded

on groundnut crop during 1988 and 1989.

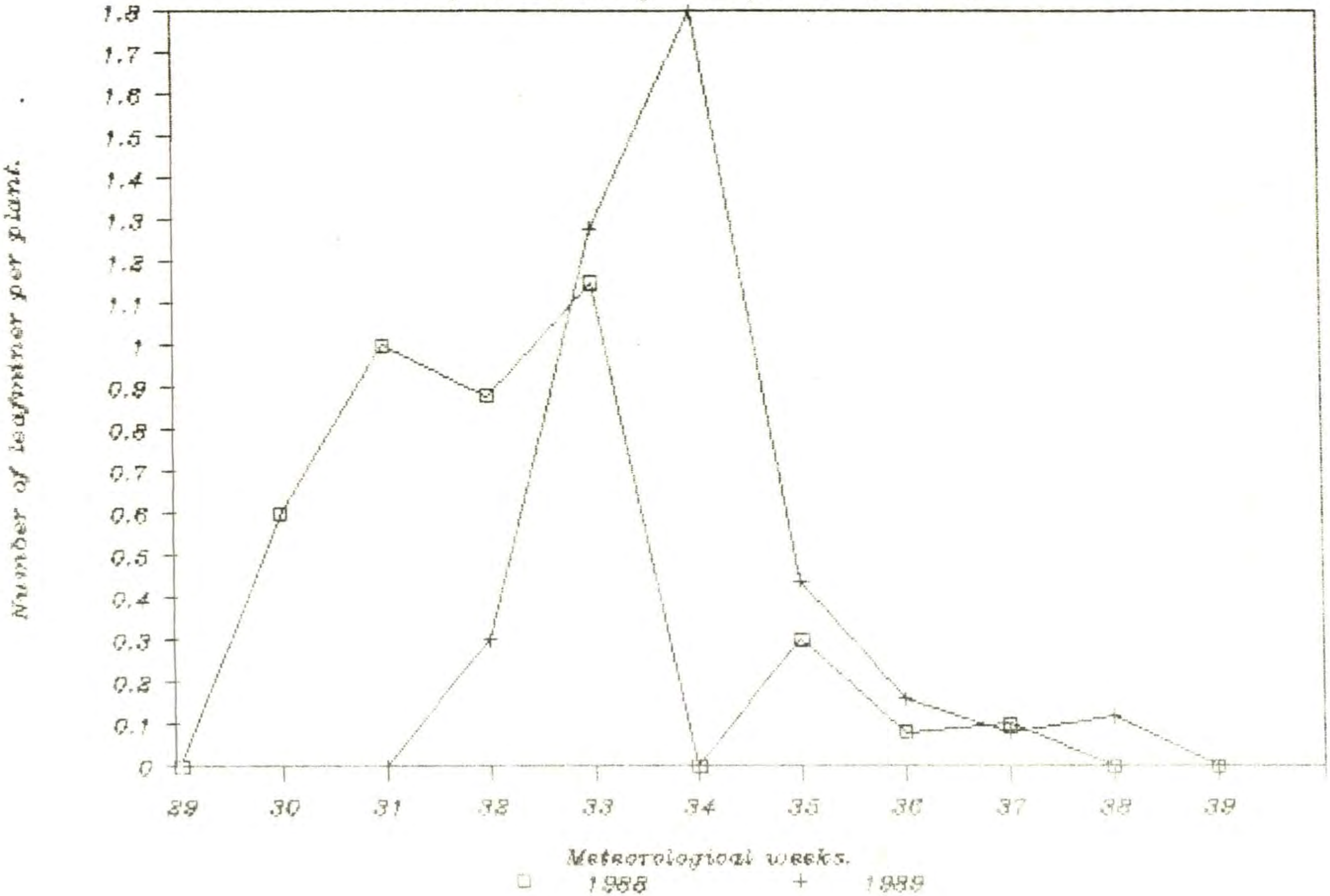


Table 12 : Population of Aproaerema modicella, recorded on groundnut crop during 1988.

Month	Meteoro-logical week	No.of leaf miner/plant	Temperature °C		% Relative humidity		Sunshine hours	Wind/ speed km/hr	Rainfall (mm)	No.of rainy days
			Max.	Min.	Mor.	Even.				
July	29	0.00	28.77	21.88	83.85	70.14	3.9	12.00	26.67	7
	30	0.60	29.87	22.24	92.28	64.28	2.2	11.3	14.52	6
August	31	1.00	28.95	22.14	88.85	69.28	0.7	9.8	0.68	2
	32	0.88	32.34	23.48	82.00	49.00	5.3	7.9	1.00	2
	33	1.15	31.35	22.95	86.00	60.00	4.7	7.7	11.62	4
	35	0.30	29.54	23.48	90.71	72.14	2.0	7.6	27.37	5
September	36	0.08	30.41	23.57	90.28	58.57	5.2	7.2	19.82	3
	37	0.10	31.20	25.87	85.57	50.28	7.7	5.5	1.55	3
	38	0.00	29.45	23.05	91.85	64.00	5.5	7.0	19.65	6

Table 13 : Population of Aproaerema modicella, recorded on groundnut crop during 1989.

Month	Meteoro-logical week	No.of leaf miner/plant	Temperature °C		% Relative humidity		Sunshine hours	Wind/ speed km/hr	Rainfall (mm)	No.of rainy days
			Max.	Min.	Mor.	Even.				
August	31	0.00	30.72	22.00	87.85	57.80	6.0	13.6	0.77	1
	32	0.30	28.94	21.92	91.28	75.85	1.8	1.87	1.87	4
	33	1.28	20.14	21.05	91.71	72.28	3.6	12.8	29.25	4
	34	1.80	27.92	22.12	89.85	76.57	2.9	11.0	9.7	6
	35	0.44	29.34	21.12	86.71	72.28	5.0	10.5	25.94	3
September	36	0.16	30.90	21.12	87.71	58.71	8.0	6.50	0.00	0
	37	0.08	31.52	21.78	85.28	64.14	5.7	10.0	3.08	3
	38	0.12	32.80	22.50	84.80	61.71	8.1	5.0	2.17	1
	39	0.00	31.80	22.75	93.28	62.57	7.9	5.6	4.48	4

4.2.4.1 Correlation studies :

Correlation co-efficients were worked out between weather components and incidence of jassids, thrips and leaf miner.

4.2.4.1.1 Correlation between weather parameters and incidence of jassids :

The correlation co-efficient between weather parameters and population of jassids are presented in Table 14.

Results revealed that during 1988 jassid population and wind speed km/hr showed positively significant correlation whereas, it was significantly negative with sunshine hours. The correlation observed with minimum temperature, morning relative humidity, rainfall and number of rainy days were positive and non significant.

Similarly non significant and negative correlation were noted with maximum temperature and evening relative humidity.

In 1989 the relation of jassid population with rainfall and number of rainy days was positively significant whereas it was negatively correlated with maximum temperature. The correlation between jassid population and other weather parameters were positive and non significant except sunshine hours, which exhibited the negative correlation.

Table 14 : Correlation co-efficient between weather parameters and population of jassids (1988 and 1989).

Abiotic factors	Correlation co-efficient (r value)		
	1988	1989	Combined effect (Pooled)
Temperature ^{o}C (maximum)	-0.332	-0.635*	-0.474*
Temperature ^{o}C (minimum)	0.483	0.004	0.337
% Relative humidity (morning)	0.324	0.590	0.236
% Relative humidity (Evening)	-0.004	0.591	0.053
Sunshine hours	-0.634*	-0.616	-0.606*
Wind spead km/hour	0.586*	0.452	0.351
Rainfall (mm)	0.178	0.642*	0.422*
Number of rainy days	0.220	0.659*	0.444*
Significant P = (0.05)*			
No.of observation (n)	14	10	24

On the basis of pooled results, the correlation between jassids population and rainfall and number of rainy days it was positive and significant. Whereas, the relation of jassids population with maximum temperature and sunshine hours was negatively significant. The correlation between jassids population and all the other remaining weather components was positive and non-significant.

4.2.4.1.2 Correlation between weather parameters and incidence of thrips :

The correlation co-efficients between weather parameters and population of thrips were worked out and presented in Table 15.

The correlation co-efficient values given in Table 15 revealed that in 1988 population of thrips was positively correlated with all weather factors studied except maximum temperature and sunshine hours. The association was significant with minimum temperature.

In 1989, the correlation of thrips population with rainfall was positively significant. Whereas, morning relative humidity, evening relative humidity, wind speed km/hour and number of rainy days showed positively non significant correlation. The association between thrips population and other remaining weather components was negative and non significant.

On the basis of pooled results the correlation of thrips population with rainfall was positive and significant. All other weather components were positively correlated with thrips population except maximum temperature and sunshine hours. However, the correlation value were non significant.

4.2.4.1.3 Correlation between weather parameters and the incidence of leaf miner :

The correlation co-efficient between weather parameters and population of leaf miner were worked out and presented in Table 16.

Table 15 : Correlation co-efficient between weather parameters and population of thrips (1988 and 1989).

Abiotic factors	Correlation co-efficient (r value)		
	1988	1989	Combined effect (Pooled)
Temperature °C (maximum)	-0.400	-0.378	-0.352
Temperature °C (minimum)	0.674*	-0.228	0.033
% Relative humidity (morning)	0.462	0.364	0.199
% Relative humidity (evening)	0.512	0.307	0.265
Sunshine hours	-0.619	-0.368	-0.316
Wind speed km/hour	0.345	0.429	0.428
Rainfall (mm)	0.538	0.713*	0.542*
Number of rainy days	0.538	0.296	0.225
* No.of observations (n)	9	9	18

* Significant P = (0.05)

The correlation co-efficient values given in Table 16 revealed that in 1988 leaf miner population was positively correlated with minimum temperature and wind speed km/hour. Whereas, all the other weather components were negatively correlated with leaf miner population. The correlation was non significant with all weather components.

During the year 1989, the correlation of leaf miner population with number of rainy days was positively significant, while maximum temperature and evening relative humidity showed negative and significant correlation.

On the basis of pooled results, the correlation of leaf miner population with sunshine hours was negative and significant, whereas, established positively significant correlation with morning relative humidity, wind speed km/hours, rainfall and number of rainy days was evident. Maximum and minimum temperature manifested negative correlation with leaf miner population.

4.2.5 Path coefficient analysis of weather factors affecting the pests of groundnut :

Though the correlation studies are helpful in measuring the association between pests of groundnut and weather parameters, they do not provide exact picture of the direct and indirect effects of association.

Table 16 : Correlation co-efficient between weather parameters and population of leaf miner during 1988 and 1989.

Abiotic factors	Correlation co-efficient (r value)		
	1988	1989	Combined effect Pooled
Temperature °C (Maximum)	0.330	-0.775*	-0.387
Temperature °C (Minimum)	-0.327	-0.062	-0.149
% Relative humidity (Morning)	-0.184	0.612	0.350
% Relative humidity (Evening)	-0.065	0.728*	0.341
Sunshine hours	-0.419	0.624	-0.514
Wind spead km/hour	0.148	0.332	0.268
Rainfall (mm)	-0.528	0.556	0.114
Number of rainy days	-0.448	0.648*	0.204
* No. of observation (n)	9	9	18

* Significant P = (0.05)

Which can be determined from the path analysis. Thus, path co-efficient analysis are very useful to pin point the important weather components that can be utilized for predicting the population of pests of groundnut. The path analysis was therefore worked out using correlation of abiotic factors with the incidence of pest complex of groundnut. The path analysis was carried out for jassids, thrips and leaf miner infesting groundnut crop.

4.2.5.1 Direct and indirect effects of weather parameters on jassid incidence :

The results of direct and indirect effects of weather parameters on jassid population during 1988-1989 alone or combined effects are presented in Table 17,18 and 19.

The results (Table 17) revealed that during 1988, minimum temperature, wind speed(km/hour)and rainfall has shown direct positive effects and all other weather factors indicated negative direct effects on jassid population. Among the weather components minimum temperature, wind speed(km/hour)and number of rainy days were most important factors as they gave higher positive and negative direct effects, respectively. Barring maximum temperature, all the components contributed towards increasing jassids population by their indirect effects via rainfall.

Table 17 : Direct (diagonal) and indirect (off diagonal) effects of the abiotic factors on the population of jassids, Empoasca kerri during 1988.

Abiotic factors	Temp. (Max.)	Temp. (Min.)	% RH (Mor.)	% RH (Even.)	Sunshine hours	Wind speed km/hr.	Rainfall (mm)	No.of rainy days
Temperature °C (Maximum)	-0.149	0.049	0.071	0.081	-0.087	0.075	0.092	0.070
Temperature °C (Minimum)	-0.287	0.869	0.697	0.348	-0.579	0.318	0.409	0.565
% Relative humidity (Morning)	0.214	-0.361	0.450	-0.251	0.297	0.239	-0.246	-0.292
% Relative humidity (Evening)	0.265	-0.195	-0.271	-0.486	0.245	-0.248	-0.197	-0.240
Sunshine hours	-0.160	0.184	0.182	0.139	-0.276	0.190	0.094	0.164
Wind spead km/hour	-0.436	0.319	0.462	0.445	0.599	0.871	0.345	0.546
Rainfall (mm)	-0.122	0.093	0.108	0.080	-0.067	0.078	0.198	0.140
Number of rainy days	0.344	-0.476	-0.475	-0.362	0.434	-0.459	-0.518	-0.732

Residual effect = 0.3478

Table 18 : Direct (diagonal) and indirect (off diagonal) effects of the abiotic factors on the population of jassids, Empoasca kerri during 1989.

Abiotic factors	Temp. (Max.)	Temp. (Min.)	% RH (Mor.)	% RH (Even.)	Sunshine hours	Wind speed km/hr.	Rainfall (mm)	No.of rainy days
Temperature °C (Maximum)	-0.016	0.001	0.007	0.012	-0.012	0.010	0.008	0.009
Temperature °C (Minimum)	-0.026	0.775	0.038	0.328	-0.071	0.121	-0.218	0.235
% Relative humidity (Morning)	-0.440	0.048	0.977	0.482	-0.309	0.054	0.537	0.781
% Relative humidity (Evening)	0.668	-0.377	-0.447	-0.891	0.703	-0.582	-0.466	-0.569
Sunshine hours	-1.514	0.179	0.613	1.536	-1.941	1.661	0.814	1.415
Wind spead km/hour	0.338	-0.079	-0.028	0.435	-0.508	-0.172	-0.228	-0.228
Rainfall (mm)	-0.343	-0.185	0.361	0.345	-0.276	0.223	0.657	0.289
Number of rainy days	0.697	-0.356	0.939	-0.882	0.856	-0.526	-0.517	-1.174

Residual effect = 0.5692

During 1989 the data (Table 18) revealed that minimum temperature, morning relative humidity and rainfall with direct positive effect and maximum temperature, evening relative humidity, sunshine hours wind speed km/hour and number of rainy days with their negative direct effects influenced the jassid population. Among all weather components, sunshine hours and number of rainy days were found to be the most important components as they exhibited highest negative direct effect. All the weather factors, except maximum temperature contributed their direct effects through evening relative humidity.

Pooled results of two years data (Table 19) revealed that minimum temperature, wind speed km/hour and rainfall exerted direct positive effects and all other weather factors had negative direct effects on jassid population. Among the weather components, sunshine hours and evening relative humidity were most important factors as they exhibited negative effects. Except maximum temperature, all the weather components contributed mainly by their indirect effect through wind speed km/hour.

4.2.5.2 Direct and indirect effects of weather parameters in the incidence of thrips :

The results on direct and indirect effects of weather parameters on thrips during 1988, and 1989 with pooled data are presented in Table 20,21 and 22.

Table 19 : Combined direct and indirect effect of the abiotic factors on the population of jassids recorded in 1988 and 1989.

Abiotic factors	Temp. (Max.)	Temp. (Min.)	% RH (Mor.)	% RH (Even.)	Sunshine hours	Wind speed km/hr.	Rainfall (mm)	No.of rainy days
Temperature °C (Maximum)	-0.176	0.038	0.067	0.02	-0.112	0.101	0.098	0.087
Temperature °C (Minimum)	-0.022	0.102	0.071	0.036	-0.058	0.021	0.031	0.057
% Relative humidity (Morning)	0.029	-0.053	-0.076	-0.045	0.040	-0.027	-0.033	-0.041
% Relative humidity (Evening)	0.226	-0.151	-0.253	-0.431	0.217	-0.229	-0.148	-0.180
Sunshine hours	-0.362	0.321	0.303	0.287	-0.570	0.373	0.212	0.361
Wind spead km/hour	-0.037	0.013	0.022	0.034	-0.042	0.064	0.019	0.026
Rainfall (mm)	-0.143	0.078	0.112	0.088	-0.096	0.076	0.257	0.157
Number of rainy days	0.011	-0.012	-0.012	-0.009	0.014	-0.009	-0.013	-0.022

Residual effect = 0.6752

The results (Table 20) indicated that in 1988, minimum temperature, wind speed km/hour and number of rainy days with their direct positive effects and maximum temperature, morning relative humidity, evening relative humidity, sunshine hours and rainfall with their direct negative effects, contributed towards the population of thrips. Amongst the weather components, morning and evening relative humidity and minimum temperature were most important weather components since they produced highest negative and positive direct effects,respectively. Barring maximum temperature all components mainly contributed towards thrips population by their indirect effects through rainfall.

During 1989 (Table 21) it was noticed that the maximum and minimum temperature, morning relative humidity, sunshine hours, wind speed km/hour and rainfall showed direct positive effects, whereas evening relative humidity and number of rainy days indicated the direct negative effects. The highest positive direct effect on population was exerted by the maximum temperature whereas, evening relative humidity produced negative effects on the population. All weather factors except the maximum temperature contributed mainly with their indirect effect through wind speed km/hour.

Pooled results (Table 22) revealed that the minimum temperature, morning relative humidity, sunshine hours, wind speed km/hour and rainfall showed direct positive effects.

Table 20 : Direct (diagonal) and indirect (off-diagonal) effect of the abiotic factors on the population of thrips observed during 1988.

Abiotic factors	Temp. (Max.)	Temp. (Min.)	% RH (Mor.)	% RH (Even.)	Sunshine hours	Wind speed km/hr.	Rainfall (mm)	No.of rainy days
Temperature C (Maximum)	-1.207	0.649	0.620	0.651	-0.720	0.129	0.898	0.560
Temperature C (Minimum)	-1.327	2.470	2.282	2.129	-1.974	-1.504	1.660	2.073
% Relative humidity (Morning)	1.445	-0.602	-2.816	-2.667	2.362	-2.208	-1.963	-2.523
% Relative humidity (Evening)	1.490	-2.382	-2.616	-2.763	2.488	-2.351	-2.727	-2.510
Sunshine hours	-0.657	0.879	0.927	0.991	-1.101	0.780	0.919	0.846
Wind spead km/hour	-0.218	1.289	1.659	1.800	-1.500	2.116	1.144	1.594
Rainfall (mm)	0.558	-0.504	-0.523	-0.577	0.627	-0.406	-0.750	-0.545
Number of rainy days	-0.483	0.875	0.934	0.947	-0.801	0.785	0.757	1.042

Residual effect = 0.0632

Table 21 : Direct (diagonal) and indirect (off-diagonal) effect of the abiotic factors on the population of thrips observed during 1989.

Abiotic factors	Temp. (Max.)	Temp. (Min.)	% RH (Mor.)	% RH (Even.)	Sunshine hours	Wind speed km/hr.	Rainfall (mm)	No.of rainy days
Temperature °C (Maximum)	7.070	0.589	3.443	6.091	-7.091	-6.271	6.076	3.794
Temperature °C (Minimum)	-0.579	6.951	1.116	3.454	-0.759	0.648	-1.706	2.715
% Relative humidity (Morning)	-0.224	0.074	0.460	0.207	-0.150	0.133	0.232	0.359
% Relative humidity (Evening)	11.271	-6.502	-5.894	-13.082	10.449	-10.090	-6.446	-9.612
Sunshine hours	2.043	-0.252	-0.753	-1.840	2.304	-2.197	-0.968	-1.734
Wind spead km/hour	-5.420	0.588	1.827	5.259	-6.014	6.307	3.094	4.136
Rainfall (mm)	-1.895	-0.867	1.782	1.740	-1.484	1.732	3.531	1.391
Number of rainy days	1.495	-0.809	-1.616	-1.522	1.559	-1.362	-0.816	-2.072

Residual effect = 0.0740

Table 22 : Combined direct and indirect effect of the abiotic factors on the population of thrips recorded in 1988 and 1989.

Abiotic factors	Temp. (Max.)	Temp. (Min.)	% RH (Mor.)	% RH (Even.)	Sunshine hours	Wind speed km/hr.	Rainfall (mm)	No.of rainy days
Temperature °C (Maximum)	-0.007	0.002	0.003	0.005	-0.005	0.005	0.004	0.004
Temperature °C (Minimum)	-0.008	0.025	0.021	0.017	-0.015	0.006	0.010	0.017
% Relative humidity (Morning)	-0.143	0.282	0.339	0.280	-0.229	0.147	0.168	0.242
% Relative humidity (Evening)	0.425	-0.437	0.520	-0.632	0.537	-0.480	-0.340	-0.455
Sunshine hours	0.244	-0.194	-0.221	-0.278	0.327	-0.258	-0.193	-0.236
Wind spead km/hour	-0.570	0.194	0.360	0.629	-0.653	0.829	0.325	0.432
Rainfall (mm)	-0.377	0.257	0.322	0.350	-0.384	0.255	0.657	0.368
Number of rainy days	0.083	-0.097	-0.105	-0.106	-0.077	-0.083	-0.147	

Residual effect = 0.7259

Whereas,other weather factors showed the negative direct effects. The highest positive and negative direct effects on thrips population were effected by wind speed km/hour and evening relative humidity, respectively. Except maximum temperature all other weather components contributed mainly by their indirect effects through wind speed km/hour.

4.2.5.3 Direct and indirect effects of weather parameters on the incidence of leaf miner :

The results (Table 23) revealed that during 1988, maximum temperature, morning relative humidity, evening relative humidity, sunshine hours and wind speed km/hour showed direct positive effects and minimum temperature, rainfall and number of rainy days indicated negative direct effects on leaf miner population. Among the weather components, evening relative humidity and rainfall were most important weather components as they showed positive and negative direct effects,respectively. All other weather components except maximum temperature mainly contributed towards leaf miner population by their indirect effects via sunshine hours.

During 1989, the minimum temperature, morning relative humidity,rainfall and number of rainy days with their direct positive effects and maximum temperature, evening relative humidity, sunshine hours and wind speed km/hour with their direct negative effects contributed towards the development of leaf miner population (Table 24).

Table 23 : Direct (diagonal) and indirect (off-diagonal) effects of the abiotic factors on the population of leaf miner observed during 1988.

Abiotic factors	Temp. (Max.)	Temp. (Min.)	% RH (Mor.)	% RH (Even.)	Sunshine hours	Wind speed km/hr.	Rainfall (mm)	No.of rainy days
Temperature °C (Maximum)	1.898	1.115	-0.972	-1.702	1.142	-1.039	-1.071	-0.071
Temperature °C (Minimum)	-0.341	-0.580	0.090	0.398	-0.422	0.504	0.194	0.252
% Relative humidity (Morning)	-0.164	-0.050	0.321	0.156	0.126	-0.001	0.124	0.100
% Relative humidity (Evening)	-2.025	-1.545	1.097	2.251	-1.749	1.287	1.439	1.272
Sunshine hours	0.400	0.483	-0.261	-0.517	0.665	-0.432	-0.121	-0.084
Wind spead km/hour	-0.119	-0.188	-0.001	0.124	-0.141	0.216	0.056	0.104
Rainfall (mm)	0.538	0.328	-0.380	-0.628	0.179	-0.255	-0.982	-0.766
Number of rainy days	0.144	0.111	-0.079	-0.144	0.032	-0.122	-0.199	-0.254

Residual effect = 0.0316

Table 24 : Direct (diagonal) and indirect (off-diagonal) effects of the abiotic factors on the population of leaf miner recorded on 1989.

Abiotic factors	Temp. (Max.)	Temp. (Min.)	% RH (Mor.)	% RH (Even.)	Sunshine hours	Wind speed km/hr.	Rainfall (mm)	No.of rainy days
Temperature °C (Maximum)	-1.306	-0.460	0.843	1.098	-1.144	0.930	0.655	0.850
Temperature °C (Minimum)	0.158	0.447	-0.198	-0.058	0.049	-0.091	-0.212	0.091
% Relative humidity (Morning)	-0.182	0.124	0.160	-0.176	0.152	0.127	0.127	0.046
% Relative humidity (Evening)	2.193	0.340	-1.480	-2.606	2.282	-1.376	-1.443	-2.114
Sunshine hours	-2.820	-0.351	2.019	2.820	-3.219	2.722	1.222	2.252
Wind spead km/hour	1.622	0.464	-1.230	-1.176	1.926	-2.278	-0.630	-0.816
Rainfall (mm)	-0.410	-0.387	0.369	0.453	-0.311	0.226	0.818	0.329
Number of rainy days	-0.030	0.009	0.008	0.037	-0.037	-0.032	0.016	0.018

Residual effect = 0.1414

Amongst, the weather components rainfall and sunshine hours were most important factors as they produced highest positive and negative effects, respectively. All other weather components mainly contributed towards leaf miner population by their indirect effects through the evening relative humidity.

On the basis of pooled results for two years (Table 25), it was observed that morning relative humidity and number of rainy days showed the direct positive effects. Whereas, all other weather factors produced the direct negative effects on population of leaf miner. Among the weather components, morning relative humidity and sunshine hours exerted highest positive and negative direct effects,respectively. All the weather factors, except maximum temperature, contributed mainly by their indirect effects through evening relative humidity.

Table 25 : Combined direct and indirect effect of the abiotic factors on the population of leaf miner recorded in 1988 and 1989.

