SEASONAL INCIDENCE AND BIO-EFFICACY OF NEEM PRODUCTS AGAINST LEAF WEBBER,
Antigastra catalaunalis DUPONCHEL INFEETING SESAME

By

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A THESIS SUBMITTED TO THE JUNAGADH AGRICULTURAL UNIVERSITY IN PARTIAL FULFILMENT OF REQUIREMENTS FOR THE AWARD OF THE DEGREE

By
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IN AGRICULTURAL ENTOMOLOGY

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July - 2011
(Registration No. J4-00547-2009)
DEDICATED
TO
MY BELOVED
PARENTS

Mayur...
The experiment on seasonal incidence of leaf webber, Antigastra sauvarshtriata Dufoursel infesting sesame crop was conducted at two different locations in Junagadh (South Saurashtra Agro-Climatic Zone) and Kurudhia Wadi (North Saurashtra Agro-Climatic Zone), July to December. Observations on number of leaf webber (larvae)/plant, number of damaged plants, damaged and healthy capsules were recorded.

The data revealed that the pest infestation was initial within a week after sowing the crop and remained continue up to the crop maturity at both the location. However, the higher pest population, i.e., more than one larva/plant, continue for the week (6 to 10 week after sowing) was recorded at Junagadh while, it was only one week (7th week after sowing) at Kurudhia Wadi. The pest population was increased continuously at both locations during the season.
SEASONAL INCIDENCE AND BIO-EFFICACY OF NEEM PRODUCTS AGAINST LEAF WEBBER, *Antigastra catalaunalis* DUPONCHEL INFESTING SESAME

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**ABSTRACT**

The investigations were carried out on seasonal incidence and bio-efficacy of neem products against leaf webber, *Antigastra catalaunalis* Duponchel infesting sesame during *Kharif* 2010.

The experiment on seasonal incidence of leaf webber infesting sesame crop was conducted at two different location i.e. Junagadh (South Saurashtra Agro-Climatic Zone) and Targhadia-Rajkot (North Saurashtra Agro-Climatic Zone). The observations on number of leaf webber (larvae)/plant, number of infested plants, damaged and healthy capsules were recorded.

The data revealed that the pest infestation was initiated within a week after sowing the crop and remained continue up to the crop maturity at both the location. However, the higher pest population, i.e. more than one larva/ plant, continue for five week (6 to 10 week after sowing) was recorded at Junagadh, while, it was only one week (7th week after sowing) at Targhadia (Rajkot). The pest population was increased continue and reached at peak during the 8th week of sowing (34th standard
week) at Junagadh and one week early at Targhadia (Rajkot) which caused 89 per cent or more plant damage at Junagadh. The plant damage was increased with increase in the pest population at both the location. The weekly weather parameters which favoured the higher pest population at both the location were maximum temperature at 31 to 32°C and minimum at 25°C with relative humidity, morning (maximum) 87 to 92 per cent and evening (minimum) 71 to 78 per cent, sunshine hours 2 to 3 with rainfall 31 to 38 mm in 2 to 3 rainy days in a week.

An experiment was conducted on bio-efficacy of different neem products against leaf webber, *A. catalaunalis* under laboratory condition. The uniform aged ten larva (2nd instar) of the pest were released in each treatment. The observations on number of larvae died were taken daily after the treatment. The results revealed that more than 50 per cent pest mortality was achieved at three day on NSKE 5 per cent treated sesame twig. While, it was at four day after spray in neem oil 1 per cent, NSKE 3 per cent, NLE 2 per cent, NLE 4 per cent and azadirachtin 0.001 per cent. Further, it was found that the 50 per cent or more mortality of the insect larvae recorded at five day after feeding on neem oil 0.5 per cent, azadirachtin 0.00045 per cent and azadirachtin 0.00075 per cent treated twigs. The mortality remained continue in all the treatments. The cent per-cent mortality on seven day was recorded due to neem oil 1 per cent, NSKE 3 per cent, NSKE 5 per cent, NLE 4 per cent and azadirachtin 0.001 per cent and on eight day due to NLE 2 per cent, azadirachtin 0.00075, 0.00045 per cent and neem oil 0.5 per cent.
A field experiment was conducted to find out the bio-
efficacy of the neem products against leaf webber, A. catalaunalis
at Targhadia (Rajkot). First application of the neem products was
given, when the pest population reached at ETL of average one
larva/four plant and the second application was done at 15 day
interval. The number of leaf webber per plant was recorded at
one day before and two, five and ten day after each spray of the
neem products. The number of healthy and damaged capsules
were recorded at the time of harvest of the crop.

The results of the two spraying of the neem products
against the leaf webber revealed that NSKE 5 per cent, NLE 4 per
cent and azadirachtin 0.001 per cent were the most effective
against the pest as they caused more than 90 per cent pest
mortality. The lower dose of NSKE at 3 per cent and NLE at 2 per
cent was also found good in effectiveness which caused more
than 83 per cent pest mortality.

Considering the capsule damage, NSKE 5 per cent and
azadirachtin 0.001 per cent recorded significantly minimum
capsule damage (3.61 to 4.84%). The treatments of NLE 4 per
cent, NSKE 3 per cent, azadirachtin 0.00075 per cent, NLE 2 per
cent and azadirachtin 0.00045 per cent were the next effective
treatments as they recorded 6.07 to 10.99 per cent capsule
damage. Neem oil 1.0 per cent and neem oil 0.5 per cent proved
to be the least effective.

The sesame yield received from 727 to 655 kg/ha from the
crop treated with NSKE 5 and 3 per cent, NLE 4 per cent and
azadirachtin 0.001 per cent against leaf webber was 45 to 39 per
cent increased over control (untreated crop). Further, it was
found that 37 to 36 per cent yield increased was recorded due to
treatment of azadirachtin 0.00075 per cent, NLE 2 per cent and azadirachtin 0.00045 per cent (634 to 625 kg/ha).

Maximum net return of ₹ 14715 with C:B ratio 12.26 was obtained from the treatment of NSKE 5 per cent followed by azadirachtin 0.00075 per cent (₹ 12015 with C:B ratio 5.72), NLE 2 per cent (₹ 11790 with C:B ratio 23.58) and NSKE 3 per cent (₹ 11475 with C:B ratio 14.34). The treatment of NLE 4 per cent, azadirachtin 0.001 per cent and azadirachtin 0.00045 per cent proved to be the next economic with the net returns of ₹ 10530 to 10125.

Thus, It can be concluded that NSKE 5 and 3 per cent, NLE 4 and 2 per cent and azadirachtin 0.00075 per cent were found highly effective and economical treatments for control of the sesame leaf webber with 83 to 93 per cent pest mortality and 48 to 39 per cent increased yield over control with higher net return.
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CERTIFICATE

This is to certify that the thesis entitled "SEASONAL INCIDENCE AND BIO-EFFICACY OF NEEM PRODUCTS AGAINST LEAF WEBBER, Antigastra catalaunalis DUPONCHEL INFESTING SESAME" submitted by Mr. VIROJA MAYUR KANTILAL in partial fulfillment of the requirements of the degree of MASTER OF SCIENCE (Agriculture) in the subject of AGRICULTURAL ENTOMOLOGY of Junagadh Agricultural University is a record of bonafide research carried out by him under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma or other similar title.

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CERTIFICATE - I

This is to certify that Mr. VIROJA MAYUR KANTILAL has successfully completed the comprehensive/preliminary examination held on 01-04-2011 as required under the regulation for post Graduate studies.

