

INCIDENCE OF INSECT PESTS OF SUMMER MUNG,
(*Vigna radiata* (L) Wilczek) AND CHEMICAL
CONTROL OF THRIPS,
(*Caliothrips indicus* Bagnall)

THESIS

Submitted to the
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur
in partial fulfilment of the requirements
for the Degree of

MASTER OF SCIENCE
IN
AGRICULTURE
(ENTOMOLOGY)

By
RAJIV CHAUHAN



DEPARTMENT OF ENTOMOLOGY
JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA
COLLEGE OF AGRICULTURE
JABALPUR, M. P.



1986

J. M. [unclear] [unclear] aya,
all [unclear]
acc. no. 32832 / 2-4-87
Initial *[initials]*

-T.
-A.
-Crip

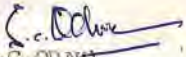
Dedicated to
My Beloved Father
SHRI MAHIPAL SINGH CHAUHAN

**Whose unfailing
affection and encouragement
always inspired me towards
Hardworking**


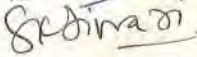

CERTIFICATE-I

This is to certify that the thesis entitled "INCIDENCE OF INSECT PESTS OF SUMMER MUNG, (VIGNA RADIATA (L.) WILCZEK) AND CHEMICAL CONTROL OF THRIP, CALIOPTHRIPS INDICUS BAGNALL", submitted in partial fulfilment of the requirements for the degree of "MASTER OF SCIENCE IN AGRICULTURE" of the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, is a record of the bonafide research work carried out by Shri RAJIV CHAUHAN under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instructions.

No part of the thesis has been submitted for any other degree or diploma (certificate awarded etc.) or has been published/published part has been fully acknowledged. All the assistance and help received during the course of the investigation have been duly acknowledged by him.


(S.C. ODAK)
Chairman of the Advisory Committee

THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE

Chairman	(Dr. S.C. Odak)	
Member	(Shri S.K. Tiwari)	
Member	(Dr. S.K. Rao)	
Member	(Shri U. Goswami)	

CERTIFICATE-II

This is to certify that the thesis entitled "INCIDENCE OF INSECT PESTS OF SUMMER MUNG (VIGNA RADIATA (L.) WILCZEK) AND CHEMICAL CONTROL OF THRIP, CALIOTHRIPS INDICUS BAGNALL" submitted by Shri RAJIV CHAUHAN to the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, in partial fulfilment of the requirements for the degree of M.Sc. (Ag.) in the Department of Entomology, has been approved by the Student's Advisory Committee and External Examiner after an oral examination of the same.

D.H.C.

External Examiner

Major Advisor

I. Odak

(Dr. S.C. Odak)

Head of the Department

S.M. Vaishampayan

(Dr. S.M. Vaishampayan)

19/12/86

Director of Instruction

S.N. Dubey

(Dr. S.N. Dubey)

ACKNOWLEDGEMENTS

I avail this precious opportunity of expressing my deep sense of gratitude to Dr. S. C. Odak, Professor, Department of Entomology, J.N.K.V.V., Jabalpur, M.P. India, and Chairman of my Advisory Committee for suggesting the problem, taking keen interest and encouragement during the course of the investigations and for correcting the manuscript.

I acknowledge with thanks the unstinging Co-operation of Dr. S. M. Vaishampayan, Professor, and Head, Department of Entomology, J.N.K.V.V., for providing necessary facilities during the research work.

My cordial thanks are to Shri S. K. Tiwari, Assistant Professor, Department of Entomology, Dr. S. K. Rao, Assistant Professor, Department of Plant Breeding & Genetics and members of my Advisory Committee for the assistance and facilities rendered to me during the course of investigation.

My sincere thanks are due to Dr. Lalchand, Professor and Head, Department of Agricultural Statistics and Shri U. Goswami, Assistant Professor, Department of Agricultural Statistics for kind advice and able guidance in completing the statistical work.

I express my sincere thanks to Dr. B.S. Thakur, Dr. O.P. Katiyar, Dr. R.K. Agrawal, Dr. R. Verma, Dr. A.K. Khatri, Dr. S.C. Vyas, Mrs. A. Moitra, Shri B.S. Choudhary, Shri S.N. Kulkarni and all other staff members of Entomology Department, who made it possible for me to complete successfully the M.Sc. (Ag.) programme.

In spite of all odds my mother gave me affection, help and her sincere efforts right from my primary education which helped me to attain this stage. No words can explain her deep love towards me. Expressing gratitude towards her means lowering her affection and love. Words fail to express my gratitude and indebtedness to my dear father who has no equal anywhere. In the long course of my education, he always gave me a helping hand and constant encouragement with a smile of love and affection and waited patiently for the day I complete my post graduation. My mother and father, are the only suitable persons to whom I can dedicate this work with a deep sense of gratitude and in their honour, I always pray God for their health, happiness and long life.

I take it to be my pious duty in thanking all my friends specially Shri J. Paul, R.K. Lokhande, J. Singh, S.B. Singh, R. Singh, P.S. Naha, N.K. Arya, S. Pagnis, V.K. Chouhan, R. Bhomik, B. Goswami, K.P. Shah, S. John, R. Singh, L. Khan, M. Thomas, J.P. Sahu, B.K. Sharma, V.M. Sharma, L.P. Tiwari, S. Saha for the Co-operation

they have provided to me and sincere thanks to Mr. N. Jagan Mohan for the Co-operation during experiment and course work.

I would like to express my heartfelt gratitude towards my sister Dr. Sandhya Behura, Mrs. Sudha Devbarman, Miss Sriti Chauhan and brother-in-law Dr. Priadarshan Behura, and Shri Jishnu Devbarman and nephew master Pratik Devbarman whose filial affection and encouragement have been a beacon of light for the successful completion of this investigation.

I wish to confer my thanks to Shri G.K. Chawla for typing this manuscript.

I am grateful to Professor S.V. Arya, Vice-Chancellor, J.N.K.V.V., Dr. S.N. Dubey, Director of Instruction, J.N.K.V.V., Dr. S.P. Singh, Dean, College of Agriculture, Dr. G.S. Rawat, Hostel Worden for the facilities and assistance accorded to me during my stay in this University.

JABALPUR

DATED : Sept. 1988

R. Chauhan
R. CHAUHAN

TABLE OF CONTENTS

<u>Chapter</u>	<u>Page</u>
I. INTRODUCTION	1-4
II. REVIEW OF LITERATURE	5-17
III. MATERIALS AND METHODS	18-23
IV. EXPERIMENTAL FINDINGS	24-42
V. DISCUSSION	43-51
VI. SUMMARY AND CONCLUSION	52-53
REFERENCES	54-59
APPENDIX	60-67

LIST OF TABLES

<u>No.</u>		<u>Page</u>
1.	Pest complex of green gram	24
2.	Population of insect pests appearing on summer mung crop (<u>Vigna radiata</u>)....	29
3.	Average population of thrips/ 20 plants in different time intervals (Transformed values as $\sqrt{x+0.5}$ in paranthesis; mean of 4 replication)	37
4.	1000 grain weight, yield of mung grain (Kg / ha) and percentage increase in yield over control	40
5.	Estimation of losses by thrips, <u>caliothrips indicus</u> Bagnall in summer mung	42

LIST OF FIGURES

Figure No.

1. Layout plan of Experimental trial.
2. Incidence of insect pests on summer mung crop.

CHAPTER I
INTRODUCTION



INTRODUCTION

Pulses form the most important group of food crops grown in India. Pulses are not only important sources of protein in average Indian diet, but they are well known for their contribution in maintaining the soil fertility through their biological nitrogen fixing quality. In spite of this, their productivity and production have been stagnant for a significant duration. Some pulses like green gram, black gram, pigeonpea etc. are grown during kharif season, while others like chick pea, lentil, pea etc. are grown during rabi season. The production of these pulses can be increased either by increasing productivity or by bringing more area under pulses. In this context, cultivation of pulses during summer season has its own importance. During last few years attempts have been made to breed varieties suitable for summer cultivation under intensive pulse research programme. As a result, many early maturing varieties of green gram have been developed.

Green gram is a rich source of nutrients. It contains 24 per cent protein, 1.3 per cent fat, 3.5 per cent minerals, 5.7 per cent carbohydrates, 0.32 per cent phosphorus, 0.12 per cent calcium, 0.07 per cent iron, 0.04 per cent fibre, and its every 100 g grain gives 334 K Cal energy (Gopalan et al., 1977).

In India, the total area under green gram is about 25 lakhs hectares with production of about 8 lakh tonnes, giving an average yield of 3.2 quintals per hectare. Its major growing states are Maharashtra, Madhya Pradesh, Uttar Pradesh, Punjab, Andhra Pradesh, Rajasthan, Karnataka and Tamil Nadu.

Summer green gram is grown in Bundelkhand and to a limited extent in other parts where irrigation is available. The exact figure of its area and production in Madhya Pradesh is not available.

In this context, Pusa Baisakhi is one of the varieties developed and recommended for summer cultivation. It is a quick maturing (65-70 days) variety, photosensitive, temperature tolerant and yields 5 to 10 quintals per hectare. It is not only very much suitable for summer season but has wider adaptability.

In spite of development of early maturing promising varieties, average yield of green gram in the state has been significantly low (283 kg/ha)^(c. 1973-74). Out of various factors responsible for such a lower yield, the colossal damage caused by various insect pests has played a significant role. There are about 60 insect species attacking the green gram in India and abroad, as reported by various workers (Shrivastava, 1964 and Nayar *et al.*, 1976).

The insect pests of green gram reported from Madhya Pradesh are Galerucid flea beetle, Madurasia obscurella Jacoby, green jassid, Anrasca kerri (Pruthi), linseed caterpillar, Spodoptera exigua (Hbn), tobacco caterpillar, S. litura (Wlk), green semilooper, Thysanoplusia (Plusia) Orichalcea (Fabr), til hawk moth, Acherontia styx West, horn caterpillar, Herse convolvuli L, Bihar hairy caterpillar, Spilosoma (Diacrisia) obliqua (Wlk), stemfly, Ophiomyia (Melanagromyza) phaseoli (Tryon), whitefly, Bemisia tabaci (Guen.), brown caterpillar, Anarsia ephippias Mey., pod borer, Maruca testulalis (Geyer), blue butterfly, Lampides boeticus L., banded blister beetle, Mylabris pustulata Fabr., hairy caterpillar, Amsacta moorei Butl., bean aphid, Aphis craccivora Koch., pea thrip, Caliothrips indicus Bagnall., green stink bug, Nezara viridula (Linn.), pea leaf miner, Phytomyza stricornis Meigen and pulse beetle, Callosobruchus spp. (Gadkari and Singh, 1979 and Odak, 1981).

Out of various insect pests attacking green gram, the crop grown in summer is severely damaged by thrips, Caliothrips indicus Bagnall. As many as 150 thrips per 20 plants were reported at Jabalpur causing 50 per cent reduction in yield (Odak, 1984). These are small black and brown coloured insects which lacerate the leaf surface causing a lot of leaf curling giving sickly appearance to plants. The thrips start appearing from one week old crop and multiply very rapidly.

Adults as well as nymphs congregate on lower side of leaves and cause large scale devastation of the summer mung crop.

A survey conducted in 1974 summer to find out the major pests and diseases of summer mung crop grown in Chattisgarh and Balaghat Districts revealed thrips and yellow mosaic to be the only factors mainly responsible for heavy losses to crop. (Odak, 1984).

The yield losses sustained by summer mung due to the attack of various insect pests can effectively be minimised if careful studies are made in respect of the pest complex, their occurrence and timely control measures.