Abiotic factors	Temp. (Max.)	Temp. (Min.)	% RH (Mor.)	% RH (Even.)	Sunshine hours	Wind speed km/hr.	Rainfall (mm)	No.of rainy days
Temperature °C (Maximum)	-0.087	-0.027	0.052	0.068	-0.064	0.054	0.045	0.051
Temperature °C (Minimum)	-0.070	-0.228	0.016	0.132	-0.039	0.120	0.025	-0.014
% Relative humidity (Morning)	-0.087	-0.010	0.145	0.062	-0.079	0.047	0.064	0.038
% Relative humidity (Evening)	0.099	0.072	-0.064	-0.125	0.081	-0.069	-0.059	-0.061
Sunshine hours	-0.424	-0.099	0.314	0.371	-0.574	0.357	0.194	0.279
Wind spead km/hour	0.142	0.121	-0.073	-0.127	0.142	-0.229	-0.042	-0.060
Rainfall (mm)	0.079	0.017	-0.068	-0.072	0.052	-0.028	-0.153	-0.094
Number of rainy days	-0.039	0.004	0.017	0.032	-0.032	0.070	0.041	0.066

Residual effect = 0.8342

4.3 Assessment of crop losses due to major pests of groundnut :

4.3.1 Population of jassids :

The weekwise data on the population of jassids are presented in Table 26. The results indicated that no significant differences could be observed amongst the treatment after 21 DAS during 1988. However, jassid population 28 DAS and subsequent weeks except 70 DAS, in plots treated with monocrotophos 0.05 per cent throughout its growth period were significantly lower than control and other insecticidal treatments. The other effective treatments were carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent followed by carbofuran 1 kg a.i./ha at early stage and monocrotophos 0.05 per cent at reproductive phase (45 DAS) of the crop.

The same trend was observed during the kharif 1989 (Table 27). The crop treated with monocrotophos 0.05 per cent throughout its growth period excepting 25 DAS recorded significantly lower incidence of jassids than all other insecticidal treatments and unprotected control. Whereas, carbofuran 1 kg a.i./ha at the time of sowing proved effective over other insecticide treatments except the application of carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent.

The data on the mean population of jassids are presented in Table 28 and depicted in Fig.4.

Table 26 : Effect of various treatments on incidence of jassid,1988.

Treatments	Number of jassids per three leaves (days after sowing)									Mean
	21	28	35	42	49	56	63	70	77	
Carbofuran 1 kg a.i./ha only.	1.20 (1.25)	1.70 (1.46)	1.60 (1.41)	1.75 (1.49)	1.70 (1.46)	1.95 (1.56)	2.65 (1.75)	1.00 (1.28)	0.25 (0.85)	1.53 (1.39)
Carbofuran 1 kg a.i./ha+lambdacyhalothrin 0.004%	1.25 (1.20)	1.80 (1.50)	1.85 (1.51)	1.80 (1.48)	2.00 (1.55)	0.50 (1.97)	2.05 (1.59)	0.75 (0.21)	0.50 (0.98)	1.38 (1.33)
Monocrotophos 0.05 % 45 DAS	3.90 (2.03)	3.85 (2.12)	3.15 (1.86)	1.80 (1.50)	2.30 (1.66)	0.70 (1.08)	1.80 (1.50)	0.65 (1.05)	0.30 (0.86)	2.05 (0.88)
Monocrotophos 0.05% Based on pest population	2.45 (1.66)	0.30 (0.87)	0.00 (0.77)	0.00 (0.70)	0.40 (0.92)	0.10 (0.76)	0.40 (0.91)	0.50 (1.09)	0.00 (0.70)	0.46 (0.92)
Control (untreated)	3.70 (1.97)	4.05 (2.10)	3.40 (1.96)	3.75 (2.05)	3.35 (1.95)	2.45 (1.70)	3.20 (1.98)	1.10 (1.25)	0.45 (0.96)	3.18 (1.77)
S.E. ±	0.20	0.15	0.15	0.08	0.09	0.08	0.10	0.08	0.05	--
C.D. (P = 0.05)	(N.S.)	0.44	0.45	0.26	0.30	0.25	0.31	(N.S.)	0.15	--

(Figures in paranthesis are transformed values)

Table 27 : Effect of various treatments on the incidence of jassid,1989.

Treatments	Number of jassids per three leaves (days after sowing)							
	25	32	39	46	53	60	67	ከፍተኛ
Carbofuran 1 kg a.i./ha only.	0.40 (0.93)	0.80 (1.11)	2.25 (1.64)	2.20 (1.63)	0.85 (1.16)	0.50 (1.12)	1.12 (0.98)	1.12 (1.22)
Carbofuran 1 kg a.i./ha+lambdacyhalothrin 0.004%	0.70 (1.07)	0.55 (0.98)	2.10 (1.59)	0.55 (1.01)	0.35 (0.98)	0.55 (1.01)	0.35 (0.91)	0.73 (1.07)
Monocrotophos 0.05 % 45 DAS	1.65 (1.45)	0.85 (1.14)	3.15 (1.90)	0.45 (0.96)	0.45 (0.95)	0.60 (1.01)	0.70 (1.07)	1.12 (1.12)
Monocrotophos 0.05% Based on pest population	2.10 (1.57)	0.05 (0.73)	1.00 (1.22)	0.10 (0.76)	0.05 (0.73)	0.25 (0.83)	0.20 (0.82)	0.53 (0.95)
Control (untreated)	2.40 (1.69)	1.00 (1.22)	3.45 (1.98)	1.90 (1.54)	0.70 (1.09)	2.10 (1.60)	1.10 (1.24)	1.80 (1.48)
S.E. ±	0.11	0.07	0.07	0.06	0.06	0.08	0.05	--
C.D. (P = 0.05)	0.34	0.22	0.21	0.18	0.19	0.24	0.17	--

(Figures in paranthesis are transformed values)

The results indicated significant diffrences during both seasons. Significantly lowest population of jassids was observed in the plots treated with monocrotophos 0.05 per cent throughout the growth period and carbofuran 1 kg a.i./ha during the vegetative growth period in both years followed by carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent and monocrotophos 0.05 per cent at reproductive stage (45 DAS). During 1989, the treatments with carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent and carbofuran 1 kg a.i./ha at vegetative stage were at par in reducing jassid incidence.

Pooled data revealed that all insecticidal treatments were significantly superior over control in reducing the jassid population. The lowest pest population was found in the treatment monocrotophos 0.05 per cent throughout the growth period as compared to other insecticidal treatments. Other effective treatments were carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent and carbofuran 1 kg a.i./ha during the vegetative growth.

4.3.2 Population of thrips :

The weekwise data on the population of thrips are presented in Table 29.

The results indicated that, during the year 1988 the treatment carbofuran 1 kg a.i./ha 56 DAS which coincided with vegetative stage had lowest pest population followed by monocrotophos 0.05 per cent throughout its growth period and carbofuran 1 kg a.i./ha +

Table 28 : Effect of various treatments on incidence of jassids during 1988 and 1989.

Treatments	Mean number of jassids/three leaves		
	1988	1989	Pooled means
Carbofuran 1 kg a.i./ha	1.73 (1.46)	1.11 (1.26)	1.42 (1.36)
Carbofuran 1 kg a.i/ha + lambdacyhalothrin 0.004 %	1.29 (1.33)	0.70 (1.09)	0.99 (1.21)
Monocrotophos 0.05% 45 DAS	2.52 (1.73)	1.09 (1.26)	1.80 (1.49)
Monocrotophos 0.05% based on pest population	0.53 (1.00)	0.50 (0.99)	0.51 (0.99)
Control (untreated)	3.37 (1.96)	1.82 (1.52)	2.59 (1.74)
S.E. ±	0.03	0.02	0.02
C.D. (P = 0.05)	0.10	0.06	0.08

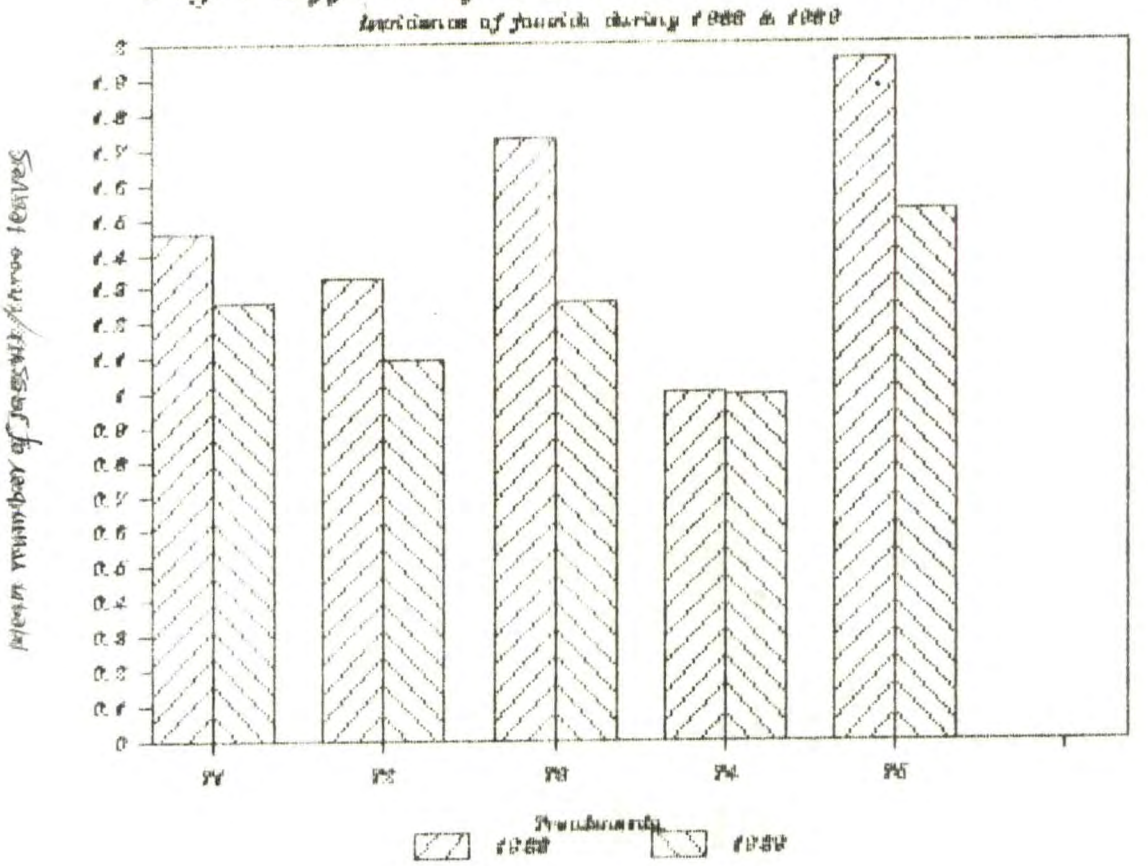
Figures in parentheses are transformed values

Table 29 : Effect of various treatments on incidence of thrips during 1988.

Treatments	No.of thrips per 3 leaves (days after sowing)				
	56	63	70	77	Mean
Carbofuran 1 kg a.i./ha	0.80 (1.13)	0.75 (1.09)	0.65 (1.05)	0.25 (0.85)	0.61 (1.03)
Carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 %	0.95 (1.16)	0.80 (1.14)	0.85 (1.16)	0.30 (0.89)	0.72 (1.08)
Monocrotophos 0.05% 45 DAS	1.95 (1.56)	1.60 (1.44)	1.30 (1.34)	0.25 (0.86)	1.27 (1.30)
Monocrotophos 0.05% based on pest population	0.85 (1.15)	0.55 (0.99)	0.70 (0.09)	0.00 (0.70)	0.52 (0.98)
Control (untreated)	2.75 (1.80)	2.85 (1.81)	3.10 (1.89)	1.15 (1.28)	2.46 (1.70)
S.E. ±	0.11	0.11	0.11	0.04	--
C.D. (P = 0.05)	0.33	0.30	0.32	0.13	--

Figures in parentheses are transformed values

Fig.4 Effect of various treatments on



Details of Treatments

T1 - Carbofuran 1 kg a.i./ha.

T2 - Carbofuran 1 kg a.i./ha + lambdacyhalothrin Ø.ØØ4 per cent.

T3 - Monocrotophos Ø.Ø5 per cent 45 DAS.

T4 - Monocrotophos Ø.Ø5 per cent based on pest population.

T5 - Control (Untreated).

Lambdacyhalothrin 0.004 per cent. The same trend was observed in subsequent weeks.

During the year 1989 (Table 30), results indicated that all insecticidal treatments were significantly superior over control in reducing thrips population except at 66 DAS, where no significant differences were noted in the treatments. The treatment with monocrotophos 0.05 per cent throughout its growth period was found promising except at 59 and 66 days after sowing.

The mean population of thrips presented in Table 31 and depicted in Fig.5 revealed that all the insecticidal treatments were found significantly superior over control in reducing the thrips population in both the years. Monocrotophos 0.05 per cent throughout its growth period emerged as an effective treatment in both the seasons except in carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent in 1988.

Pooled results revealed that the average population of thrips was minimum in the treatment with monocrotophos 0.05 per cent throughout the growth period followed by carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent, carbofuran 1 kg a.i./ha at vegetative stage and monocrotophos 0.05 per cent at reproductive stage (45 DAS).

Table 30 : Effect of various treatments on incidence of thrips during 1989.

Treatments	No.of thrips per 3 leaves (days after sowing)					
	40	47	52	59	66	Mean
Carbofuran 1 kg a.i./ha	9.30 (3.11)	0.85 (1.13)	0.20 (0.82)	0.95 (1.10)	0.55 (1.01)	2.36 (1.43)
Carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 %	8.65 (2.98)	0.60 (1.03)	0.00 (0.70)	1.80 (1.32)	0.75 (1.09)	2.36 (1.42)
Monocrotophos 0.05% 45 DAS	11.75 (3.43)	0.60 (1.04)	0.10 (0.76)	1.55 (1.38)	0.60 (1.04)	2.92 (1.53)
Monocrotophos 0.05% based on pest population	1.95 (1.55)	0.30 (0.89)	0.00 (0.70)	1.55 (1.29)	0.55 (1.04)	0.89 (1.09)
Control (untreated)	12.15 (3.54)	1.80 (1.50)	0.45 (0.95)	1.60 (1.20)	0.95 (1.80)	3.66 (1.80)
S.E. ±	0.18	0.06	0.05	0.09	0.06	--
C.D. (P = 0.05)	0.55	0.19	0.16	0.30	(N.S.)	--

Figures in parentheses are transformed values

Table 31 : Effect of various treatments on incidence of thrips during 1988 and 1989.

Treatments	Mean number of jassids/three leaves		
	1988	1989	Pooled means
Carbofuran 1 kg a.i./ha	1.18 (1.29)	2.56 (1.74)	1.87 (1.51)
Carbofuran 1 kg a.i/ha + lambdacyhalothrin 0.004 %	0.76 (1.11)	1.70 (1.47)	1.23 (1.29)
Monocrotophos 0.05% 45 DAS	1.44 (1.38)	2.80 (1.81)	2.12 (1.59)
Monocrotophos 0.05% based on pest population	0.54 (1.01)	0.89 (1.17)	0.71 (1.09)
Control (untreated)	2.68 (1.77)	3.69 (2.02)	3.16 (1.89)
S.E. ±	0.03	0.05	0.04
C.D. (P = 0.05)	0.11	0.16	0.14

Figures in parentheses are transformed values

4.3.3 Infestation of leaf miner :

4.3.3.1 Leaf miner per plant :

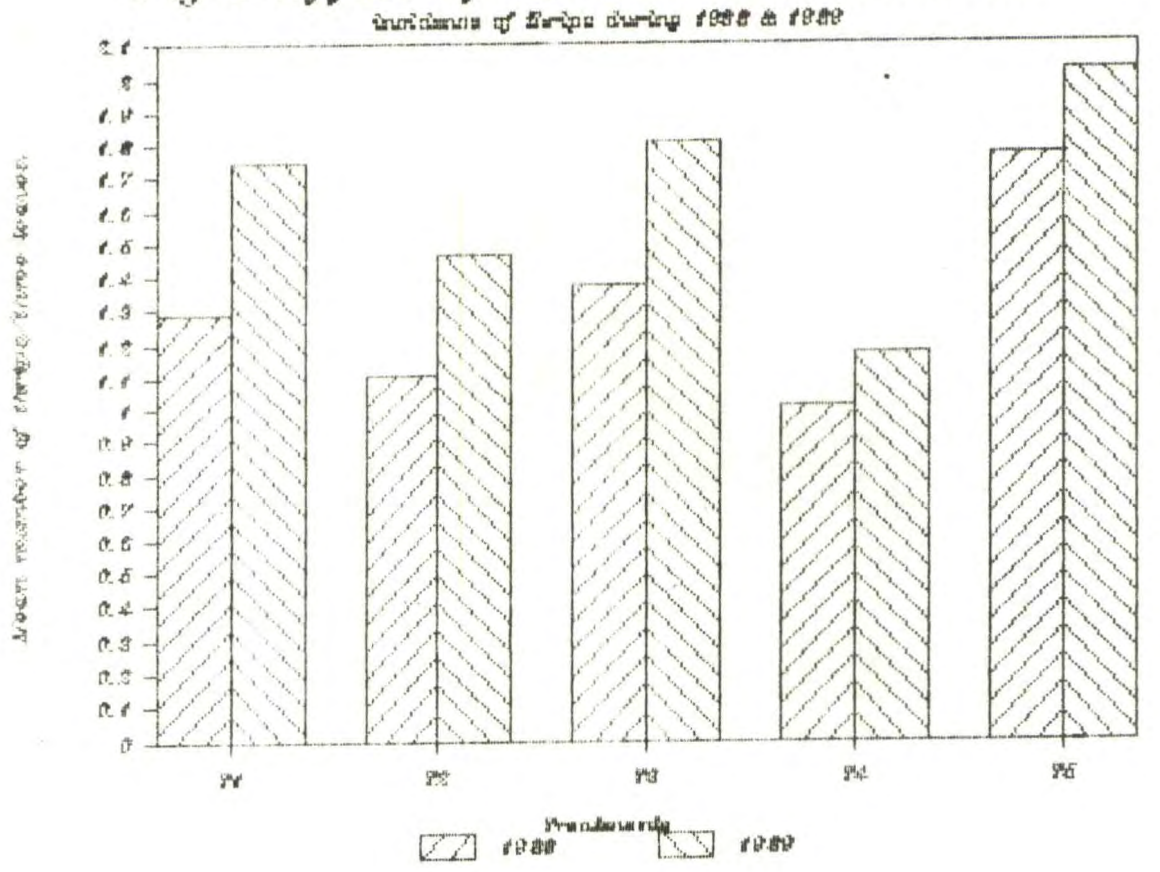
The weekwise data on the population of leaf miner per plant are given in Table 32. The results indicated that in the year 1988, the infestation of leaf miner started 35 DAS. The treatment with monocrotophos 0.05 per cent throughout the growth period was found to be superior over all other insecticidal treatments and control except 56 DAS.

During 1989, the results (Table 33) indicated that the infestation of leaf miner started 40 DAS. The lowest leaf miner infestation was observed in the plots treated with monocrotophos 0.05 per cent throughout its growth period.All the insecticidal treatments were significantly superior over control during the period of study.

Mean data pertaining to the infestation of leaf miner per plant are presented in Table 34 and depicted in Fig.6.

The results showed that count of leaf miner per plant in all insecticidal treatments was significantly lower as compared to the untreated control during the both the years. The treatment with monocrotophos 0.05 per cent throughout growth period had significantly less number of leaf miner larvae per plant than all other insecticidal treatments in both the years. Carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent and monocrotophos 0.05 per cent after 45 DAS, the next treatments in order of efficacy.

Fig 5 Effect of various treatments on



Details of Treatments

T1 - Carbofuran 1 kg a.i./ha.

T2 - Carbofuran 1 kg a.i./ha + lambdacyhalothrin Ø.ØØ4 per cent.

T3 - Monocrotophos Ø.Ø5 per cent 45 DAS.

T4 - Monocrotophos Ø.Ø5 per cent based on pest population.

T5 - Control (Untreated).

Table 32 : Effect of various treatments on incidence of leaf miner,1988.

Treatments	No.of leaf miner per plant (days after sowing)				
	35	42	49	56	Mean
Carbofuran 1 kg a.i./ha	0.50 (0.73)	0.00 (0.70)	0.50 (0.99)	0.45 (0.95)	0.25 (1.84)
Carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 %	0.00 (0.70)	0.00 (0.70)	0.45 (0.96)	0.45 (0.96)	0.22 (0.83)
Monocrotophos 0.05% 45 DAS	0.10 (0.76)	0.10 (0.76)	0.65 (1.06)	0.90 (1.18)	0.43 (0.94)
Monocrotophos 0.05% based on pest population	0.00 (0.70)	0.00 (0.70)	0.15 (0.79)	0.45 (0.91)	0.15 (0.77)
Control (untreated)	0.25 (0.85)	0.15 (0.79)	1.05 (1.24)	1.75 (1.49)	0.80 (1.09)
S.E. ±	0.03	0.02	0.04	0.03	--
C.D. (P = 0.05)	0.11	(N.S.)	0.14	0.11	--

Figures in parentheses are transformed values

Table 33 : Effect of various treatments on incidence of leaf miner,1989.

Treatments	No.of leaf miner per plant (days after sowing)			
	40	47	52	Mean
Carbofuran 1 kg a.i./ha	0.10 (0.77)	0.90 (1.18)	0.45 (0.97)	0.48 (0.97)
Carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 %	0.05 (0.73)	1.05 (1.24)	0.55 (1.01)	0.55 (0.99)
Monocrotophos 0.05% 45 DAS	0.10 (0.75)	1.25 (1.31)	0.80 (1.13)	0.71 (1.08)
Monocrotophos 0.05% based on pest population	0.00 (0.70)	0.50 (0.99)	0.30 (0.88)	0.26 (0.85)
Control (untreated)	0.25 (0.85)	1.45 (1.38)	1.00 (1.22)	0.90 (1.15)
S.E. ±	0.02	0.03	0.03	--
C.D. (P = 0.05)	0.08	0.10	0.10	--

Figures in parentheses are transformed values

Pooled analysis indicated that,all the insecticidal treatments were significantly superior than untreated control in reducing the population of leaf miner. The treatment with monocrotophos 0.05 per cent throughout the growth period was found to be superior over other insecticidal treatments. Other effective treatments were carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent and monocrotophos 0.05 per cent at reproductive growth period (45 DAS) which were at par.

4.3.3.2 Per cent infestation of leaf miner :

The data showing percentage infestation of leaf miner are presented in Table 35 and represented in Fig.7.

The data indicated that, the lowest percentage infestation of leaf miner was observed in the plots treated with monocrotophos 0.05 per cent throughout the growth period in both the years (5.66 and 5.21 per cent), respectively. Next best treatments were carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent (9.03 per cent) and monocrotophos 0.05 per cent at 45 days after sowing (9.26 per cent). However, these treatments were at par with each other in the year 1988.

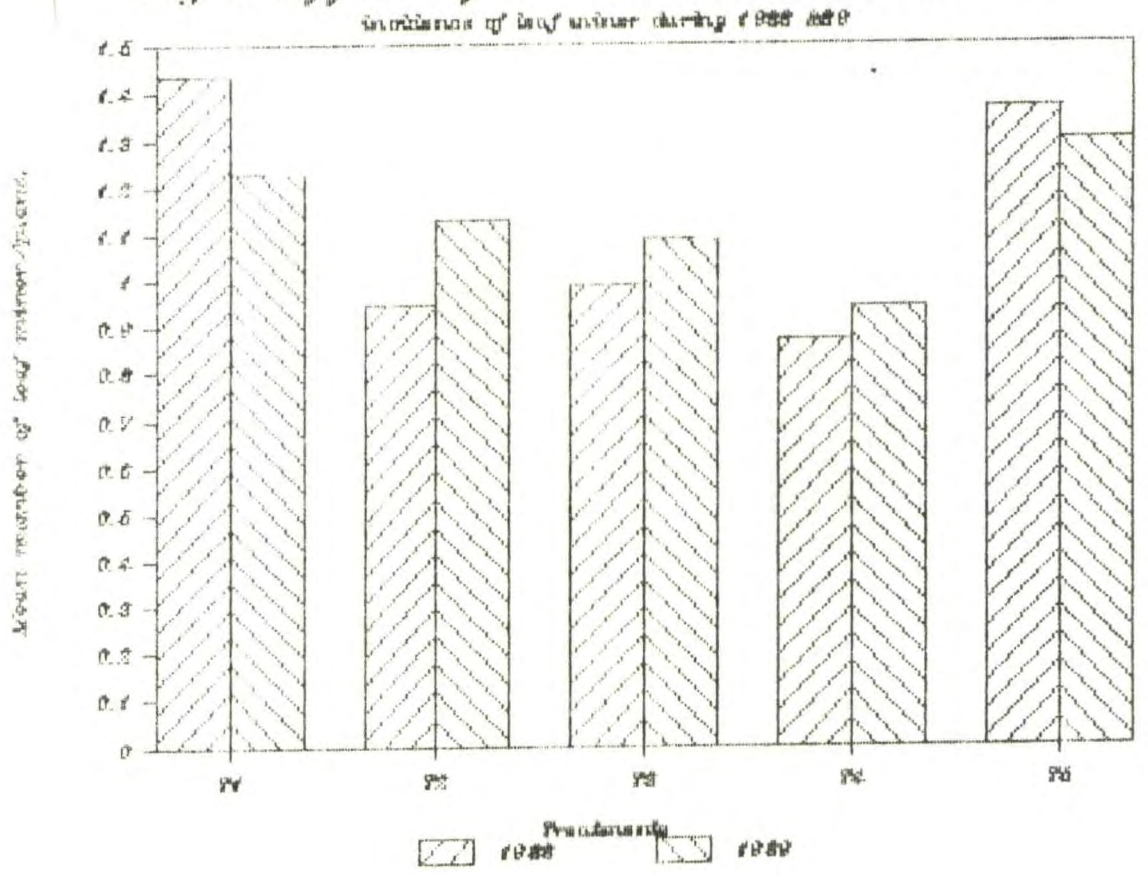
During 1989, the treatment with carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent was found to be significantly superior over other insecticidal treatments except monocrotophos 0.05 per cent throughout the growth period.

Table 34 : Effect of various treatments on incidence of leaf miner during 1988 and 1989.

Treatments	Mean number of leaf miner/plant		
	1988	1989	Mean
Carbofuran 1 kg a.i./ha	0.65 (1.44)	1.02 (1.23)	0.83 (1.18)
Carbofuran 1 kg a.i/ha + lambdacyhalothrin 0.004 %	0.42 (0.95)	0.80 (1.13)	0.61 (1.04)
Monocrotophos 0.05% 45 DAS	0.50 (0.99)	0.70 (1.09)	0.60 (0.04)
Monocrotophos 0.05% based on pest population	0.27 (0.87)	0.40 (0.94)	0.33 (0.90)
Control (untreated)	1.40 (1.37)	1.22 (1.30)	1.31 (1.33)
S.E. ±	0.01	0.01	0.01
C.D. (P = 0.05)	0.05	0.05	0.05

Figures in parentheses are transformed values

Fig 6 Effect of various treatments on



Details of Treatments

T1 - Carbofuran 1 kg a.i./ha.