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This is to certify that the thesis entitled "SEASONAL INCIDENCE AND BIO-EFFICACY OF NEEM PRODUCTS AGAINST LEAF WEBBER, Antigastra catalaunalis DUPONCHEL INFESTING SESAME" submitted by Mr. VIROJA MAYUR KANTILAL to Junagadh Agricultural University, Junagadh in partial fulfillment of the requirements for the degree of M. Sc. (Agri.) in the subject of AGRICULTURAL ENTOMOLOGY after recommendation by the external examiner was defended by the candidate before the following members of the examination committee. The performance of the candidate in the oral examination was satisfactory; we therefore, recommend that the thesis be approved.

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INCIDENCE AND BIO-EFFICACY OF NEEM PRODUCTS AGAINST
LEAF WEBBER, Antigastra catalaunalis DUPONCHEL
INFesting SESAME” as suggested by the external examiner and
the advisory committee in the oral examination held on 17/08/2011.
The final copies of the thesis duly bound and corrected have been
submitted on 23/08/2011.

Place : Junagadh
Date : 23 -08- 2011

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Date : July, 2011
# CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>INTRODUCTION</td>
<td>1-3</td>
</tr>
<tr>
<td>II</td>
<td>REVIEW OF LITERATURE</td>
<td>4-11</td>
</tr>
<tr>
<td>III</td>
<td>MATERIALS AND METHODS</td>
<td>12-17</td>
</tr>
<tr>
<td>IV</td>
<td>RESULTS AND DISCUSSION</td>
<td>18-44</td>
</tr>
<tr>
<td>V</td>
<td>SUMMARY AND CONCLUSION</td>
<td>45-48</td>
</tr>
<tr>
<td></td>
<td>REFERENCES</td>
<td>I-VI</td>
</tr>
<tr>
<td>Table No.</td>
<td>Title</td>
<td>Page No.</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>1</td>
<td>Name of the neem products evaluated against sesamum leaf webber, A. catalaunalis</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Population of sesamum leaf webber at Junagadh during Kharif 2010</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>Correlation matrix of population of sesame leaf webber with weather parameters at Junagadh during Kharif 2010</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Population of sesamum leaf webber at Main Dryland Research Station, JAU, Targhadia (Rajkot) during Kharif 2010</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>Correlation matrix of population of sesame leaf webber with weather parameters at Main Dryland Research Station, JAU, Targhadia (Rajkot) during Kharif 2010</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>Efficacy of the neem products against sesamum leaf webber, A. catalaunalis under laboratory condition</td>
<td>27</td>
</tr>
<tr>
<td>7</td>
<td>Bio-efficacy of the neem products against sesame leaf webber, A. catalaunalis (first spray)</td>
<td>34</td>
</tr>
<tr>
<td>8</td>
<td>Bio-efficacy of the neem products against sesame leaf webber, A. catalaunalis (second spray)</td>
<td>36</td>
</tr>
<tr>
<td>9</td>
<td>Sesame capsules damaged due to the leaf webber in various neem products</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>10</td>
<td>Yield of sesamum in various neem products applied against leaf webber, <em>A. catalaunalis</em> during <em>Kharif</em> 2010</td>
<td>41</td>
</tr>
<tr>
<td>11</td>
<td>Economics of the different neem formulations evaluated against sesame leaf webber, <em>A. catalaunalis</em> during <em>Kharif</em> 2010</td>
<td>43</td>
</tr>
</tbody>
</table>
# List of Figures

<table>
<thead>
<tr>
<th>Figure No.</th>
<th>Title</th>
<th>After page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Correlation between population of sesame leaf webber and weather parameters at Junagadh during <em>Kharif</em> 2010</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Correlation between population of sesame leaf webber and weather parameters at Targhadia (Rajkot) during <em>Kharif</em> 2010</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Bio-efficacy of different neem formulations against sesame leaf webber, <em>A. cattaluaialis</em> under laboratory condition</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Bio-efficacy of different neem formulations against sesame leaf webber, <em>A. cattaluaialis</em> after first spray</td>
<td>34</td>
</tr>
<tr>
<td>5</td>
<td>Bio-efficacy of different neem formulations against sesame leaf webber, <em>A. cattaluaialis</em> after second spray</td>
<td>36</td>
</tr>
<tr>
<td>6</td>
<td>Per cent capsule damage to sesamum due to leaf webber, <em>A. cattaluaialis</em> in different treatments</td>
<td>39</td>
</tr>
<tr>
<td>7</td>
<td>Economics of the different neem products evaluated against sesamum leaf webber</td>
<td>43</td>
</tr>
</tbody>
</table>
## List of Plates

<table>
<thead>
<tr>
<th>Plate No.</th>
<th>Caption</th>
<th>After page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Experimental site for seasonal incidence of sesame leaf webber, <em>A. catalaunalis</em></td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Experimental site for bio-efficacy of the neem products against sesame leaf webber, <em>A. catalaunalis</em> under laboratory condition</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Experimental site for bio-efficacy of the neem products against sesame leaf webber, <em>A. catalaunalis</em> under field condition</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>Leaf webber, <em>A. catalaunalis</em> infestation on sesame</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Healthy and infested sesame capsules due to infestation of leaf webber, <em>A. catalaunalis</em></td>
<td>20</td>
</tr>
</tbody>
</table>
INTRODUCTION

Sesame (Sesamum indicum L.) is an important and very ancient oil seed crop cultivated extensively in India, Burma, China and Japan. It is also cultivated in the hotter and drier parts of Africa and the Mediterranean region. In recent years, the cultivation of sesame has been receiving much attention in the USA, Mexico and in some of the Latin American Countries.

Sesame is rich in oil (46 to 54%) and protein (12 to 30%). Nearly 78 per cent of the seeds produced in India are used for oil extraction and 2.5 per cent for seed purpose. The rest of the seeds are used in confectionary and in religious ceremonies. Nearly 73 per cent of the oil is used for edible purpose and 8 per cent for the medicinal, chemical, pharmaceutical (Joshi, 1961).

Sesame in India is mainly cultivated in the States Rajasthan, Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka, Uttar Pradesh, West Bengal, Orissa and Punjab (Singhal, 2003).

In India, sesame was cultivated in an area of about 17.8 lakh hectare with the production of 7.57 lakh tonnes of seeds with productivity of 421 kg/ha. In Gujarat, sesame was cultivated in an area of about 2.26 lakh hectare and produced about 0.50 lakh tonnes of seeds. The average yield productivity of the State was 356 kg/ha (Arion, 2010).

The major sesame growing districts in Gujarat State are Anand, Bhavnagar, Jamnagar, Rajkot, Kutch and Surendranagar. The high remunerative return of sesame culture...
CHAPTER I
INTRODUCTION

Sesame (Sesamum indicum L.) is an important and very ancient oil seed crop cultivated extensively in India, Burma, China and Japan. It is also cultivated in the hotter and drier parts of Africa and the Mediterranean region. In recent years, the cultivation of sesame has been receiving much attention in the USA, Mexico and in some of the Latin American Countries.

Sesame is rich in oil (46 to 54%) and protein (12 to 20%). Nearly 78 per cent of the seeds produced in India are used for oil extraction and 2.5 per cent for seed purpose. The rest of the seeds are used in confectionery and in religious ceremonies. Nearly 73 per cent of the oil is used for edible purpose and 8.3 per cent for hydrogenation, 4.2 per cent for industrial purpose in the manufacture of paints, pharmaceuticals and insecticides (Joshi, 1961).

Sesame in India is mainly cultivated in the States of Rajasthan, Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka, Uttar Pradesh, West Bengal, Orrissa and Punjab (Singhal, 2003).

In India, sesame was cultivated in an area of about 17.99 lakh hectare with the production of 7.57 lakh tonne of seeds with productivity of 421 kg/ha. In Gujarat, sesame was cultivated in an area of about 2.26 lakh hectare and produced about 0.80 lakh tonne of seeds. The average yield (productivity) of the State was 356 kg/ha (Anon., 2010).