In Madhya Pradesh and in the country at large very little work seems to have been done on the above aspects. Present investigations were therefore, undertaken on summer green gram (Pusa Baisakhi) with the following objectives :

1. To record the incidence of the insect pests through out the crop growing season.
2. Evaluation of insecticides against major pests like thrips.
3. Estimation of losses caused by thrips to the summer green gram.

CHAPTER II
REVIEW OF LITERATURE



REVIEW OF LITERATURE

Very little literature is available on the work related to insect pests of green gram specially grown during summer season. The review work collected here, therefore, includes the work reported on green gram grown both in kharif and summer seasons:

2.1 Incidence of insect pests

Srivastava (1964) and Nayar et al. (1976) listed a number of pests of kharif green gram viz., brown caterpillar, Anarsia ephippias (May), aphid Aphis craccivora (Koch.), pod borer, Meruca testulalis (Gayer), blister beetle, Mylabris pustulata (Fabr.), Bihar hairy caterpillar Diacrisia obliqua (Wlk.), sphinx caterpillar, Herse convolvuli L., blue butterfly, Lampides boeticus (L.), leaf roller, Lamprosema indicata F., leaf roller, Eucosma melanaula Mey., Tricentrus bicolor Dist., bug, Chauliops fallax Scott., Zaphanera publica (Singh), bug, Riptortus pedestris F., butterfly, Euchrysops cnejus (F.), Anticarsia irrorata B., Biblemma hemirhoda Wlk., Heliothis armigera Hb., Seratina binchani Ckll., Alcides collaris P., Pachytychius munconis Mshll., Apion ampulum, Fst. and Azasia rubricans B.

The galerucid flea beetle, Magdurasia obscurella, Jacoby., green jassid, Anrasca kerri (Pruthi)., stemfly, Ophiomyia (Malanagromyza) phaseoli (Tryon) were the main pests of green gram during young stage (Saunders, 1968; Saxena, 1973; Sharma and Bhalla, 1977; Gupta and Saxena, 1979 and Saxena et al., 1981).

Gibson (1969) reported M. obscurella to attack the green gram crop as soon as seedlings emerged out. The infestation by these beetle according to Anonymous (1971) was severe from July to October but it was more harmful to young plants. Stemfly O. phaseoli also attacked the young crop.

Singh and Singh (1971) investigated the succession of the pests and their population built up in the green gram (kharif, variety H-45) at New Delhi. There were three major pests viz., Empoasca kerri (Jassid), Plusia orichalcea (Semi-looper) and Phytomyza horticola (Goursau) (leaf miner), and four minor pests viz., Nezara viridula (green bug.), Oxya valax (grass hopper), Spodoptera exiguus (leaf roller) and Callosobruchus sp. (pulse beetle), at different stages of plant growth. Jassid and semi-looper appeared first, followed by leaf miner, the population of which continued to build up and attained peaks simultaneously by the third week of September during the active vegetative stage of the

crop. The highest incidence of jassid, leaf miner and semi-looper was 86, 38 and 6/9 plants respectively.

In Madhya Pradesh, Galerucid beetle, Madurasia obscurella Jacoby, pod borer, Meruca festuhalis, Jassid, E.kerri, white flies Bemisia tabaci were reported as kharif mung pests (Odak, 1973).

Peter (1973) reported O.phaseoli, S.litura, Lamprosoma diemenalis, Apogonia spp., Pagria sp., Riptortus linearis (L.), Maladera sp., Lepadoretus sp., Atractomorpha sp., Elimaca sp., Coptosoma sp., and Bothrogonia ferriuginea (F.), as the pests of green gram in Malasia.

Odak (1974) reported that mung crop grown in summer was severely damaged by thrips, Caliothrips indicus Bagnall. He also reported that thrips both young and adults congregate on the underside of the leaf and fed on the leaves scrapping the chlorophyl resulting in crinkling appearance of the leaves.

Saxena et al., (1976) reported that insect pests attacking summer moong were flea beetle Medurasia obscurella, stemfly Ophiomyia phaseoli and jassid Empoasca kerri.

Pablo and Pangga (1976) from Zimbabwe reported a number of pests on green gram which include Ophiomyia (Melanagromyza) phaseoli (Tryon), Abhis cricciivora Koch., Mocis undata and Tetranychus urticae.

Srivastava and Singh (1976) reported M. obscurella, B. tabaci, Adisura alkinsoni, O. velox, Amsacta spp., Diacrisia obliqua and Chrotogonus trachypterus as the pests of green gram in Uttar Pradesh.

Bott and Kingston (1976) reported green stink bug Nezara viridula (Linn.) as a major pest on green gram in Australia.

Pal et al. (1977) found aphid and moong weevil Cyrtosena connata Mshl. to be the main pests of green gram throughout the crop growing season at Jodhpur.

Singh and Singh (1978) reported green gram to be attacked by E. kerri, P. orichalcea, N. viridula, Oxya velox Fabr., S. exigua, Callosobruchus spp., L. exigua, B. tabaci and O. phaseoli at New Delhi.

The Nymphal population of E. kerri were monitored from late April or early May to late September at Hariyana. Population began to increase with the onset of the monsoon rains after mid June, and peak numbers were recorded from mid July to mid August and late July to late August in next year. (Chaudhary, Yadav, Poonia and Rastogi, 1977-78).

Gupta and Singh (1978-79) reported larvae of Agrocercops sp., damaging green gram (V. radiata) and black gram

(V.mungo) at Varanasi during rainy season. The peak period of attack was July-September and 20 to 30% of leaves were damaged. Between 8 to 12 larvae were present in damaged trifoliates in every 10 plants.

Gupta and Saxena (1979) noted that the young crop of green gram was attacked severely by M.obscurella, whereas, in slightly older crop the attack of Jassid was more.

In Madhya Pradesh, M.obscurella, Thysanoplusea orichalcea (Fabr.), E.kerri, Spodoptera exigua (Hüb.), Acherontia styx west wood., Herse convolvuli L., S.litura, Spilosoma (Diacrisia) obliqua (Wlk.), O.phaseoli, B.tabaci, Anarsia ephippias Mey., Meruca testulalis (Geyer), Lampides boeticus L., Mylabris pustulata Fabr., Callosobruchus sp., and Amsacta moorei Butl., were reported as green gram pests during kharif season (Gadkari and Singh, 1979 and Odak, 1981).

Odak (1980) reported incidence of as many as 150 thrips/20 plants on summer green gram at Jabalpur.

Chhabra et al., (1981) from Ludhiana reported the bean aphid, Aphis cricivora Koch. and whitefly, Bemisia tabaci (genn.) at vegetative growth stage of green gram.

Odak (1980) reported flea beetles to be a major pest in kharif crop. They are small nocturnal insects, which

stippled the leaves of host plants with small more or less circular holes. About 9 to 10 holes per leaf were found to be made by this beetle affecting about 50 per cent leaves of green gram under Jabalpur conditions. He also reported brown caterpillar Anartia ephiuppias Mey., pod borer Meruca testulalis and blue butterfly Lampides basticus L., to be important pests of floral and fruiting parts of black gram, green gram and cowpea. Further, he reported damage by Banded blister Mylabris pustulata Fabr. on flowers buds and green pods of the pulses.

Saxena (1981) reported M. obscurella and A. kerri attacking young crop of green gram at New Delhi.

At Kanpur, insects pests generally found on summer moong were Thrips, Caliothrips indicus Bagnall, jassid, Empoasca spp., whitefly, Bemisia tabaci, flea beetle, Monolepta signata, galerucid beetle, Lepadoretus sp., semilooper, Plusia orichalsis, stemfly, Ophiomyia phaseoli, Hairy caterpillar Diacrisia obliqua (Anonymous, 1982).

2.2 Chemical control

Myar (1919) claimed effective control of thrips infesting onion and cabbage by using one and half pound of fish oil resin soap in 4 gallons of water.

Sharma and Bhalia (1963) conducted trials against thrips damaging apple blossom and obtained promising results with dieldrin at the rate of 0.05 lbs. per 100 gallons of water.

Singh and Vaishampayan (1967) reported a spray of DDT and BHC 0.25 per cent to be very effective in controlling the thrips Caliothrips indicus Bagnall on pea.

Veval (1968) recommended following insecticides for the control of thrips.

Dusting BHC 10% @ 8-10 kg/acre or DDT 5% @ 6-8 kg/acre or carbaryl 10% @ 6-8 kg/acre at an interval of 10-15 days.

Or

Spraying DDT 50 WP @ 1-1.5 kg/acre or BHC 50 WP @ 1.5 kg/acre at an interval of 15-20 days.

Or

Spraying Lindane 20 E.C. @ 500 ml or DDT 25 E.C. @ 1.5 litre or dimethoate 30 E.C. @ 1.5 litre or Endrin 20 E.C. @ 400 ml/acre at an interval of 15 days.

Malathion, thiometon, parathion, phosphonidon, methyl demeton were also recommended by him.

Odak (1973) conducted an insecticidal trial against pest complex of summer mung crop. The soil treatment with disulfoton 5G and phorate 10G @ 1 kg a.i./ha, each in combination with foliar spray of monocrotophos 0.04% and monocrotophos alone were significantly effective not only in reducing the population of thrips but also recorded significantly higher yields also. He also reported that Disulfoton alone was effective in reducing the population of Jassids and whiteflies and in general, seed treatment with Carbofuron (1:50) was found to be effective treatment as regards percentage of leaf damage, number of holes per leaf by M. obscurella and percentage of pods damaged by borer.

Odak (1974) reported 2 sprays of monocrotophos 0.04% to be effective in reducing thrip population on summer mung crop.

Odak and Thakur (1975-76) tried monocrotophos 0.04% alone and in combination with soil application of systemic granular insecticides (Disulfoton @ 1 kg a.i./ha) and water spray against insect pests of summer mung found all treatments except water spray to receive significantly lower population of thrips as compared to control.

They also reported that out of various insecticidal treatments including that of soil application with phorate 10G,

quinalphos 5G, disulfoton 5G, and seed treatments with carbofuron 50 W.P. tried against insect pests of kharif green gram, disulfoton 5G followed by monocrotophos spray and monocrotophos spray alone had significantly less number of holes/leaf. All the insecticidal treatments had low pod borer damage.

Saxena et al. (1976) reported seed treatment by carbofuron 2% to be effective against insect pest complex of green gram giving yield increase to the extent of 82.2 to 110%. It proved more effective than disulfoton 5% granules.

Vyas and Saxena (1976-77) reported delay in germination of crop treated with phorate and disulfoton granules and recommended their use not exceeding 6% concentration.

According to Anonymous (1978-79), the only pests causing damage to mung crop at Jabalpur were Jassid and thrips. Among the insecticidal treatments Solvirex 5% alone or in combination with monocrotophos 0.04% proved significantly superior not only in reducing the population of thrips but that they were effective till 3 weeks after application of insecticides.

Field tests carried out in Haryana India to evaluate the effectiveness of 9 sprays and 7 dust formulations of

insecticides against Madurasia obscurella Jac. whiteflies and pod borers on mung bean (V. radiata) during kharif (hot) season showed sprays of 0.04% monocrotophos, 0.07% endosulfan and dusts of 2% neem seed kernel (Azadiracta indica), 4% phosalone, 5% carbaryl, 4% endosulfan or 10% HCH to be effective in controlling the insect pests (Yadav and Poonia, 1978-79).