T2 - Carbofuran 1 kg a.i./ha + lambdacyhalothrin Ø.ØØ4 per cent.

T3 - Monocrotophos Ø.Ø5 per cent 45 DAS.

T4 - Monocrotophos Ø.Ø5 per cent based on pest population.

T5 - Control (Untreated).

Table 35 : Effect of various treatments on per cent infestations of leaf miner during 1988 and 1989.

Treatments	Per cent infestation of lear miner		
	1988	1989	Pooled means
Carbofuran 1 kg a.i./ha	12.58 (20.66)	11.09 (19.39)	11.83 (20.02)
Carbofuran 1 kg a.i/ha + lambdacyhalothrin 0.004 %	9.03 (17.44)	7.86 (16.33)	8.44 (16.88)
Monocrotophos 0.05% 45 DAS	9.26 (17.70)	9.99 (18.38)	9.62 (18.04)
Monocrotophos 0.05% based on pest population	5.66 (14.74)	5.21 (14.13)	5.43 (13.44)
Control (untreated)	23.78 (29.15)	23.81 (29.70)	23.79 (29.16)
S.E. +	0.58	0.55	0.57
C.D. (P = 0.05)	1.78	1.70	1.76

Figures in parentheses are transformed values

Pooled results indicated that all insecticidal treatments were significantly superior over control. The lowest percentage infestation was observed in the plots treated with monocrotophos 0.05 per cent (5.43 per cent), throughtout the growth period. It was followed by carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent (8.44 per cent) and monocrotophos 0.05 per cent at reproductive growth period (45 DAS) 9.62 per cent and were at par.

4.3.4 Number of pods per plant and avoidable losses due to major pests of groundnut :

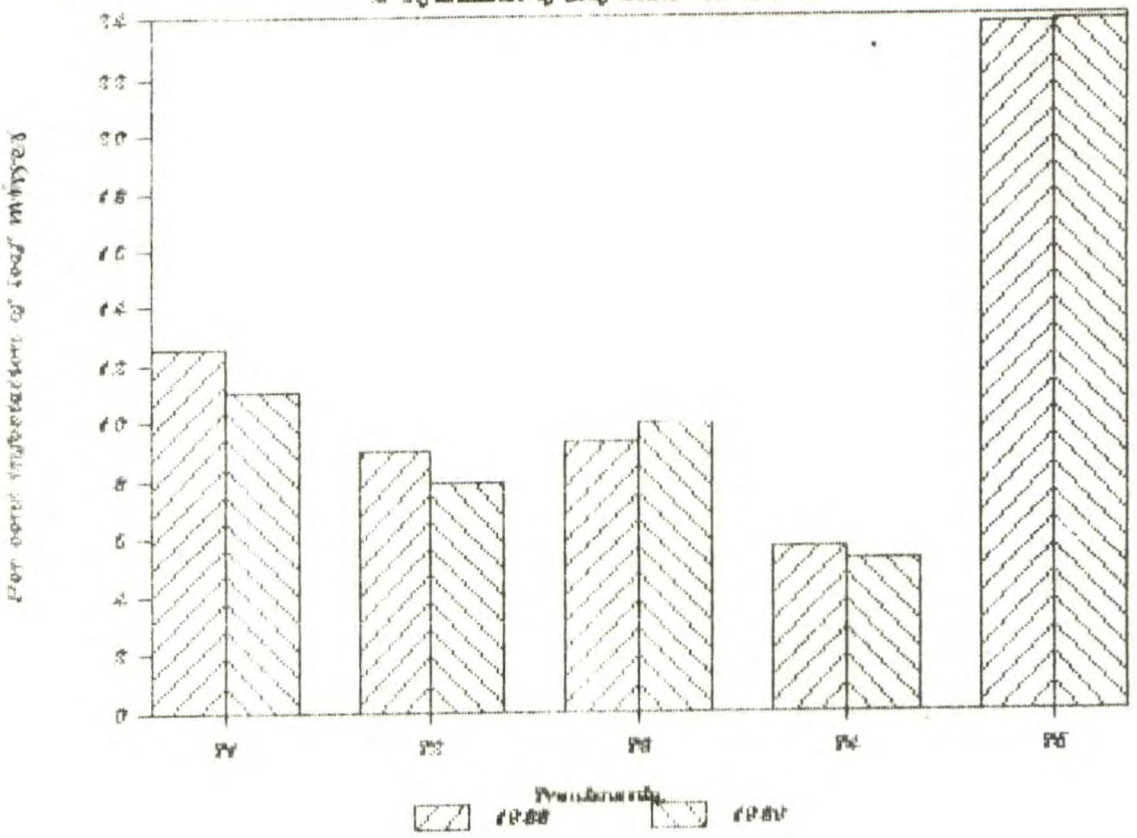
The data on number of pods per plant and percentage avoidable loss due to major pests of groundunt are presented in Table 36.

4.3.4.1 Effect on number of pods per plant :

The results indicated that the treatment with monocrotophos 0.05 per cent throughout the growth period recorded significantly more number of pods per plant, than rest of the treatments.

In the next season, the highest pod number was observed in the treatment with monocrotophos 0.05 per cent through-out the growth period. Next promising treatments were carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent followed by carbofuran 1 kg a.i./ha through its vegetative stage and monocrotophos 0.05 per cent at reproductive stage (45 DAS).

Fig.7.Effect of various treatments on



Details of Treatments

T1 - Carbofuran 1 kg a.i./ha.

T2 - Carbofuran 1 kg a.i./ha + lambdacyhalothrin Ø.ØØ4 per cent.

T3 - Monocrotophos Ø.Ø5 per cent 45 DAS.

T4 - Monocrotophos Ø.Ø5 per cent based on pest population.

T5 - Control (Untreated).

Table 36 : Effect of various treatments on number of pods per plant.

Treatments	Mean number of pods/plant			Per cent aviodable loss
	1988	1989	Pooled mean	
Carbofuran 1 kg a.i./ha	10.40 (3.29)	10.20 (3.26)	10.30 (3.27)	17.73
Carbofuran 1 kg a.i./ha + lambdacy-halothrin 0.004 %	11.30 (4.42)	10.80 (3.35)	11.05 (3.40)	7.58
Monocrotophos 0.05% 45 DAS	11.00 (3.38)	9.70 (3.19)	10.35 (3.28)	17.33
Monocrotophos 0.05% based on pest population	14.25 (3.83)	11.85 (3.51)	13.05 (3.67)	---
Control (untreated)	9.90 (3.21)	8.50 (3.00)	9.20 (3.10)	26.35
S.E. ±	0.10	0.06	0.10	---
C.D. (P = 0.05)	0.32	0.20	0.32	---

Figures in parentheses are transformed values

Pooled analysis indicated that the treatment with monocrotophos 0.05 per cent throughout the growth period ranked first in recording highest pod number. Rest of the insecticidal treatments were at par with each other.

4.3.4.2 Per cent avoidable loss in pod number per plant : (Table 36)

The results concluded that per cent avoidable loss in groundnut due to pest complex was of the order of 26-35 per cent. The per cent avoidable loss recorded in treatment with monocrotophos 0.05 per cent throughout the growth period, carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent, monocrotophos 0.05 per cent at reproductive stage (45 DAS) and carbofuran 1 kg a.i./ha during its vegetative stage were 0.00, 7.58, 17.33 and 17.73, respectively.

4.3.5 Effect of insecticidal treatments on the yield and per cent avoidable loss due to groundnut pest complex :

The data on yield per plant and per cent avoidable loss due to groundnut pest complex are presented in Table 37.

4.3.5.1 Yield per plant :

The results indicated that the treatment with monocrotophos 0.05 per cent throughtout its growth period out yielded all other treatments. Rest of the insecticidal treatments were at par with control during 1988.

Plate No.3 : T4. Monocrotophos Ø.Ø5 per cent on the basis of pest population.

Plate No.3 : T2. Carbofuran 1 kg a.i./ha + Lambdacyhalothrin Ø.ØØ4 per cent.


T4


T2

Table 37 : Effect of various treatments on yield per plant :

Treatments	Yield of dry pods /plant (g)			Per cent aviodable loss
	1988	1989	Pooled mean	
Carbofuran 1 kg a.i./ha	7.65	7.57	7.61	18.60
Carbofuran 1 kg a.i./ha + lambdacy-halothrin 0.004 %	8.12	7.81	8.28	11.44
Monocrotophos 0.05% 45 DAS	7.80	6.35	7.07	24.38
Monocrotophos 0.05% based on pest population	10.90	8.45	9.25	Nil
Control (untreated)	6.82	6.35	6.38	29.62
S.E. ±	0.05	0.39	0.45	---
C.D. (P = 0.05)	1.54	1.21	1.39	---

In the year 1989,the highest yield per plant was recorded in plots treated with monocrotophos 0.05 per cent throughout its growth period,carbofuran 1 kg a.i./ha +lambdacyhalothrin 0.004 per cent and carbofuran 1 kg a.i./ha at vegetative stage which were at par.

Pooled results suggested that the treatments with monocrotophos 0.05 per cent throughout its growth period and carbofuran 1 kg a.i./ha +lambdacyhalothrin 0.004 per cent gave significantly higher pod yield per plant. The application of carbofuran 1 kg a.i./ha and monocrotophos 0.05 per cent (45 DAS) were the next best treatments.

4.3.5.2 Per cent avoidable loss in yield per plant.

The per cent avoidable loss in yield per plant was minimum in the treatment with monocrotophos 0.05 per cent throughout its growth period. The per cent avoidable loss in yield per plant was maximum (29.62 per cent) in control, carbofuran 1 kg a.i./ha at vegetative stage (18.60 per cent) and carbofuran 1 kg a.i./ha (11.44 per cent).

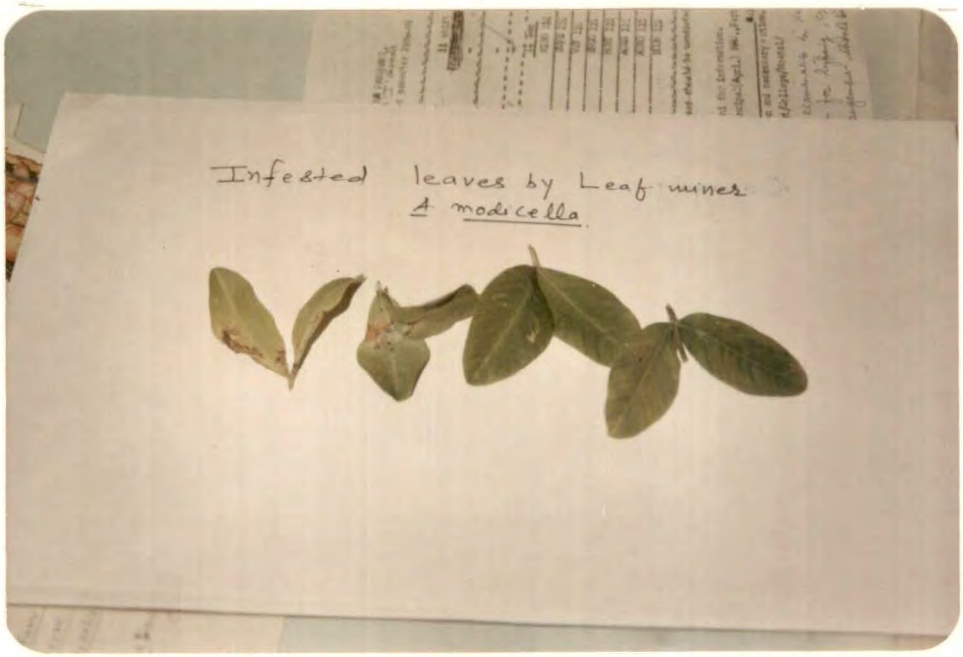
4.3.6 Yield of dry pod and per cent avoidable loss due to groundnut pest complex :

The data on the yield of dry pods and per cent avoidable loss due to groundnut pests are presented in Table 38, and depicted is Fig.-8.

Plate No.4 : Control (Untreated plot)

Plate No.4 : Infested leaves due to
Aproaerema modicella


Control


Infested leaves by Leaf miner
A modicella

4.3.6.1 Yield of dry pods :

The results suggested that significantly highest yield of dry pods was recorded when the crop was treated with monocrotophos 0.05 per cent throughout its growth period (608.25 kg/ha) during 1988.

In the next season, the treatment with monocrotophos 0.05 per cent throughout the growth period (1441.75 kg/ha) and carbofuran 1 kg a.i./ha + lambdacyhalothrin higher dry pod yield than rest of the treatments which were at par.

Pooled results confirmed that all insecticidal treatments were significantly superior over control in increasing the dry pod yield of groundnut. The maximum yield was recorded in plots treated with monocrotophos 0.05 per cent throughout the growth period (692.18 kg/ha) and carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent (610.48 kgs/ha) which were at par. Other promising treatments were carbofuran 1 kg a.i./ha at vegetative stage (551.18 kg/ha) and monocrotophos 0.05 per cent at reproductive stage.

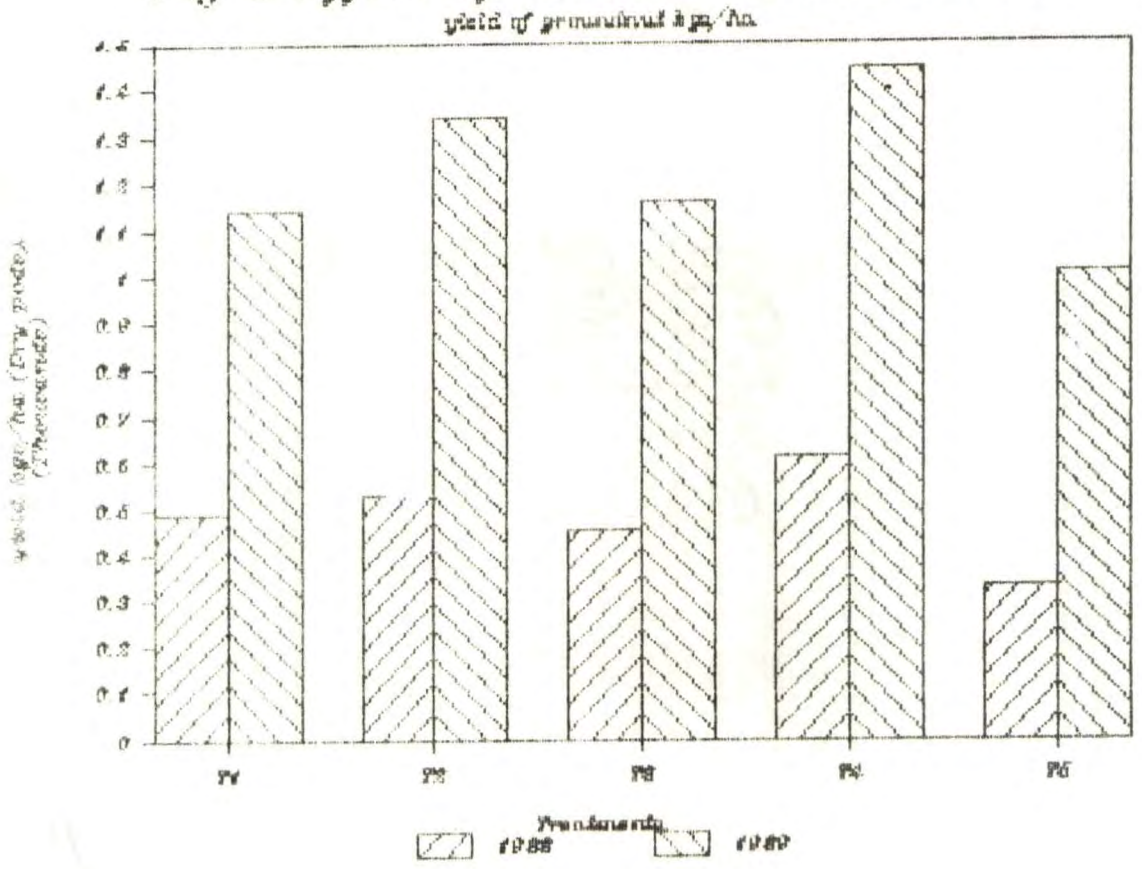
4.3.6.2 Per cent avoidable loss in the yield of dry pods due to groundnut pest complex :

The treatments with monocrotophos 0.05 per cent throughout the growth period, carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent,carbofuran 1 kg a.i./ha during vegetative stage and monocrotophos 0.05 per cent at reproductive stage recorded 11.80, 20.37 and 24.24

Table 38 : Effect of various treatments on yield of groundnut kgs/ha.

Treatments	Yield kgs/ha (Dry pods)			Per cent aviodable loss
	1988	1989	Pooled mean	
Carbofuran 1 kg a.i./ha	485.00	1142.25	551.18	20.37
Carbofuran 1 kg a.i./ha + lambdacy-halothrin 0.004 %	529.00	1338.25	610.48	11.80
Monocrotophos 0.05% 45 DAS	453.25	1159.25	524.34	24.24
Monocrotophos 0.05% based on pest population	608.25	1441.75	692.18	Nil
Control (untreated)	329.00	1007.75	397.34	42.59
S.E. ±	18.18	54.33	40.51	---
C.D. (P = 0.05)	56.02	167.05	124.82	---

Fig 8 Effect of various treatments on



Details of Treatments

T1 - Carbofuran 1 kg a.i./ha.

T2 - Carbofuran 1 kg a.i./ha + lambdacyhalothrin Ø.ØØ4 per cent.

T3 - Monocrotophos Ø.Ø5 per cent 45 DAS.

T4 - Monocrotophos Ø.Ø5 per cent based on pest population.

T5 - Control (Untreated).

per cent avoidable loss respectively, due to groundnut pest complex.

The yield of dry pods was reduced considerably due to groundnut pest complex in the unprotected plots during vegetative stage. The per cent avoidable loss in untreated control was to the tune of 42.59 per cent.

4.4 Incidence of major pests on different groundnut cultivars :

4.4.1 Incidence of jassids on different cultivars during kharif 1988 :

The observations on the incidence of jassid at weekly interval on fourteen cultivars of groundnut were recorded and presented in Table 39.

Data on the incidence of jassids on different cultivars during 1988 indicated that all fourteen cultivars of groundnut were equally preferred by the jassids at 40, 50 and 60 days after sowing. There were no significant differences amongst different cultivars. However, 20, 30 and 70 days after sowing, significant differences were observed in jassid incidence. At 20 days after sowing, the incidence of jassid per three leaves varied from 0.60 to 4.35. The minimum incidence was observed in the cultivars LGS-10 (0.60 jassids/3 leaves) followed by NCAC-343 (0.80 jassids/3 leaves) 9/136-2187 (1.50 jassid /3 leaves), ICG-1363 (1.70 jassids/3 leaves) and ICG-33 (1.70 jassids/3 leaves).

Table 39 : Incidence of jassids on different groundnut cultivars during 1988.

Treatment	Number of jassids/3 leaves (Days after sowings)						Mean
	20	30	40	50	60	70	
ICG-1363	1.70 (1.46)	0.80 (1.12)	1.20 (1.29)	1.20 (1.29)	1.00 (1.22)	0.30 (0.88)	1.03 (1.23)
JL-24	3.70 (1.95)	2.30 (1.67)	1.80 (1.51)	0.60 (1.04)	1.30 (1.34)	0.50 (0.98)	1.70 (1.48)
SBXI	1.80 (1.47)	1.70 (1.48)	1.10 (1.66)	1.90 (1.54)	1.80 (1.51)	0.40 (0.94)	1.61 (1.45)
TMV-2	2.30 (1.66)	2.70 (1.76)	1.70 (1.47)	0.60 (1.04)	0.70 (1.06)	0.80 (1.14)	1.30 (1.30)
9/136-2187	1.50 (1.36)	0.70 (1.09)	1.70 (1.47)	1.80 (1.51)	1.80 (1.51)	0.20 (0.83)	1.15 (1.29)
ICG-9559	3.30 (1.93)	1.00 (1.22)	1.40 (1.37)	1.70 (1.46)	1.00 (1.19)	0.60 (1.04)	1.50 (1.37)
ICG-134	4.35 (2.18)	1.00 (1.20)	1.80 (1.50)	1.00 (1.19)	1.00 (1.22)	0.20 (0.82)	1.55 (1.38)
ICG-33	1.70 (1.47)	0.90 (1.18)	1.20 (1.30)	1.40 (1.36)	1.40 (1.37)	0.20 (0.82)	1.13 (1.25)
NCAC-343	0.80 (1.10)	0.80 (1.13)	0.90 (1.18)	0.70 (1.12)	1.20 (1.20)	0.60 (1.04)	0.83 (1.14)
ICG-10718	1.90 (1.54)	2.20 (1.64)	2.60 (1.71)	2.30 (1.67)	2.10 (1.61)	0.30 (0.89)	1.90 (1.54)
ICG-49	2.90 (1.71)	1.60 (1.44)	2.20 (1.64)	2.30 (1.37)	1.40 (1.37)	0.40 (0.93)	1.80 (1.51)
GB-FDS-273	2.20 (1.61)	1.10 (1.24)	1.60 (1.42)	1.60 (1.44)	2.00 (1.54)	0.40 (0.53)	1.48 (1.36)
ICG-5030	2.80 (1.79)	2.00 (1.58)	1.80 (1.51)	2.30 (1.67)	2.00 (1.58)	0.70 (1.09)	1.93 (1.55)
LGS-10	0.60 (1.00)	0.80 (1.41)	1.00 (1.22)	1.40 (1.37)	0.90 (1.18)	0.20 (0.83)	0.81 (1.14)
S.E. ±	0.24	0.13	0.13	0.20	0.15	0.12	---
C.D. P = 0.05	0.75	0.40	(N.S.)	(N.S.)	(N.S.)	0.38	---

Figures in paranthesis are transformed values.

Maximum incidence was observed in the cultivar ICG-134 (4.35 jassids/3 leaves). At 30 days after sowing the minimum incidence was observed on LGS-10 (0.80 jassids/3 leaves), NCAC-343 (0.80 jassids/3 leaves) and ICG-1363 (0.80 jassids/3 leaves) which were at par. The maximum incidence was observed on TMV-2 (2.70 jassids/3 leaves) and JL-24 (2.30 jassids/3 leaves), which were at par. Same trend was observed 70 days after sowing. The cultivars LGS-10, ICG-33, ICG-134 and 9/136-2187 showed less incidence of jassids as compared to other cultivars of groundnut.

During 1989, the significant differences were observed in jassid incidence on different cultivars at 20,30,50 and 60 days after sowing (Table 40). At 20 days after sowing, significantly lower incidence of jassids was observed on the cultivars ICG-134, LGS-10, ICG-5030, ICG-10718, NCAC-343, ICG-9559 and 9/136-2187. The maximum incidence was observed on GB-FDS-273 (1.20 jassids/3 leaves). After 30 days of sowing, the cultivars LGS-10, SBXI, LGS-9556 and NCAC-343 showed minimum incidence. Significantly low incidence was observed on the cultivars LGS-10, ICG-134, SBXI and JL-24 after 50 days of sowing. The highest incidence was observed on the ICG-49 (1.30 jassids/3 leaves). After 60 days of sowing significantly lower population was observed on SBXI, LGS-10, NCAC-343 and ICG-33. The maximum incidence was observed on the cultivar GB-FDS-273 (1.10 jassids/3 leaves). However, at 40 and 70 days after sowing, no

Table 40 : Incidence of jassids on different groundnut cultivars during 1989.

Treatment	Number of jassids/3 leaves (Days after sowings)						Mean
	20	30	40	50	60	70	
ICG-1363	0.70 (1.08)	1.20 (1.30)	1.10 (1.26)	0.90 (1.18)	0.80 (1.14)	0.30 (0.88)	0.83 (1.15)
JL-24	0.50 (0.98)	0.90 (1.18)	1.30 (1.34)	0.50 (1.00)	0.40 (0.94)	0.20 (0.83)	0.63 (1.06)
SBXI	0.50 (0.99)	0.40 (0.94)	0.90 (1.18)	0.60 (1.04)	0.30 (0.88)	0.10 (0.76)	0.46 (0.97)
TMV-2	0.40 (0.92)	1.00 (1.22)	1.60 (1.44)	0.90 (1.18)	0.60 (1.44)	0.30 (0.88)	0.80 (1.14)
9/136-2187	0.10 (0.76)	0.90 (1.18)	1.20 (1.30)	0.80 (1.14)	0.70 (1.09)	0.40 (0.98)	0.68 (1.08)
ICG-9559	0.10 (0.76)	0.60 (1.04)	1.20 (1.30)	0.80 (1.14)	0.60 (1.14)	0.40 (0.93)	0.61 (1.05)
ICG-134	0.20 (0.82)	0.50 (1.00)	0.70 (1.09)	0.60 (1.04)	0.30 (0.88)	0.30 (0.88)	0.48 (0.98)
ICG-33	0.50 (0.96)	0.80 (1.14)	1.00 (1.22)	0.90 (1.18)	0.50 (1.00)	0.20 (0.83)	0.65 (1.07)
NCAC-343	0.40 (0.92)	0.60 (1.04)	0.90 (1.18)	1.20 (1.30)	0.40 (0.98)	0.30 (0.88)	0.66 (1.07)
ICG-10718	0.40 (0.93)	0.80 (1.14)	0.90 (1.18)	1.00 (1.22)	0.07 (1.44)	0.20 (0.82)	0.65 (1.07)
ICG-49	0.80 (1.14)	1.20 (1.30)	1.80 (1.51)	1.30 (1.34)	0.80 (1.14)	0.20 (0.83)	1.01 (1.22)
GB-FDS-273	1.20 (1.29)	1.60 (1.44)	1.20 (1.30)	1.00 (1.22)	1.10 (1.26)	0.30 (0.88)	1.06 (1.24)
ICG-5030	0.30 (0.88)	1.10 (1.26)	1.30 (1.34)	0.90 (1.18)	0.90 (1.18)	0.40 (1.93)	0.81 (1.14)
LGS-10	0.40 (0.92)	0.30 (0.88)	0.90 (1.18)	0.30 (0.88)	0.40 (0.94)	0.30 (0.88)	0.43 (0.94)
S.E. ±	0.08	0.0E	0.12	0.05	0.08	0.06	---
C.D. P = 0.05	0.26	0.25	(N.S.)	0.17	0.26	(N.S.)	---

Figures in paranthes€s are transformed values.

Table 40 : Incidence of jassids on different groundnut cultivars during 1989.