The major sesame growing districts in Gujarat State are Amreli, Bhavnagar, Jamnagar, Rajkot, Kutch and Surendranagar. The high remunerative return of sesame allure
the farmers to undertake its extensive and intensive cultivation not only in State but also over the country.

Among various constraints attributed to low yield of this crop, insect pests are the most serious ones. Out of 67 pests reported infesting the crop, leaf webber, *Antigastra catalaunalis* Dup. (Lepidoptera: Pyralidae) is the key pest (Kumar, 1992; Abuja and Bakhetia, 1995; Biswas *et al.*, 2001 and Thakur and Ghorpade, 2006). The sesame leaf webber was observed for the first time by Lefroy (1906) as a minor pest of sesame in India. Joshi (1961) reported that *A. catalaunalis* was specific to *Sesamum indicum* L. and no alternate host has been recorded so far.

Sesame leaf webber, *A. catalaunalis* is capable to cause complete failure of the crop, as it attacks the plant at all stages of growth. Damage is caused by the larvae which feed on top leaves and tender parts of the stem and remaining inside the leaf web in early stage of the crop growth. The larvae make web with the top leaves by folding them and feeding inside. During the later stage of the crop, larva feeds inside the flower and also bore the tender capsules. A single larva can destroy two to three plant in a week. The maximum infestation occurs in month of September and October (Atwal, 1986).

Desai and Patel (1965) recorded 28.60 per cent infested plants during *Kharif* at Junagadh (Gujarat). While, Jakhmola and Yadav (1974) from Madhya Pradesh reported 2 to 39 per cent capsule infestation. Cheema and Singh (1987) from Punjab reported that the infested pods carried 53.1 per cent less seeds than the healthy ones. Rohilla and Singh (1992) from Haryana and Kumar and Goel (1994) from Uttar Pradesh reported 64 per cent and 66 per cent reduction in grain yield due to this pest.
Ahuja and Bakhetia (1995) revealed that the pyralid, *A. catalaunalis* is the most serious pest infesting sesame causing up to 90% yield loss.

In the early sixties, some papers were published in India, reporting that neem seed kernel extract showed a strong anti-feedant effect on the desert locust (*Schistocerca gregaria* Forsk.) and on the migratory locust (*Locusta migratoria* R. and F.) (Pradhan et al., 1962). The reports from India came when worldwide concern had developed on the harmful effects of most synthetic insecticides on mammals and the environment.

The effects of the most synthetic insecticides are harmful to mammals and environment. Eco-friendly insecticides have high target selectivity, environment compatibility, economic viability and novel mode of action and are considered much safer to environment and other beneficial organisms as well as rational approach at a long run. It has also drawn the attention of entomologist to develop economically viable, effective and eco-friendly approaches for the pest management practices. Among such eco-friendly approaches, neem products form is one of the most important components which can be employed to control the pest with reduced chances of development of resistance. Neem possesses chaving the anti-feedant, phagodeterrent, growth and metamorphosis inhibiting effects on the target pest. The present investigations were therefore, carried out with the following objectives,

1. Seasonal incidence of leaf webber, *A. catalaunalis* on sesame
2. Bio-efficacy of the neem products against leaf webber, *A. catalaunalis* under laboratory condition
3. Bio-efficacy of the neem products against leaf webber, *A. catalaunalis* under field condition
REVIEWS
OF
LITERATURE

Sesame is most commonly cultivated oilseed crop in
Gujarat and also over the country. The crop is damaged by a
number of insect pests. The major pest infesting the crop in
Gujarat is leaf webber, A. catalaunica. It is also known by
various names viz., 11 or sesame leaf roller (Mecoc), 11 or
Devi and Patel, 1955), sesame shoot and leaf webber (Vittal
Saroja, 1966), 11 leaf and pod borer (Teesta and Minakka, 1989),
and sesame leaf webber and capsule borer (Cheminon and
Morton, 1957) The eggs of the leaf webber are laid on the
present study in the year 2001 and annual hatch has been recorded,
season presented under the following

1. Seasonal incidence of leaf webber A. catalaunica
   infesting sesame

2. Bio-
   efficacy of various protect against sesame leaf
   webber A. catalaunica under field conditions

2.1 Seasonal incidence of leaf webber A. catalaunica
   infesting sesame

Morris (1937) from Cypiritia reported that the larvae of the
pest severely damaged pods of sesame at the month of August
and September.

Mention et al. (1964) from Bihar observed that the infestation of
the crop by the pest took place at Morris and especially
at the beginning of December, when it was noted that the
infestation was observed in the...
CHAPTER II
REVIEW OF LITERATURE

Sesame is most commonly cultivated oilseed crop in Gujarat and also over the country. The crop is damaged by number of insect pests. The major pest infesting the crop in Gujarat is leaf webber, *A. catalaunalis*. It is also known by various names *viz.*, *Til* or sesame leaf roller (Menon *et al.*, 1960; Desai and Patel, 1965), sesame shoot and leaf webber (Vittal and Saroja, 1966), *Til* leaf and pod borer (Teotia and Husain, 1965) and sesame leaf webber and capsule borer (Cheema and Singh, 1987). The available literature on the different aspects of the present study in India and abroad has been reviewed and presented under the following headings.

1. Seasonal incidence of leaf webber, *A. catalaunalis* infesting sesame

2. Bio-efficacy of neem product against sesame leaf webber, *A. catalaunalis* under laboratory condition

3. Bio-efficacy of neem product against sesame leaf webber, *A. catalaunalis* under field condition

2.1 **Seasonal incidence of leaf webber, *A. catalaunalis* infesting sesame**

Morris (1937) from Cyprus reported that the larvae of this pest severely damaged pods of sesame in the month of August and September.

Menon *et al.* (1960) from Bihar stated that the infestation of the crop by the pest took place in March and continued up to the beginning of December, when it was harvested. Maximum infestation was observed in May and September to November.
The pest was not much seen during July to August due to rains and in the later part of December due to severity of winter.

Desai and Patel (1965) reported the leaf webber, *A. catalaunalis* as a major pest in *Kharif* sesame crop in Gujarat. Heavy infestation by the pest was noticed during the month of August and September. The attack by the pest usually started, when the crop was about 15 day old and continued up to harvest.

Teotia and Husain (1965) from Uttar Pradesh observed that the pest infestation on newly germinated sesame crop began early in July or if the rains were heavy, it was delayed till the end of July. The pest continued to breed on sesame crop up to the end of September in the case of early maturing varieties and up to mid-October in the case of late maturing varieties.

Chaudha (1974) from Nigeria reported that incidence of the pest was higher in dry sunny weather than in wet weather and outbreak occurred, when a long dry spell had been proceeded by heavy rains. There was positive correlation between the abundance of the pest and sunshine hours.

Choudhary *et al.* (1986) reported that daily maximum temperature had a significant and negative effect on population build up of this pest at Delhi.

Cheema and Singh (1987) in Punjab observed that the pest continued to breed on the sesame crop during August to the end of the September in the case of early maturing varieties and up to the November in the case of late maturing varieties.

Ahuja (1989) observed that the pest appeared soon after germination and remained till maturity of the sesameum crop in Rajasthan. Maximum per cent plant infestation and higher number of larvae were recorded in the month of September. The
weather data of four year revealed that mean maximum and minimum temperatures ranged from 35.5 to 37.0°C and 24.0 to 26.0°C and no rainfall were observed during peak activity period. The rainfall resulted in accumulation of water in webbed leaf and flower causing mortality of the larvae.

According to Singh et al. (1990) in Haryana, the peak population of the pest was observed on crop, when the maximum and minimum temperatures were 34.5 and 22.5°C, respectively with 65 per cent relative humidity.

Singh et al. (1992) in Bihar observed maximum multiplication of pest during 1st and 2nd week of September and the minimum population during 1st week of August. The fluctuation in the population during different weeks of months showed no significant correlation with any of the meteorological parameters.