According to Anonymous (1980) thrips, Caliothrips indicus and Megaluro thrips distalis of green gram can be controlled by seed treatment with 4% carbofuran on weight basis or pre-sowing basal application with phorate 10G aldicarb 10G or disulfoton 5G at the rate of 1 kg a.i./ha, followed by monocrotophos 0.04% or endosulfan 0.07% or dimethoate 0.03% spray at the rate of 600 to 1000 litres/ha.

Dusting with the endosulfan, malathion, methyl parathion or quinalphos dusts at the rate of 20-25 kg/ha 4-6 weeks after sowing was also recommended to control whitefly, Bemisia tabaci (Anonymous, 1980).

In controlling Aphid and Thrips, malathion 0.05%, dimethoate 0.03% or monocrotophos 0.04% spray was recommended (Anonymous, 1980).

Was et al. (1981) determined residues of foliar application of monocrotophos 0.04% on green gram and did not observe any detectable residues at harvest.

Yadav et al., (1981) evaluated a number of insecticides against insect pests of green gram and found monocrotophos 0.04% and endosulfan 0.07% to be most effective.

Application of Aldicarb 10G or Disulfoton 5G or Phorate 10G at the rate of 1 kg/ha at the time of sowing were recommended to control thrips, jassid, whitefly and stemfly of summer mung (Anonymous, 1982).

Odak (1984) reported Disyston 5G or solvirex or phorate 10G @ 1 kg a.i./ha, applied in furrows at the time of sowing followed by two sprays of endosulfan 35 E.C. (1 litre/ha) or monocrotophos 40 E.C. (500 ml/ha) once four weeks after and the other six weeks after germination to effectively control most of the pests of kharif mung or alternatively leaf eating insects could be controlled either by foliar sprays of monocrotophos or endosulfan or by dusting the crop with BHC 10% @ 20 kg/ha.

2.3 Losses by Thrips

Very little work seems to have been done on this aspect as is evident from the literature.

Anand (1926) reported that in addition to acting as pollinators thrips blight the flowers and destroy tender parts of the bloom.



Andrewartha and Kilpatrick (1950) recorded that apple blossom thrips, Thrips imaginis Bagn. consumed a lot of pollen during the course of their feeding and sucked the sap from the stamens and the ovary causing them to wither and die.

Ananthakrishnan (1955) reported considerable damage by Thrips palmi Karny to sesamum flowers.

Seshagiri et al. (1968) observed losses to the extent of 67.1 per cent in pea crop due to Caliothrips indicus Bagnall.

Rawat et al. (1969) reported 36.0 per cent reduction in pod setting in red gram due to Frankliniella sulphurea (Schmütz) and Taeniothrips nigricornis (Schmütz).

In an experiment conducted at Jabalpur on summer mung crop, a foliar spray of monocrotophos 40 E.C. (750 ml/ha) gave effective control and recorded 250 kg more yield (Anonymous, 1973-74).

Odak (1974) carried out a survey of insect pests of summer mung in Madhya Pradesh and reported thrips to be a major pest causing 25 to 30% reduction in yield.

A survey was conducted in summer to find out the major pests and diseases of summer mung crop grown in

Chattisgarh and Balaghat districts. Thrips and yellow mosaic were found to be only factors mainly responsible for heavy losses to crop (Anonymous, 1974).

Odak and Thakur (1975-76) found foliar spray of monocrotophos 0.04% alone controlled thrips, recording significantly higher yield (833 kg/ha) as compared to control (432 kg/ha) in summer mung.

Odak (1984) conducted plant protection trial on summer mung crop on cultivators fields in Bilaspur and Balaghat districts of M.P. and reported losses to the extent of 125 and 200 kg/ha respectively due to thrips. Cost benefit ratios of 1:3.5 and 1:4 respectively were reported by him due to insecticidal treatment.

*

CHAPTER III
MATERIALS AND METHODS



MATERIALS AND METHODS

The field investigations on the incidence of insect pests on summer green gram (Vigna radiata) were carried out in the crop sown on the area of Nucleus Project, Department of Plant Breeding and Genetics while that on chemical control and losses caused by them on the crop was carried out in the experimental area of the Department of Entomology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during summer season (March to May 1985).

3.1 Incidence of insect pests on summer mung

A regular survey starting from one week old crop was carried out at one week's interval to record different pests of summer mung. The insect pests appearing on crop right from one week old crop upto harvest were recorded. The crop was kept unprotected for this purpose. The sequence in which these pests appeared was also noted. The status of different insect pests recorded was determined on the basis of the damage caused by them.

For observation a sample of 20 plants randomly selected from the field was chosen and population of different insect pests thereon was assessed. Observation on different insect pests were recorded as detailed below.

Thrips : In early stage of crop growth observations were recorded by counting both nymphal and adult population of thrips on each plant individually. In the later stages of crop growth the population of thrips was assessed by shedding each plant on a piece of white paper and counting total number of nymphs and adult thrips.

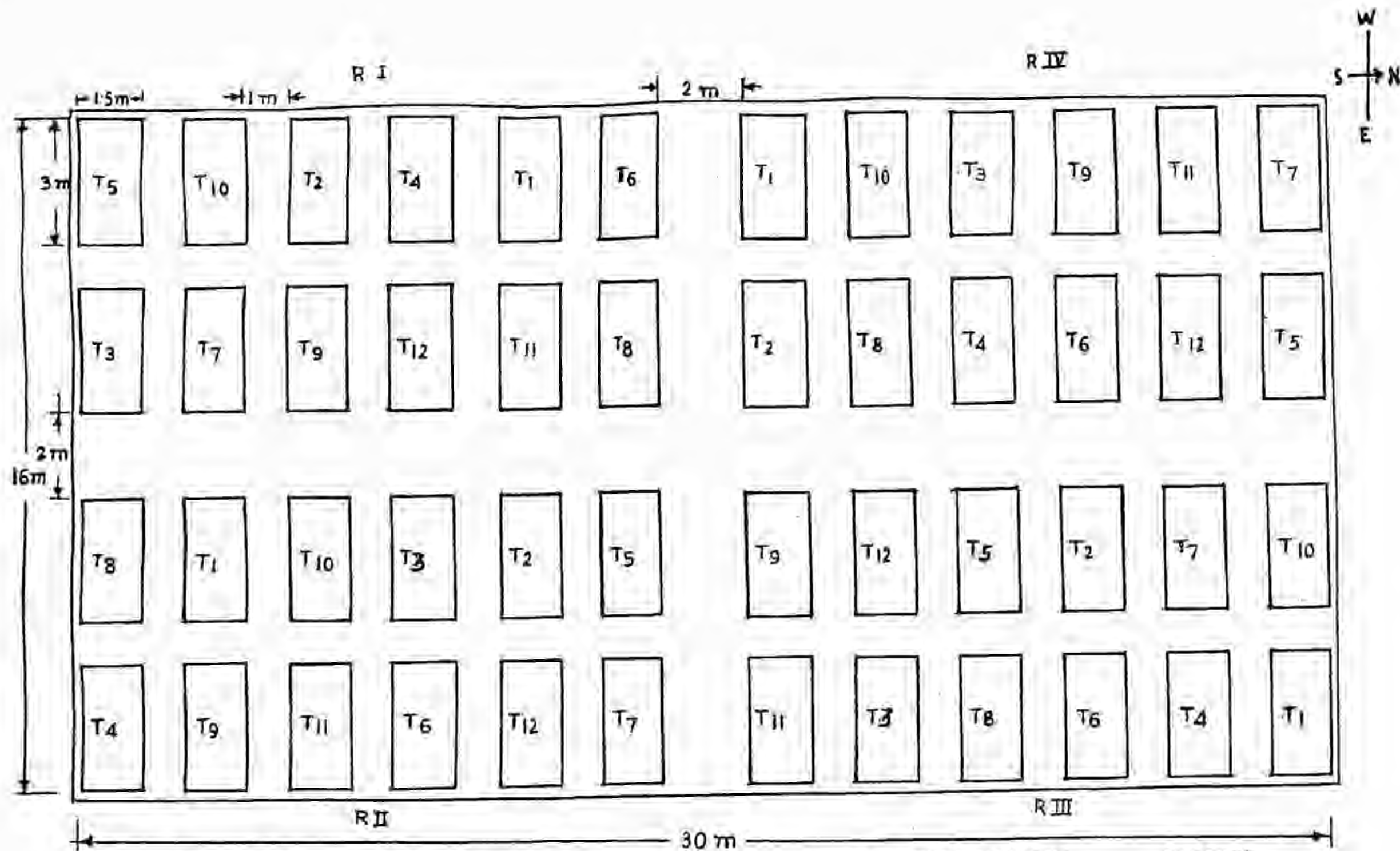
Other insects : For observing other insects, different set of 20 plants was used and the population of jassids, white-flies, flea beetle and others were counted thereon without disturbing the plant.

3.2 Chemical control

A field experiment was laid out in a simple randomized block design with 12 treatments replicated four times. The treatments consisted of ten insecticides, plain water and control as detailed below.

Field specifications and layout

The layout and the randomized arrangements of treatments is detailed in Fig.1.



T₁ - NEXION 0.035 %
 T₂ - ACEPHATE 0.075 %
 T₃ - DECAMETHRIN 0.004 %
 T₄ - CYPERMETHRIN 0.090 %
 T₅ - FENVALERATE 0.020 %
 T₆ - MONOCROTOPHOS 0.020 %

TREATMENTS

T₇ - PHOSPHAMIDON 0.050 %
 T₈ - ENDOSULFAN 0.070 %
 T₉ - QUINALPHOS 0.025 %
 T₁₀ - OXIDEMETON-METHYL 0.250 %
 T₁₁ - WATER SPRAY
 T₁₂ - CONTROL

FIG. 1 : LAYOUT PLAN OF EXPERIMENTAL TRIAL



3.2.1 Plot specification

Plot size (Gross)	:	1.5 x 3 m
Plot size (Net)	:	1.2 x 2.90 m
Number of replications	:	4
Row to row distance	:	30 cm
Plant to plant distance	:	5 cm
Total area	:	30 x 16 sq. mt.
Fertilizer applied	:	25 kg N and 40 kg P_2O_5 /ha
Date of sowing	:	22nd March, 1985
Number of irrigations	:	3
Number of weedings	:	2

Treatments

S.No.	Chemical name	Commercial name	Formulation	Conc. used	Quantity used/litre
1.	Nexion	Bromophos	35 E.C.	0.035%	1 ml
2.	Acephate	Orthene	75 S.P.	0.075%	2 gm
3.	Decamethrin	Decis	25 E.C.	0.004%	1.6 ml
4.	Cypermethrin	Cymbush	25 E.C.	0.009%	0.36 ml
5.	Fenvalerate	Sumicidin	20 E.C.	0.02%	1 ml
6.	Monocrotophos	Nuvacron	40 E.C.	0.04%	1 ml
7.	Phosphemidon	Dimecron	85 E.C.	0.05%	0.58 ml
8.	Endosulfan	Thiodan	35 E.C.	0.07%	2 ml
9.	Quinalphos	Ekalux	25 E.C.	0.025%	1 ml
10.	Oxidemeton methyl	Metasystox	25 E.C.	0.25%	1 ml
11.	Water spray	-	-	-	-
12.	Control	-	-	-	-

After seeding on 20th March, a come up irrigation was given on 22nd March, germination started on 25th March and was complete by 26th March. The weeding was done on 28th March and on 28th April while the crop was irrigated on 10th April and 2nd May.

The insecticides were applied in the field with the appearance of pests on the crop. In all, two sprayings were given, one on one week old crop and the second on four weeks old crop. The quantity of spray liquid used was 400 ml/plot i.e. 900 lit/ha. A 3 litre compression sprayer was used for spraying.