Treatment	Number of jassids/3 leaves (Days after sowings)						Mean
	20	30	40	50	60	70	
ICG-1363	0.70 (1.08)	1.20 (1.30)	1.10 (1.26)	0.90 (1.18)	0.80 (1.14)	0.30 (0.88)	0.83 (1.15)
JL-24	0.50 (0.98)	0.90 (1.18)	1.30 (1.34)	0.50 (1.00)	0.40 (0.94)	0.20 (0.83)	0.63 (1.06)
SBXI	0.50 (0.99)	0.40 (0.94)	0.90 (1.18)	0.60 (1.04)	0.30 (0.88)	0.10 (0.76)	0.46 (0.97)
TMV-2	0.40 (0.92)	1.00 (1.22)	1.60 (1.44)	0.90 (1.18)	0.60 (1.44)	0.30 (0.88)	0.80 (1.14)
9/136-2187	0.10 (0.76)	0.90 (1.18)	1.20 (1.30)	0.80 (1.14)	0.70 (1.09)	0.40 (0.98)	0.68 (1.08)
ICG-9559	0.10 (0.76)	0.60 (1.04)	1.20 (1.30)	0.80 (1.14)	0.60 (1.14)	0.40 (0.93)	0.61 (1.05)
ICG-134	0.20 (0.82)	0.50 (1.00)	0.70 (1.09)	0.60 (1.04)	0.30 (0.88)	0.30 (0.88)	0.48 (0.98)
ICG-33	0.50 (0.96)	0.80 (1.14)	1.00 (1.22)	0.90 (1.18)	0.50 (1.00)	0.20 (0.83)	0.65 (1.07)
NCAC-343	0.40 (0.92)	0.60 (1.04)	0.90 (1.18)	1.20 (1.30)	0.40 (0.98)	0.30 (0.88)	0.66 (1.07)
ICG-10718	0.40 (0.93)	0.80 (1.14)	0.90 (1.18)	1.00 (1.22)	0.07 (1.44)	0.20 (0.82)	0.65 (1.07)
ICG-49	0.80 (1.14)	1.20 (1.30)	1.80 (1.51)	1.30 (1.34)	0.80 (1.14)	0.20 (0.83)	1.01 (1.22)
GB-FDS-273	1.20 (1.29)	1.60 (1.44)	1.20 (1.30)	1.00 (1.22)	1.10 (1.26)	0.30 (0.88)	1.06 (1.24)
ICG-5030	0.30 (0.88)	1.10 (1.26)	1.30 (1.34)	0.90 (1.18)	0.90 (1.18)	0.40 (1.93)	0.81 (1.14)
LGS-10	0.40 (0.92)	0.30 (0.88)	0.90 (1.18)	0.30 (0.88)	0.40 (0.94)	0.30 (0.88)	0.43 (0.94)
S.E. ±	0.08	0.08	0.12	0.05	0.08	0.06	---
C.D. P = 0.05	0.26	0.25	(N.S.)	0.17	0.26	(N.S.)	---

Figures in paranthesis are transformed values.

significant differences could be observed in the incidence of jassids.

The data on the mean population of jassids on different cultivars are presented in Table 41 and depicted in Fig.9.

The results of 1988 season indicated significant differences amongst the groundnut cultivars. The incidence of jassids/3 leaves varied from 0.80 to 1.96. The lowest incidence was recorded on NCAC-343 (0.80 jassids/3 leaves) and LGS-10 (0.86 jassids/3 leaves). The higher incidence was recorded on ICG-10718,ICG-5030, JL-24, SBXI and ICG-59 which were at par.

During the year 1989, the cultivar LGS-10 and NCAC-343 showed least jassids incidence as compared to other cultivars. The highest incidence was recorded in ICG-10718, JL-24, ICG-33 and ICG-49 which were at par.

In both the years, pooled analysis revealed overall similar trend of incidence of jassids on different cultivars. The lowest incidence was observed on the cultivars NCAC-343 and LGS-10. These were significantly superior over the cultivars JL-24, SBXI and TMV-2. The highest incidence was observed on the cultivars ICG-10718, JL-24, ICG-5030 and ICG-49 and were at par.

4.4.2 Incidence of thrips on different cultivars of groundnut :

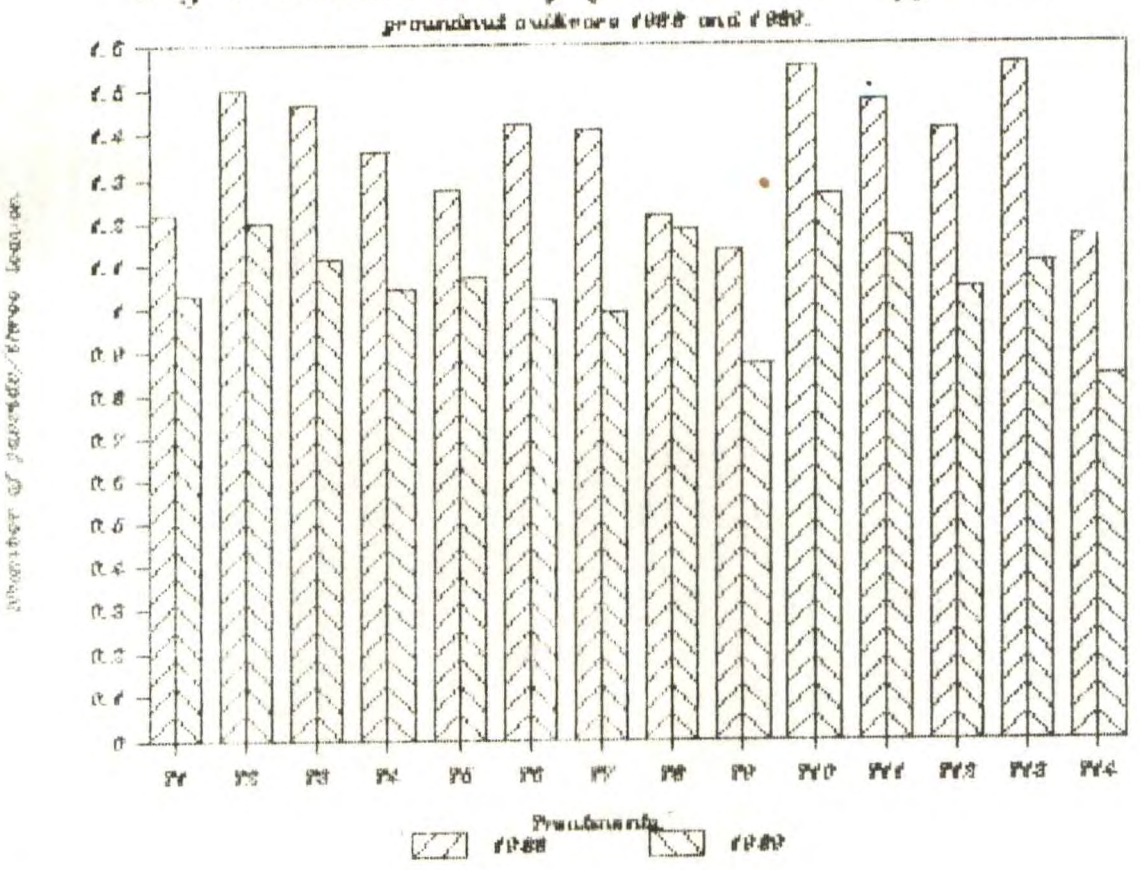
The weekwise data on the population of thrips recorded on different groundnut cultivars during 1988 and 89 are presented in Table 42 and 43.

Table 41 : Incidence of jassids on different groundnut cultivars, (1988 and 1989 seasons).

Treatment	Number of jassids/3 leaves		
	1988	1989	Pooled mean
ICG-1363	1.04 (1.22)	0.57 (1.03)	0.80 (1.05)
JL-24	1.82 (1.50)	1.82 (1.20)	1.38 (1.23)
SBXI	1.70 (1.47)	0.75 (1.11)	1.22 (1.13)
TMV-2	1.38 (1.36)	0.68 (1.04)	0.98 (1.08)
9/136-2187	1.14 (1.27)	0.65 (1.07)	0.99 (0.99)
ICG-9559	1.54 (1.42)	0.55 (1.02)	1.04 (1.07)
ICG-134	1.51 (1.41)	0.50 (0.99)	1.01 (1.04)
ICG-33	1.12 (1.21)	0.90 (1.18)	1.01 (1.18)
NCAC-343	0.80 (1.13)	0.27 (0.87)	0.53 (0.90)
ICG-10718	1.92 (1.55)	1.11 (1.26)	1.51 (1.29)
ICG-49	1.70 (1.48)	0.85 (1.16)	1.27 (1.20)
GB-FDS-273	1.52 (1.41)	0.60 (1.04)	1.06 (1.08)
ICG-5030	1.96 (1.56)	0.72 (1.10)	1.34 (1.16)
LGS-10	0.86 (1.16)	0.22 (0.84)	0.54 (0.88)
S.E. $\pm$	0.07	0.02	0.05
C.D. P = 0.05	0.22	0.09	0.17

Figures in paranthesis are transformed values.

Fig 9 Incidence of jassids on different



Details of Treatments

T1 - ICG-1363	T2 - JL-24
T3 - SBXI	T4 - TMV-2
T5 - 9/136-2187	T6 - ICG-9559
T7 - 134	T8 - ICG-33
T9 - NCAC-343	T10- ICG-10718
T11- ICG-49	T12- GB-FDS-273
T13- ICG-5030	T14- LGS-10

Table 42 : Incidence of thrips on different groundnut cultivars,during 1988.

Treatment	Number of thrips/3 leaves (Days after sowing)			
	40	50	60	Mean
ICG-1363	3.00 (1.87)	1.00 (1.22)	1.00 (1.22)	1.66 (1.43)
JL-24	1.84 (1.52)	1.22 (1.31)	0.54 (1.01)	1.16 (1.28)
SBXI	1.44 (1.39)	1.24 (1.31)	0.94 (1.20)	1.20 (1.30)
TMV-2	1.44 (1.39)	1.04 (1.24)	0.54 (1.10)	1.00 (1.21)
9/136-2187	0.54 (1.13)	0.74 (1.15)	0.25 (0.71)	0.51 (0.99)
ICG-9559	0.89 (1.17)	0.90 (1.18)	0.48 (0.98)	0.75 (1.11)
ICG-134	1.00 (1.22)	1.10 (1.16)	0.28 (0.88)	0.79 (1.12)
ICG-33	0.99 (1.22)	0.80 (1.14)	0.49 (0.99)	0.76 (1.12)
NCAC-343	0.60 (1.04)	0.80 (1.13)	0.00 (0.70)	0.46 (0.98)
ICG-10718	0.90 (1.15)	0.50 (0.99)	0.20 (0.83)	0.53 (0.99)
ICG-49	1.54 (1.14)	1.20 (1.33)	0.58 (1.03)	1.10 (1.26)
GB-FDS- 273	0.94 (1.20)	0.90 (1.18)	0.20 (0.83)	0.68 (1.07)
ICG-5030	1.00 (1.22)	0.10 (1.26)	0.30 (0.89)	0.76 (1.12)
LGS-10	0.50 (0.83)	1.10 (1.26)	0.00 (0.70)	0.53 (0.93)
S.E. ±	0.13	0.11	0.05	---
C.D. P = 0.05	0.41	(N.S.)	0.15	---

Figures in paranthesēs are transformed values.

Table 43 : Incidence of thrips on different groundnut cultivars,during 1989.

Treatment	Number of thrips/3 leaves (Days after sowing)			
	50	60	70	Mean
ICG-1363	0.99 (1.22)	1.09 (1.26)	0.60 (1.04)	0.89 (1.17)
JL-24	0.70 (1.09)	0.60 (1.04)	0.70 (1.09)	0.66 (1.07)
SBXI	0.60 (1.04)	0.60 (1.12)	0.40 (1.93)	0.53 (1.03)
TMV-2	1.10 (1.22)	0.60 (1.04)	0.60 (1.04)	0.76 (1.10)
9/136-2187	0.70 (1.08)	0.80 (1.13)	0.40 (0.94)	0.63 (1.05)
ICG-9559	0.70 (1.08)	0.70 (1.09)	0.40 (0.94)	0.60 (1.03)
ICG-134	0.30 (0.89)	0.55 (1.02)	0.50 (1.00)	0.45 (0.97)
ICG-33	1.10 (1.22)	0.60 (1.04)	0.60 (1.04)	0.76 (1.10)
NCAC-343	0.40 (0.94)	0.70 (1.08)	0.80 (1.13)	0.63 (1.05)
ICG-10718	0.60 (1.04)	0.90 (1.18)	0.50 (1.00)	0.66 (1.07)
ICG-49	1.20 (1.30)	1.00 (1.22)	0.70 (1.09)	0.96 (1.20)
GB-FDS- 273	1.50 (1.41)	0.90 (1.18)	0.80 (1.14)	1.06 (1.24)
ICG-5030	1.10 (1.26)	0.90 (1.04)	0.60 (1.04)	0.86 (1.15)
LGS-10	0.40 (0.94)	0.55 (1.02)	0.40 (0.94)	0.45 (0.96)
S.E. ±	0.16	0.10	0.05	---
C.D. P = 0.05	0.49	(N.S.)	(N.S.)	---

Figures in paranthesis are transformed values.

The results indicated that during the kharif season of 1988, all the fourteen cultivars of groundnut were equally preferred by thrips at 50 days after sowing. There were no significant differences amongst cultivars. At 40 days after sowing, the incidence of thrips varied from 0.50 to 3.00 thrips/3 leaves. The minimum incidence of thrips was observed on the cultivars LGS-10 (0.50 thrips/3 leaves) NCAC-343 (0.60 thrips/3 leaves) and 9/136-2187 (0.53 thrips/3 leaves) which were at par. The cultivar LGS-10 was recorded (1.84 thrips/3 leaves) SBXI (1.44 thrips/3 leaves) and TMV-2 (1.44 thrips/3 leaves). At 60 days of sowing no incidence was observed on the cultivars LGS-10 and NCAC-343. The highest incidence of thrips was noted on the cultivars ICG-1363 (1.00 thrips/3 leaves), SBXI (0.94 thrips/3 leaves), JL-24 (0.54 thrips/3 leaves) and TMV-2 (0.54 thrips/3 leaves).

During 1989 (Table 43) significant differences were observed in different groundnut cultivars at 50 days of sowing whereas at 60 and 70 days after sowing no significant differences could be observed. At 50 days the incidence of thrips varied from (0.30 to 1.50 thrips/3 leaves). The minimum incidence was observed on the cultivars ICG-134 (0.30 thrips/3 leaves), LGS-10 (0.40 thrips/3 leaves) and NCAC-343 (0.40 thrips/3 leaves) which were at par.

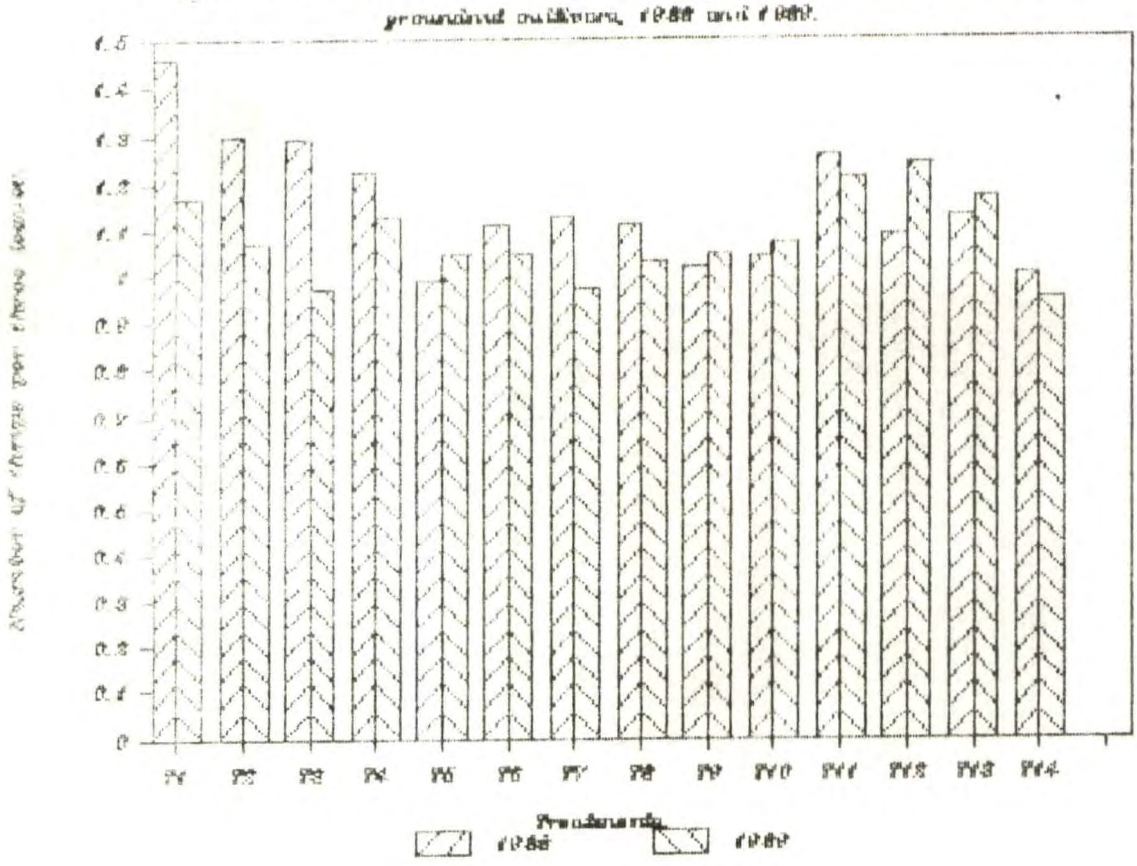
The data on the mean population of thrips on different cultivars are presented in Table 44 and represented in Fig.10.

Table 44 : Incidence of thrips on different groundnut cultivars, (1988 and 1989 seasons).

Treatment	Number of thrips/3 leaves		
	1988	1989	Pooled mean
ICG-1363	1.65 (1.46)	0.89 (1.17)	1.27 (1.31)
JL-24	1.20 (1.30)	0.66 (1.07)	0.93 (1.18)
SBXI	1.20 (1.29)	0.46 (0.97)	0.83 (1.13)
TMV-2	1.00 (1.22)	0.79 (1.13)	0.89 (1.17)
9/136-2187	0.50 (0.99)	0.63 (1.05)	0.53 (1.02)
ICG-9559	0.75 (1.11)	0.63 (1.05)	0.69 (1.08)
ICG-134	0.80 (1.13)	0.46 (0.97)	0.63 (1.05)
ICG-33	0.75 (1.11)	0.69 (1.03)	0.72 (1.07)
NCAC-343	0.55 (1.02)	0.63 (1.05)	0.59 (1.03)
ICG-10718	0.60 (1.04)	0.66 (1.07)	0.63 (1.04)
ICG-49	1.10 (1.26)	1.01 (1.21)	1.05 (1.23)
GB-FDS-273	0.70 (1.09)	1.06 (1.24)	0.88 (1.16)
ICG-5030	0.80 (1.13)	0.89 (1.17)	0.84 (1.15)
LGS-10	0.50 (1.00)	0.43 (0.95)	0.46 (0.97)
S.E. ±	0.06	0.03	0.04
C.D. P = 0.05	0.19	0.11	(N.S.)

Figures in paranthesℓs are transformed values.

Fig. 10 Incidence of thrips on different



Details of Treatments

T1 - ICG-1363	T2 - JL-24
T3 - SBXI	T4 - TMV-2
T5 - 9/136-2187	T6 - ICG-9559
T7 - 134	T8 - ICG-33
T9 - NCAC-343	T10 - ICG-10718
T11- ICG-49	T12- GB-FDS-273
T13- ICG-5030	T14- LGS-10

During the year 1988, differences in groundnut cultivars were significant. The incidence varied from 0.50 to 1.65 thrips/3 leaves. The minimum incidence was observed on the cultivars LGS-10 (0.50 thrips/3 leaves), 9/136-2187 (0.50 thrips/3 leaves) and NCAC-343 (0.55 thrips/3 leaves). The highest incidence on ICG-1363 (1.65 thrips/3 leaves) was observed.

In 1989, the cultivars LGS-10 and SBXI showed least incidence as compared to other cultivars. The highest incidence was recorded on the cultivars ICG-49, GB-FDS-273, ICG-1363 and ICG-5030.

However, pooled results showed the non-significant differences in the pest incidence amongst the different cultivars of groundnut.

4.4.3 Incidence of leaf miner on different cultivars of groundnut :

The weekwise data on population of leaf miner in kharif season of 1988 and 1989 are presented in Table 45 and 46 respectively.

The data revelaed that there were no differences amongst the different cultivars of groundnut at 60 days after sowing. At 40 days after sowing, the incidence of leaf miner varied from 0.60 to 1.60 larvae/plant. The lowest incidence was observed on NCAC-343, ICG-33,LGS-10 and ICG-134.At 50 days after sowing the maximum incidence was found on the ICG-9559,JL-24,ICG-33 and ICG-10718. The cultivar LGS-10 recorded significantly lower incidence than JL-24, ICG-9559 and ICG-33.

Table 45 : Incidence of leaf miner on different groundnut cultivars,during 1988.

Treatment	Number of leaf miner/plant (Days after sowings)			
	40	50	60	Mean
ICG-1363	1.00 (1.22)	0.90 (1.18)	0.00 (0.70)	0.63 (1.03)
JL-24	1.30 (1.34)	1.20 (1.30)	0.40 (0.94)	0.96 (1.19)
SBXI	1.50 (1.41)	1.10 (1.26)	0.20 (0.83)	0.93 (1.16)
TMV-2	1.60 (1.44)	1.00 (1.22)	0.10 (0.77)	0.90 (1.14)
9/136-2187	0.90 (1.18)	1.00 (1.22)	0.20 (0.83)	0.70 (0.90)
ICG-9559	1.20 (1.30)	1.60 (1.44)	0.40 (0.94)	1.00 (1.22)
ICG-134	0.85 (1.16)	0.80 (1.14)	0.15 (0.80)	0.60 (1.03)
ICG-33	0.70 (1.09)	1.20 (1.30)	0.20 (0.83)	0.63 (1.07)
NCAC-343	0.60 (1.04)	0.70 (1.09)	0.00 (0.70)	0.43 (0.91)
ICG-10718	1.00 (1.22)	1.20 (1.30)	0.40 (0.94)	0.86 (1.14)
ICG-49	1.30 (1.34)	0.90 (1.18)	0.20 (0.83)	0.80 (1.11)
GB-FDS- 273	1.50 (1.41)	1.00 (1.22)	0.00 (0.70)	0.83 (1.12)
ICG-5030	1.30 (1.34)	1.10 (1.26)	0.00 (0.70)	0.80 (1.11)
LGS-10	0.80 (1.14)	0.60 (1.04)	0.00 (0.70)	0.46 (0.96)
S.E. ±	0.08	0.07	0.04	---
C.D. P = 0.05	0.24	0.21	(N.S.)	---

Figures in paranthese are transformed values.

Table 46 : Incidence of leaf miner on different groundnut cultivars,during 1989.

Treatment	Number of leaf miner/plant (Days after sowings)			
	30	40	60	Mean
ICG-1363	1.00 (1.22)	0.90 (1.11)	0.70 (0.76)	0.68 (1.02)
JL-24	1.60 (1.44)	1.40 (1.37)	0.10 (0.77)	1.03 (1.19)
SBXI	1.50 (1.41)	1.20 (1.30)	0.30 (0.89)	1.00 (1.20)
TMV-2	1.00 (1.22)	0.80 (1.14)	0.10 (0.76)	0.63 (1.04)
9/136-2187	0.80 (1.14)	1.30 (1.34)	0.20 (0.83)	0.76 (1.10)
ICG-9559	0.90 (1.18)	1.20 (1.30)	0.10 (0.76)	0.73 (1.08)
ICG-134	1.40 (1.37)	0.70 (1.09)	0.00 (0.70)	0.70 (1.05)
ICG-33	1.30 (1.34)	1.50 (1.41)	0.00 (0.70)	0.93 (1.15)
NCAC-343	1.10 (1.26)	1.30 (1.34)	0.20 (0.83)	0.85 (1.14)
ICG-10718	1.50 (1.41)	1.20 (1.30)	0.40 (0.76)	1.03 (1.15)
ICG-49	1.30 (1.34)	1.00 (1.22)	0.20 (0.80)	0.83 (1.13)
GB-FDS- 273	1.00 (1.22)	1.20 (1.30)	0.10 (0.76)	0.76 (1.09)
ICG-5030	1.50 (1.41)	1.30 (1.34)	0.20 (0.83)	1.00 (1.19)
LGS-10	0.40 (1.17)	0.80 (1.12)	0.10 (0.76)	0.43 (0.01)
S.E. ±	0.07	0.10	0.05	---
C.D. P = 0.05	0.23	(N.S.)	(N.S.)	---

Figures in paranthesis are transformed values.

The results of 1989 indicated that the lowest incidence was observed on cultivar LGS-10 (0.40 larvae/plant) at 30 days of sowing. Differences among different cultivars were not evident after 40 and 60 days.

The data on the mean population of leaf miner on different cultivars are presented in Table 47 and depicted in Fig.11.

The results indicated that during the year 1988, the incidence of leaf miner varied significantly on different cultivars of groundnut. It ranged from 0.45 to 1.00 leaf miner larvae/plant. The incidence was higher in ICG-9559, JL-24, SBXI, GB-FDS-273 and TMV-2 and were at par.