Sinha and Prasad (1992) in Bihar reported that A. catalaunalis started appearing on sesame in August with the maximum activity in 2nd week of September (5.6 insect/plant), when average temperature, relative humidity and rainfall were 28.7 ± 4°C, 85.5% and 29.2 mm, respectively.

Kumar and Goel (1994) in Uttar Pradesh studied the impact of climatic factors on the population dynamics of A. catalaunalis. They reported that the pest was active from germination to till harvest. The larval population reached at peak, 80.33/m² and 85.17/m², in the 1st and 2nd weeks of October. Average weekly temperatures of 28.85 to 29.75°C and relative humidity of 71.21 to 72.21 per cent coupled with no rainfall were the most favourable environmental conditions for rapid population increase. There was a strong negative
correlation between larval population and the minimum temperature and afternoon RH.

The maximum population of leaf roller was recorded during the 2nd week of October at Junagadh (Anon., 1995), during 1st week of September at Amreli (Anon., 1995) and during August at Rajkot (Anon., 1997) in Gujarat.

Rakholiya (2000) revealed that the pest commenced in the last week of August, which steadily increased and reached at the peak in 3rd week of September (2.2 larva/plant). Maximum temperature and sunshine hours were found favourable for pest development.

**Yield losses**

Kumar and Goel (1995) from Haryana found that the pest caused yield loss up to 74 per cent. Kapadia (1996) reported upto 100 per cent crop losses in sesame due to *A. catalaunalis* with seed damage of 73.4 per cent. Gupta *et al.* (2002) reported that grain yield loss due to *A. catalaunalis* ranged 6.2 to 43.1 per cent. ETL of average 5 larva/20 plant was recommended by Dryland Research Station, JAU, Targhadia, Rajkot (Anon., 2005). Patel *et al.* (2009) conducted an experiment at Dryland Research Station on estimation of yield losses due to sesame leaf webber for consecutive 7 year i.e. from 1999 to 2005. The results revealed that the loss in yield was maximum i.e. 34.31 per cent with 0.65 larva/plant during 2005. While, minimum 7.69 per cent yield loss with 0.2 larva/plant during 2001. Further, it was found that average 15.85 per cent yield loss over seven year was recorded.
2.2 Bio-efficacy of neem product against sesame leaf webber A. catalaunalis under laboratory condition

Singh and Singh (1992) from Haryana reported that all the treatments of neem kernel suspension (NKS) were significantly different from 'Control' by having lesser survivals of hatchings emerged from egg-pods laid in them by the females of the desert locust due to 1% neem kernel suspension treatment.

Kachare et al. (1994) reported that the treatment neem oil 1 per cent showed significantly repellent action for egg laying by pulse beetle up to 100 day after treatment. No hatching of eggs at 33 day of storage was noticed in neem oil 1 per cent. Neem oil 1 per cent was quite effective at 66 and 100 day in suppressing the egg hatching.

Singh (2005) reported that the neem oil can significantly reduce the population of Callosobruchus chinensis (Linn) at 0.5, 1.0, 1.5 and 2.0 per cent concentration with 33.00, 36.00, 39.75 and 45.75 per cent mortality respectively.

Das et al. (2010) evaluated neem kernel aqueous extract (NKAE) and reported that the larval mortality of red slug caterpillar was maximum after 72 hr of treatment at all the concentration and recorded 12.92 to 98.23 per cent in 1st, 9.07 to 39.4 per cent in 2nd, 7.53 to 32.63 per cent in 3rd and 2.59 to 11.9 per cent in 4th instar at 2, 4, 6 and 8 per cent concentrations of NKAE respectively.

Pande et al. (2010) reported that the methalonic and water both the extract were effective against the bihar hairy caterpillar Spilarctia oblique (Walker) at various concentrations (2.5, 5.0, 7.5, 10 per cent). The extract of neem seed in both the solvent exhibited the mortality in the first instar larvae.
2.3 Bio-efficacy of neem product against sesame leaf webber, *A. catalaunalis* in field condition

2.3.1 Efficacy

Muralibhaskaran *et al.* (1993) evaluated the efficacy of six plant product and one check chemical against *A. catalaunalis*. Among them, neem oil (2%) resulted in lower shoot webber damage up to 7 day after the treatment.

Singh and Singh (1997) reported that flowers and capsules infested by *A. catalaunalis* was minimum in the crop treated with endosulfan 0.07 per cent (5.2%) followed by neem oil 1 per cent (7.3%), neem kernel extract 2 per cent (7.5%) and neem leaves extract 2 per cent (7.6%).

Flower and capsule damage caused by leaf roller were reported to be minimum in neem oil (10 ml/l) and endosulfan (0.07%) followed by NKE (in cow urine) (30 ml/l) treatments with increased mean grain yield of sesame variety JT-22 (Gupta, 2003).

Nath *et al.* (2002) evaluated the efficacy of neem-based formulations (Neem seed kernel extract, Neemark, Nimbicidin, Neemta 2100, Aniloguard Plus and RD-9 Repelin) on *A. catalaunalis* infesting sesame Cv. Gujarat-1 at Varanasi, Uttar Pradesh. Among the various treatments, neem seed kernel extract (5%) was the most effective in reducing the pest population. While, Nimbicidin was the most effective neem-based commercial formulation.

Ahuja and Kalyan (2003) evaluated the efficacy of neem seed kernel extract (5%), neem oil (1%), neemgold (0.3%) and raze (0.5%) against leaf webber/capsule borer, *A. catalaunalis* infesting sesame and found that neemgold was the most effective
with minimum plant infested (19.29%) and minimum capsule damage (8.66%) followed by neem oil and neem seed kernel extract.

Gupta (2003) reported that the flower damage caused by *A. catalaunalis* was minimum in neem oil (10 ml/l) (10.2%) followed by endosulfan (0.07%) (12.2%), neem kernel extract (30 ml/l) (13.5%) and neem leaf extract (30 ml/l) (13.6%) in cow urine. Whereas, capsule damaged was minimum in endosulfan (1.8%) followed by neem oil (2.3%) and neem kernel extract in cow urine (2.8%).

Ahirwar *et al.* (2008) evaluated the efficacy of neem [*Azadirachta indica*] oil, neem leaf extract (NLE), neem seed kernel extract (NSKE), cow butter milk, cow urine, garlic bud and red pepper [*Capsicum*] extracts and endosulfan (control) against leaf roller/capsule borer, *A. catalaunalis* on sesame Cv. TKG-22. Neem oil @ 10 ml/litre, NLE (in cow urine) @ 30 ml/litre and NSKE (in cow urine) @ 30 ml/litre were highly effective and on a par with endosulfan 0.07 per cent @ 2 ml/litre in reducing larval population and flower and capsule damaged caused by *A. catalaunalis* larvae.

### 2.3.2 Yield and economics

Muralibaskaran *et al.* (1993) evaluated the efficacy of six plant product and one check of chemical against *A. catalaunalis*. Among them, neem oil (2%) yielded the best cost benefit ratio of 3.67 followed by endosulfan (0.07%), neem kernel extract (2%) and tobacco decoction 1 per cent.

Flower and capsule damage caused by leaf roller were reported to be minimum in neem oil (10 ml/l) and endosulfan (0.07%) followed by neem kernel extract (in cow urine) (30 ml/l)
treatments with increased mean grain yield of sesame variety JT-22 (Gupta et al., 1999).

Gupta (2003) reported that the application of neem oil (10 ml/l) resulted in the lowest bud and flower damage (13.3%), with highest grain yield (655 kg/ha) and net profit (Rs 2636/ha).

Ahuja and Kalyan (2003) evaluated the efficacy of neem seed kernel extract (5%), neem oil (1%), neemgold (0.3%) and raze (0.5%) against leaf webber/capsule borer, A. catalaunalis infesting sesame. Among the plant products, neemgold was the most effective and gave the highest seed yield (390 kg/ha) followed by neem oil and neem seed kernel extract.