3.2.2 Method of observation

Observation on total number of thrips were recorded on 20 plants/plot randomly selected from each plot. Details of observation were same as mentioned in 3.1.

Pre treatment observations were taken 24 hours before spraying while post treatment observations were taken 24 hours, 4 days, 7 days, 15 days, 21 days and 27 days after treatment.

3.2.3 Grain weight and grain yield

One thousand seeds randomly taken from each plot were weighed. mean of the four replications was calculated and the data thus obtained were put to statistical analysis.

3.2.4 Grain yield

The grain yield from each net plot was recorded at harvest and subjected to statistical analysis.

3.3 Estimation of losses

Losses caused by thrips were estimated by a non replicated paired plot design. Variety Pusa Baisakhi was sown in two adjacent plots, each measuring 10 x 5m. One was treated with monocrotophos 0.04% used @ 2.5 ml/plot i.e. 500 ml a.i./ha, while the other was kept unprotected. In all two sprays, one on one week old crop and the second on four weeks old crop were given. Like-wise, net plot yield from each plot was recorded and was converted into kg/ha. Accordingly the cost benefit ratio was worked out taking into account the prevailing market price of insecticide, mung grain and labour cost.

3.4 Statistical analysis

The data on pest population was subjected to statistical analysis after converting them in transformed values $\sqrt{x + 0.5}$. The data thus transformed was subjected to statistical analysis for knowing the significance of different treatments. Similarly, data on one thousand grain weight and grain yield per net plot were also subjected to statistical analysis.

Following analysis of variance table was used:

S.No.	Source of variation	d.f.	S.S.	M.S.S.	F _c	F _t
1.	Block	(r-1)				
2.	Treatment	(t-1)				
3.	ERROR	(r-1)(t-1)				
	Total	rt-1				

*



CHAPTER IV
EXPERIMENTAL FINDINGS



EXPERIMENTAL FINDINGS

The results on the incidence of insect pests, their chemical control by some morden insecticides and losses caused by major pests like thrips, Caliothrips indicus Bagnall on summer green gram, Vigna radiata are given in this chapter.

4.1 Incidence of insect pests

Incidence of different insect pests on summer green gram Vigna radiata was recorded at different stages of crop, that is, during vegetative stage (28th March to 23rd April), flowering and podding stage (24th April to 15th May) and at harvest (22nd May). A list of pests recorded on summer green gram is given in Table 1. The nature of damage caused by each pest along with the pest population recorded is also described in the following pages.

Table 1. Pest complex of green gram.

S.No.	Name	Entomological name	Order	Family
1.	Thrips	<u>Caliothrips indicus</u> Bagnall	Thysanoptera	Thripidae
2.	Flea beetle	<u>Medurasia obscurella</u> Jacoby	Coleoptera	Galerucidae
3.	Jassids	<u>Amrasca kegri</u> (Pruthi)	Hemiptera	Cicadellidae
4.	Pod borer	<u>Meruca testulalis</u> (Geyer)	Lepidoptera	Pyralidae
5.	Green semi-looper	<u>Thysanoplusia orichalcea</u> (Fabr)	Lepidoptera	Noctuidae
6.	White fly	<u>Bemisia tabaci</u> (Guen.)	Hemiptera	Alexandridae
7.	Idnseed caterpillar	<u>Spodoptera exigua</u> (Hbn.)	Lepidoptera	Noctuidae
8.	Bihar hairy caterpillar	<u>Diacrisia obliqua</u> (Wlk.)	Lepidoptera	Pyralidae

4.2 Nature of damage

4.2.1 Thrips, Caliothrips indicus Bagnall

These are small black and brown coloured insects which lacerate the leaf surface causing a lot of curling giving sickly appearance to plants. ^(Plat. I) The nymphs and adults rasp the ventral or dorsal surfaces of tender leaves and flowers and suck the coagulating cell sap. The infested leaves become discoloured showing whitish specks. Adults as well as nymphs congregates on lower side of leaves and cause large scale devastation of the summer mung crop.

4.2.2 Flea beetle, Medurasia obscurella Jacoby

The adult flea beetles attack the young plants as soon as they emerge. These are small yellowish brown nocturnal insects which stipple the leaves of green gram. Small whitish specks and tiny holes result due to their feeding. The affected young plants do not have enough foliage to tolerate the voracious feeding and the damage caused and usually is quite devastating which amount to a loss of relatively large percentage of leaf surface with resultant loss in plant vigour and in severe cases death of plants.



Plat- 1. Crinkled leaves (Calotheis indicus Boymall)
2. Healthy leaves

4.2.3 Jassids, Amrasca kerri (Pruthi)

Both nymphs and adults suck plant sap. Infested leaves become brittle and dry. Due to heavy desapping, plants show poor growth.

4.2.4 Pod borer, Meruca testulalis (Geyer)

The larvae feed and damage the leaves, by rolling and webbing them. At flowering and pod formation stages they feed on flowers, buds and pods by webbing them together.

4.2.5 White fly, Bemisia tabaci (Gunn)

The nymphal stages suck up the cell sap. The adults act as vectors of yellow mosaic disease and as such they are considered important.

4.3 Population of insect pests

The data on average population of different insect pests/20 plants recorded at each stage are presented in Table 2 and are diagrammatically presented in Fig.2.

4.3.1 Thrips, Caliothrips indicus Bagnall

Thrips were the first to appear on the crop at 3 leaf stage, that is, on about 7 to 8 days old crop. As many as

65 thrips per 20 plants were observed on 1 week old crop. The population then declined and continued to remain so throughout the whole vegetative stage. An average of 52 thrips/20 plants was recorded during the vegetative stage. At flowering and podding stage the population again increased slightly, declining in subsequent weeks till the population reached 7 thrips/20 plants at harvest. An average of 24.75 thrips/20 plants was recorded during flowering and podding stage.

4.3.2 Flea beetle, Medurasia obscurella Jacoby

In the first week after germination the population of flea beetle was very low, that is, 6/20 plants, which increased to 20 beetles/20 plants in 2nd week. During subsequent weeks the population remained more or less so throughout vegetative stage of the crop recording an average of 16.50 beetles/20 plants. The flea beetle population was practically nil in the flowering and podding stage of the crop.

4.3.3 Jassid, Amrasca kerkii (Pruthi)

Like that of flea beetle the population of jassids was low i.e. 3/20 plants on one week old crop but on 15 days old crop it increased to 20 jassids/20 plants and continued to remain so throughout the vegetative stage of the crop. The

average jassid population during vegetative stage was recorded to be 15.75/20 plants. The average population of the pest remained low (4.75/20 plants) during flowering and podding stage while nil population was recorded at harvest.

4.3.4 White fly, Bemesia tabaci (Guen.)

Its incidence was first recorded on 15 days old crop when as many as 9 white flies/20 plants were noted. Their population remained more or less same till three weeks old crop, but it reached its peak (17/20 plants) on four weeks old crop. The average population recorded during vegetative stage was 9.25 white flies/20 plants. No population was recorded in the earlier part of flowering and podding but as many as 14 and 9 white flies/20 plants were observed in the subsequent weeks. However, their average population during this stage of the crop was 5.75 white flies/20 plants. At harvest practically no white flies were observed. In general, about 10 per cent plants were infected by yellow mosaic.

4.3.5 Leaf feeding insects

Among leaf feeding insects, only three species, namely green semilooper, Thysanoplusia orichalcea (Fabr.),

TABLE 2: POPULATION OF INSECT PESTS APPEARING ON SUMMER MOONG CROP (Vigna radiata)

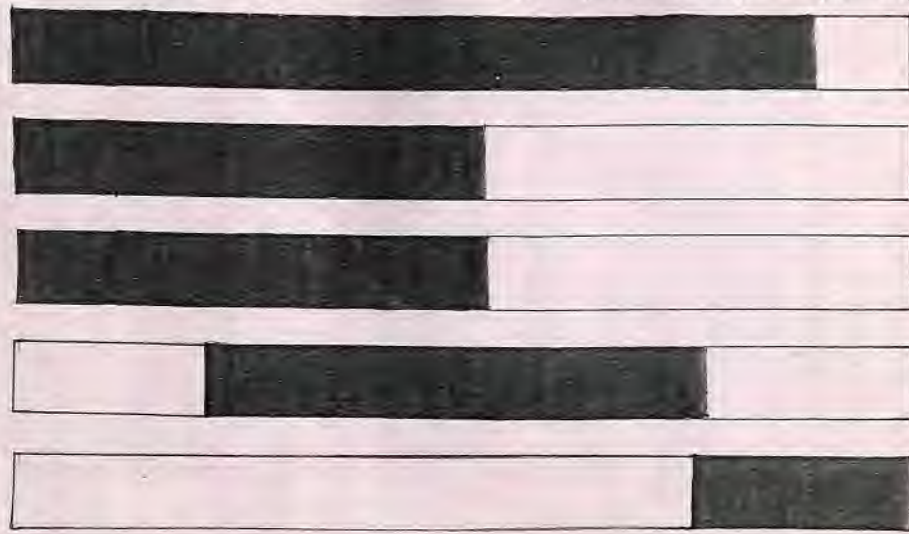
S.N.	COMMON NAME WITH THEIR SCIENTIFIC NAME	VEGETATIVE STAGE (28 th MARCH TO 23 rd APRIL)					FLOWERING AND PODDING STAGE (24 th APRIL TO 15 th MAY)					AT HARVEST (22 nd MAY)	
		I st Obser.	II nd Obser.	III rd Obser.	IV th Obser.	Mean/20 Plants	I st Obser.	II nd Obser.	III rd Obser.	IV th Obser.	Mean/20 Plants	I st Obser.	Mean
1.	Thrips <u>Caliothrips indicus</u> Bagnell	65	50	46	47	52.00	5.9	23	09	08	24.75	07	07.00
2.	Flea beetle <u>Medurasia obscurella</u> Jacoby	06	10	19	21	16.50	07	0	0	02	02.25	0	0.00
3.	Jassids <u>Amrasca kerri</u> Pruthi	03	20	18	22	15.75	10	0	0	09	04.75	0	0.00
4.	White fly <u>Bemisia tabaci</u> Guen	0	9	11	17	09.25	0	14	09	0	05.75	01	01.00
5.	Green Semilooper <u>Thysanoplusia orichalcea</u> Fabr	0	0	0	07	01.75	09	03	0	01	03.25	0	0.00
6.	Linseed Caterpillar <u>Spodoptera exigua</u> Hubn	0	0	0	10	02.50	0	09	11	0	05.00	0	0.00
7.	Bihar hairy caterpillar <u>Diaericia obliqua</u> Wlk	0	0	07	08	03.75	06	03	01	01	02.75	01	01.00
8.	Pod borer <u>Meruca testulata</u> Gayer	0	0	0	0	00.00	0	10	14	09	08.25	5%	POD DAMAGED

MARCH

APRIL

MAY

VEGETATIVE STAGE (21st March to 23rd April) FLOWERING AND PODDING (24th April to 15th May) MATURITY (22nd May)



THRIPS*
Caliothrips indicus Bagn.

FLEA BEETLE
Meduresia obscurella Jacoby

JASSIDS
Amrasee kerri Pruthi

WHITE FLY
Bemisia tabaci Guen.