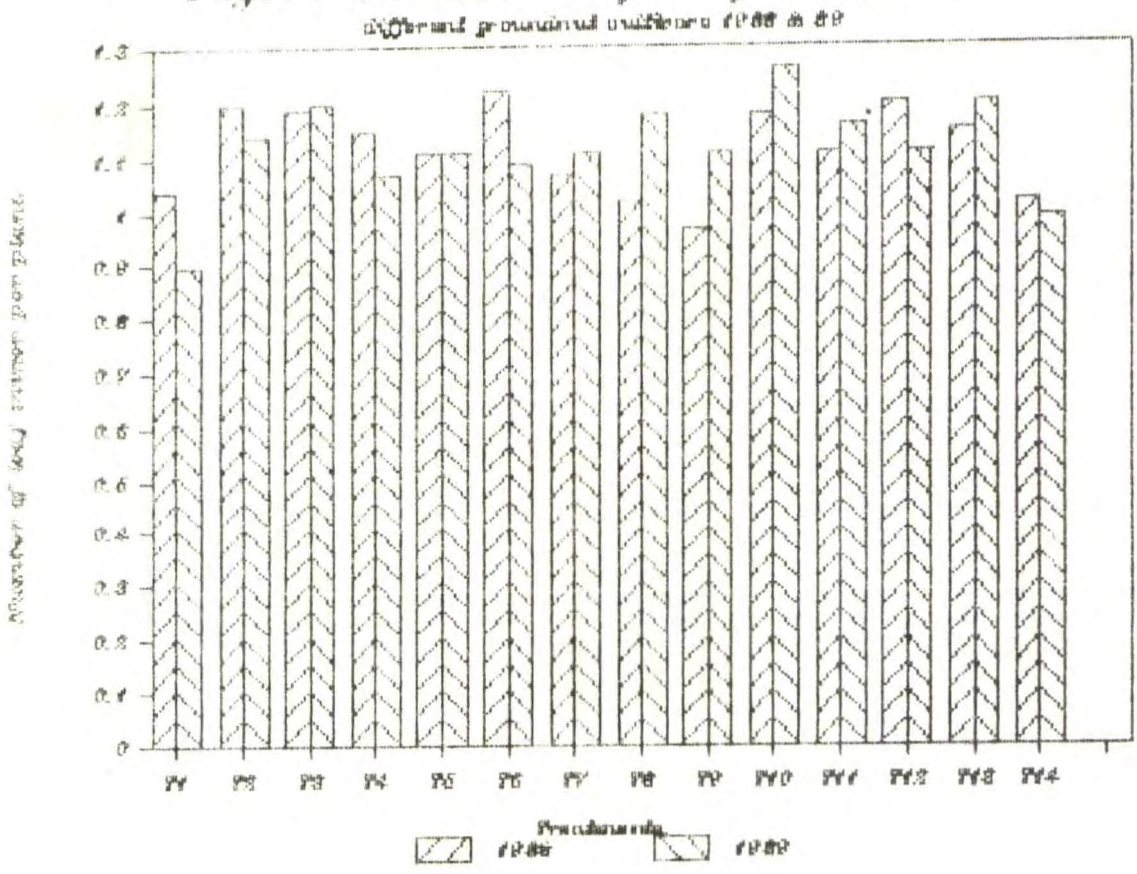
During the year 1989, the lowest infestation was observed on LGS-10, ICG-1363, TMV-2 and ICG-9559 and the highest on the cultivar ICG-10718 (1.10 larvae/plant).

Pooled results indicated significant differences amongst the different cultivars of groundnut. The cultivar LGS-10 was found significantly superior over the cultivars viz. JL-24 and SBXI in minimising the leaf miner infestation. The cultivars ICG-10718, JL-24, SBXI, ICG-5030 and GB-FDS-273 recorded higher infestation and were at par.

4.4.4 Effect of different cultivars on yield of groundnut :

The data on yield of different cultivars of groundnut during the year 1989 are presented in Table 48 and represented in Fig.12.

Fig. 11 Incidence of leaf miner on



Details of Treatments

T1 - ICG-1363	T2 - JL-24
T3 - SBXI	T4 - TMV-2
T5 - 9/136-2187	T6 - ICG-9559
T7 - 134	T8 - ICG-33
T9 - NCAC-343	T10- ICG-10718
T11- ICG-49	T12- GB-FDS-273
T13- ICG-5030	T14- LGS-10

Table 47 : Incidence of leaf miner on different groundnut cultivars,during 1988 and 1989.

Treatment	Number of leaf miner/plant		
	1988	1989	Pooled mean
ICG-1363	0.60 (1.04)	0.65 (0.90)	0.62 (0.97)
JL-24	0.95 (1.20)	1.00 (1.14)	0.97 (1.17)
SBXI	0.95 (1.19)	0.95 (1.20)	0.05 (1.19)
TMV-2	0.90 (1.15)	0.65 (1.07)	0.77 (1.11)
9/136-2187	0.75 (1.11)	0.75 (1.11)	0.75 (1.11)
ICG-9559	1.00 (1.22)	0.70 (1.09)	0.85 (1.15)
ICG-134	0.65 (1.07)	0.75 (1.11)	0.70 (1.09)
ICG-33	0.65 (1.02)	0.90 (1.18)	0.77 (1.10)
NCAC-343	0.45 (0.97)	0.75 (1.11)	0.60 (1.04)
ICG-10718	0.90 (1.18)	1.10 (1.26)	1.00 (1.22)
ICG-49	0.75 (1.11)	0.85 (1.16)	0.80 (1.13)
GB-FDS-273	0.95 (1.20)	0.75 (1.11)	0.85 (1.15)
ICG-5030	0.85 (1.15)	0.95 (1.20)	0.90 (1.17)
LGS-10	0.55 (1.02)	0.50 (0.99)	0.52 (1.00)
S.E. ±	0.04	0.05	0.04
C.D. P = 0.05	0.13	0.15	0.14

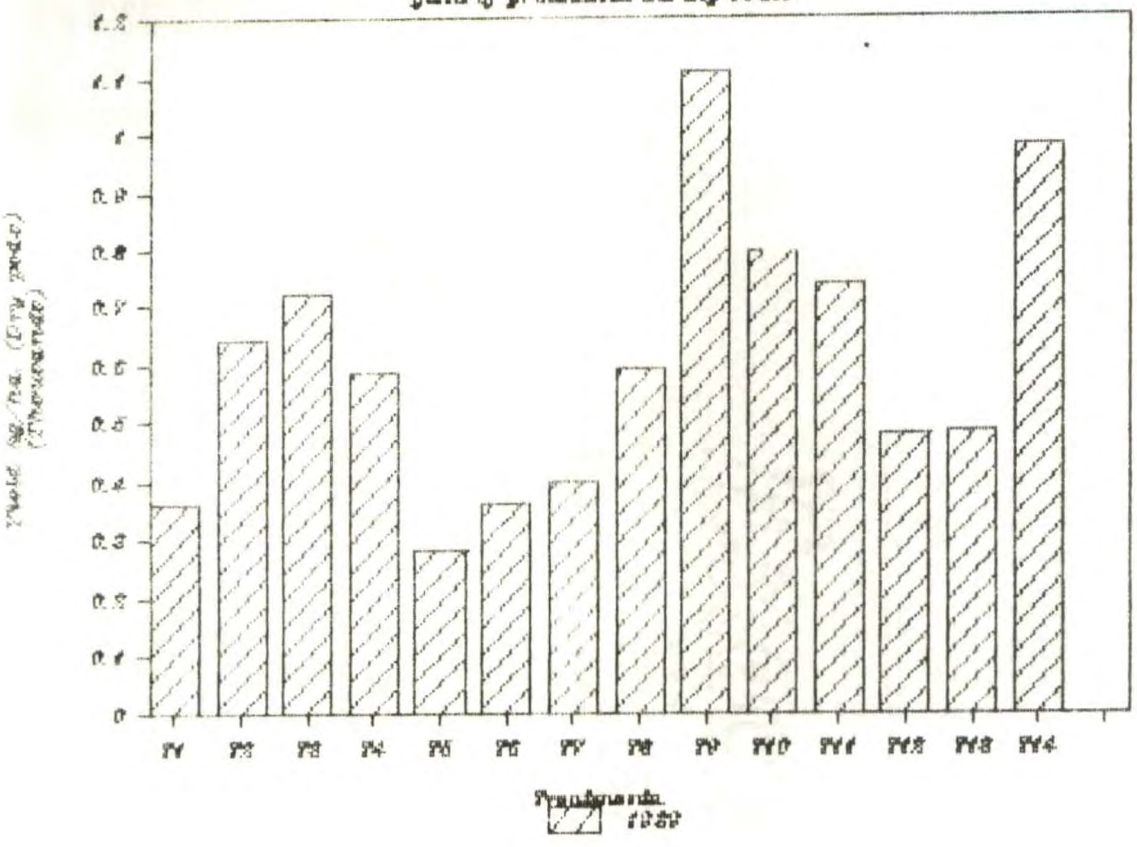
Figures in paranthesis are transformed values.

Table 48 : Effect of different cultivars on yield of groundnut during 1989.

Treatments	Yield kg/ha (Dry pods)
ICG-1363	361.00
JL-24	644.00
SBXI	721.00
TMV-2	588.00
9/136-2187	282.50
ICG-9559	360.50
ICG-134	399.50
ICG-33	588.50
NCAC-343	1110.50
ICG-10718	794.00
ICG-49	734.00
GB-FDS-273	477.50
ICG-5030	482.50
LGS-10	977.00
S.E. ±	73.28
C.D. (P = 0.05)	223.88

Fig.12 Effect of different cultivars on

yield of groundnut during 1989.



Details of Treatments

T1 - ICG-1363	T2 - JL-24
T3 - SBXI	T4 - TMV-2
T5 - 9/136-2187	T6 - ICG-9559
T7 - 134	T8 - ICG-33
T9 - NCAC-343	T10- ICG-10718
T11- ICG-49	T12- GB-FDS-273
T13- ICG-5030	T14- LGS-10

The results indicated that the highest pod yield of 1110.50 kg/ha was recorded by NCAC-343 followed by LGS-10 (977.00 kg/ha), ICG-10718 (794 kg/ha) and ICG-49 (734 kg/ha).

4.5 Efficacy of different insecticides against major pests of groundnut :

4.5.1 Effect of insecticides on the incidence of jassids :

Effect of different insecticides on the incidence of jassids was recorded one day before application and 1 and 7 days after applciation. Data pertaining to average number of jassids per 3 leaves during kharif seasons of 1988 and 1989 are presented in Table 49,50,51,52 and 53 and graphically presented in Fig.13.

The incidence of jassids was not noticed in the plots treated with carbofuran and phorate insecticides (Table 49) during 1988. The incidence of jassids before the application of insecticides varied from 3.40 to 4.06 jassids/3 leaves. One day after application of Ist spray the incidence varied from 0.20 to 3.73 jassids/3 leaves and all the insecticidal treatments significantly reduced the jassid population over control. The lowest incidence was observed in the treatment with lambdacyhalothrin 0.004 per cent followed by monocrotophos 0.05 per cent. Incidence of jassids varied from 0.20 to 3.06/3 leaves after seven days of application. The lowest infestation was observed in plots treated with monocrotophos 0.05 per cent followed by lambdacyhalothrin 0.004 per cent and ethofenprox 0.05 per cent.

Table 49 : Effect of different treatments on population of jassids (kharif 1988).

Treatments	Number of jassid nymphs per three leaves				Number of jassid nymphs per three leaves			
	Before treatment	Days after I spray 1	7	Mean	Before treatment	Days after II spray 1	7	Mean
Carbofuran 1 kg a.i./ha monocrotophos 0.05%	--	0.73 (1.10)	0.46 (0.97)	0.59 (1.03)	1.53 (1.41)	0.06 (0.74)	0.13 (0.78)	0.09 (0.76)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	--	0.63 (1.03)	0.53 (1.00)	0.58 (1.01)	1.80 (1.58)	0.00 (0.70)	0.06 (0.74)	0.03 (0.72)
Monocrotophos 0.05%	3.80 (2.06)	0.33 (0.89)	0.20 (0.82)	1.66 (0.85)	0.06 (1.46)	0.13 (0.74)	0.09 (0.78)	0.09 (0.76)
Lambdacyhalothrin 0.004%	4.13 (2.14)	0.20 (0.82)	0.33 (0.89)	0.26 (0.85)	1.46 (1.39)	0.26 (0.86)	0.13 (0.78)	0.19 (0.82)
Cartap 0.1 %	3.53 (2.00)	0.53 (1.00)	1.20 (1.29)	0.86 (1.14)	1.66 (1.46)	0.46 (0.97)	0.20 (0.82)	0.33 (0.89)
Indiara 1 %	3.86 (2.08)	1.20 (1.29)	1.33 (1.24)	1.26 (1.31)	1.66 (1.45)	1.33 (1.34)	0.13 (0.78)	0.73 (0.06)
Neemark 1 %	3.60 (2.01)	0.66 (1.06)	1.86 (1.52)	1.26 (1.29)	1.33 (1.34)	0.93 (1.19)	0.40 (0.92)	0.66 (1.05)
Triazophos 0.05%	3.80 (2.14)	0.40 (0.92)	1.06 (1.24)	0.73 (1.08)	1.40 (1.36)	0.33 (0.90)	0.20 (0.82)	0.26 (0.86)
Ethofenprox 0.05%	3.40 (2.03)	0.60 (1.04)	0.40 (0.93)	0.40 (0.98)	1.46 (1.39)	0.33 (0.89)	0.20 (0.82)	0.26 (0.85)
Control (Untreated)	4.06 (2.13)	3.73 (2.05)	3.06 (1.88)	3.39 (1.96)	2.20 (1.63)	1.93 (1.55)	0.60 (1.04)	1.26 (1.29)
S.E. ±	0.08	0.06	0.06	--	0.07	0.06	0.06	--
C.D. (P = 0.05)	N.S.	0.26	0.19	--	N.S.	0.18	N.S.	--

Figures in parantheses are transformed values

The incidence of jassids varied from 0.06 to 2.20 jassids/3 leaves and there were no significant differences amongst the different treatments before second spray. After 24 hours of second spraying the incidence of jassids varied from 0.00 to 1.93 jassids/3 leaves. All treated plots were significantly superior in reducing the jassid population over control. The lowest infestation was observed in the plots treated with phorate 1 kg a.i./ha + monocrotophos 0.05 per cent followed by monocrotophos 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent and lambdacyhalothrin 0.004 per cent. However, after 7 days of spraying, the incidence of jassids varied from 0.06 and 0.60 jassids/3 leaves. No significant differences were observed amongst treatments.

The data pertaining to the incidence of jassids during 1989 season before first spraying are given in Table 50. The differences amongst treatments were non significant, however, numerically the population fluctuated from 2.60 to 2.93 jassids/3 leaves before the application. The lowest incidence was observed in plots treated with monocrotophos 0.05 per cent after 24 hours of application. All the insecticidal treatments significantly reduced the incidence over control, except Indiara 1% and Neemark 1%. Seven days after first spray, the jassid incidence varied from 0.40 to 2.26 jassids/3 leaves. The lowest incidence was observed in the plots treated with monocrotophos 0.05 per cent. The next best

Table 50 : Effect of different treatments on population of jassids (kharif 1989).

Treatments	Number of jassid nymphs per three leaves				Number of jassid nymphs per three leaves			
	Before treatment	Days after I spray 24 hrs	7days	Mean	Before treatment	Days after II spray 24 hrs	7days	Mean
Carbofuran 1 kg a.i./ha monocrotophos 0.05%	--	0.60 (1.02)	0.60 (1.04)	0.60 (1.03)	1.13 (1.27)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	--	0.80 (1.13)	0.53 (1.00)	0.66 (1.06)	0.86 (1.18)	0.13 (0.78)	0.00 (0.70)	0.06 (0.74)
Monocrotophos 0.05%	2.50 (1.76)	0.46 (0.97)	0.40 (0.92)	0.43 (0.94)	1.00 (1.22)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)
Lambdacyhalothrin 0.004%	2.66 (1.77)	0.93 (1.19)	1.00 (1.21)	0.96 (1.20)	1.00 (1.22)	0.33 (0.90)	0.13 (0.76)	0.23 (0.84)
Cartap 0.1 %	2.86 (1.83)	0.93 (1.19)	0.86 (1.15)	0.89 (1.17)	1.20 (1.29)	0.13 (0.78)	0.13 (0.78)	0.13 (0.78)
Indiara 1 %	2.66 (1.77)	2.13 (1.62)	1.73 (1.48)	1.93 (1.55)	1.06 (1.24)	0.86 (1.16)	0.20 (0.83)	0.53 (0.99)
Neemark 1 %	2.93 (1.84)	2.20 (1.63)	1.53 (1.41)	1.86 (1.52)	0.66 (1.07)	0.80 (1.13)	0.06 (0.74)	0.46 (0.93)
Triazophos 0.05%	2.86 (1.82)	0.80 (1.13)	0.66 (1.06)	0.73 (1.09)	0.60 (1.04)	0.40 (0.93)	0.06 (0.74)	0.23 (0.83)
Ethofenprox 0.05%	2.80 (1.81)	0.73 (1.09)	0.73 (1.10)	0.73 (1.09)	0.86 (1.16)	0.13 (0.78)	0.06 (0.74)	0.09 (0.76)
Control (Untreated)	2.93 (1.84)	2.46 (1.75)	2.26 (1.66)	2.34 (1.70)	1.53 (1.39)	1.26 (1.32)	0.20 (0.83)	0.73 (1.07)
S.E. ±	0.05	0.06	0.09	--	0.04	0.04	0.03	--
C.D. (P = 0.05)	N.S.	0.18	0.29	--	N.S.	0.12	0.09	--

Figures in parantheses are transformed values

treatments were phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, triazophos 0.05 per cent, ethofenprox and lambdacyhalothrin 0.004 per cent.

Before second spray, there were no significant differences amongst treatments. Numerically the incidence varied from 0.66 to 1.53 jassids/3 leaves. After 24 hours of second spray, the incidence of jassids varied from 0.00 to 1.26 jassids/3 leaves. No population of jassids was observed in the plots treated with monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent. Next best treatments were phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, cartap 0.05 per cent and ethofenprox 0.05 per cent, and were at par. Similarl trend was observed after seven days of second spray.

It is evident from the data (Table 51) that during the year 1988 the incidence of jassids before treatments varied from 3.13 to 3.93 and that of 1989 varied from 1.76 and 2.03 jassids/3 leaves. No significant differences amongst the treatments could be observed in both the years before application.

Data (Table 52) indicated that all the insecticidal treatments significantly reduced jassids incidence over control during both the years. The treatment of monocrotophos 0.05 per cent proved most effective followed by lambdacyhalothrin 0.004 per cent in 1988 and ethofenprox in 1989.

Table 51 : Effect of various treatments on the population of jassid.

Treatments	Mean number of jassids/ 3 leaves before spraying		Pooled mean (weighted)
	1988	1989	
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	3.13 (1.89)	1.80 (1.41)	2.46 (1.52)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	3.53 (1.99)	1.86 (1.51)	2.64 (1.62)
Monocrotophos 0.05%	2.93 (2.09)	1.83 (1.51)	2.88 (1.65)
Lambdacyhalothrin 0.004 %	3.66 (2.03)	1.80 (1.51)	2.73 (1.63)
Cartap 0.1 %	3.53 (2.00)	2.03 (1.58)	2.78 (1.67)
Indiara 1 %	3.26 (1.93)	1.87 (1.53)	2.56 (1.62)
Neemark 1 %	3.66 (2.03)	1.83 (1.52)	2.74 (1.64)
Triazophos 0.05%	3.13 (1.90)	1.76 (1.49)	2.44 (1.58)
Ethofenprox 0.05%	3.13 (1.90)	1.83 (1.52)	2.48 (1.60)
Control (Untreated)	3.66 (2.11)	1.86 (1.53)	2.76 (1.66)
S.E. ±	0.07	0.04	0.06
C.D. (P = 0.05)	N.S.	N.S.	N.S.

Figures in paranthesis are transformed values

Table 52 : Effect of various treatments on the population of jassids.

Treatments	Mean number of jassids/ 3 leaves at 24 hours spraying		Pooled mean
	1988	1989	
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	0.73 (1.10)	0.60 (1.04)	0.66 (1.07)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	0.63 (0.96)	0.61 (1.07)	0.63 (0.96)
Monocrotophos 0.05%	0.33 (0.89)	0.20 (0.82)	0.26 (0.86)
Lambdacyhalothrin 0.004 %	0.42 (0.93)	0.66 (1.07)	0.53 (0.95)
Cartap 0.1 %	0.63 (1.04)	0.66 (1.07)	0.63 (1.05)
Indiara 1 %	1.40 (1.33)	1.10 (1.27)	1.25 (1.30)
Neemark 1 %	1.26 (1.37)	1.10 (1.27)	1.18 (1.27)
Triazophos 0.05%	1.10 (1.28)	0.80 (1.13)	0.95 (1.20)
Ethofenprox 0.05%	0.63 (0.92)	0.40 (0.93)	0.50 (0.92)
Control (Untreated)	4.00 (2.11)	2.06 (1.60)	3.03 (1.85)
S.E. ±	0.06	0.04	0.05
C.D. (P = 0.05)	0.19	0.13	0.17

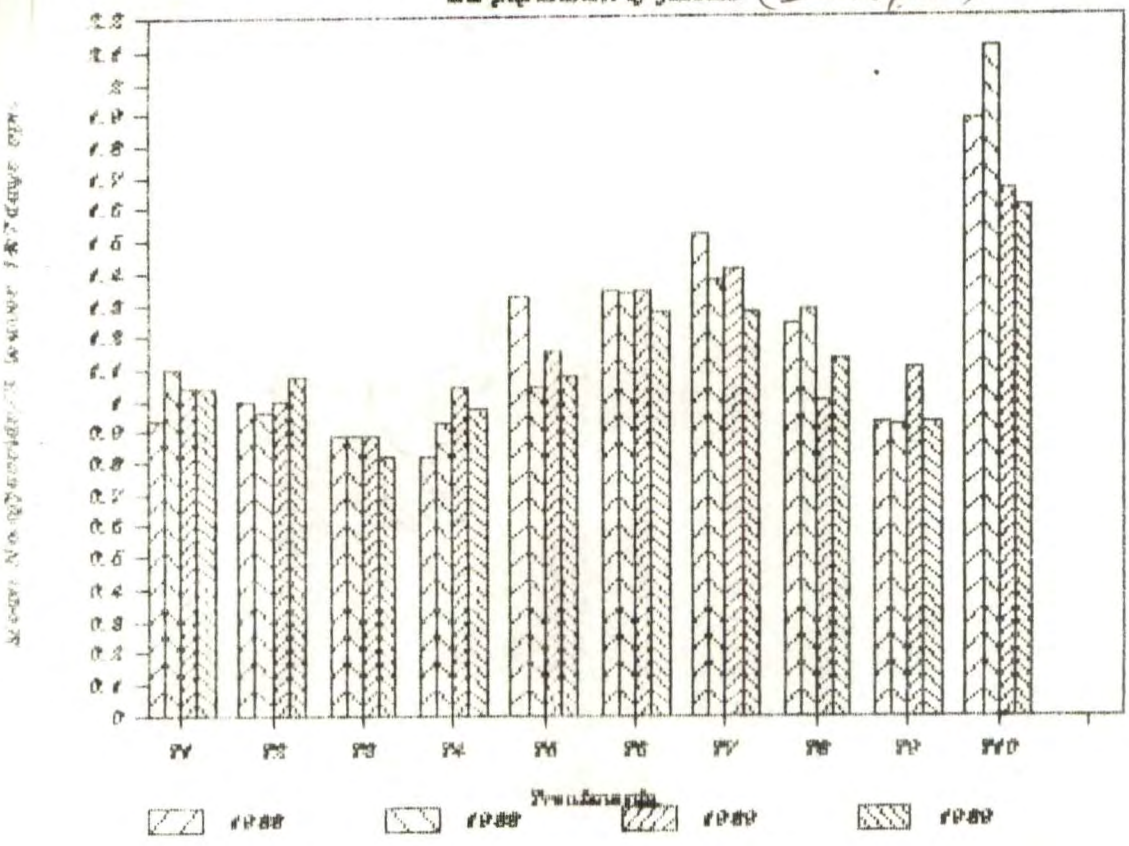
Figures in paranthesis are transformed values

phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, cartap 0.1 per cent,triazophos 0.05 per cent, Neemark 1% and Indiara 1 % after one day of application.

The pooled analysis revealed that significantly lower population of jassids was recorded in the treatment with monocrotophos 0.05 per cent, ethofenprox 0.05 per cent, lambdacyhalothrin 0.004 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, cartap 0.1 per cent, which were at par with each other. The treatment with carbofuran 1 kg a.i./ha, monocrotophos 0.05 per cent, triazophos 0.05 per cent, Neemark 1 % and Indiara 1% were next best and provided good control over unprotected plots.

Data on incidence of jassids/3 leaves seven days after sowing are given in Table 53. It was revealed that the incidence of jassids varied from 0.20 to 3.06 in 1988 and 0.33 to 2.26 during the year 1989. All the insecticidal treatments significantly controlled the jassids population over control, in both the years. In 1988, the lowest incidence was observed in lambdacyhalothrin 0.004 per cent followed by monocrotophos 0.05 per cent, ethofenprox 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent and phorate 1 kg a.i./ha + monocrotophos 0.05 per cent.

Fig. 13 Effect of various treatments on the population of insects (1 and 7 DAT)



Details of Treatments

T1 - Carbofuran 1 kg a.i./ha + monocrotophos Ø.Ø5%

T2 - Phorate 1 kg a.i./ha + monocrotophos Ø.Ø5%

T3 - Monocrotophos Ø.Ø5%

T4 - Lambdacyhalothrin Ø.ØØ4%

T5 - Cartap Ø.1 %

T6 - Indiara 1 %

T7 - Neemark 1 %

T8 - Triazophos Ø.Ø5 %

T9 - Ethofenprox Ø.Ø5 %

T1Ø- Control (untreated)

Table 53 : Effect of various treatments on the population of jassids.

Treatments	Mean number of jassids/ 3 leaves 7 days after spraying		Pooled mean
	1988	1989	
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	0.40 (0.94)	0.60 (1.04)	0.50 (0.99)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	0.53 (1.00)	0.53 (1.00)	0.53 (1.00)
Monocrotophos 0.05%	0.33 (0.89)	0.33 (0.89)	0.33 (0.89)
Lambdacyhalothrin 0.004 %	0.20 (0.82)	0.60 (1.04)	0.40 (0.92)
Cartap 0.1 %	1.26 (1.32)	0.86 (1.15)	1.06 (1.23)
Indiara 1 %	1.33 (1.34)	1.33 (1.34)	1.33 (1.34)
Neemark 1 %	1.80 (1.52)	1.53 (1.41)	1.66 (1.46)
Triazophos 0.05%	1.06 (1.24)	0.53 (1.00)	0.79 (1.12)
Ethofenprox 0.05%	0.40 (0.93)	0.73 (1.10)	0.56 (1.01)
Control (Untreated)	3.06 (1.88)	2.26 (1.66)	2.66 (1.77)
S.E. ±	0.06	0.07	0.06
C.D. (P = 0.05)	0.18	0.20	0.20

Figures in paranthesis are transformed values

In 1989, the incidence of jassids rose to the level of 2.26 per three leaves. The lowest incidence was observed in monocrotophos 0.05 per cent. The next best treatments were phorate 1 kg a.i./ha + monocrotophos 0.05 per cent,triazophos 0.05 per cent,lambdacyhalothrin 0.004 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent which were at par.

The pooled analysis indicated that the average population of jassids was minimum in the treatment with monocrotophos 0.05 per cent but it did not differ significantly from lambdacyhalothrin 0.004 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent and ethofenprox 0.05 per cent. These treatments were significantly superior in reducing the jassid population over triazophos 0.05 per cent, cartap 0.1 per cent, Indiara 1 %, Neemark 1 % and control.