Ahirwar et al. (2008) revealed that neem oil @ 10.0 ml/litre, neem leaf extract (in cow urine) @ 30 ml/litre and neem seed kernel extract (in cow urine) @ 30 ml/litre were highly effective against leaf roller/capsule borer.
MATERIALS AND METHODS

The present investigations on “seasonal incidence and bioefficacy of several products against leaf webber Argytolaphis cotonella (Hemiptera: Miridae) infesting sesame” were carried out at the Instructional Farm, College of Agriculture, Junagarh Agricultural University, Junagadh and at Main Dry Farming Research Station, JAU, Taranga (Region) during Kharif 2010.

The details of materials and methods adopted during the studies are as under.

3.1 Seasonal incidence

The seasonal variety of A. cotonella was observed on dated 16 June, 2010 at Junagadh and on 24th June, 2010 at Taranga. The location was at Junagadh at 24.2°N 69.6°E and at Taranga at 24.2°N 70.5°E.

All the recommended agronomical practices and crop husbandry were adopted timely to raise the good crop. From the whole plot 4 quadrates having the size of 90 cm x 120 cm were selected randomly. From each quadrates 20 plants were selected randomly and tagged. The observations on number of leaf webber/plant, number of infested plants damaged and number of webber/plant were recorded at weekly intervals starting from initial infestation till harvest of the crop.
CHAPTER III
MATERIALS AND METHODS

The present investigations on “seasonal incidence and bio-
efficacy of neem products against leaf webber, Antigastra
catalaunalis Duponchel infesting sesame” were carried out at the
Instructional Farm, College of Agriculture, Junagadh
Agricultural University, Junagadh and at Main Dry Farming
Research Station, JAU, Targhadia (Rajkot) during Kharif, 2010.
The details of materials and methods adopted during these
studies are as under.

3.1 Seasonal incidence of leaf webber, A. catalaunalis on
sesame (Plate 1)

The experiment on the seasonal incidence of the leaf
webber infesting sesame crop was laid down at two different
location i.e. at Junagadh (in South Saurashtra Agro-Climatic
Zone) and at Dry farming Research Station, JAU, Targhadia-
Rajkot (in North Saurashtra Agro-Climatic Zone). The plot size of
the experimental field was 10 m X 20 m with the spacing of 45
cm X 15 cm. The sesame variety GT-3 was sown on dated 25th
June, 2010 at Junagadh and on 24th June, 2010 at Targhadia.
All the recommended agronomical practices and crop husbandry
were adopted timely to raise the good crop. From the whole plot,
10 quadrates having the size of 0.9 m X 1.5 m were randomly
selected. From each quadrate, five plant were selected randomly
and tagged. The observations on number of leaf webber
(larvae)/plant, number of infested plants, damaged and healthy
capsules were recorded at weekly interval starting from
germination till harvest of the crop.
Plate 1. Experimental site for seasonal incidence of sesame leaf webber, A. catalaunalis

Plate 2. Technique followed for the study of bio-efficacy of the neem products against sesame leaf webber, A. catalaunalis under laboratory condition

Plate 3. Experimental site for bio-efficacy of the neem products against sesame leaf webber, A. catalaunalis under field condition
Correlation study

The meteorological data on different weather parameters *viz.*, temperature (maximum and minimum), relative humidity (morning and evening), mean bright sunshine hours and rainfall in different standard weeks were obtained from the Meteorological Observatory located near the experimental fields at Junagadh and at Targhadia (Rajkot) during the season.

With a view to study the impact of different weather parameters on the pest population, a simple correlation was worked out.

3.2 Bio-efficacy of the neem products against leaf webber, *A. catalaunalis* under laboratory condition (Plate 2)

The experiment was conducted in Laboratory of Department of Entomology, College of Agriculture, Junagadh Agricultural University, Junagadh. The experiment was laid down in Completely Randomized Design with three replications.

Methodology

The larvae of leaf webber, *A. catalaunalis* were collected from field and fed on the flowers and leaves of sesame individually in plastic vials in laboratory for mass rearing. After pupation, small tender sesame twigs were kept in the vials. The adults started to emerge after 4-5 day and were released in newly developed plastic cages (15"x12"). The cages were covered with wet muslin cloth and tied with a rubber band. The adults inside the cages were fed on 5% honey/sucrose solution. For proper aeration inside the cage, 4 hole (5"x5") covered with a wire mesh were made. Five pair of adults were released in each cage. The eggs laid on the sesame leaves were then transferred in plastic vials and observed for hatching. Egg laying started after
Materials and Methods

5-6 day of release (Ahuja et al, 2003). The uniform aged (2nd instar) larvae were collected and used for the study.

The solutions of the neem products (Table 1) were prepared in laboratory as per method given by Singh and Singh (2000) and Sridhar and Vijayalakshmi (2002) and applied topically with help of baby sprayer on sesame twig with leaves and flowers/buds. The treated twigs were dried under the ceiling fan for 10 minute. The uniform aged ten larva (2nd instar) of the pest were released in each treatment and replicated thrice. Only water spray was kept as control. The observations on number of larvae died were taken daily after the treatment. The data on number of leaf webber died was converted to corrected per cent mortality by using the following formula given by Henderson and Tilton (1955). The data of corrected mortality percentage obtained were transformed into arc sine percentage and statistical analysis was carried out using the technique given by Panse and Sukhatme (1985). All the larvae released on different neem products were died up to 8 day after feeding on the treated food (sesame twigs).

Corrected per cent mortality = 100 X \left( \frac{T_a \times C_b}{T_b \times C_a} - 1 \right)

Where,

\( T_b = \) Number of leaf webber larvae observed before treatment,
\( T_a = \) Number of leaf webber larvae observed after treatment,
\( C_b = \) Number of leaf webber larvae observed from untreated (control) before treatment,
\( C_a = \) Number of leaf webber larvae observed from untreated (control) after treatment.
3.3 Bio-efficacy of the neem products against leaf webber, *A. catalaunalis* under field condition (Plate 3)

A field experiment was conducted with objective to find out the bio-efficacy of the neem products against leaf webber, *A. catalaunalis* at Dry Farming Research Station, JAU, Targhadia (Rajkot) during *Kharif*, 2010. The sesame Cv. GT-3 was sown on dated 24th June, 2010 with the spacing of 45 cm X 15 cm in Randomized Block Design with four replication and ten treatment (Table 1). The gross and net plot sizes were kept as 2.7 m X 5.1 m and 1.8 m X 4.1 m, respectively.

**Methodology**

The crop was raised as per recommended agronomic practices. In each plot, the plant population was maintained by thinning and gap filling operations.

The spraying of the neem products (Table 1) was done with the help of knapsack sprayer and due care was taken to obtain uniform spray coverage. All necessary care was taken to prevent the drift of the insecticides to the adjacent plot. First application of the neem products was given when the pest population was reached at ETL of average one larva/four plant (Anon., 2005) and the second application was done at 15 days after first spray application.