POD BORER
Meruca testulalis Gaye

SHADED AREA SHOWS ACTIVE PERIOD OF INSECT PESTS

* MAJOR PEST

FIG. 2: INCIDENCE OF INSECT PESTS ON SUMMER MUNG CROP

Linseed caterpillar, Spodoptera exigua (Hbn.) and Bihar hairy caterpillar, Diacrilia obliqua (Wlk) were recorded but their average population was very low during vegetative stage of the crop (1.75, 2.50 and 3.75/20 plants respectively). However, there was a slight increase in their average population during flowering and podding stage of the crop (3.25, 5.00 and 2.75/20 plants respectively).

The population of these leaf feeding insects was in general very low to cause any economic damage to the crop.

4.3.6 Pod borer, Meruca testulalis (Geyer)

This pest appeared during flowering and podding stage of the crop. During this stage the pest population varied from 9 to 14 with an average of 8.25 larvae/20 plants. At harvest the pod damage to the extent of 5% was recorded.

From the population trend of different species of insect pests observed at different stages of crop it was found that the thrip was the most important pest which not only caused lot of leaf damage but that they were persistent throughout the whole growing stage of crop. The flea beetle was next in importance which caused damage only during early stage of the crop. The jassid was active during vegetative stage of the crop but its population was not high enough to cause any appreciable damage. The pod borer did not seem

to be important pest as it caused only 5% pod damage. White fly was yet an important pest which transmitted yellow mosaic disease. Among the leaf defoliators all the three species recorded did not seem to cause any economic damage to the crop.

4.4 Evaluation of insecticides against thrips (Caliothrips indicus Bagnall)

The data recorded on average population of thrips/20 plants, 24 hours before and 24 hours, 4 days, 7 days, 15 days, 21 days and 27 days after treatments are tabulated in Table 3.

From the table it is clear that differences in the number of thrips among different treatments were not significant 24 hours before treatment indicating more or less uniform distribution of pest among the crop.

At twenty four hours after first treatment, the differences in population of thrips among different treatments were significant. All the insecticidal treatments significantly reduced the population of thrips as compared to control. Water spray recorded lower population of thrips (52) as compared to control (74 thrips) but both of them were at par. Among the insecticidal treatments all treatments were

significantly superior to decamethrin 0.004% and water spray. However, acephate 0.075%, cypermethrin 0.09%, monocrotophos 0.04%, phosphamidon 0.05%, quinalphos 0.025% and oxidemeton methyl 0.25% were the most effective treatments recording zero level of thrip population.

At 4 days after 1st treatment, the differences in thrip population among different treatments were significant. All the insecticidal treatments except Nexlon 0.035%, phosphomidon 0.05% and water spray proved significantly more effective as compared to control (93.5 thrips). Among the insecticidal treatments acephate 0.075%, decamethrin 0.004%, cypermethrin 0.09%, fenvalerate 0.02%, endosulfan 0.07%, oxidemeton methyl 0.25% continued to show zero level of thrip population and were significantly superior to quinalphos 0.025% (20.25 thrips) phosphamidon 0.05% (27.5 thrips) and nexlon 0.035% (27.0 thrips).

At 7 days after 1st treatment, the differences in population of thrips among different treatments were significant. Fenvalerate 0.02%, decamethrin 0.004% and cypermethrin 0.09% with zero to 7.25 thrips were significantly most effective as compared to other treatments except monocrotophos 0.04% (11 thrips) and

endosulfan 0.07% (9.75 thrips). Phosphamidon 0.05% (32.5 thrips), acephate 0.075% (38.5 thrips) nexlon 0.035% (38.5 thrips), oxidemeton methyl 0.25% (42.75 thrips), quinalphos 0.025% (50.0 thrips), water spray (50.75 thrips) and control (53.75 thrips) were at par with each other.

At 15 days after 1st treatment, the differences in thrip population among different treatments were significant. Monocrotophos 0.04% (17.25 thrips), phosphamidon 0.05% (21.25 thrips), nexlon 0.035% (21.25 thrips) were significantly superior to all other treatments except acephate 0.075% (23.0 thrips) and cypermethrin 0.09% (25.75 thrips), which did not differ significantly from each other but both were significantly better than all other treatments like fenvalerate 0.02% (31 thrips), decamethrin 0.004% (33.25 thrips), quinalphos 0.025% (37.25 thrips), oxidemeton methyl 0.25% (38.75 thrips), water spray (42 thrips) and control (44.25 thrips). Last mentioned three treatments were at par with each other.

At 21 and 27 days after 1st treatment, the differences in thrip population among different treatments were not significant indicating that all the insecticidal treatments lost their efficacy at this time. However, the population of thrips during these observations varied from 44.5 to 91.75 thrips.

At 24 hours after 2nd treatment, the differences in thrip population among different treatments were significant. All the insecticidal treatments except endosulfan 0.07% (3 thrips) recorded zero level of thrip population but all of them proved significantly superior to water spray (17 thrips) which in turn was significantly superior to control (32 thrips).

At 4 days after 2nd treatment, the differences in thrip population among different treatments were significant. All the insecticidal treatments along with water spray proved significantly superior to control (29.25 thrips). Among insecticidal treatments nexion 0.035%, decamethrin 0.004%, cypermethrin 0.09%, fenvalerate 0.02%, monocrotophos 0.04%, endosulfan 0.07% and oxidemeton methyl 0.25% recorded zero level of thrip population and proved significantly more effective as compared to acephate 0.075% (2 thrips) and phosphamidon 0.05% (2 thrips) and quinalphos 0.025% (1.5 thrips) which were at par with each other but in turn were significantly superior to water spray (19 thrips) and control (29.25 thrips).

At 7 days after 2nd treatment, the differences in thrip population among different treatments were significant. Cypermethrin 0.09% (1 thrip) and phosphamidon 0.05% (1 thrip) proved significantly more effective in reducing the pest

population as compared to other treatments except fenvalerate 0.02% (1.75 thrips) and decamethrin 0.004% (2.50 thrips). It was followed by monocrotophos 0.04% (4.00 thrips) and nexion 0.035% (5.00 thrips) which were significantly more effective as compared to quinalphos 0.025% (11.00 thrips), water spray and control. Water spray, however harboured significantly less pest population (20.25 thrips) as compared to control (30.00 thrips).

At 15 days after 2nd treatment, the differences in thrip population among different treatments were significant. Phosphamidon 0.05% (5.25 thrips) proved significantly more effective as compared to all other treatments. Acephate 0.075% (12 thrips) and fenvalerate 0.02% (14.75 thrips) were significantly more effective as compared to water spray (23.5 thrips), quinalphos 0.025% (22.25 thrips), oxydemeton methyl 0.25% (24.5 thrips) and control (29.00) which were at par with each other.

At 21 days after 2nd treatment, the differences in thrip population among different treatments were significant. Phosphamidon 0.05% (19.5 thrips), acephate 0.075% (9.75 thrips), cypermethrin 0.09% (11.75 thrips) and fenvalerate 0.02% (13.5 thrips) recorded significantly lower population of thrips as compared to water spray (21.25 thrips).



MONOCROTOPHOS TREATED PLOT



CONTROL PLOT

decamethrin 0.004% (22.5 thrips), quinalphos 0.025% (23 thrips), oxidemeton methyl 0.25% (23.25 thrips), nexion 0.035% (19.75 thrips) and control (27.5 thrips). Nexion 0.035%, however, proved to be least effective insecticide.

At 27 days after 2nd treatment, the differences in thrip population among different treatments were significant. Phosphamidon 0.05% (7.75 thrips), acephate 0.075% (7.75 thrips), cypermethrin 0.009% (9.0 thrips) and fenvalerate 0.02% (10 thrips) were the most effective treatments recording lower population of thrips as compared to other treatments except endosulfan 0.07% (13.5 thrips). It was followed by monocrotophos 0.04% (15.75 thrips) which was superior to quinalphos 0.025% (17.5 thrips), oxidemeton methyl 0.25% (20 thrips) and control (22.25 thrips). The latter three treatments were at par with each other.

It is thus seen that cypermethrin 0.09%, phosphamidon 0.05%, fenvalerate 0.02%, monocrotophos 0.04% followed by endosulfan 0.07% and decamethrin 0.004% were the most effective treatments in significantly reducing the population of thrips both after first and second spraying. However, decamethrin and endosulfan seemed to slightly lose their effectiveness 15 and 7 days after spray respectively. Nexion 0.035% and quinalphos 0.025% seemed to consistently lose their effectiveness 7 days after spraying and hence were the least effective

TABLE-3: AVERAGE POPULATION OF THRIPS/20 PLANTS IN DIFFERENT TREATMENTS AT DIFFERENT TIME INTERVALS (TRANSFORMED VALUES AS $\sqrt{x+0.5}$ IN PARANTHESES; MEAN OF 4 REPLICATIONS)

S.N.	CHEMICAL NAME	COMMERCIAL NAME	FORMULATION	CONC. USED	PRE-TREAT																
					AFTER FIRST TREATMENT								AFTER SECOND TREATMENT								
					24 HOURS	24 HOURS	Δ DAYS	7 DAYS	15 DAYS	21 DAYS	27 DAYS	24 HOURS	4 DAYS	7 DAYS	15 DAYS	21 DAYS	27 DAYS				
1	NEXION	BROMOPHOS	35 E.C.	0.035%	53.5 (7.226)	10.50 (2.16)	27.00 (4.699)	38.50 (6.071)	22.00 (4.737)	67.00 (8.14)	66.25 (8.079)	0.00 (0.707)	0.00 (0.707)	5.00 (2.319)	19.75 (4.496)	19.75 (4.496)	16.75 (4.144)				
2	ACEPHATE	ORTHANE	75 S.P.	0.075%	54.25 (7.388)	0.00 (0.707)	0.00 (0.707)	38.50 (5.40)	23.00 (4.811)	60.00 (7.714)	59.25 (7.686)	0.00 (0.707)	2.00 (1.414)	8.75 (3.025)	12.00 (3.510)	9.75 (3.189)	7.75 (2.66)				
3	DECAMETHRIN	DECIS	25 E.C.	0.004%	72.00 (8.484)	36.50 (5.847)	0.00 (0.707)	5.00 (1.662)	33.25 (5.774)	91.75 (9.379)	87.50 (9.27)	0.00 (0.707)	0.00 (0.707)	2.50 (6.99)	20.25 (4.545)	22.50 (4.730)	17.5 (4.21)				
4	CYPERMETHRIN	CYMBUSH	25 E.C.	0.09%	65.50 (8.023)	0.00 (0.707)	0.00 (0.707)	7.25 (1.888)	25.75 (5.114)	53.25 (7.28)	52.75 (7.251)	0.00 (0.707)	0.00 (0.707)	1.00 (1.184)	18.50 (4.322)	11.75 (3.472)	9.00 (3.024)				
5	FENVALERATE	SUMICIDIN	20 E.C.	0.02%	66.75 (8.165)	2.00 (1.259)	0.00 (0.707)	0.00 (0.707)	31.00 (5.64)	46.75 (6.810)	47.75 (6.810)	0.00 (0.707)	0.00 (0.707)	1.75 (1.474)	14.75 (3.866)	13.50 (3.784)	10.00 (3.23)				
6	MONOCROTOPHOS	NUVACRON	40 E.C.	0.04%	64.75 (7.987)	0.00 (0.707)	0.00 (0.707)	11.00 (2.197)	17.25 (4.497)	66.75 (8.083)	64.50 (7.972)	0.00 (0.707)	0.00 (0.707)	4.00 (2.044)	19.00 (4.368)	17.50 (4.234)	15.25 (3.967)				
7	PHOSPHAMIDON	DIMEGRON	85 E.C.	0.05%	60.05 (7.741)	0.00 (0.707)	27.50 (4.64)	32.50 (5.028)	21.25 (4.658)	67.00 (8.207)	68.25 (8.281)	0.00 (0.707)	2.00 (1.414)	1.00 (1.184)	5.25 (2.365)	9.50 (3.139)	7.75 (2.833)				
8	ENDOSULFAN	THIODAN	35 E.C.	0.07%	56.75 (7.527)	4.75 (1.63)	0.00 (0.707)	9.75 (2.585)	34.75 (5.932)	60.00 (7.723)	61.25 (7.825)	3.00 (1.414)	0.00 (0.707)	7.75 (2.865)	19.25 (4.316)	19.50 (4.423)	13.50 (3.711)				
9	QUINALPHOS	EKALUX	25 E.C.	0.025%	72.75 (8.546)	0.00 (0.707)	20.25 (3.55)	50.00 (6.887)	37.75 (6.182)	45.75 (6.763)	47.75 (6.904)	0.00 (0.707)	1.50 (1.167)	11.00 (3.38)	24.25 (4.967)	23.00 (4.837)	17.5 (4.23)				
10	OXIDEMETON METHYL	METASYSTOX	25 E.C.	0.25%	60.75 (7.851)	0.00 (0.707)	0.00 (0.707)	42.75 (6.381)	38.75 (6.262)	88.50 (8.903)	74.25 (8.489)	0.00 (0.707)	0.00 (0.707)	7.25 (2.559)	24.50 (4.982)	23.25 (4.867)	20.00 (4.520)				
11	WATER SPRAY				69.25 (8.224)	52.00 (7.19)	70.25 (4.316)	50.75 (6.999)	42.00 (6.517)	48.00 (6.858)	60.00 (7.714)	17.00 (4.175)	19.00 (4.412)	20.25 (4.545)	23.50 (4.889)	21.25 (4.542)	17.5 (4.23)				
12	CONTROL				57.75 (7.615)	74.00 (8.558)	93.50 (6.303)	53.75 (7.305)	44.25 (6.686)	44.50 (6.563)	67.75 (8.238)	32.00 (5.616)	29.25 (5.397)	30.00 (5.386)	29.00 (4.994)	27.50 (4.751)	22.25 (4.751)				
	S.E.m ±				0.56	0.618	0.758	1.004	0.158	0.78	0.620	0.264	0.240	0.248	0.254	0.281	0.187				
	C.O. AT 5%				N.S.	1.777	2.180	2.889	0.454	N.S.	N.S.	0.759	0.690	0.712	1.079	0.808	0.537				