4.5.2 Effect of insecticides on incidence of thrips :

The data regarding the incidence of thrips recorded after treatment application on groundnut during 1988 and 1989 were given in Table 54,55,56,57 and 58 and depicted in Fig.14.

It may be seen from the data presented in Table 54 that no significant differences could be observed among the treatments during 1988.The incidence of thrips before treatments exhibited 3.46 to 4.13 thrips/3 leaves. The incidence varied in the range of 0.46 to 3.46 thrips/3 leaves after 24 hours of spray. The lowest incidence was observed in the plots treated with

Table 54 : Effect of various treatments on the population of thrips during 1988.

Treatments	Number of thrips per three leaves				Number of thrips per three leaves			
	Before treatment	Days after I spray 24 hrs	7days	Mean	Before treatment	Days after II spray 24 hrs	7days	Mean
Carbofuran 1 kg a.i./ha monocrotophos 0.05%	--	0.86 (1.16)	0.53 (1.00)	0.69 (1.08)	3.80 (2.05)	0.33 (0.00)	0.06 (0.74)	0.19 (0.82)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	--	0.60 (1.04)	0.60 (1.03)	0.60 (1.03)	3.73 (2.05)	0.53 (1.00)	0.13 (0.78)	0.32 (0.85)
Monocrotophos 0.05%	3.73 (2.05)	0.46 (0.97)	0.00 (0.70)	0.23 (0.85)	3.73 (2.05)	0.06 (0.74)	0.06 (0.74)	0.06 (0.74)
Lambdacyhalothrin 0.004%	3.80 (2.06)	0.60 (1.04)	0.53 (1.00)	0.56 (1.02)	3.93 (2.02)	0.53 (1.00)	0.06 (0.74)	0.29 (0.87)
Cartap 0.1 %	3.73 (2.04)	0.66 (1.04)	0.26 (0.86)	0.46 (0.95)	3.73 (2.05)	0.86 (0.16)	0.20 (0.83)	0.80 (0.99)
Indiara 1 %	3.86 (2.08)	1.80 (1.37)	0.93 (1.18)	1.36 (1.27)	4.13 (2.14)	2.13 (1.60)	0.40 (0.93)	1.26 (1.26)
Neemark 1 %	3.60 (2.02)	2.00 (1.29)	1.80 (1.51)	1.90 (1.40)	3.53 (2.00)	2.46 (1.72)	0.73 (1.10)	1.59 (1.41)
Triazophos 0.05%	3.53 (2.00)	0.80 (1.13)	0.40 (1.21)	0.60 (1.17)	3.60 (2.03)	0.86 (1.16)	0.13 (0.78)	0.49 (0.97)
Ethofenprox 0.05%	3.46 (1.98)	0.73 (1.18)	0.80 (1.25)	0.76 (1.22)	3.73 (2.04)	0.60 (1.04)	0.26 (0.86)	0.43 (0.95)
Control (Untreated)	4.13 (2.14)	3.76 (2.08)	2.26 (1.66)	3.06 (1.87)	4.00 (2.11)	3.26 (1.93)	1.00 (1.22)	2.13 (1.57)
S.E. ±	0.05	0.10	0.08	--	0.05	0.06	0.06	--
C.D. (P = 0.05)	N.S.	0.31	0.25	--	N.S.	0.18	0.178	--

Figures in parantheses are transformed values

monocrotophos 0.05 per cent followed by phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent and cartap 0.1 per cent. Seven days after first spraying, the incidence of thrips varied from 0.26 to 2.26 thrips per three leaves. The lowest incidence was observed in the plots treated with monocrotophos 0.05 per cent followed by cartap 0.1 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent and lambdacyhalothrin 0.004 per cent.

Before second spraying, there were no significant differences among the treatments. The incidence of thrips was 3.53 to 4.13 per three leaves. However, after 24 hours of second spray, the incidence of thrips varied from 0.06 to 3.26 thrips per three leaves. The lowest incidence was observed in monocrotophos 0.05 per cent followed by carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, phorate 1 kg a.i/ha + monocrotophos 0.05 per cent and lambdacyhalothrin 0.004 per cent, which were at par. The treatment with monocrotophos 0.05 per cent offered good control over rest of treatments including untreated plots.

After seven days of second spray, all the insecticidal application of treatments were significantly superior over control except Neemark 1 % and the incidence varied from 0.06 to 1.00 thrips per three leaves. The lowest incidence was recorded in the

monocrotophos 0.05 per cent.

Data on the incidence of thrips presented in Table 55 revealed that during 1989 the incidence of thrips before treatments varied from 8.53 to 11.13 thrips per three leaves and there were no significant differences amongst the treatments. After 24 hours of first spray, the incidence varied from 0.33 to 6.26 thrips per three leaves. The lowest incidence was observed in monocrotophos 0.05 per cent. The next best treatments were phorate 1 kg a.i./ha + monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent. Seven days after spraying all insecticidal treatments provided good control of thrips over the control and incidence of thrips varied from 0.26 to 2.93 thrips per three leaves. The lowest infestation was observed in the treatments with monocrotophos 0.05 per cent,phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent and ethofenprox 0.05 per cent.

No significant differences could be observed amongst the treatments before second spray.

After 24 hours of second spraying, the incidence of thrips varied from 0.13 to 2.80. All the insecticidal treatments were significantly superior over control. The best treatments were monocrotophos 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent and cartap 0.1 per cent. The incidence of thrips was reduced to 0.60 thrips per three leaves seven days after

Table 55 : Effect of various treatments on the population of thrips during 1989.

Treatments	Number of thrips per three leaves				Number of thrips per three leaves			
	Before treatment	Days after I spray 24 hrs	7days	Mean	Before treatment	Days after II spray 24 hrs	7days	Mean
Carbofuran 1 kg a.i./ha monocrotophos 0.05%	--	0.73 (1.10)	0.53 (1.00)	0.63 (1.05)	1.60 (1.44)	0.13 (0.78)	0.06 (0.74)	0.09 (0.76)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	--	0.73 (1.09)	0.26 (0.85)	0.49 (0.97)	1.46 (1.39)	0.20 (0.83)	0.00 (0.70)	0.10 (0.76)
Monocrotophos 0.05%	10.46 (3.26)	0.33 (0.89)	0.46 (0.97)	0.39 (0.93)	2.13 (1.61)	0.13 (0.78)	0.06 (0.74)	0.09 (0.76)
Lambdacyhalothrin 0.004%	10.80 (3.18)	0.93 (1.18)	0.66 (1.06)	0.79 (1.12)	1.73 (1.82)	0.26 (0.85)	0.46 (0.97)	0.36 (0.91)
Cartap 0.1 %	10.46 (3.26)	0.93 (1.19)	1.53 (1.41)	1.23 (1.30)	1.73 (1.47)	0.13 (0.78)	0.33 (0.89)	0.23 (0.85)
Indiara 1 %	8.53 (2.98)	3.06 (2.19)	0.93 (1.19)	1.99 (1.65)	2.40 (1.68)	1.20 (1.29)	0.46 (0.97)	0.83 (1.13)
Neemark 1 %	10.60 (3.32)	4.73 (2.28)	1.46 (1.39)	3.09 (1.83)	2.20 (1.96)	1.53 (1.41)	0.40 (0.92)	0.96 (1.16)
Triazophos 0.05%	11.13 (3.40)	1.20 (1.27)	0.86 (1.15)	1.03 (1.21)	2.20 (2.30)	0.40 (0.93)	0.13 (0.78)	0.26 (0.88)
Ethofenprox 0.05%	8.13 (2.93)	1.13 (1.25)	0.66 (1.07)	0.89 (1.16)	1.93 (1.55)	1.13 (0.78)	0.20 (0.82)	0.16 (0.80)
Control (Untreated)	10.33 (3.24)	6.25 (2.55)	2.93 (1.84)	4.59 (2.19)	3.13 (1.90)	2.80 (1.81)	0.60 (1.04)	1.70 (1.48)
S.E. ±	0.02	0.10	0.07	--	0.17	0.06	0.05	--
C.D. (P = 0.05)	N.S.	0.30	0.23	--	N.S.	0.18	0.17	--

Figures in parantheses are transformed values

spray. The lowest number was observed in the plots treated with phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, followed by monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent.

It is evident from the Table 56 that during both the years, there were no significant differences between treatments. The incidence of thrips varied from 3.46 to 4.13 and 4.93 to 6.06 thrips per three leaves, during 1988 and 1989 respectively before sprayings.

From the data given in Table 57 it is observed that all insecticidal treatments were significantly superior over control in both the years. During 1988, significantly lower population of thrips was recorded in all the treatments. The treatments with monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent, cartap 0.1 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, ethofenprox 0.05 per cent, triazophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent were at par. The incidence of thrips varied from 0.46 and 3.86 per three leaves after 24 hours of treatment.

During 1989, the treatment with monocrotophos 0.05 per cent came out most promising over other insecticidal treatments including control. Other effective treatments were phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, triazophos 0.05 per cent and ethofenprox 0.05 per cent in

Table 56 : Effect of various treatments on the population of thrips.

Treatments	Mean number of thrips/ 3 leaves before spraying		Pooled mean
	1988	1989	
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	3.73 (2.05)	5.56 (2.45)	4.64 (2.25)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	3.63 (1.93)	5.70 (2.48)	4.61 (2.23)
Monocrotophos 0.05%	3.73 (2.05)	5.56 (2.45)	4.64 (2.25)
Lambdacyhalothrin 0.004 %	3.80 (2.06)	5.50 (2.47)	4.65 (2.25)
Cartap 0.1 %	3.73 (2.04)	5.43 (2.42)	3.58 (2.23)
Indiara 1 %	3.86 (2.08)	4.93 (2.33)	4.39 (2.20)
Neemark 1 %	3.60 (2.02)	6.06 (2.55)	4.83 (2.28)
Triazophos 0.05%	3.53 (2.00)	6.00 (2.54)	4.76 (2.27)
Ethofenprox 0.05%	3.46 (2.02)	5.80 (2.50)	4.63 (2.26)
Control (Untreated)	4.13 (2.14)	5.73 (2.48)	4.93 (2.51)
S.E. $\pm$	0.05	0.05	0.05
C.D. (P = 0.05)	(N.S.)	(N.S.)	(N.S.)

Figures in paranthesis are transformed values

Table 57 : Effect of various treatments on the population of thrips.

Treatments	Mean number of thrips/ 3 leaves 24 hours after spraying		Pooled mean
	1988	1989	
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	0.86 (1.16)	0.73 (1.10)	0.79 (1.13)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	0.60 (1.04)	0.73 (1.09)	0.66 (1.06)
Monocrotophos 0.05%	0.46 (0.97)	0.33 (0.89)	0.39 (0.93)
Lambdacyhalothrin 0.004 %	0.60 (1.04)	0.93 (1.18)	0.76 (1.11)
Cartap 0.1 %	0.60 (1.04)	0.93 (1.19)	0.76 (1.11)
Indiara 1 %	1.80 (1.51)	2.53 (1.73)	2.16 (1.62)
Neemark 1 %	2.00 (1.56)	2.20 (1.63)	2.10 (1.59)
Triazophos 0.05%	0.80 (1.13)	0.83 (1.14)	0.81 (1.13)
Ethofenprox 0.05%	0.73 (1.10)	0.86 (1.16)	0.79 (1.13)
Control (Untreated)	3.86 (2.08)	3.80 (2.06)	3.83 (2.07)
S.E. $\pm$	0.06	0.05	0.06
C.D. (P = 0.05)	0.20	0.16	0.19

Figures in paranthesis are transformed values

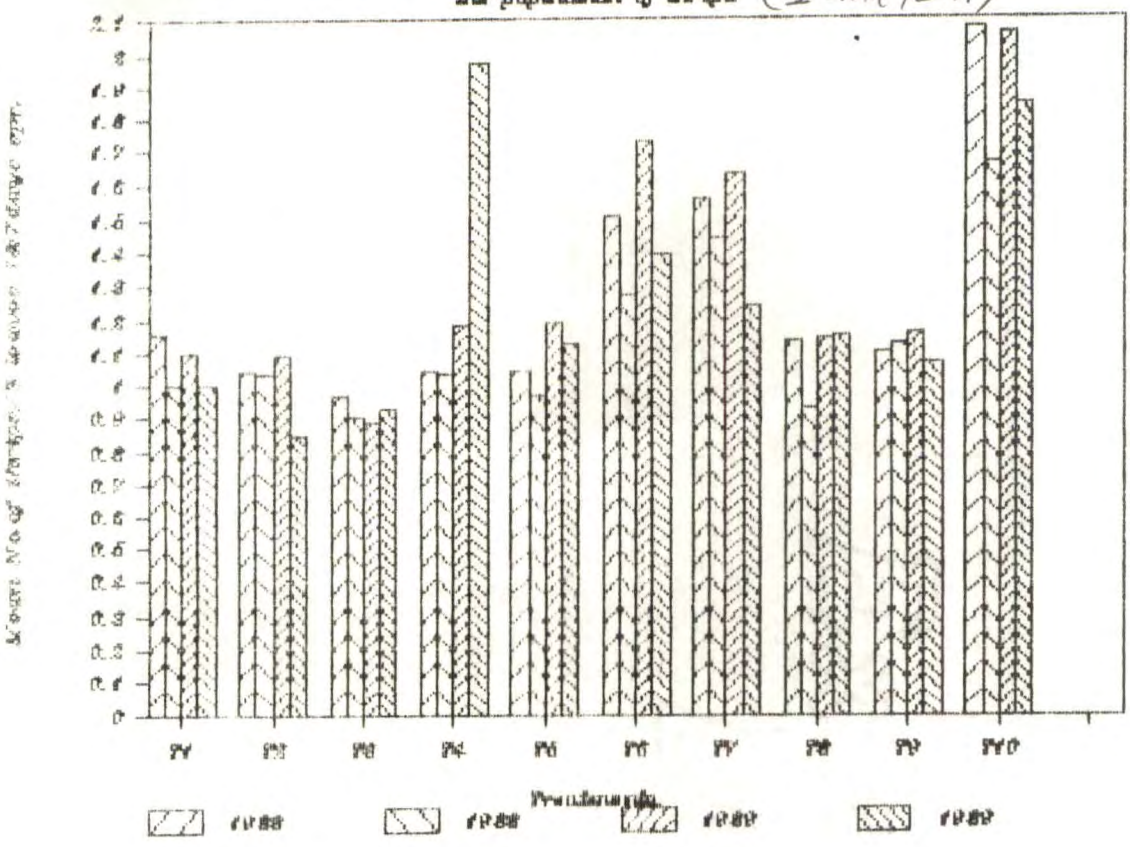
reducing population of thrips.

The pooled analysis revealed that significantly lower incidence of thrips was recorded in monocrotophos 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent, cartap 0.1 per cent, ethofenprox 0.05 per cent, triazophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent than Indiara 1 %, Neemark 1 % and control.

The results presented in Table 58 inferred that incidence of thrips seven days after treatment varied from 0.33 to 2.26 and 0.26 to 2.93 thrips per three leaves during the year 1988 and 1989, respectively. During the first season, all the insecticidal treatments were significantly superior over control. The lowest incidence was observed in the treatments with monocrotophos 0.05 per cent, triazophos 0.05 per cent, cartap 0.1 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent and phorate 1 kg a.i./ha + monocrotophos 0.05 per cent.

Similar trend was noted during 1989. The treatments phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent and ethofenprox 0.05 per cent were found more effective in reducing the thrips population and were at par.

Fig. 14 Effect of various treatments on the population of Scirpophaga (1 and 7 DAT)



Details of Treatments

T1 - Carbofuran 1 kg a.i./ha + monocrotophos Ø.Ø5%

T2 - Phorate 1 kg a.i./ha + monocrotophos Ø.Ø5%

T3 - Monocrotophos Ø.Ø5%

T4 - Lambdacyhalothrin Ø.ØØ4%

T5 - Cartap Ø.1 %

T6 - Indiara 1 %

T7 - Neemark 1 %

T8 - Triazophos Ø.Ø5 %

T9 - Ethofenprox Ø.Ø5 %

T1Ø- Control (untreated)

Table 58 : Effect of various treatments on the population of thrips.

Treatments	Mean number of thrips 3 leaves 7 days after spraying		Pooled mean
	1988	1989	
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	0.53 (1.00)	0.53 (1.00)	0.53 (1.00)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	0.60 (1.03)	0.26 (0.85)	0.43 (0.94)
Monocrotophos 0.05%	0.33 (0.90)	0.40 (0.93)	0.36 (0.91)
Lambdacyhalothrin 0.004 %	0.60 (1.03)	0.56 (0.97)	0.53 (1.00)
Cartap 0.1 %	0.46 (0.97)	0.46 (1.12)	0.46 (1.04)
Indiara 1 %	1.13 (1.27)	1.46 (1.39)	1.29 (1.33)
Neemark 1 %	1.60 (1.44)	1.33 (1.24)	1.46 (1.38)
Triazophos 0.05%	0.40 (0.93)	0.86 (1.15)	0.63 (1.09)
Ethofenprox 0.05%	0.80 (1.12)	0.66 (1.07)	0.73 (1.09)
Control (Untreated)	2.26 (1.66)	2.93 (1.84)	2.59 (1.75)
S.E. $\pm$	0.06	0.08	0.07
C.D. (P = 0.05)	0.19	0.23	0.21

Figures in paranthese are transformed values

The pooled results indicated that average population of thrips was minimum in the treatments with monocrotophos 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent and cartap 0.1 per cent. The incidence varied from 0.36 to 2.59 thrips per three leaves in different treatments.

4.5.3 Effect of insecticides on incidence of leaf miner :

Effect of different insecticdies on groundnut leaf miner during 1988 and 1989 are presented in Table 59, 60, 61, 62 and 63 and graphically depicted in Fig.15.

It is evident from data (Table 59) that during 1988 the incidence of leaf miner before treatment varied from 1.20 to 1.86 larvae per plant and there were no significant differences among the treatments. After 24 hours of first spraying, the incidence of leaf miner varied from 0.06 to 1.46 larvae per plant. The lowest infestation was observed in plot treated with monocrotophos 0.05 per cent followed by ethofenprox 0.05 per cent, triazophos 0.05 per cent and lambdacyhalothrin 0.004 per cent. Seven days after spraying, all the insecticidal treatments were significantly superior over control except Indiara 1% and the incidence of leaf miner varied from 0.06 to 1.33 larvae per plant. The lowest incidence was observed in the plots treated with

Table 59 : Effect of different treatments on the population of leaf miner during 1988.

Treatments	Number of leaf miner per plant				Number of leaf miner per plant		
	Before treatment	Days after I spray 24 hrs	7days	Mean	Before treatment	Days after II spray 24 hrs	7days
Carbofuran 1 kg a.i./ha monocrotophos 0.05%	--	0.46 (0.97)	0.33 (0.90)	0.39 (0.93)	1.44 (1.37)	0.53 (1.00)	0.00 (0.70)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	--	0.46 (0.97)	0.13 (0.78)	0.29 (0.87)	1.33 (1.34)	0.13 (0.78)	0.00 (0.70)
Monocrotophos 0.05%	1.46 (1.39)	0.06 (0.74)	0.06 (0.74)	0.06 (0.74)	1.20 (1.29)	0.13 (0.78)	0.00 (0.70)
Lambdacyhalothrin 0.004%	1.33 (1.34)	0.40 (0.94)	0.46 (0.97)	0.43 (0.95)	1.53 (1.41)	0.66 (1.07)	0.13 (0.78)
Cartap 0.1 %	1.33 (1.34)	0.60 (1.04)	0.46 (0.93)	0.53 (0.98)	1.26 (1.32)	0.80 (1.12)	0.00 (0.70)
Indiara 1 %	1.53 (1.41)	1.00 (1.22)	0.86 (1.16)	0.93 (1.19)	1.53 (1.41)	0.93 (1.18)	0.33 (0.89)
Neemark 1 %	1.26 (1.32)	1.00 (1.22)	0.73 (1.10)	0.86 (1.16)	1.26 (1.32)	1.13 (1.26)	0.20 (0.89)
Triazophos 0.05%	1.20 (1.29)	0.40 (0.93)	0.26 (0.96)	0.33 (0.94)	1.26 (1.32)	0.80 (1.12)	0.06 (0.74)
Ethofenprox 0.05%	1.33 (1.34)	0.40 (0.92)	0.20 (0.83)	0.30 (0.87)	1.40 (1.37)	0.93 (0.81)	0.00 (0.70)
Control (Untreated)	1.86 (1.53)	1.46 (1.37)	1.33 (1.37)	1.49 (1.35)	1.80 (1.42)	1.60 (1.44)	0.46 (1.27)
S.E. ±	0.04	0.04	0.07	--	0.04	0.05	0.05
C.D. (P = 0.05)	N.S.	0.13	0.23	--	N.S.	0.16	0.15

Figures in parantheses are transformed values

monocrotophos 0.05 per cent. The other effective treatments in descending order were phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, ethofenprox 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent.

Before application of second spraying there were no significant differences in the treatments. 24 hours after treatment, the infestation of leaf miner attained the level of 1.60 larvae per plant. The effective treatments were phorate 1 kg a.i./ha + monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent. Seven days after spraying no incidence of leaf miner was noted in monocrotophos 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent and ethofenprox 0.05 per cent.

In the year 1989 (Table 60) leaf miner count before first spraying was 1.33 to 1.73 larvae per plant and there were no significant differences among treatments. However, 24 hours after spraying, infestation of leaf miner varied from 0.13 to 1.40 larvae per plant. The lowest incidence was recorded in monocrotophos 0.05 per cent, followed by ethofenprox 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent which were at par. Seven days after first spraying no significant differences were observed among the treatments.

Table 60 : Effect of different treatment on population of leaf miner during 1989

Treatments	Number of leaf miner per plant				Number of leaf miner per plant			
	Before treatment	Days after I spray 24 hrs	7days	Mean	Before treatment	Days after II spray 24 hrs	7days	Mean
Carbofuran 1 kg a.i./ha monocrotophos 0.05%	--	0.46 (0.97)	0.40 (0.82)	0.43 (0.89)	2.00 (0.89)	0.46 (0.97)	0.00 (0.70)	0.23 (0.83)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	--	0.40 (0.94)	0.26 (0.86)	0.33 (0.90)	1.93 (1.55)	0.53 (1.00)	0.13 (0.78)	0.33 (0.89)
Monocrotophos 0.05%	1.73 (1.48)	0.13 (0.78)	0.20 (0.83)	0.16 (0.80)	2.06 (1.59)	0.26 (0.86)	0.13 (0.78)	0.19 (0.82)
Lambdacyhalothrin 0.004%	1.40 (1.36)	0.73 (1.10)	0.46 (0.97)	0.59 (1.03)	1.86 (1.86)	0.93 (1.19)	0.13 (0.78)	0.80 (0.98)
Cartap 0.1 %	1.46 (1.39)	0.60 (1.00)	0.26 (0.86)	0.43 (0.93)	2.00 (1.90)	0.60 (1.04)	0.20 (0.82)	0.40 (0.93)
Indiara 1 %	1.40 (1.36)	1.13 (1.27)	0.46 (0.97)	0.79 (1.12)	1.93 (2.22)	0.60 (1.44)	0.20 (0.82)	0.90 (1.13)
Neemark 1 %	1.66 (1.46)	0.93 (1.18)	0.40 (0.93)	0.66 (1.05)	1.73 (1.81)	1.33 (1.34)	0.20 (0.82)	0.76 (1.08)
Triazophos 0.05%	1.20 (1.30)	0.60 (1.04)	0.33 (0.89)	0.46 (0.96)	1.73 (1.82)	0.73 (1.10)	0.06 (0.74)	0.39 (0.92)
Ethofenprox 0.05%	1.33 (1.34)	0.33 (0.89)	0.20 (0.82)	0.26 (0.85)	1.93 (1.88)	0.60 (1.04)	0.06 (0.74)	0.33 (0.89)
Control (Untreated)	1.33 (1.34)	1.40 (1.36)	0.66 (1.07)	1.03 (1.21)	2.26 (1.97)	1.66 (1.46)	0.26 (0.86)	0.96 (1.16)
S.E. ±	0.05	0.06	0.06	--	0.30	0.05	0.06	---
C.D. (P = 0.05)	N.S.	0.188	N.S.	--	N.S.	0.157	N.S.	---

Figures in parantheses are transformed values

The differences in leaf miner infestation were not evident prior to second spray and the incidence of leaf miner varied from 1.73 to 2.26 larvae per plant. After 24 hours of spraying, the incidence varied from 0.26 to 1.66 larvae per plant. The lowest incidence of leaf miner was observed in the plots treated with monocrotophos 0.05 per cent. All the insecticidal treatments except Indiara 1 % and Neemark 1 % have better control of leaf miner. After seven days of spraying, no significant differences amongst the insecticidal treatments were observed.

The data presented in Table 61 indicated that no significant differences before spraying could be observed in treatments and the leaf miner count varied from 1.40 to 1.60 and 1.60 to 1.73 larvae per plant during the years 1988 and 1989, respectively.

It was observed from the Table 62 that the incidence of leaf miner, 24 hours after spraying varied from 0.06 to 1.53 larvae per plant during 1988. The treatment with monocrotophos 0.05 per cent was the most superior among insecticidal treatments, which gave significant reduction of leaf miner. The other effective treatments in desending orders were ethofenprox 0.05 per cent, triazophos 0.05 per cent,lambdacyhalothrin 0.004 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent and cartap 0.1 per cent.

Table 61 : Effect of various treatments on the population of leaf miner.

Treatments	Mean number of leaf miner per plant befor treatment		Pooled mean
	1988	1989	
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	1.40 (1.37)	1.70 (1.47)	1.55 (1.22)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	1.46 (1.39)	1.60 (1.44)	1.53 (1.41)
Monocrotophos 0.05%	1.46 (1.39)	1.66 (1.46)	1.56 (1.42)
Lambdacyhalothrin 0.004 %	1.40 (1.37)	1.70 (1.47)	1.55 (1.32)
Cartap 0.1 %	1.46 (1.41)	1.73 (1.48)	1.59 (1.44)
Indiara 1 %	1.40 (1.34)	1.60 (1.44)	1.50 (1.29)
Neemark 1 %	1.48 (1.41)	1.70 (1.47)	1.59 (1.34)
Triazophos 0.05%	1.40 (1.37)	1.60 (1.44)	1.44 (1.29)
Ethofenprox 0.05%	1.60 (1.44)	1.63 (1.44)	1.61 (1.35)
Control (Untreated)	1.53 (1.41)	1.60 (1.46)	1.56 (1.43)
S.E. $\pm$	0.03	0.02	0.03
C.D. (P = 0.05)	N.S.	N.S.	N.S.