For judging the field bio-efficacy of the neem products against the sesame leaf webber, *A. catalaunalis*, five plant from each treatment (net plot) were randomly selected and tagged. The number of leaf webber per plant was recorded at one day before and two, five and ten day after spray application of the neem products. The mean number of larvae per plant was worked out. The number of healthy and damaged capsules were recorded at harvest of the crop.
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Technical Name</th>
<th>Trade Name</th>
<th>Formulation</th>
<th>Concentration (%)</th>
<th>Manufacturing agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neem oil</td>
<td>-</td>
<td>Crude extract</td>
<td>0.5</td>
<td>Local manufacture</td>
</tr>
<tr>
<td>2</td>
<td>Neem oil</td>
<td>-</td>
<td>Crude extract</td>
<td>1.0</td>
<td>Local manufacture</td>
</tr>
<tr>
<td>3</td>
<td>Neem seed kernel extract (NSKE)</td>
<td>-</td>
<td>Crude extract</td>
<td>3.0</td>
<td>Manually extracted from seeds of local neem tree</td>
</tr>
<tr>
<td>4</td>
<td>Neem seed kernel extract (NSKE)</td>
<td>-</td>
<td>Crude extract</td>
<td>5.0</td>
<td>Manually extracted from seeds of local neem tree</td>
</tr>
<tr>
<td>5</td>
<td>Neem leaf extract (NLE)</td>
<td>-</td>
<td>Crude extract</td>
<td>2.0</td>
<td>Manually extracted from leaves of local neem tree</td>
</tr>
<tr>
<td>6</td>
<td>Neem leaf extract (NLE)</td>
<td>-</td>
<td>Crude extract</td>
<td>4.0</td>
<td>Manually extracted from leaves of local neem tree</td>
</tr>
<tr>
<td>7</td>
<td>Azadirachtin</td>
<td>Neemarin</td>
<td>0.15 EC</td>
<td>0.00045% (3ml/litre)</td>
<td>Biotech International Ltd., New Delhi</td>
</tr>
<tr>
<td>8</td>
<td>Azadirachtin</td>
<td>Neemarin</td>
<td>0.15 EC</td>
<td>0.00075% (5ml/litre)</td>
<td>Biotech International Ltd., New Delhi</td>
</tr>
<tr>
<td>9</td>
<td>Azadirachtin</td>
<td>Neemarin</td>
<td>0.15 EC</td>
<td>0.001% (7ml/litre)</td>
<td>Biotech International Ltd., New Delhi</td>
</tr>
<tr>
<td>10</td>
<td>Control (water spray)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
The data on number of leaf webber were converted to corrected per cent mortality by using the formula given by Henderson and Tilton (1955). The data on mortality percentage obtained were transformed into arc sine percentage and statistical analysis was carried out using the technique given by Panse and Sukhatme (1985).

**Yield and Economics**

The harvesting of the crop was done when 90 to 95 per cent leaves and pods became yellowish. Produce of each plot was harvested, threshed and cleaned to remove trash. Seed yield (kg/plot) was recorded from net plot area. The yield received per plot was converted into kilograms per hectare. The yield increased over control was also calculated by using the following formula.

\[
\text{Yield increased (\%) } = 100 \times \left( \frac{T - C}{C} \right)
\]

Where,

- \( T \) = Yield of treated plot (kg/ha)
- \( C \) = Yield of untreated plot (kg/ha)

Net return (\₹/ha) and cost benefit ratio (CBR) of each treatment was calculated on the basis of current market price.
RESULTS AND DISCUSSION

The investigations were carried out on seasonal incidence and bio-efficacy of nem products against leaf webber, A. cattaneum, A. cattaneum, infesting sesame at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh and at Main Dry Farming Research Station, Junagadh Agricultural University, Taragadia (Rajst) during Kharif 2010. The results are presented and discussed in this chapter under the following headings:

4.1 Seasonal incidence of leaf webber in sesame
4.2 Bio-efficacy of the nem products against sesame leaf webber, A. cattaneum
4.3 Bio-efficacy of the nem products against sesame leaf webber, A. cattaneum under field condition

4.1.1 Location: Junagadh

The experiment on the seasonal incidence of the leaf webber infesting sesame crop was laid down at two different locations i.e. at Junagadh (South Saurashtra Agro-climatic Zone) and at Main Dry Farming Research Station, JAU, Taragadia (Rajst) (North Saurashtra Agro-climatic Zone).

The data presented in Table 2 and depicted in Fig. 1 revealed that the infection the leaf webber (Plate 4) on sesame crop commenced just after the seed sowing (2-3rd standing) week and recorded an exponential increase at the 1st week of sowing (27th standing) week.
CHAPTER IV
RESULTS AND DISCUSSION

The investigations were carried out on seasonal incidence and bio-efficacy of neem products against leaf webber, *Antigastra catalaunalis* Duponchel infesting sesame at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh and at Main Dry Farming Research Station, Junagadh Agricultural University, Targhadia (Rajkot) during *Kharif*, 2010. The results are presented and discussed in this chapter under the following headings.

4.1 Seasonal incidence of leaf webber, *A. catalaunalis* on sesame

4.2 Bio-efficacy of the neem products against sesame leaf webber, *A. catalaunalis* under laboratory condition

4.3 Bio-efficacy of the neem products against sesame leaf webber, *A. catalaunalis* under field condition

4.4 Yield and economics

4.1 
**Seasonal incidence of leaf webber, *A. catalaunalis* on sesame**

The experiment on the seasonal incidence of the leaf webber infesting sesame crop was laid down at two different location i.e. at Junagadh (South Saurashtra Agro-Climatic Zone) and at Main Dry farming Research Station, JAU, Targhadia - Rajkot (North Saurashtra Agro-Climatic Zone).

4.1.1 **Location: Junagadh**

The data presented in Table 2 and depicted in Fig. 1 revealed that the infestation of the leaf webber (Plate 4) on sesame crop commenced just after the seed germination i.e. in the 1st week of sowing (27th standard week) and recorded average
Table 2. Population of sesame leaf webber at Junagadh during *Kharif* 2010

<table>
<thead>
<tr>
<th>Std. week</th>
<th>WAS</th>
<th>No. of larvae/plant</th>
<th>Plant damage (%)</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
<th>Sunshine (hr.)</th>
<th>Rainfall</th>
<th>Rainy day</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>1</td>
<td>0.04</td>
<td>7.00</td>
<td>31.3</td>
<td>26.2</td>
<td>89.0</td>
<td>79.0</td>
<td>1.2</td>
</tr>
<tr>
<td>28</td>
<td>2</td>
<td>0.10</td>
<td>11.46</td>
<td>31.7</td>
<td>25.5</td>
<td>93.0</td>
<td>85.0</td>
<td>1.9</td>
</tr>
<tr>
<td>29</td>
<td>3</td>
<td>0.24</td>
<td>23.42</td>
<td>31.3</td>
<td>25.3</td>
<td>94.0</td>
<td>85.0</td>
<td>0.8</td>
</tr>
<tr>
<td>30</td>
<td>4</td>
<td>0.48</td>
<td>32.56</td>
<td>29.2</td>
<td>24.7</td>
<td>96.0</td>
<td>82.0</td>
<td>1.3</td>
</tr>
<tr>
<td>31</td>
<td>5</td>
<td>0.72</td>
<td>48.62</td>
<td>29.6</td>
<td>24.5</td>
<td>96.0</td>
<td>89.0</td>
<td>1.2</td>
</tr>
<tr>
<td>32</td>
<td>6</td>
<td>1.10</td>
<td>61.36</td>
<td>29.6</td>
<td>24.8</td>
<td>95.0</td>
<td>86.0</td>
<td>1.1</td>
</tr>
<tr>
<td>33</td>
<td>7</td>
<td>1.22</td>
<td>73.84</td>
<td>30.8</td>
<td>25.3</td>
<td>91.0</td>
<td>78.0</td>
<td>1.5</td>
</tr>
<tr>
<td>34</td>
<td>8</td>
<td>1.38</td>
<td>88.92</td>
<td>31.4</td>
<td>25.2</td>
<td>92.0</td>
<td>77.0</td>
<td>3.0</td>
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<tr>
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<td>9</td>
<td>1.14</td>
<td>75.22</td>
<td>30.1</td>
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<td>95.0</td>
<td>92.0</td>
<td>0.8</td>
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<tr>
<td>36</td>
<td>10</td>
<td>1.20</td>
<td>61.12</td>
<td>29.4</td>
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<td>89.0</td>
<td>0.4</td>
</tr>
<tr>
<td>37</td>
<td>11</td>
<td>0.98</td>
<td>52.28</td>
<td>29.5</td>
<td>24.4</td>
<td>95.0</td>
<td>81.0</td>
<td>0.1</td>
</tr>
<tr>
<td>38</td>
<td>12</td>
<td>0.64</td>
<td>44.18</td>
<td>33.4</td>
<td>23.0</td>
<td>88.0</td>
<td>58.0</td>
<td>8.1</td>
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<td>0.34</td>
<td>30.64</td>
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<td>85.0</td>
<td>63.0</td>
<td>7.9</td>
</tr>
<tr>
<td>40</td>
<td>14</td>
<td>0.18</td>
<td>18.52</td>
<td>36.5</td>
<td>22.3</td>
<td>80.0</td>
<td>37.0</td>
<td>9.1</td>
</tr>
</tbody>
</table>