insecticidal treatments. So was the case with water spray which reduced the thrip population just after spray but had no effect on thrip population thereafter.

4.5 Yield and 1000 grain weight : The yield data and that of 1000 grain weight are presented in Table 4.

The differences in 1000 grain weight among different treatments were significant. Monocrotophos 0.04% recorded highest grain weight (20.70 g) which did not differ significantly from that of fenvalerate 0.02%, phosphamidon 0.05%, decamethrin 0.004%, cypermethrin 0.009% and nexlon 0.035% (19.96 to 20.01 g) but was significantly more as compared to quinalphos, 0.025%, acephate, 0.075%, oxidemeton methyl, 0.25%, endosulfan 0.07%, and water spray (18.62 to 19.56 g) and all the treatments recorded significantly higher grain weight as compared to control (17.81 g). It is thus evident that monocrotophos 0.04% treated plots yielded bolder seeds followed by other insecticides like fenvalerate 0.02% phosphamidon, 0.05%, decamethrin 0.004% and cypermethrin 0.009%.

4.6 Yield

The differences in net plot yield recorded from different treatments were significant. All the insecticidal

treatments were at par and recorded significantly higher yield (526.1 to 610.7 kg/ha) as compared to water spray and control (279.9 and 184.9 kg/ha respectively). The percent increase in yield among different treatments over water spray and control varied from 88.10 in oxydemeton methyl to 118.18 in monocrotophos and from 51.38 in water spray to 230.28 in monocrotophos, respectively. Among insecticidal treatments monocrotophos 0.04% recorded highest yield (610.7 kg/ha) followed by phosphamidon 0.05% fenvalerate, 0.02% cypermethrin 0.009% and endosulfan 0.07% (561.1, 560.2, 559.5, 558.8 kg/ha respectively). Water spray recorded lowest yield (279.9 kg/ha).

In view of the effectiveness of different insecticidal treatments against thrips and the grain yield obtained it can be said that monocrotophos 0.04% followed by phosphamidon 0.05%, cypermethrin 0.009%, fenvalerate 0.02% were the most effective treatments, when first treatment was given on 1 week old crop followed by the second on 4 weeks old crop. Decamethrin 0.004% and endosulfan 0.07% stood next in order of effectiveness while Nexion 0.035% and quinalphos 0.025% were the least effective treatments. Water spray did provide temporary reduction in pest population but failed to record significant increase in yield.

TABLE 4: 1000 GRAIN WEIGHT, YIELD OF MUNG, GRAIN (Kg/ha) AND PERCENTAGE INCREASE IN YIELD OVER CONTROL

S.N.	CHEMICAL NAME	COMMERCIAL NAME	FORMULATION	CONC. USED	WEIGHT OF 1000 GRAINS (g)	YIELD Kg/ha	PERCENT INCREASE IN YIELD OVER WATER SPRAY	PERCENT (%) INCREASE OVER CONTROL
1.	NEXION	BROMOPHOSL	35 E.C.	0.035%	19.96	549.2	96.21	197.02
2.	ACEPHATE	ORTHANE	75 S.P.	0.075%	19.44	544.6	94.56	194.53
3.	DECAMETHRIN	DECIS	25 E.C.	0.004%	20.00	526.1	87.95	184.53
4.	CYPERMETHRIN	CYMBUSH	25 E.C.	0.009%	19.98	559.5	99.89	202.59
5.	FENVALE RATE	SUMICIDIN	20 E.C.	0.02%	20.10	560.2	100.14	202.97
6.	MONOCROTOPHOS	NUVACRON	40 E.C.	0.04%	20.70	610.7	118.18	230.28
7.	PHOSPHAMIDON	DIMECRON	85 E.C.	0.05%	20.03	561.1	100.46	203.46
8.	ENDOSULFAN	THIODRN	35 E.C.	0.07%	19.16	558.8	99.64	202.21
9.	QUINALPHOS	EKALUX	25 E.C.	0.075%	19.56	543.4	94.14	193.88
10.	OXIDE METON METHYL	METASYSTOX	25 E.C.	0.25%	19.18	526.5	88.10	184.74
11.	WATER SPRAY	-	-	-	18.62	279.9	-	51.37
12.	CONTROL	-	-	-	17.81	184.9	-	-
	S.E _m ±				0.306	58.9		
	C.D. AT 5%				0.879	120.0		

5. Estimation of losses

The yield obtained both from protected and unprotected crops along with the thrip population recorded are presented in Table 5.

From the table, it is evident that the crop treated twice with monocrotophos 0.04% recorded 21.55 thrips/20 plants as compared to 45.44 thrips/20 plants recorded from untreated crop. It resulted in grain yield of 483 kg/ha from monocrotophos treated plot as compared to 161 kg/ha from control giving 200% increase in yield over control. The quantity of grain saved per hectare was 322 kg. Taking into account the prevailing market price of mung grain i.e. Rs. 5/- per kg, the cost of mung grain saved comes to Rs. 1610 per ha and the net profit was Rs. 1376/-. The cost of treatment being Rs. 284, the cost benefit ratio work out to be 1:5. It shows that by spending a rupee on plant protection measures a farmer is likely to get a return of Rs. 5/-.

*

TABLE 5 : ESTIMATION OF LOSSES BY THRIPS, Caliothrips indicus Bagnall IN SUMMER MUNG

VARIETY	THRIPS/20 PLANTS (AVERAGE OF 4 OBSERVATION)		YIELD (Kg/ha)		QUANTITY OF GRAIN SAVED (Kg)	INCREASE % OVER CONTROL	COST OF GRAIN SAVED (Rs)	COST OF TREATMENT	NET PROFIT	COST BENEFIT RATIO
	TREATED	CONTROL	TREATED	CONTROL						
PUSA BAISAKHI	2155	45.44	483	161	322	200	1610	184+100 = 284	1376	1:5

MARKET PRICE OF MUNG GRAIN - Rs 5 /- PER Kg

COST OF TREATMENT USED (MONOCROTOPHOS 40 EC) Rs 184 /- PER LITRE

QUANTITY OF INSECTICIDES USED (IN 2 TREATMENTS) - 1 LITRE

COST OF INSECTICIDES USED - Rs 184 /-

COST OF LABOUR (2 TREATMENTS) - Rs 100.00

CHAPTER V
DISCUSSION



DISCUSSION

The findings on the incidence of different insect pests on summer green gram, evaluation of some insecticides against thrips, Caliothrips indicus Bagnall and losses caused by them (thrips) have been discussed below.

6.1 Incidence of insect-pests

Incidence of different insect pests on green gram Vigna radiata was recorded at different stages of the crop, that is, during vegetative stage, flowering and podding stage and at harvest. Total number of eight insect pests as listed below were recorded on different stages of the crop.

1. Thrips - Caliothrips indicus Bagnall
2. Flea beetles - Medurasia obscurella Jacoby.
3. Jassids - Amrasca kerri Pruthi.
4. Pod borer - Maruca testulalis Geyer.
5. White fly - Bemesia tabaci Guen.
6. Green semilooper - Thysanoplusia orichalcea Fabr.
7. Linseed caterpillar - Spodoptera litura Hbn.
8. Bihar hairy Caterpillar - Dicrisis obliqua Wlk.



The Thrips (Caliothrips indicus Bagnall) were first to appear in the crop at three leaf stage and continued their activity till the harvest of the crop. Their population was very high on one week old crop (65 thrips/20 plants) while an average of 52 thrips/20 plants was recorded during vegetative stage. At flowering and podding stage also the population of thrips was higher but as the plant reached harvest the population declined. Thus, the pest was not only present throughout the growing stage of the crop but it caused a lot of leaf curling and was considered to be the most important and major pest of summer green gram. The present findings are in complete conformity with those of Odak (1973, 1974 and 1980) and Anonymous (1982) who also reported thrips Caliothrips indicus Bagnall, to cause severe damage to the summer green gram by scraping the chlorophyll resulting in crinkling appearance of the leaves.

The flea beetles (Madurasia obscurella Jacoby) also appeared during 1 week old crop and remained active throughout the vegetative stage of the crop, as well as during flowering and podding stage of the crop. An average of 16.5 beetles/20 plants were recorded during vegetative stage of the crop. This pest is thus an important pest on seedling causing lot of foliage damage. Present findings are in accordance with those of Odak (1973), Saxena et al. (1976) and Anonymous (1982)

who also reported the flea beetles to be a pest harmful to the seedling stage of the summer mung crop. However, this pest has also been reported from the seedling stage of kharif crop (Saunders, 1968; Gibson, 1969; Saxena, 1973; Anonymous, 1971; Sharma and Bhalla, 1973; Gupta and Saxena, 1979; Saxena et al., 1981; Anonymous, 1971; Shrivastava and Singh, 1976; Gupta and Saxena, 1979; Gadkari and Singh, 1979; Odak, 1980). Like that of flea beetle the population of Jassids (Amrasca kerri Pruthi) was recorded during vegetative stage of the crop (15.75/20 plants). The jassid population was higher on slightly older crop i.e. 15 days old crop. (20 Jassids/20 plants) While it declined during flowering and podding stage. This population was not high enough to cause any appreciable damage to the crop. Anonymus (1982) also reported the Jassids to be a pest of summer mung crop during vegetative stage. Many workers have reported this pest to be a major one on vegetative stage of kharif mung crop (Saunders, 1968; Saxena, 1973; Sharma and Bhalla, 1977; Gupta and Saxena, 1979; Singh and Singh 1971; Singh and Singh, 1978; Saxena et al., 1981; Choudhary, Yadav, Poonia and Rastogi, 1977-78; Gadkari and Singh, 1979; Odak, 1981).