Figures in paranthesis are transformed values

Table 62 : Effect of various treatments on the population of leaf miner.

Treatments	Mean number of leaf miner per plant 24 Hours after sprauing		Pooled mean
	1988	1989	
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	0.46 (0.97)	0.46 (0.98)	0.46 (0.97)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	0.46 (0.97)	0.46 (0.97)	0.46 (0.97)
Monocrotophos 0.05%	0.06 (0.74)	0.26 (0.87)	0.16 (0.80)
Lambdacyhalothrin 0.004 %	0.46 (0.94)	0.83 (1.15)	0.61 (0.98)
Cartap 0.1 %	0.53 (1.00)	0.60 (1.04)	0.56 (1.02)
Indiara 1 %	1.00 (1.22)	1.36 (1.35)	1.16 (1.28)
Neemark 1 %	0.96 (1.20)	1.13 (1.27)	1.04 (1.23)
Triazophos 0.05%	0.40 (0.93)	0.66 (1.07)	0.53 (1.00)
Ethofenprox 0.05%	0.33 (0.89)	0.46 (0.97)	0.59 (0.93)
Control (Untreated)	1.53 (1.41)	1.53 (1.41)	1.53 (1.41)
S.E. ±	0.04	0.03	0.04
C.D. (P = 0.05)	0.13	0.11	0.12

Figures in paranthes es are transformed values

During 1989 all the insecticidal treatments were found to be significantly superior over control, except Indiara 1 %. The lowest infestation was manifested in monocrotophos 0.05 per cent followed by ethofenprox 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, which were at par.

The pooled analysis revealed that all the insecticidal treatments were significantly superior over control except Indiara 1 %. The lowest infestation of leaf miner was recorded in monocrotophos 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent and ethofenprox 0.05 per cent, which were at par.

Further, the results indicated (Table 63) that incidence of leaf miner seven days after spraying application of insecticides varied from 0.06 to 1.46 per plant during the year 1988 and from 0.20 to 0.66 per plant in the year 1989.

In the year 1988, the treatments with monocrotophos 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, triazophos 0.05 per cent and ethofenprox 0.05 per cent were found to be superior in reducing the population of leaf miner per plant and were at par.

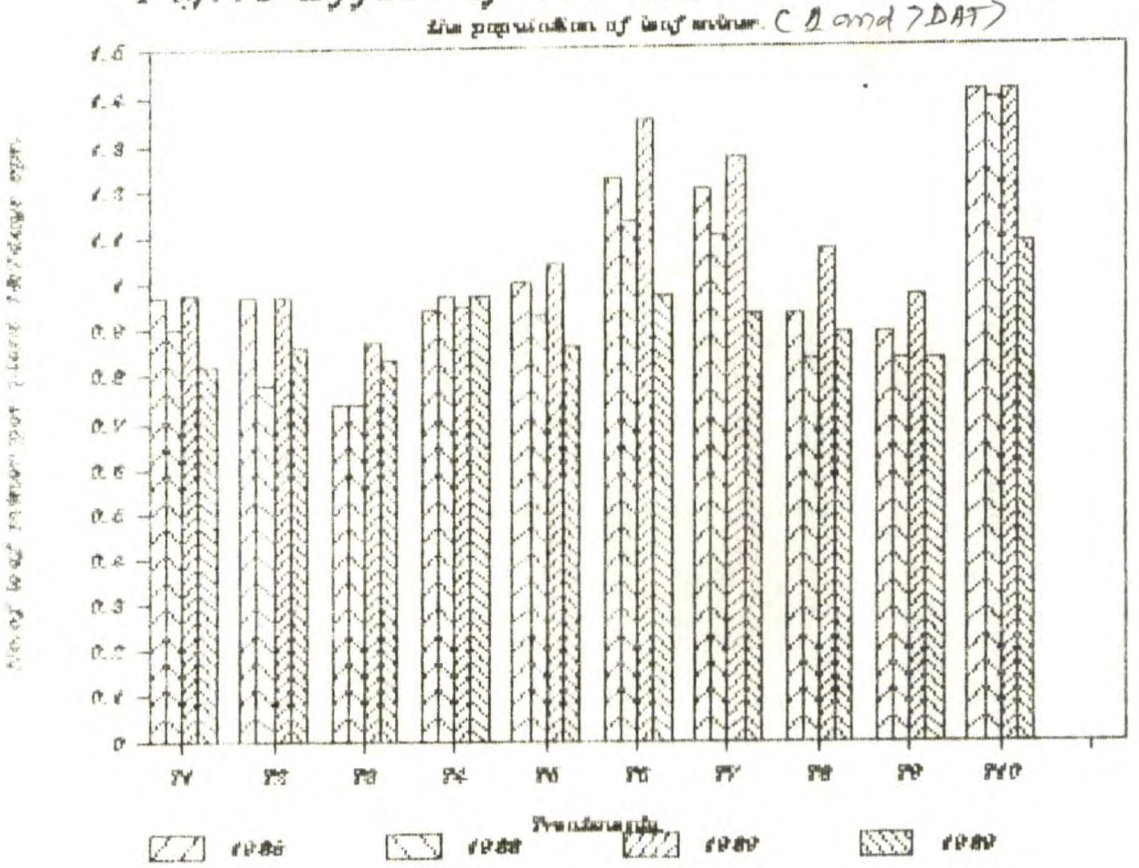
During the year 1989, the differences among the insecticidal treatments and control were not evident.

Table 63 : Effect of various treatments on the population of leaf miner.

Treatments	Mean number of leaf miner per plant 7days after spraying		Pooled mean
	1988	1989	
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	0.33 (0.90)	0.20 (0.82)	0.26 (0.86)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	0.13 (0.78)	0.26 (0.86)	0.19 (0.83)
Monocrotophos 0.05%	0.06 (0.74)	0.20 (0.83)	0.13 (0.78)
Lambdacyhalothrin 0.004 %	0.46 (0.97)	0.46 (0.97)	0.46 (0.97)
Cartap 0.1 %	0.40 (0.93)	0.26 (0.86)	0.33 (0.89)
Indiara 1 %	0.80 (1.13)	0.46 (0.97)	0.63 (1.05)
Neemark 1 %	0.73 (1.10)	0.40 (0.93)	0.56 (1.01)
Triazophos 0.05%	0.20 (0.83)	0.33 (0.89)	0.26 (0.85)
Ethofenprox 0.05%	0.20 (0.83)	0.20 (0.83)	0.20 (0.83)
Control (Untreated)	1.46 (1.39)	0.66 (1.08)	1.01 (1.23)
S.E. ±	0.04	0.06	0.05
C.D. (P = 0.05)	0.13	N.S.	0.17

Figures in paranthesis are transformed values

Fig. 15 Effect of various treatments on



Details of Treatments

T1 - Carbofuran 1 kg a.i./ha + monocrotophos Ø.Ø5%

T2 - Phorate 1 kg a.i./ha + monocrotophos Ø.Ø5%

T3 - Monocrotophos Ø.Ø5%

T4 - Lambdacyhalothrin Ø.ØØ4%

T5 - Cartap Ø.1 %

T6 - Indiara 1 %

T7 - Neemark 1 %

T8 - Triazophos Ø.Ø5 %

T9 - Ethofenprox Ø.Ø5 %

T1Ø- Control (untreated)

Pooled results of two years indicated that average number of leaf miner per plant was minimum in monocrotophos 0.05 per cent and maximum in untreated control.The treatments with monocrotophos 0.05 per cent, ethofenprox 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, triazophos 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, cartap 0.1 per cent were significantly superior in reducing the leaf miner incidence.

4.5.4 Effect of insecticides on percentage infestation of leaf miner :

The data pertaining to the percentage leaf miner infestation are presented in Table 64 and graphically presented in Fig.16.

It is observed from the data that per cent infestation of leaf miner varied from 10.66 to 25.72 per cent in 1988, whereas, it ranged from 9.81 to 28.76 per cent in 1989.

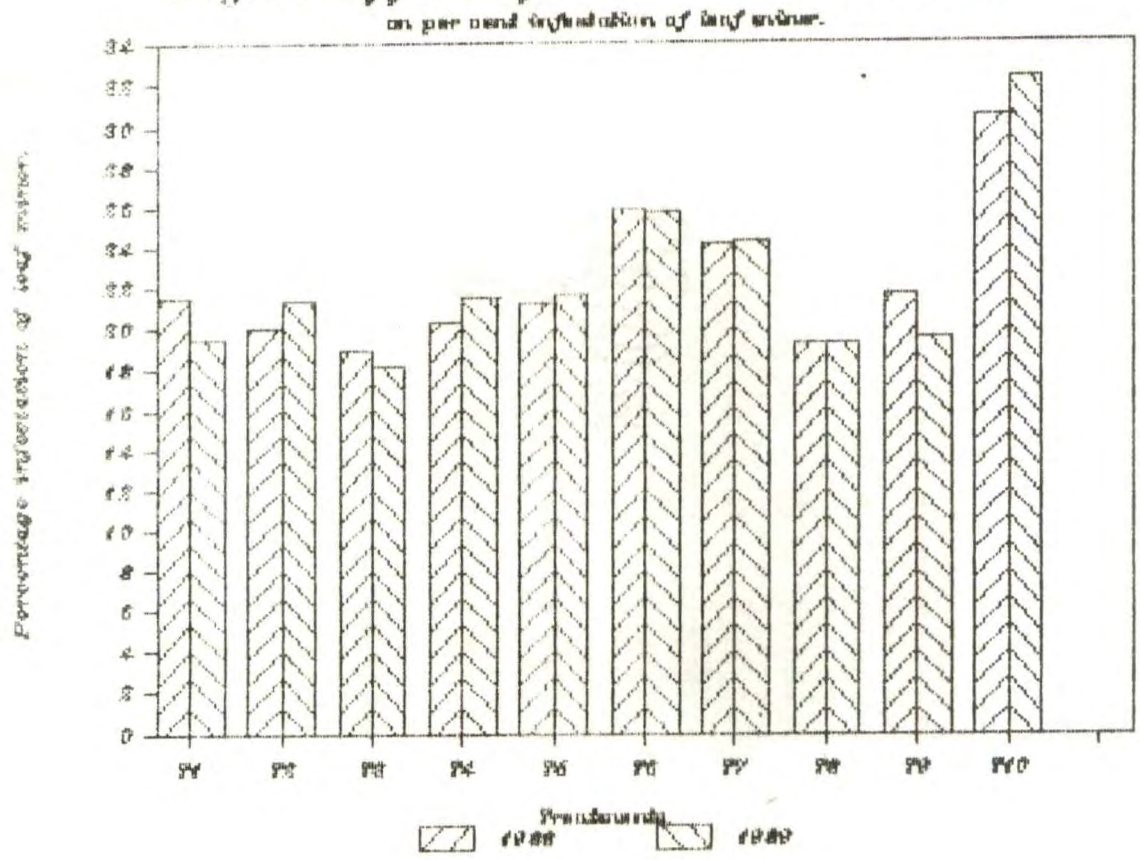
In 1988, all the insecticidal treatments were significantly superior to control. The lowest per cent infestation was recorded in the treatment with monocrotophos 0.05 per cent (10.66), phorate 1 kg a.i./ha + monocrotophos 0.05 per cent (11.83), lambdacyhalothrin 0.004 per cent (12.10), cartap 0.1 per cent (12.24), carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent (13.00) and ethofenprox 0.05 per cent (13.65) which were at par.

Table 64 : Effect of various treatments on per cent infestation of leaf miner.

Treatments	Percentage infestation of leaf miner		
	1988	1989	Pooled mean
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	13.00 (21.44)	11.20 (19.50)	12.10 (20.47)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	11.83 (20.04)	13.33 (21.35)	12.58 (20.71)
Monocrotophos 0.05%	10.66 (19.00)	9.81 (18.19)	10.23 (12.76)
Lambdacyhalothrin 0.004 %	12.10 (20.34)	13.43 (21.46)	12.76 (20.90)
Cartap 0.1 %	13.24 (21.19)	13.62 (21.58)	13.43 (21.43)
Indiara 1 %	19.02 (25.81)	18.88 (25.73)	18.95 (25.77)
Neemark 1 %	16.80 (24.17)	16.96 (24.29)	16.88 (24.23)
Triazophos 0.05%	10.95 (19.26)	10.97 (19.32)	10.96 (19.29)
Ethofenprox 0.05%	13.65 (21.59)	11.17 (19.49)	12.41 (20.54)
Control (Untreated)	25.72 (30.47)	28.76 (32.40)	27.24 (31.43)
S.E. $\pm$	1.15	0.68	0.95
C.D. (P = 0.05)	3.33	2.03	2.82

Figures in paranthesis are transformed values

Fig. 16 Effect of various treatments



Details of Treatments

T1 – Carbofuran 1 kg a.i./ha + monocrotophos 0.05%

T2 – Phorate 1 kg a.i./ha + monocrotophos 0.05%

T3 – Monocrotophos 0.05%

T4 – Lambdacyhalothrin 0.004%

T5 – Cartap 0.1 %

T6 – Indiara 1 %

T7 – Neemark 1 %

T8 – Triazophos 0.05 %

T9 – Ethofenprox 0.05 %

T10– Control (untreated)

Similar trend was noted during 1989, where all the insecticidal treatments were significantly superior over control. The treatment with monocrotophos 0.05 per cent (9.81), triazophos 0.05 per cent (10.97),carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent 0.05 (11.20) proved more effective in reducing per cent infestation of leaf miner over control.

Pooled anaylsis indicated that the lowest infestation of leaf miner was found in treatments with monocrotophos 0.05 per cent (10.23) followed by triazophos 0.05 per cent (10.96), carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent (12.10), phorate 1 kg a.i./ha + monocrotophos 0.05 per cent (12.85), ethofenprox 0.05 per cent (12.41) and lambdacyhalothrin 0.004 per cent (12.76), which were at par.

4.5.5 Effect of insecticides on number of pods per plant :

The data pertaining to number of pods per plant are presented in Table 65.

The results from Table 65 indicated that, during 1988, the treatment with monocrotophos 0.05 per cent was significantly superior over all the insecticidal treatments and control in increasing the number of pods per plant, followed in lambdacyhalothrin 0.004 per cent, cartap 0.1 per cent, ethofenprox 0.05 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, triazophos 0.05 per cent and Indiara 1 % which were at par.

Table 65 : Effect of various treatments on number of pods per plant.

Treatments	Mean number of pods per plant		
	1988	1989	Pooled mean
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	9.66 (3.18)	14.20 (3.81)	11.93 (3.49)
Phorate 1 kg a.i./ha + monocrotophos 0.05%	9.33 (3.12)	12.00 (3.51)	10.66 (3.31)
Monocrotophos 0.05%	14.20 (3.82)	16.00 (4.05)	15.10 (3.93)
Lambdacyhalothrin 0.004 %	10.53 (3.30)	10.80 (3.35)	10.66 (3.32)
Cartap 0.1 %	10.20 (3.26)	10.86 (3.36)	10.53 (3.31)
Indiara 1 %	8.06 (2.91)	10.40 (3.28)	9.23 (3.09)
Neemark 1 %	7.53 (2.82)	10.26 (2.94)	8.89 (3.88)
Triazophos 0.05%	9.26 (3.11)	10.82 (3.35)	10.04 (3.23)
Ethofenprox 0.05%	9.73 (3.19)	11.66 (3.47)	10.69 (2.32)
Control (Untreated)	6.33 (2.60)	8.53 (3.00)	7.43 (2.33)
S.E. ±	0.13	0.21	0.23
C.D. (P = 0.05)	0.40	0.65	0.71

Figures in paranthesℓs are transformed values

In the year 1989 treatments with monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent were significantly superior in increasing the number of pods per plant and were at par. Other effective treatments were phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, ethofenprox 0.05 per cent, cartap 0.1 per cent, triazophos 0.05 per cent and lambdacyhalothrin 0.004 per cent.

Pooled analysis revealed that the treatments with monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent recorded significantly higher number of pods per plant over the remaining treatments and were at par. However, no significant differences were observed among the remaining treatments except ethofenprox 0.05 per cent.

4.5.6 Effect of insecticides on yield per plant :

The data on yield per plant are presented in Table 66.

In the year 1988, significantly higher yield per plant was recorded in plots treated with monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent followed by lambdacyhalothrin 0.004 per cent, Indiara 1 %, ethofenprox 0.05 per cent and phorate 1 kg a.i./ha + monocrotophos 0.05 per cent.

Table 66 : Effect of various treatments on yield per plant (Dry pods).

Treatments	Yield per plant in gms (Dry pods)		
	1988	1989	Pooled mean
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	9.96	30.00	12.75
Phorate 1 kg a.i./ha + monocrotophos 0.05%	8.01	29.00	9.56
Monocrotophos 0.05%	12.10	37.00	13.95
Lambdacyhalothrin 0.004 %	9.66	35.00	10.76
Cartap 0.1 %	7.36	34.00	11.25
Indiara 1 %	8.23	24.66	9.90
Neemark 1 %	7.58	25.33	9.38
Triazophos 0.05%	7.58	28.00	9.66
Ethofenprox 0.05%	8.01	31.00	10.35
Control (Untreated)	5.33	20.00	6.82
S.E. $\pm$	0.93	2.76	2.06
C.D. (P = 0.05)	2.70	8.20	6.11

During the year 1989, treatments with monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent, cartap 0.1 per cent, ethofenprox 0.05 per cent, lambdacyhalothrin 0.004 per cent + monocrotophos 0.05 per cent and phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, registered the highest yield per plant over the control.

Pooled analysis indicated that all the treatments gave significantly higher yields over control. Highest yield was registered in the plots treated with monocrotophos 0.05 per cent (13.95).

4.5.7 Effect of insecticides on yield of groundnut (Dry pods) :

The data on yield of groundnut pods are presented in Table 67 and graphically depicted in Fig.17.

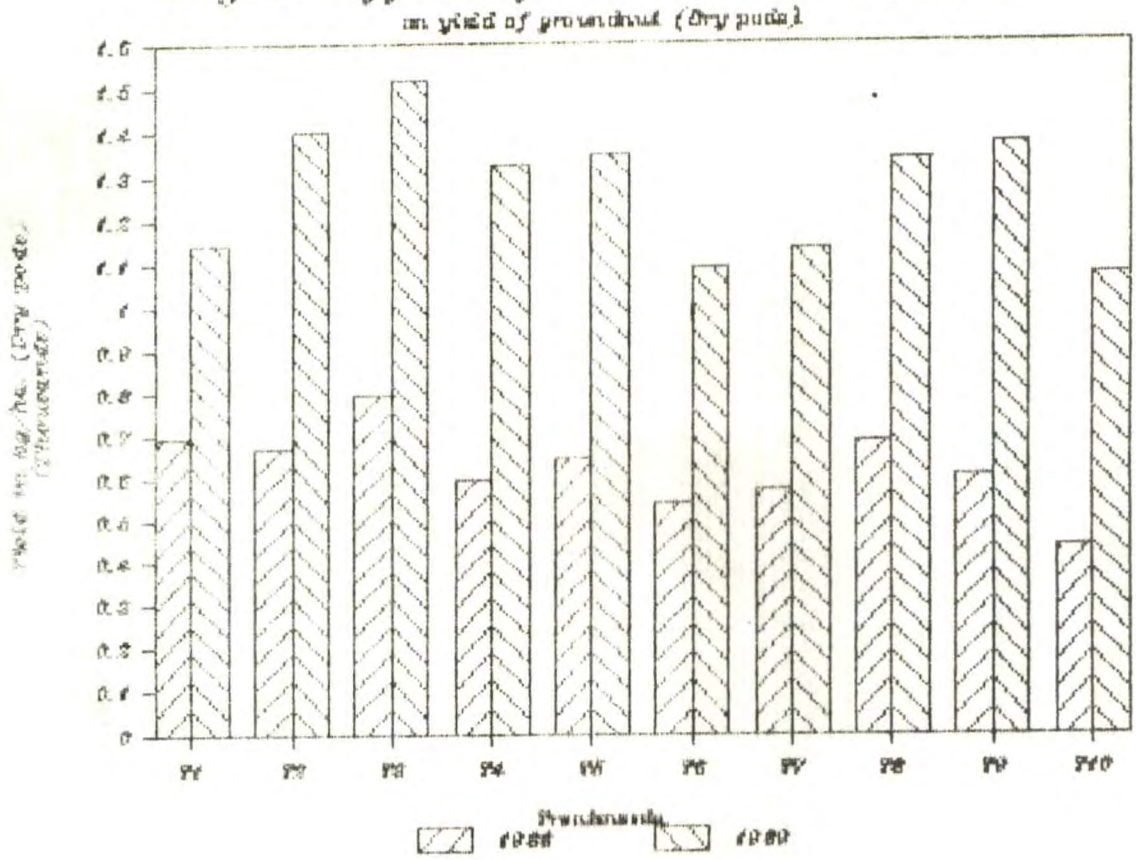
In yield of dry pods varied from 434 to 793 kg/ha during 1988 and 1070.66 to 152 .33 kg/ha during 1989. All the insecticidal treatments were significantly superior over control in increasing the yield of dry pods. Highest dry pod yield of 793 kg/ha was recorded by monocrotophos 0.05 per cent as against carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent (693.66 kg/ha), triazophos 0.05 per cent (683 kg/ha) and phorate 1 kg a.i./ha + monocrotophos 0.05 per cent (670.00 kg/ha), which were at par.

Similar trend was observed during 1989. The highest yield was observed in monocrotophos 0.05 per cent (1522.33 kg/ha) which was at par with carbofuran 1 kg a.i./ha +

Table 67 : Effect of various treatments on yield of groundnut (Dry pods).

Treatments	Yield in kg/ha (Dry pods)		
	1988	1989	Pooled mean
Carbofuran 1 kg a.i./ha + monocrotophos 0.05%	693.66	1413.66	1053.66
Phorate 1 kg a.i./ha + monocrotophos 0.05%	670.00	1402.66	1036.33
Monocrotophos 0.05%	793.00	1522.33	1157.66
Lambdacyhalothrin 0.004 %	594.00	1321.66	957.83
Cartap 0.1 %	641.66	1348.00	994.82
Indiara 1 %	536.66	1086.33	810.99
Neemark 1 %	569.00	1127.33	848.16
Triazophos 0.05%	683.33	1332.33	1007.83
Ethofenprox 0.05%	599.66	1370.00	984.32
Control (Untreated)	434.00	1070.66	752.33
S.E. ±	49.72	55.44	84.43
C.D. (P = 0.05)	143.59	164.75	250.52

Fig. 17 Effect of various treatments



Details of Treatments

T1 - Carbofuran 1 kg a.i./ha + monocrotophos Ø.Ø5%

T2 - Phorate 1 kg a.i./ha + monocrotophos Ø.Ø5%

T3 - Monocrotophos Ø.Ø5%

T4 - Lambdacyhalothrin Ø.ØØ4%

T5 - Cartap Ø.1 %

T6 - Indiara 1 %

T7 - Neemark 1 %

T8 - Triazophos Ø.Ø5 %

T9 - Ethofenprox Ø.Ø5 %

T1Ø- Control (untreated)

monocrotophos 0.05 per cent (1413.66 kg/ha) and phorate 1 kg a.i./ha + monocrotophos 0.05 per cent (1402.66 kg/ha) followed by ethofenprox 0.05 per cent (1370 kgs/ha), cartap 0.1 per cent (1348 kgs/ha), triazophos 0.05 per cent (1332.33 kgs/ha) and lambdacyhalothrin 0.004 per cent (1321.66 kgs/ha).

Pooled anaylsis indicated that the treatments with monocrotophos 0.05 per cent (1157.66 kgs/ha), carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent (1053.66 kgs/ha), phorate 1 kg a.i./ha + monocrotophos 0.05 per cent (1036.33 kgs/ha) and triazophos 0.05 per cent (1007.83 kgs/ha) were found to be significantly superior over control in increasing the dry pod yield, however, rest of the treatments were at par with control.

DISCUSSION

Chapter V

DISCUSSION

Groundnut crop suffers severely from the attack of jassids and thrips in early stage and leaf miner in reproductive stage. These pests cause heavy damage and loss in the yield of groundnut. Present investigations were therefore, undertaken to study the biology of leaf miner, population dynamics of major pests, assessment of crop losses, field screening of different cultivars and efficacy of different insecticides to reduce their attack. The results obtained are discussed here in the light of findings of earlier workers.

5.1 Biology of Leaf miner, Aproaerema modicella (Deventer) on Groundnut and Soybean :

Biology of leaf miner, A. modicella was studied on two host plants during 1988.

5.1.1 Egg :

In the laboratory as well as field condition, eggs were laid singly or in groups of two or three on the lower side of leaves, twigs and growing points. The average egg period was 5.46 and 5.52 days on groundnut and soybean, respectively. Egg development was comparatively more faster on groundnut than soybean.

According to Pruthi (1957) and Nayar et al. (1976), the incubation period varied from 2 to 3 days. Gujrathi et al. (1973) recorded average incubation period of 3.0

days. Whereas, Kapadia et al.(1982) reported, 7.45 days as the egg period of leaf miner on groundnut in Gujarath. Lavekar et al. (1992) observed incubation period to be 5.30 days on soybean. The incubation period noted in the present study was almost in the same range. The variation in incubation period could be attributed to fluctuations in temperature and relative humidity condition and the host variety on which the studies were under taken.

5.1.2 Larva :

The neonate larva was light green, became dark green coloured when full grown. The larval period ranged from 13 to 15 days on groundnut and 8 to 10 days on soybean.

Nayar et al. (1976) recorded 9 to 17 days larval duration. Gujrathi et al. (1973) pointed out that leaf miner passed through four instars during larval development on soybean. Kapadia et al.(1982) found that larval duration of leaf miner was from 14 to 23 days accompanied in three instars, whereas, Lavekar et al. (1992) noted larval period of 8 to 11 days with four larval instars on soybean.

Present investigation are in confirmity with the findings of above workers.

5.1.3 Pupa :

Pre pupal period did not last for more than one day. But the pupal duration ranged from 5-7 days and 5-8 days on groundnut and soybean,respectively.Pupal duration in case of male and female did not differ in groundnut whereas, in soybean, duration of female pupa was slightly longer than male pupa.

Gujrathi et al.(1973) recorded 4 to 6 days as pupal duration on soybean. According to Kapadia et al. (1982) pupal period recorded on groundnut varied from 6 to 13 days. Nayar et al.(1976) reported 3 to 7 days as pupal period on soybean and a pupal period of 5 to 8 days on soybean (Lavekar et al.,1992). In present studies, not much variation in pupal period was observed on the contrary,the pupal period partly agreed with the studies by Gujrathi et al.(1973) and Nayar et al. (1976).