*WAS = Week after sowing,  Max. = Maximum,  Min. = Minimum*
Table 3. Correlation matrix of population of sesame leaf webber with weather parameters at Junagadh during Kharif 2010

<table>
<thead>
<tr>
<th>Insect pest</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
<th>Sunshine hr.</th>
<th>Rainfall</th>
<th>Rainy day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max.</td>
<td>Min.</td>
<td>Morning</td>
<td>Evening</td>
<td></td>
</tr>
<tr>
<td>Sesame leaf webber</td>
<td><strong>r</strong> = -0.5030</td>
<td><strong>r</strong> = 0.1023</td>
<td><strong>r</strong> = 0.4607</td>
<td><strong>r</strong> = 0.3727</td>
<td><strong>r</strong> = -0.3485</td>
</tr>
</tbody>
</table>

Number of observations (weeks): 14

* Significant at 5% (r=0.532)

** Significant at 1% (R=0.661)
Plate 4. Leaf webber, *A. catalaunalis* infestation on capsule of sesame

Plate 5. Healthy and infested sesame capsules due to infestation of leaf webber, *A. catalaunalis*
0.04 larva/plant with 7 per cent plant infested. After commencement, the pest population increased steadily during each succeeding week i.e. 2nd to 7th week after sowing (28th to 33rd standard week) and 0.10 to 1.22 larva/plant recorded with 11.46 to 73.84 per cent plant damage. The leaf webber population reached at peak during the 8th week of sowing (34th standard week) when 1.38 larva/plant and 88.92 per cent plant damage was recorded. After reaching at the peak, the pest population steadily declined from the 9th to 14th week of sowing (35th to 40th standard week).

The data presented in Table 3 on correlation co-efficient of the leaf webber population revealed that none of the weather parameters was found significantly correlated with the population of sesame leaf webber. However, relative humidity (morning and evening), minimum temperature, rainfall and rainy days were positively correlated and maximum temperature and sunshine hours were negatively correlated with the pest population.

Congenial weather condition for high multiplication of sesame leaf webber at Junagadh was maximum and minimum temperature of 30.4°C and 24.8°C with maximum and minimum relative humidity of 93.5 per cent and 84 per cent, respectively.

4.1.2 Location: Targhadia (Rajkot)

The data presented in Table 4 and depicted in Fig. 2 revealed that the infestation of the leaf webber on sesame crop commenced just after the seed germination i.e. in the 1st week after sowing (27th standard week) and recorded 0.10 larva/plant with the plant damage of 30 per cent. After commencement, the pest population declined slightly in the 2nd week after sowing (28th standard week) and it was increased steadily during each
succeeding week i.e. 3\textsuperscript{rd} to 6\textsuperscript{th} week after sowing (29\textsuperscript{th} to 32\textsuperscript{nd} standard week) and recorded 0.10 to 0.44 larva/plant (36 to 90\% plant damage) during this period. The leaf webber population increased fast and reached at a peak during the 7\textsuperscript{th} week of sowing (33\textsuperscript{rd} standard week) and recorded 1.16 larva/plant. The maximum plant damage of 94 per cent was recorded in the 8\textsuperscript{th} week after sowing (34\textsuperscript{th} standard week). After reaching at peak, the pest population steadily decreased in the 8\textsuperscript{th} to 12\textsuperscript{th} week after sowing (34\textsuperscript{th} to 38\textsuperscript{th} standard week), with the maturity of the crop.

The data given in Table 5 on correlation co-efficient of the leaf webber population on sesame with the weather parameters revealed that none of the weather parameters was significantly correlated with the pest population. However, the correlation between the pest population and minimum temperature and morning relative humidity was non-significant and positive. While, maximum temperature, sunshine hours, rainfall and rainy day were negatively correlated with the pest population.

Congenial weather condition for high multiplication of sesame leaf webber at Targhadia was maximum and minimum temperature of 31.6\textdegree C and 25.1\textdegree C with maximum and minimum relative humidity of 87 per cent and 71 per cent, respectively.

The study on seasonal abundance of sesame leaf webber was carried out at two different location i.e. at Junagadh in South Saurashtra Agro-climatic Zone and at Targhadia (Rajkot) in North Saurashtra Agro-climatic Zone. The pest infestation was initiated within a week after sowing of the crop and remained continue up to the crop maturity at both the location. However, the higher pest population i.e. more larvae/plant continue for five week (6 to 10 week after sowing) was recorded at Junagadh.
While, it was only one week (7th week after sowing) at Targhadia (Rajkot). The pest population reached at a peak during the 8th week of sowing (34th standard week) at Junagadh and one week early at Targhadia (Rajkot) which caused 89 per cent or more plant damage. The plant damage was increased with increased in the pest population at both the location. Further, it was also found that the weather parameters which favoured higher pest population at both the locations were temperature maximum 31 to 32°C and minimum 25°C with relative humidity, morning (maximum) 87 to 92 per cent and evening (minimum) 71 to 78 per cent, sunshine hours 2 to 3 with rainfall 31 to 38 mm in 2 to 3 rainy day in a week.

According to Desai and Patel (1965), attack of leaf webber, A. catalaunalis in Kharif sesame usually started when the crop was 15 days old and continued up to harvest. Ahuja (1989) and Kumar and Goel (1994) observed that this pest appeared soon after germination and remained till maturity of the crop. Thus, the present findings are in confirmation with the earlier reports.

Earlier, Choudhary et al. (1986) reported that maximum temperature had a significant negative effect on population build up of this pest. Similar results were also reported by Ahuja (1989), Singh et al. (1990) and Singh et al. (1992). Thus, the present findings are more or less in agreement with the result reported by earlier workers.
Table 4. Population of sesame leaf webber at Main Dryland Research Station, JAU, Targhadia (Rajkot) during Kharif 2010