The incidence of whitefly Bemisia tabaci Guen. was recorded on 15 days old crop but its population was higher (17 white flies/20 plants) on 4 weeks old crop. The average

population recorded during vegetative stage was 9.25 white flies/20 plants while that recorded during flowering and fruiting stage was 5.75 flies/20 plants, resulting in appearance of yellow mosaic in about 10% plants. Present findings are in conformity with those of Odak (1973) and Anonymous (1982) who also reported white flies to be a serious pest of summer mung crop. It is also been reported to be a pest of kharif mung by Singh and Singh (1978), Gadkari and Singh (1979), Odak (1981) and Chhabra et al. (1981).

Among leaf feeding insects only three species namely green semilooper Thysanoplusia orichalcea (Fabr.), Linseed Caterpillar, Spodoptera eridania Hubn. and Bihar hairy caterpillar, Diacricia obliqua Wlk. were recorded but their population was in general very low to cause any economic damage to the crop. Anonymous (1982) has also reported 1st and 3rd species to be the pest of summer mung crop but there is no report of Spodoptera eridania Hubn. to be a pest of summer mung crop. However, many workers have reported these and other species of leaf feeding caterpillars to be a group of major pest on kharif sown crop (Gadkari and Singh, 1979; Singh and Singh, 1978; Odak, 1981; Peter, 1973; Nayer et al., 1976).

The pod borer, Meruca testulalis Geyer appeared only during flowering and podding stage of the crop but its



population was very low and caused damage not exceeding 5% pod. Thus, pod borer did not seem to be an important pest. No body has reported the pest from the summer crop but this pest along with brown caterpillar, Anarsia ephippias (May) and blue butterfly. Lampides boeticus (L.) were reported to be the major pests of kharif crop (Srivastava, 1964; Nayar et al., 1976; Gadkari and Singh, 1979; and Odak, 1981).

It is thus seen that summer mung crop suffers heavy losses from thrips followed by white flies, while during seedling stage flea beetles may sometimes cause severe damage. Other pests like jassids, leaf eating caterpillars, and pod borer were minor pests. No other pest has been recorded during the present studies. Anonymous (1982) on the contrary reported stemfly to be a pest of summer mung. A number of pests have however been reported as pests of kharif mung crop by many workers (Srivastava, 1964; Nayar et al., 1976; Peter, 1973; Bott and Kingston, 1976; Pal et al., 1977; Pablo and Pangga, 1976).

6.2 Evaluation of insecticides against thrips, *Galiotrips indicus* Bagnall.

In view of the effectiveness of different insecticidal treatments and the grain yield obtained from them,

monocrotophos 0.04% followed by phosphamidon 0.05%, cypermethrin 0.009% and fenvelerate 0.02% proved to be the most effective treatments not only in reducing thrips population but also recorded higher yields (559.5 kg/ha from cypermethrin to 610.7 kg/ha from monocrotophos), when first treatment was given on one week old crop followed by the second on four weeks old crop. These findings regarding the effectiveness of monocrotophos confirm those of Odak (1973 and 1974), Odak and Thakur (1975-76) and Anonymous (1978-79, 1980) who also reported monocrotophos 0.04% alone or in combination with soil treatment of disulfoton 5G, phorate 10G or aldicarb 10G @ 1 kg a.i./ha to significantly reduce thrip population on summer mung registering higher yield. Soil treatment with above mentioned granular insecticide alone has also been reported to control pest complex including thrips on summer mung (Anonymous, 1982). Monocrotophos 0.04% alone or monocrotophos and endosulfan 0.07% in combination with soil application of granular insecticides or seed treatment with carbofuron 2% along with other insecticides have also been reported to be effective against pest complex of kharif mung (Odak, 1973; Odak and Thakur, 1975-76; Saxena *et al.*, 1976; Yadav and Poonia, 1978-79; Anonymous, 1980; Yadav *et al.*, 1981 and Odak, 1984). However, endosulfan 0.07% in the present findings has been found to reduce the thrip population temporarily upto 7 days after treatment.

Thrips on onion, cabbage, apple blossoms, pea and red gram are reported to be controlled by application of fish oil rosin soap, dieldrin and IDT and BHC in the form of spray (Ayyar, 1919; Sharma and Bhalla, 1963; Singh and Vaishampayan, 1967, 1969).

Monocrotophos treated plots recorded highest 1000 grain weight (20.70 g) followed by that of fenvelerate, phosphamidon, decamethrin and cypermethrin which apparently reflected the grain yield recorded from them. Monocrotophos treated plots (610.7 kg/ha) followed by phosphamidon, fenvelerate and cypermethrin thus recorded highest grain yield/ha. These insecticides, thus, seem to have some hormonal effect on plant.

6.3 Losses caused by thrips

Thrips have been reported to act as pollinators, besides blighting the flowers and tender parts of the bloom (Anand, 1926). Different species of thrips have also been reported to cause damage to sesamum flowers and apple blossoms. Reduction in pod setting to the extent of 36% and losses to the extent of 67% have been reported in red gram and pea crops respectively (Andrewartha and Kilpatrick, 1950; Ananthakrishnan, 1955; Rawat *et al.*, 1969; Vaishampayan, Singh and Seshagiri, 1968).



However, in the present findings the thrips, Caliothrips indicus have been recorded to cause severe damage to summer mung crop, Which amply support the findings of Anonymous (1974) who reported through surveys that thrips and yellow mosaic were the major limiting factors in summer mung production in M.P. The summer mung crop treated with monocrotophos 0.04% twice reduced the thrip population resulting in 200% increase in yield of mung grain saving grain worth Rs.1610 providing cost benefit ratio of 1:5. These findings are in accordance with those of Odak (1984) who reported losses due to thrips of 125 to 200 kg mung grain/ha at Bilaspur and Balaghat districts of M.P. He has also reported cost benefit ratio of 1:3.5 to 4 by the treatment of monocrotophos. In the present findings the increase in yield was 322 kg/ha due to pest control which amply support the findings of Odak and Thakur (1975-76) who reported an increase in yield of 401 kg/ha. Anonymous (1973-74), on the other hand, reported increased yield to the extent of 250 kg/ha. In the present studies the reduction in yield to the extent of 66% was recorded due to thrips damage while Anonymous (1973-74) reported it to be 25-30%.

Besides pest population, there may be a number of factors like location, soil type, variety of the crop, fertilizer used, irrigations available etc. which may

determine the yield of mung grain at a time. Further, the losses in terms of rupees and the benefit accrued due to use of a pesticide may depend on market price of grain, pesticide and labour cost which are likely to vary from year to year and place to place. These in turn, are responsible for variation in losses caused due to pest incidence and the benefit obtained by pest control.

*

CHAPTER VI
SUMMARY CONCLUSIONS



SUMMARY AND CONCLUSION

6.1 Incidence of insect pests

Weekly survey of summer mung crop revealed that thrips, Caliothrips indicus Bagnall, flea beetle, Madurasia obscurella Jacoby, jassids Amrasca kerri (Pruthi), white fly, Bemisia tabaci Guen. were the main pests which damaged the crop. Among them thrip, Caliothrips indicus Bagnall was the major and most important pest which was not only active throughout all the growing stages of crop but caused serious damage by scrapping the chlorophyll content of leaves resulting in their crinkling. The flea beetle was next in importance which caused damage only during early stage of the crop. Likewise, jassid was also active during vegetative stage of the crop but its population was not high enough to cause any appreciable damage. The pod borer, Meruca testulalis (Geyer) caused only 5% pod damage and does not seem to be an important pest of summer mung. Whitefly was an important pest because it transmitted yellow mosaic disease in the plant. All the three species of leaf defoliators viz. Green semilooper, Thysanoplusia orichalcea (Fabr.), Linseed caterpillar, Spodoptera exiguu (Hübner) and Bihar hairy caterpillar, Diacricia obliqua (Wlk.) were the minor pests.

6.2 Chemical control and yield

On the basis of the effectiveness of different insecticidal treatments against thrips and the grain yield obtained it can be said that monocrotophos 0.04% followed by phosphamidon 0.05%, cypermethrin 0.009% and fenvalerate 0.02% were the most effective treatments when first treatment was given one week old crop followed by second on 4 weeks old crops. These treatments were effective not only in reducing thrip population but also recorded higher grain weight and yields (20.70, 526.1 to 610.7 kg/ha respectively) as compared to water spray and control (279.9 and 184.9 kg/ha respectively). Water spray did provide temporary reduction in thrip population but failed to record higher yield.

6.3 Estimation of losses

Monocrotophos 0.04% treated plot yielded 483 kg/ha as compared to 161 kg/ha from control. The quantity and cost of mung grain saved comes to 322 kg and Rs. 1610/ha respectively, giving 200% increase in grain yield. Taking into account the cost of plant protection inputs, the cost benefit ratio comes to 1:5. It means that a farmer is likely get profit of Rs.5/- after investing an amount of Rs. 1/- in plant protection measures.

REFERENCES



REFERENCES

- Anand P.N. (1926). Thysanoptera in pollination of flowers. Amer. Nat. 60 (667) : 177-182.
- Andrewartha, H.G. and Kilpatrick, D.T. (1950). The apple thrips. J. Dept. Agr. S. Aust. 54 (12) : 586-596.
- Ananthakrishnan, T.N. (1955). A note on Thrips palmi Karny. attacking Seesamum indicum. J. Bom. Nat. Soc. 52 (4) : 951-953.
- Anonymous (1978). Agricultural Statistics of Madhya Pradesh Directorate of Agriculture, M.P. Bhopal.
- Anonymous (1980). Major insect pests of green gram and other pulses. In "New Vistas in pulse production". I.C.A.R. New Delhi.
- Anonymous (1982). All India Coordinated Pulse Improvement Project. I.C.A.R. Important Pests of Pulse Crops in India and their management Publication 2.
- Ayyar, T.V.R. (1919). A note on our present knowledge of Indian Thysanoptera and their economic importance. Rep. Proc. 3rd ent. Meet. Pusa : 618-622.
- Babu, M.H., Bhattacharya, A.K. and Rathore, Y.K. (1978). Development of behaviour of three lepidopterous pests on soybean and green gram. Z. angew. Ent. 85 (1) : 108-112.

- Bott, W. and Kingston, R.W. (1976). Mung bean an important new grain legume Od. Agric. J. 102 : 438-442.
- Chaudhary, J.P., Yadav, L.S., Poonia, R.S. and Rastogi, K.B. (1980). Some observations on field population of Empoasca kerri (Pruthi) a Jassid pest of mung bean crop in Haryana. Haryana Agril. Univ. J. Res. 10 (2) : 250-252.
- Chhabra, K.S., Brar, J.J. and Kooner, B.S. (1981). Jassid species recorded on green gram, black gram and red gram in the Punjab. Pulse Crop Newslit 1 (2) : 1981.
- Gadkari, P.D. and Singh, L. (1979). "Pulse Crops of Madhya Pradesh". Publ. Directorate of Extension, JNKVV., Jabalpur, M.P. India, p.165.
- Gopalan, C., Ramasastri, B.V. and Balasubramanian, S.C. (1977). Nutritive value of Indian Foods, compiled by Saini, R.S. Indian Farming 31 (5) : 41.
- Gupta, R.N. and Saxena, H.P. (1979). Evaluation of some insecticides for the control of Madurusia obscurella Jacoby and Empoasca kerri Pruthi on green gram, Pestology 11 (2) : 29-32.
- Gupta, P.K. and Singh, Janardan (1980). Incidence of leaf miner Acrogercodes spp. on green gram and black gram at Varanasi (W.P.), Indian J. Pl. Prot. 8 (2) : 176.