5.1.4 Life cycle :

The average developmental period of leaf miner from egg to adult emergence ranged from 24-29 days and 21.23 days on groundnut and soybean, respectively. Life cycle of male and female adults was much the same on both the host plants.

Gujrathi et al.(1973) reported duration of 16 to 22 days for completion of life cycle on soybean. The leaf miner took 15 to 28 days (Mehata and Verma, 1968),7.27 days (Kapadia et al.,1982). According to Lavekar et al.

(1992), it required 21 to 22 days on soybean for completion of life cycle. The present findings confirm their results.

5.1.5 Adult :

The moths of leaf miner were small, dark brown occupying adult span of 6 to 10 days and 5-8 days in female and male, respectively on groundnut and 5-10 days and 4-9 days in female and male, respectively on soybean.

The fecundity of the female as observed on groundnut and soybean was in the range of 80-187 and 85-198 eggs, respectively.

Gujrathi et al. (1973) observed average fecundity 66.6 eggs/female. A single female laid as much as 109.93 eggs during its adult span of 7.27 days (Kapadia et al. 1982). Nayar et al. (1976) recorded an average of 181 eggs per female during adult life of leaf miner, whereas, Lavekar et al. (1992) noted that female moth laid 92 to 200 eggs with an average of 131.25, during the adult period.

Present findings of 6-12 days correspond to the observations of Lavekar et al. (1992).

5.2 Population dynamics of major pests of groundnut:

The crop grown during kharif seasons of 1988 and 1989 were examined for incidence of major pests of groundnut.

5.2.1 Incidence of jassids.

During the year 1988, the incidence of jassids

started during second week of July (28th meteorological week). It continued till fourth week of October (43rd meteorological week), reaching maximum (2.94 jassids/3 leaves) during second week of August and minimum in first week of October.

In 1989, the incidence of jassids (0.31 jassids/3 leaves) commenced during the first of August (31st meteorological week) which prevailed upto first week of October (40th meteorological week) reaching its maximum (3.51 jassids/3 leaves) during third week of August and minimum of 0.12 jassids/3 leaves in first week of October.

Amin (1982) reported that the population of jassids remained at low level during hot summer months from April to June. The population of jassids gradually increased from first week of July and reached maximum in early September and remained at a low level during rest of the season in groundnut. Kenchaiah and Porte (1989) recorded the lower population of jassids (1-15 per cent) on groundnut during both the seasons. Their observations corroborate the present findings to a greater extent.

5.2.2 Incidence of thrips :

During the year,1988 the incidence of thrips (1.68 thrips/3 leaves) began from third week of August (33th meteorological week). It rose to its maximum (1.68 thrips/3 leaves) during the same week and declined to

minimum of 0.40 thrips/3 leaves during first week of October. During the next season (1989), population of thrips (9.75 thrips/3 leaves) commenced from third week of August (33th meteorological week) and continued upto third week of September (38th meteorological week) reaching its peak in middle of August.

Kenchaiah and Porte (1989) found incidence of thrips within of range of 1-15, throughout the survey period showing a greater fluctuation in the population.

5.2.3 Incidence of leaf miner :

The population of leaf miner (0.60 larvae/plant) was first noticed in the last week of July (30th meteorogical week) during 1988 which lasted upto second week of September reaching maximum population (1.15 leaf miner larvae/plant) in middle of August.

In the next season (1989) population of leaf miner was noted from the second week of August (32nd meteorological week), little later than 1988. Maximum incidence of leaf miner (1.80 larvae/plant) was recorded in the fourth week of August (34th meteorological week) and the minimum (0.08 leaf miner larvae/plant) during second week of September.

Khan and Raodeo (1987) found that Aproaerema modicella was active from early June to December with 5 population peaks. Kenchaiah and Porte (1989) reported more than 25 per cent leaf miner infestation on groundnut in Karnataka during both the seasons.

5.2.4 Correlation between weather parameters and incidence of jassids :

Pooled results showed the correlation of jassid population with rainfall and number of rainy days to be positive and significant and with maximum temperature and sunshine as negatively significant.

5.2.5 Correlation between weather parameters and incidence of thrips :

On the basis of pooled results the correlation of thrips population with rainfall was positive and significant.All other weather components were positively correlated with thrip population except maximum temperature and sunshine hours.

In the absence of published literature, the findings on weather parameters and population of jassids and thrips could not be discussed in its proper per spective.

5.2.6 Correlation between weather parameters and incidence of leaf miner :

On the basis of pooled results, the leaf miner population and sunshine hours indicated negative and significant correlation whereas, it established positively significant correlation with relative humidity, wind speed km/hour, rainfall and number of rainy days.

Logiswaran et al. (1982) reported that in both varieties TMV-7 and TMV-10, morning relative humidity percentage showed a significantly negative correlation. While the maximum temperature and minimum temperature showed significantly positive association with leaf miner. They further found that in both varieties maximum and minimum temperature exhibited a negative correlation with infestation. Ghule et al.(1989) found significant positive and negative correlations between pest incidence and sunshine hours and pest incidence and relative humidity respectively. Pooled analysis of three years data revealed that the increase in relative humidity, minimum and maximum temperature and intensity of rainfall were responsible for decrease in population of leaf miner of groundnut. The results of present investigations are in agreement with the above findings.

4.2.5 Path co-efficient analysis of weather factors affecting the pests of groundnut :

4.2.5.1 Direct and indirect effects of weather parameters on jassid incidence :

Pooled results revealed that minimum temperature, wind speed km/hour and rainfall exerted direct positive effect and all the other weather factors a negative direct effect on jassid population.

Since, there is no much published literature on direct and indirect effects of weather parameters on jassid, the findings could not be discussed at length.

5.2.5.2 Direct and indirect effects of weather parameters on incidence of thrips :

Pooled results revealed that minimum tempearture, morning relative humidity, sunshine hours, wind speed km/hour and rainfall showed direct positive effect, whereas, other weather parameters showed negative direct effects on thrips.

5.2.5.3 Direct and indirect effects of weather parameters on leaf miner incidence :

Pooled analysis for two years data, revealed that morning relative humidity and number of rainy days showed the direct positive effect, whereas, all other weather factors exerted the direct negative effects on population of leaf miner.

5.3 Assessment of crop losses due to major pests of groundnut :

5.3.1 Population of jassid :

The jassid population was significantly low in the plot treated with monocrotophos 0.05 per cent throughout the growth period in both the years followed by carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent, carbofuran 1 kg a.i./ha at early stage and monocrotophos 0.05 per cent at reproductive phase. The pooled analysis indicated the similar trend.

Effective control of jassids has been obtained with monocrotophos and carbofuran by several workers. Srivasubramanian and Palani-Swamy (1986) reported that monocrotophos 0.075 per cent was effective in minimising the jassids population and other pests. Shetgar (1992) recorded significantly reduced jassid and thripspopulation with four applications of monocrotophos 0.05 per cent. Present findings are in accordance with the results of the above workers.

5.3.2 Population of thrips :

The population of thrips was significantly low in all the insecticidal treatments as compared to control, in both the years. Monocrotophos 0.05 per cent, throughout the growth period emerged as effective treatment in both the seasons. The other effective treatments were carbofuran 0.05 per cent + lambdacyhalothrin 0.004 per cent, carbofuran 1 kg a.i./ha in early stage of growth and monocrotophos 0.05 per cent at 45 DAS. Pooled results showed that average population of thrips was minimum with monocrotophos 0.05 per cent throughout the growth period followed by carbofuran 1 kg a.i/ha + lambdacyhalothrin 0.004 per cent, carbofuran 1 kg a.i./ha at vegetative stage and monocrotophos 0.05 per cent at 45 DAS.

Thimmaiah and Panchbhavi (1973) obtained significant control of thrips on groundnut with carbofuran seed treatment at 4 per cent and disulfotan 5 per cent granules. Samal and Parida (1983) observed that application of 0.05 per cent monocrotophos protected the crop against thrips, cicadellid and aphids. Sirisingh and Pitak (1987) noted that five applications of monocrotophos to groundnut at 0.2, 0.1, 0.05 and 0.025 kg a.i./ha reduced the population of Scirtothrips dorsalis. The present findings confirmed the results of above researches.

5.3.3 Infestation of leaf miner :

5.3.3.1 Leaf miner per plant :

The results showed that count of leaf miner larvae per plant in all the insecticidal treatments was significantly lower as compared to the untreated control in both the years. The treatment with monocrotophos 0.05 per cent throughout the growth period showed significantly less number of leaf miner larvae per plant. Next effective treatments were carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent and monocrotophos 0.05 per cent at 45 DAS. Pooled analysis indicated that monocrotophos 0.05 per cent throughout the growth period was significantly superior over other insecticidal treatments and control.

Khan and Raodeo (1979) found that monocrotophos 0.05 per cent along with other insecticides was effective in reducing the leaf miner on groundnut. Mundhe and Dabhade (1980) obtained the more effective control of Stomopteryx subscivella in soybean with monocrotophos 0.05 per cent. Rajput and Gowda (1992) found that isofenphos 2 to 5 kg a.i/ha, carbofuran 4 kg a.i./ha and phorate 4 kg a.i./ha were more effective in supressing Aproaerema modicella infestation. Present findings are in agreement with the results of the above workers.

5.3.4 Avoidable loss in pods per plant :

The per cent avoidable loss in groundnut pods due to pest complex was 26.35 per cent on the basis of pooled results of 1988 and 1989.

As no information is available on this aspect, the results can not be discussed conclusively.

5.3.5 Avoidable loss in yield :

The treatment with monocrotophos 0.05 per cent throughout the growth period out yielded than other treatments in both the seasons, followed by carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent and carbofuran 1 kg a.i./ha at vegetative stage. Pooled results further established that application of monocrotophos 0.05 per cent throughout the growth period gave significantly higher pod yield and recorded minimum

per cent avoidable loss. Pooled results indicated that the per cent avoidable loss in groundnut yield due to pest complex was 42.59 per cent.

Many researchers worked out avoidable loss in groundnut due to pest complex. Senapati and Patnaik (1980) reported a loss of 29 per cent, due to thrips. Sing and Rawat (1981) estimated avoidable lossess to the tune of 52.29 per cent. Anonymous (1982) reported the losses to 21.9 per cent. Jagtap and Ghule (1984) recorded 15.87 per cent loss in groundnut due to aphids and leaf miner and Shetgar (1992) noted 40.34 per cent loss in pod yield due to foliage pests of groundnut.

These results partially supported the findings of present studies.

5.4 Incidence of major pests on different groundnut cultivars :

5.4.1 Incidence of jassids on different cultivars during 1988 :

The results of 1988 season indicated significant differences among groundnut cultivars. The incidence of jassids per three leaves varied from 0.80 to 1.96. The lowest incidence was recorded on NCAC-343 (0.80 jassids/3 leaves) and LGS-10 (0.86 jassids/3 leaves). The higher incidence was recorded on ICG-10718,ICG-5030, JL-24, SBXI and ICG-49 which were at par.

During the year 1988, the cultivar LGS-10 and NCAC-343 showed least jassid incidence as compared to other cultivars. Pooled analysis revealed same trend of incidence on different cultivars.

Campbell et al.(1987) reported that variety GP-NCAC-343 was resistant to complex of insects at all the three locations and crosses containing this variety including GP-NC-343 and NC-7 and GP-343 x NC-7 were resistant to thrips, leaf hoppers and defoliators. Anonymous (1988) observed minimum number of jassids on NCAC-343, ICG-10718 and ICG-134. In further studies Anonymous (1989) reported lowest incidence of 1.60 jassids on NCAC-343 (1.67) and LB-19 (1.67).

The results of present investigations are in agreement with above findings.

5.4.2 Incidence of thrips on different cultivars of groundnut :

During the year 1988, differences in respect of thrip incidence on groundnut cultivars were significant. The incidence varied from 0.50 to 1.65 thrips/3 leaves. The minimum incidence was observed on the cultivars LGS-10 (0.50 thrips/3 leaves), 9/136-918 (0.50 thrips/3 leaves) and NCAC-343 (0.55 thrips/3 leaves). The highest incidence (1.65 thrips/3 leaves) was observed on ICG-1363.

In 1989 the cultivars LGS-10 and SBXI showed least incidence as compared to other cultivars. The highest incidence was recorded on cultivars ICG-49, GB-FDS-ICG-1363, and ICG-5030. However, pooled results for two seasons did not show significant variation in the pest incidence.

Anonymous (1988) found minimum number of thrips on NCAC-343, ICG-10718 and ICG-134. Incidence of 2.73 thrips was observed on ICG-2741 followed by NCAC-343 (2.80) and ICG-869 (2.80).

5.4.3 Incidence of leaf miner on different cultivars of groundnut :

Pooled results for two seasons indicated significant differences. The cultivar LGS-10 was found significantly superior over JL-24 and SBXI in recording lower infestation of leaf miner. The cultivars ICG-10718, JL-24, SBXI, ICG-5030 and GB-FDS-273 recorded higher infestation and were at par.

Lewin et al.(1971) found that leaflets infested by leaf miner averaged to 12.3 per plant as compared with 7.0 to 8.7 per cent in spreading and semi-spreading varieties of groundnut.

5.5 Efficacy of different insecticides against major pests of groundnut :

5.5.1 Effect of insecticides on the incidence of jassids :

During the year 1988, the incidence of jassids before treatment application was non-significant. After 24 hours of spraying all insecticidal treatments significantly reduced jassid incidence over control in both the years. The treatment of monocrotophos 0.05 per cent proved most effective followed by lambdacyhalothrin 0.004 per cent in 1988 and ethofenprox 0.05 per cent in 1989. The pooled analysis revealed that significantly low population of jassids was recorded in the treatments viz. monocrotophos 0.05 per cent, ethofenprox 0.05 per cent, lambdacyhalothrin 0.004 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent and cartap 0.1 per cent which were at par.

Seven days after treatment the incidence of jassids varied from 0.20 to 1.88 in 1988 and 0.60 to 1.66 jassids during the year 1989. All the insecticidal treatments significantly controlled the jassid population over control in both the years. In 1988, the lowest incidence was observed in lambdacyhalothrin 0.004 per cent followed by monocrotophos 0.05 per cent, ethofenprox 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent. In 1989 the incidence of jassids rose to the level of 2.26 jassids/3 leaves. The lowest incidence was observed in monocrotophos 0.05 per cent.

The pooled results indicated that the average population of jassids was minimum in the treatment with monocrotophos 0.05 per cent but it did not differ significantly from lambdacyhalothrin 0.004 per cent, carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent and ethofenprox 0.05 per cent.

Saboo and Puri (1978) observed no incidence of leaf hopper in plot treated with quinalphos 350 g a.i./ha spray. Shivasubramanian and Palaniswamy (1986) reported that monocrotophos 0.05 per cent was effective in minimising the population of jassids and other pests. Shetgar (1992) recorded significant reduction in jassid and thrips population with four applications of monocrotophos 0.05 per cent. The results of present investigation are in agreement with above findings.

5.2.2 Effect of insecticides on incidence of thrips :

The pooled analysis of the data for two years revealed significantly lower incidence of thrips in monocrotophos 0.05 per cent,phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent, cartap 0.1 per cent and ethofenprox 0.05 per cent than Indiara 1 %, Neemark 1 % and control.

After 7 days of spraying the incidence of thrips varied from 0.33 to 2.26 and 0.26 to 2.93 thrips, per three leaves during the year 1988 and 1989,respectively.

Pooled results indicated that average population of thrips was minimum in the treated plots with monocrotophos 0.05 per cent and phorate 1 kg a.i./ha + monocrotophos 0.05 per cent. The incidence ranged from 0.36 to 2.59 thrips per three leaves in different treatments. Thimmaiah and Panchabhavi (1973) obtained significant control of thrips on groundnut by carbofuran seed treatment at 4 per cent and disulfotan 5 per cent granules. Samalo and Parida (1983) observed that combined application of a 0.05 per cent monocrotophos and 0.225 per cent of the fungicide chlorothaonil protected the crop against thrips and other pests on groundnut. Sirisingh and Pitak (1987) found that five applications of monocrotophos to groundnut @ 0.2, 0.1, 0.05 and 0.025 kg/ha,at fortnightly intervals reduced the population of Scirtothrips dorsalis.

Findings of present studies are in agreement with these reports.

5.5.3 Effect of insecticides on incidence of leaf miner :

The pooled analysis revealed that all the insecticidal treatments were significantly superior over control except Indiara 1%.The lowest infestation of leaf miner was noted in monocrotophos 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent which were at par. Further average number of leaf miner per plant was

minimum in plots treated with the monocrotophos 0.05 per cent and maximum in untreated control at 7 days after treatments. The treatment with monocrotophos 0.05 per cent, ethofenprox 0.05 per cent, phorate 1 kg a.i./ha + monocrotophos 0.05 per cent, triazophos 0.05 per cent and cartap 0.1 per cent were significantly superior in reducing the leaf miner incidence.

Khan and Raodeo (1979) reported that sprays of 0.05 per cent quinalphos,0.05 per cent dichlorvos,0.06 per cent monocrotophos, 0.05 per cent chlorfenvinphos and 0.02 per cent phosphamidon applied at 550 liters per hectare provided effective control of the leaf miner. Khan and Raodeo (1979) found that dimethoate, carbaryl, disulfotan and phorate granules gave significant control of leaf miner one week after treatment. Parida (1983) reported that monocrotophos 0.05 per cent offered good control of major groundnut pests including leaf miner. Rajput et al.(1984) observed that monocrotophos 0.05 per cent along with other insecticides at 500 litres spray solution/ha were more effective treatments in reducing larval population of Aproaerema modicella in groundnut. Muthaiah and Hussain (1991) found that monocrotophos 0.05 per cent was very effective in controlling leaf miner on groundnut.

5.5.4 Effect of insecticides on number of pods per plant :

Pooled analysis indicated that the treatments with monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent recorded significantly higher number of pods per plant over remaing treatments and were at par.

5.5.5 Effect of insecticides on yield per plant and yield of groundnut (dry pods) :

In the year, 1988 significantly higher yield per plant was recorded in plots treated with monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent. During the year 1989, the treatments with monocrotophos 0.05 per cent, lambdacyhalothrin 0.004 per cent, cartap 0.1 per cent and ethofenprox 0.05 per cent registered the highest yield per plant over control.

Pooled analysis revealed that all the treatments gave significantly higher yield than control. Highest yield was registered in monocrotophos 0.05 per cent (13.95 gm/plant) treated plots.

As regards dry pod yield of groundnut, the pooled analysis indicated that the treatments with monocrotophos 0.05 per cent (115.66 kgs/ha), carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent (1053.66

kgs/ha), phorate 1 kg a.i./ha + monocrotophos 0.05 per cent (1036.33 kgs/ha) and triazophos 0.05 per cent (1007.83 kgs/ha) were significantly superior over control in increasing the dry pod yield.

Sangappa and Ali (1977) reported that monocrotophos gave increased yield and economic returns. Logiswaran and Rao (1982) found that yields of plots treated with monocrotophos averaged to 2.00 kg/plot as against 0.95 kg/plot in control.Samalo and Parida (1983) reported that monocrotophos 0.05 per cent offered good control of major pests in groundnut.

The effectiveness of application of monocrotophos 0.05 per cent observed in the present investigation are supported by the findings of earlier workers.

SUMMARY

Chapter VI

SUMMARY

Investigations were carried out to study the biology of leaf miner, population dynamics of major pests, assessment of crop losses, field screening of different groundnut cultivars and efficacy of different insecticides during the year 1988 and 1989. The results obtained are summarised below.

6.1 Biology of Aproaerema modicella (Deventer) was studied on groundnut and soybean. The average egg period was 5.46 and 5.52 days, larval period varied from 13 to 15 days and 8 to 10 days with pupal period from 5 to 7 and 5 to 8 days on groundnut and soybean, respectively. Average developmental period of leaf miner from egg to adult emergence ranged from 24 to 29 and 21 to 23 days on groundnut and soybean, respectively. Adult span lasted for 6 to 10 days and 5 to 10 days in females, 5 to 8 and 4 to 9 days in male, on groundnut and soybean, respectively. The fecundity of female on groundnut and soybean was in the range of 80 to 187 and 85 to 198 eggs, respectively. The sex ratio observed was 1:1.46 in groundnut and 1:1.50 in soybean.

6.2 Jassid incidence in 1988 started during second week of July, reaching its maximum (2.94 jassids/3 leaves) during second week of August. In 1989, the incidence of jassids (0.31 jassids/3 leaves) commenced

during the first week of August and prevailed upto first week of October.

Incidence of thrips (1.68 thrips/3 leaves) began from third week of August. It rose to a maximum of 1.68 thrips/3 leaves during the same week in 1988. During 1989, population of thrips (9.75 thrips/3 leaves) commenced from third week of August, reaching its peak in the same week.

The population of leaf miner (0.60 larvae/plant) was first noted in the last week of July during 1988 and reaching its maximum (1.15 larvae/plant) in middle of August. During 1989 the incidence was noticed from second week of August. Maximum (1.80 larvae/plant) and minimum (0.08 larvae/plant) incidence was recorded in fourth week of August and second week of September, respectively.

Correlation of jassid population and wind speed km/hour was positively significant whereas, it showed significantly negative correlation with sunshine hours during 1988. The relation of jassid population with rainfall and number of rainy days was positively significant during 1989. The same trend was observed in pooled results also.

The thrips population was positively correlated with all weather factors except maximum temperature and sunshine hours during 1988. During next season,

correlation of thrips population with rainfall was positively significant. On the basis of pooled results correlation of thrips with rainfall was positive and significant.

Leaf miner population was positively correlated with minimum temperature and wind speed km/hour during 1988. The correlation of leaf miner population with number of rainy days was positively significant in next season. On the basis of pooled results, leaf miner population and sunshine hours indicated negative and significant correlation.

During 1988 the path co-efficient analysis of abiotic factors affecting the jassid population on groundnut, revealed that minimum temperature, wind speed km/hour and rainfall exerted direct positive effects and the rest with negative effects. During next season, minimum temperature, morning relative humidity and rainfall showed the direct positive effects. The same trend was observed in pooled results.

Minimum temperature, wind speed km/hour and number of rainy days showed direct positive effects on population of thrips during 1988. However, maximum and minimum temperature, morning relative humidity, sunshine hours showed direct positive effects during 1989. Pooled results revealed that minimum temperature, morning relative humidity and sunshine hours had direct positive effects.

During 1988, maximum temperature, morning relative humidity, evening relative humidity and sunshine hours showed direct positive effects on leaf miner population. Whereas, in 1989 season the minimum temperature, morning relative humidity and rainfall showed direct positive effects. Pooled analysis revealed the same trend.

6.3 In loss assessment, the jassid and thrips population was significantly low in the treatment with monocrotophos 0.05 per cent throughout the growth period followed by carbofuran 1 kg a.i./ha + lambdacyhalothrin 0.004 per cent, carbofuran 1 kg a.i./ha in early stage of growth and monocrotophos 0.05 per cent in reproductive phase.

The leaf miner infestation in the treatment monocrotophos 0.05 per cent throughout the growth period, showed significantly less number of leaf miner larvae per plant. The lowest per cent infestation of 5.66 and 5.21 was observed in plots treated with monocrotophos 0.05 per cent throughout the growth period in 1988 and 1989.

As regards number of pods, yield per plant and yield, the treatment of monocrotophos 0.05 per cent throughout the growth period was significantly superior in having higher number of pods per plant and yield per plant as well as the higher dry pod yield of 608.25 kgs/ha and 1441.75 kgs/ha during 1988 and 1989, respectively.

Per cent avoidable loss in pod numbers per plant recorded in monocrotophos 0.05 per cent and control was nil and 26.35 per cent, respectively. Per cent avoidable loss in yield/plant was maximum (29.62 per cent) in untreated control. As regards yield of dry pods, the per cent avoidable loss in untreated control was 42.29 per cent whereas no loss was recorded in treatment with monocrotophos 0.05 per cent throughout the growth period.

6.4 In varietal reaction incidence of jassids per three leaves varied from 0.80 to 1.96. The lowest incidence was recorded on NCAC-343 (0.80 jassids/3 leaves) during 1988. Next season LGS-10 and NCAC-343 showed least jassid incidence as compared to other cultivars. Pooled analysis revealed the same trend.

The incidence of thrips on groundnut cultivars varied from 0.50 to 1.65 thrips/3 leaves. The minimum incidence was observed on LGS-10 (0.50 thrips/3 leaves). The highest incidence (1.65 thrips/3 leaves) was observed on ICG-1363, during 1988. Next season (1989) same trend was observed. However, pooled results showed no significant differences in pest incidence among different cultivars of groundnut.

The incidence of leaf miner varied significantly on different cultivars of groundnut ranging from 0.40 to 1.00 larvae/plant. The higher incidence was recorded in ICG-9559 and JL-24 in 1988. Next season, the lowest incidence was observed in LGS-10, ICG-1363, TMV-2 and ICG-9559. Pooled results indicated that the cultivar LGS-10 was found significantly superior over JL-24 and SBXI in recording lower infestation of leaf miner.

The dry pod yield recorded in different cultivars was significant. The highest pod yield of 1110.50 kgs/ha was recorded in NCAC-343 followed by LGS-10 (977 kg/ha) during 1989.

6.5 In field testing of insecticides, application of monocrotophos 0.05 per cent significantly reduced the incidence of jassids and thrips during 1988 and 1989, followed by lambdacyhalothrin 0.004 per cent in 1988 and ethofenprox 0.05 per cent in 1989. The pooled results indicated that average population of jassids and thrips was minimum in the treatment with monocrotophos 0.05 per cent.

The treatment with monocrotophos 0.05 per cent was most effective among insecticidal treatments in reducing incidence of leaf miner. The other effective treatments in descending order were ethofenprox 0.05 per cent, triazophos 0.05 per cent, lambdacyhalothrin 0.004 per cent and cartap 0.1 per cent. Pooled results indicated the same trend.

In yield, the application of monocrotophos 0.05 per cent and carbofuran 1 kg a.i./ha + monocrotophos 0.05 per cent were significantly superior in increasing the number of pods/plant and yield per plant in both the years, 1988 and 1989. Pooled results followed the similar trend.

As regards dry pod yield of groundnut, it varied from 434 to 793 kgs/ha during 1988 and 1070.66 to 1527.33 kgs/ha during 1989. The highest dry pod yield of 793 kgs/ha during 1988 and 1522.33 kgs/ha in 1989, was recorded in monocrotophos 0.05 per cent. Pooled results showed the similar trend.

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* Original not seen.