- Kenneth, E. Gibson (1969). The pest problem in pulse crops.
In "Proc. Third Annual Workshop Conference on Pulses".
I.C.A.R. : 150-152.
- Nayar, K.K., Ananthkrishnan, T.N. and David, B.V. (1976). List
of insects infesting green gram, Vigna radiata in India.
General and Applied Entomology TATA McGraw hill
Publishing Co. : 498-499.
- Odak, S.C. (1973-74). An insecticidal trial against pest
complex of summer mung with special reference to thrips.
Report of Entomological Research work done on kharif
pulses (1973-74), JNKVV., Jabalpur, M.P., India.
- Odak, S.C. and Thakur, B.S. (1975-76). Chemical control of
insect pests of summer mung. Annual Report (kharif)
Deptt. of Entomology, JNKVV., Jabalpur, M.P., India.
- Odak, S.C. (1980). Important insects pests of mung crop and
their control. Training cum Discussion Seminar on
summer mung production Technology, JNKVV., Jabalpur
on 19th March to 21st March 1980.
- Odak, S.C. (1981). Major insect pests of kharif pulses and
their control. Training cum Seminar of kharif
pulses, Jabalpur, 22nd June to 1st July, 1981.
- Odak, S.C. (1984). Important insects and pests of summer mung
crop and their control measures. Training cum Seminar
of summer mung. Jabalpur 30th January, 1984.

- Pablo, S.J. and Pangga, G.A. (1971). Granular systemic insecticides in the control of pests attacking many mung beans. Philippines J.Pl.Ind. 36 (1/3): 21-28.
- Pal, S.K. and Kushwaha, K.S. (1977). Relative toxicity of some insecticides to the adult of mung Weevil *Cyrtosemia cognata* Marshall. Indian J. Ent. 39 (4) : 381-383.
- Peter Col, A.C. (1973). Some insects pests of green gram *Phaseolus aureus*. Malaysian Agric.J. 49 (2) : 131-142.
- Rawat, R.R., Singh, Z. and Jokhmola, S.S. (1969). Effect of infestation of blossom-thrips on pod setting in Pigeon pea, (*Cajanus cajan* (L.) Millsp. Indian J. agric. Sci. 39 (7) : 623-625.
- Saxena, H.P., Kumar, S. and Prasad, S.K. (1976). Efficacy of some granular insecticides against gelerucid beetle (*Macdurusia obscurella* Jacoby) infesting kharif pulses, Indian J. Ent. 33 (4) : 470-471.
- Sharma, P.L. and Bhalla, O.P. (1963). Occurrence of thrips damaging apple blossoms in Himachal Pradesh, Indian J. Ent. 25 (1) : 85-86.





- Sharma, P.L., and Bhalla, O.P. (1977). Chemical control of pests of green gram (Vigna radiata L. Wilczek) and black gram (Vigna mungo L. Hepper), Pesticides 11 (10) : 41-42.
- Singh, Z. and Vaishampayan, S.M. (1967). Results of trials on chemical control of Caliothrips indicus (Bagnall) on pea. Indian J. Ent. 29 (2) : 219-220.
- Singh, R.M. and Singh, R.N. (1978). Succession of insect pests in green gram and black gram under dry land condition at New Delhi. Indian J. Ent. 39 (4) : 365-370.
- Srivastava, A.S. (1964). Polyphagous pests. Entomological Research during the last 10 years. Report of Entomologist to Government of Uttar Pradesh, Kanpur, India, p. 58-65.
- Srivastava, B.K. (1964). Pest of pulse crops. In "Entomology in India", Publ. Entomological Society of India, New Delhi : 83-92.
- Srivastava, K.M. and Singh, L.N. (1976). A review of the pest complex of kharif pulses in U.P. PANS 22 (3) : 333-335.
- Srivastava, A.S., Awasthi, B.K. and Nigam, P.M. (1977). Incidence of Myllocerus maculosus Dens. on leguminous crops (Coleoptera) : Curculionidae. Labdev, J. Sci. Technol. (B), 13 (3/2) : 215-216.

Volokhovskii, E.H., and Zile Shigh (1969). Studies on competitive effectiveness against clover thrips of seed corn (*Zizania glauca* L.) / Palley, Indian J. Agric. Sci. 29 (1) : 33-36.

Venki, S.T. (1960). Phytopathology 7 (7) : 40.

Wise, S.E. and Jensen, R.V. (1977). Observations on the phytochemistry and plant stress due to dimethoate and phorate pest treatment in *Zizania glauca* (Wing) myanmarica. Bumipin 7 (9/10) : 40-45.

Yuan, H.H., Jensen, R.V. and Jain, R.K. (1981). Persistence of dimethoate in green gram (*V. radiata* L.) clover. Indian J. Pl. Prot. 7 (2) : 145-149.

Zafar, I.S., Patel, P.S. and Honkar, U.S. (1981). Effectiveness of certain insecticides against the insect pests of wing bean. Indian J. Pl. Prot. 7 (2) : 165-169.

APPENDIX





APPENDIX

APPENDIX-I

Analysis of variance before treatment

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	8,550	2.85	2.245	2.90
2.	Treatment	11	7,608	0.691	0.544	2.09
3.	Error	33	41,909	1.269		
Total		47	58,067			

S.Em. \pm = 0.56

Non significant

APPENDIX-II

Analysis of variance at 24 hours after first treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	3,978	1,326	0.86	2.90
2.	Treatment	11	364,223	33.11	21.65	2.09
3.	Error	33	50,465	1.529		
Total		47	418,666			

S.Em. \pm = 0.618

C.D. at 5% = 1.777

APPENDIX-III

Analysis of variance at 4 days after 1st treatment

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	14.601	4.86	2.11	2.90
2.	Treatment	11	201.883	18.35	7.97	2.09
3.	Error	33	75.948	2.30		
Total		47	292.432			

$$S.E.m. \pm = 0.758$$

$$C.D. \text{ at } 5\% = 2.180$$

APPENDIX-IV

Analysis of variance at 7 days after 1st treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	46.657	15.55	3.84	2.90
2.	Treatment	11	260.325	23.66	5.85	2.09
3.	Error	33	133.47	4.04		
Total		47	440.46			

$$S.E.m. \pm = 1.004$$

$$C.D. \text{ at } 5\% = 2.889$$

APPENDIX-V

Analysis of variance at 15 days after 1st treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	0.524	0.174	1.705	2.90
2.	Treatment	11	26.470	2.406	23.588	2.09
3.	Error	33	3.393	0.102		
Total		47	30.387			
S.Em. \pm			= 0.158			
C.D. at 5%			= 0.454			

APPENDIX-VI

Analysis of variance at 21 days after 1st treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	121.358	40.452	16.463	2.90
2.	Treatment	11	35.037	3.185	1.296	2.09
3.	Error	33	81.098	2.457		
Total		47	237.493			
S.Em. \pm			= 0.78			
Non significant.						

APPENDIX-VII

Analysis of variance at 27 days after 1st treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	2.955	0.985	0.63	2.90
2.	Treatment	11	20.706	1.88	1.22	2.09
3.	Error	33	51.014	1.54		
Total		47	74.675			

$$S.E.m. \pm = 0.620$$

Non significant.

APPENDIX-VIII

Analysis of variance at 24 hours after 2nd treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	0.603	0.201	0.71	2.90
2.	Treatment	11	119.030	10.82	38.64	2.09
3.	Error	33	9.45	0.28		
Total		47	129.083			

$$S.E.m. \pm = 0.264$$

$$C.D. \text{ at } 5\% = 0.759$$



APPENDIX-IX

Analysis of variance at 4 days after 2nd treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	1.298	0.432	1.83	2.90
2.	Treatment	11	112.614	10.237	43.56	2.09
3.	Error	33	7.781	0.235		
Total		47	121.693			

$$S.Em. \pm = 0.240$$

$$C.D. \text{ at } 5\% = 0.690$$

APPENDIX-X

Analysis of variance at 7 days after 2nd treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	4.922	1.640	6.58	2.90
2.	Treatment	11	74.942	6.812	27.35	2.09
3.	Error	33	88.219	0.249		
Total		47	88.083			

$$S.Em. \pm = 0.248$$

$$C.D. \text{ at } 5\% = 0.712$$

APPENDIX-XI

Analysis of variance at 15 days after 2nd treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	0.926	0.308	1.18	2.90
2.	Treatment	11	28.357	2.577	9.91	2.09
3.	Error	33	8.6	0.260		
Total		47	37.883			

$$S.E.m. \pm = 0.254$$

$$C.D. \text{ at } 5\% = 0.730$$

APPENDIX-XII

Analysis of variance at 21 days after 2nd treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	0.794	0.264	0.83	2.90
2.	Treatment	11	20.02	1.82	5.75	2.09
3.	Error	33	10.43	0.316		
Total		47	31.244			

$$S.E.m. \pm = 0.281$$

$$C.D. \text{ at } 5\% = 0.808$$

APPENDIX-XIII

Analysis of variance at 27 days after 2nd treatment.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	0.937	0.312	2.22	2.90
2.	Treatment	11	19.374	1.761	12.57	2.09
3.	Error	33	4.62	0.14		
Total		47	24.931			

$$S.E.m. \pm = 0.187$$

$$C.D. \text{ at } 5\% = 0.537$$

APPENDIX-XIV

Analysis of variance of 1000 grains weight.

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	0.1075	0.0358	0.0944	2.90
2.	Treatment	11	46.0075	4.1823	11.03	2.09
3.	Error	33	12.5048	0.3789		
Total		47	58.6198			

$$S.E.m. \pm = 0.306$$

$$C.D. \text{ at } 5\% = 0.879$$



APPENDIX-XV

Analysis of variance of net plot yield (g).

S.No.	Source	df.	S.S.	M.S.S.	F.cal.	F.tab.
1.	Replication	3	7012.68	2337.56	2.745	2.90
2.	Treatment	11	88356.006	8032.3642	9.43	2.09
3.	Error	33	28101.512	851.56097		
Total		47	123470.2			

$$S.E.M. \pm = 20.63$$

$$C.D. \text{ at } 5\% = 42.00$$

APPENDIX- XVI

Yield (kg/ha)

$$S.E.M. \pm = 58.9$$

$$C.D. \text{ at } 5\% = 120.0$$

VITA

The author of this thesis, Rajiv Chauhan, Son of Shri Mahipal Singh Chauhan, was born on 22nd June 1959 at Agartala, Tripura. He passed his higher secondary examination in the year 1975 with first division from Central Board of Secondary Education, Agartala, Tripura. He also participated as a football player for National Meet of Kandria Vidhyalaya Sanghathan held at Karakwasla in the year 1974. He completed his B.Sc. with Second Division from Indore University in the year 1979 in the traditional system. He passed his B.Sc.(Ag.) with 2.57 CGPA out of 4.00 scale from Birsa Agricultural University in Trimester system in the year 1983.

He then continued his post-graduate studies in Entomology under J.N.K.V.V., Jabalpur in Semester System and completed the course work for M.Sc.(Ag.) in the year 1986 with 3.01 O.C.G.A. out of 4.00 scale.