<table>
<thead>
<tr>
<th>Std. week</th>
<th>WAS</th>
<th>No. of larvae/plant</th>
<th>Plant damage (%)</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
<th>Sunshine (hr.)</th>
<th>Rainfall</th>
<th>Rainy day</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>1</td>
<td>0.10</td>
<td>30.00</td>
<td>33.5</td>
<td>83.0</td>
<td>3.0</td>
<td>102.8</td>
<td>4.0</td>
</tr>
<tr>
<td>28</td>
<td>2</td>
<td>0.04</td>
<td>36.00</td>
<td>32.7</td>
<td>80.0</td>
<td>4.4</td>
<td>20.0</td>
<td>2.0</td>
</tr>
<tr>
<td>29</td>
<td>3</td>
<td>0.10</td>
<td>52.00</td>
<td>33.4</td>
<td>88.0</td>
<td>4.6</td>
<td>92.9</td>
<td>6.0</td>
</tr>
<tr>
<td>30</td>
<td>4</td>
<td>0.20</td>
<td>28.00</td>
<td>29.6</td>
<td>93.0</td>
<td>1.4</td>
<td>163.3</td>
<td>6.0</td>
</tr>
<tr>
<td>31</td>
<td>5</td>
<td>0.18</td>
<td>30.00</td>
<td>31.5</td>
<td>90.0</td>
<td>1.3</td>
<td>164.3</td>
<td>3.0</td>
</tr>
<tr>
<td>32</td>
<td>6</td>
<td>0.44</td>
<td>50.00</td>
<td>30.5</td>
<td>88.0</td>
<td>3.4</td>
<td>55.3</td>
<td>3.0</td>
</tr>
<tr>
<td>33</td>
<td>7</td>
<td>1.16</td>
<td>90.00</td>
<td>32.7</td>
<td>86.0</td>
<td>2.7</td>
<td>42.5</td>
<td>3.0</td>
</tr>
<tr>
<td>34</td>
<td>8</td>
<td>0.94</td>
<td>94.00</td>
<td>31.4</td>
<td>89.0</td>
<td>2.0</td>
<td>19.2</td>
<td>2.0</td>
</tr>
<tr>
<td>35</td>
<td>9</td>
<td>0.30</td>
<td>60.00</td>
<td>31.4</td>
<td>90.0</td>
<td>1.3</td>
<td>201.5</td>
<td>6.0</td>
</tr>
<tr>
<td>36</td>
<td>10</td>
<td>0.30</td>
<td>64.00</td>
<td>30.8</td>
<td>91.0</td>
<td>1.8</td>
<td>30.0</td>
<td>4.0</td>
</tr>
<tr>
<td>37</td>
<td>11</td>
<td>0.20</td>
<td>70.00</td>
<td>29.9</td>
<td>88.0</td>
<td>2.9</td>
<td>85.1</td>
<td>4.0</td>
</tr>
<tr>
<td>38</td>
<td>12</td>
<td>0.10</td>
<td>80.00</td>
<td>34.4</td>
<td>82.0</td>
<td>7.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**WAS** = Week after sowing,  **Max.** = Maximum,  **Min.** = Minimum
Table 5. Correlation matrix of population of sesame leaf webber with weather parameters at Main Dryland Research Station, JAU, Targhadia (Rajkot) during Kharif 2010

<table>
<thead>
<tr>
<th>Insect pest</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
<th>Sunshine hr.</th>
<th>Rainfall</th>
<th>Rainy day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max.</td>
<td>Min.</td>
<td>Morning</td>
<td>Evening</td>
<td></td>
</tr>
<tr>
<td>Sesame leaf webber</td>
<td>r=-0.1084</td>
<td>0.0764</td>
<td>0.1829</td>
<td>-0.0220</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>r=-</td>
<td></td>
<td>r=</td>
<td>r=</td>
<td>r=-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.2943</td>
<td>-0.2726</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of observations (weeks): 12

* Significant at 5% (r=0.532)
Fig. 2: Correlation between population of sesame leaf webber and weather parameters at Targhedia (Rajkot) during Kharg 2010

The data are presented in the graph, showing the relationship between population of leaf webber and various weather parameters such as rainfall, sunshine hours, minimum temperature, maximum temperature, and relative humidity.

The graph indicates that the highest correlation is observed between the number of leaves on a plant and the rainfall, with a positive correlation. However, the correlation with other weather parameters is less pronounced. The data suggest that rainfall plays a significant role in the population of leaf webbers, with an increase in rainfall leading to an increase in the population of leaf webbers.
4.2 Bio-efficacy of the neem products against sesame leaf webber, *A. catalaunalis* under laboratory condition

The experiment was conducted to find out the bio-effectiveness of neem products *viz.*, neem oil, neem seed kernel extract (NSKE), neem leaf extract (NLE) and azadirachtin (commercial product) at different concentrations (Table 1). Sesame twigs were sprayed with the different treatments of the neem products and uniform aged 2nd instar larvae of sesame leaf webber were released on the treated twigs. The mortality of the insect larvae was recorded daily after application of the treatments.

**Mortality at one day after spray**

The data on mortality of the insect larvae at one day after treatment are presented in Table 6 and depicted in Fig. 3. The data revealed that the treatment of NSKE 5 per cent recorded the significantly the highest mortality of 28.26 per cent of the leaf webber and proved to be the most effective at one day after the treatment. However, it was at par with the treatments of NLE 4 per cent and neem oil 1.0 per cent with the mortality of 25.95 and 23.56 per cent, respectively.

Azadirachtin 0.001 per cent and NSKE 3 per cent were found the moderately toxic as it caused 21.60 and 13.88 per cent mortality, respectively.

The minimum 8.29 per cent mortality was recorded in the treatment of azadirachtin 0.00045 per cent and was found relatively the least toxic against the leaf webber. However, it was at par with the treatments of azadirachtin 0.00075 per cent, neem oil 0.5 per cent and NLE 2 per cent with the mortality of 9.66, 10.83 and 11.85 per cent, respectively.
Table 6. Efficacy of the neem products against sesamum leaf webber, *A. catalaunalis* under laboratory condition

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Treatment</th>
<th>1 DAS</th>
<th>2 DAS</th>
<th>3 DAS</th>
<th>4 DAS</th>
<th>5 DAS</th>
<th>6 DAS</th>
<th>7 DAS</th>
<th>8 DAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neem oil 0.5%</td>
<td>19.22</td>
<td>24.28</td>
<td>34.63</td>
<td>44.04</td>
<td>56.44</td>
<td>64.55</td>
<td>68.01</td>
<td>90.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10.83)</td>
<td>(16.90)</td>
<td>(32.29)</td>
<td>(48.33)</td>
<td>(69.44)</td>
<td>(81.53)</td>
<td>(85.98)</td>
<td>(100.00)</td>
</tr>
<tr>
<td>2</td>
<td>Neem oil 1.0%</td>
<td>29.04</td>
<td>32.96</td>
<td>42.12</td>
<td>51.40</td>
<td>65.21</td>
<td>74.32</td>
<td>90.00</td>
<td>90.00</td>
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<td></td>
<td></td>
<td>(23.56)</td>
<td>(29.60)</td>
<td>(44.99)</td>
<td>(61.09)</td>
<td>(82.42)</td>
<td>(92.69)</td>
<td>(100.00)</td>
<td>(100.00)</td>
</tr>
<tr>
<td>3</td>
<td>NSKE 3%</td>
<td>21.87</td>
<td>26.51</td>
<td>36.45</td>
<td>45.77</td>
<td>58.32</td>
<td>69.28</td>
<td>90.00</td>
<td>90.00</td>
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<tr>
<td></td>
<td></td>
<td>(13.88)</td>
<td>(19.92)</td>
<td>(35.29)</td>
<td>(51.34)</td>
<td>(72.41)</td>
<td>(87.48)</td>
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<td>(100.00)</td>
</tr>
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<td>4</td>
<td>NSKE 5%</td>
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<td>36.04</td>
<td>45.19</td>
<td>54.60</td>
<td>70.38</td>
<td>81.07</td>
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<td></td>
<td></td>
<td>(28.26)</td>
<td>(34.61)</td>
<td>(50.34)</td>
<td>(66.44)</td>
<td>(88.73)</td>
<td>(97.59)</td>
<td>(100.00)</td>
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</tr>
<tr>
<td>5</td>
<td>NLE 2%</td>
<td>20.14</td>
<td>25.04</td>
<td>35.24</td>
<td>44.62</td>
<td>57.02</td>
<td>68.56</td>
<td>72.37</td>
<td>90.00</td>
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<td></td>
<td></td>
<td>(11.85)</td>
<td>(17.91)</td>
<td>(33.29)</td>
<td>(49.33)</td>
<td>(70.37)</td>
<td>(86.64)</td>
<td>(90.83)</td>
<td>(100.00)</td>
</tr>
<tr>
<td>6</td>
<td>NLE 4%</td>
<td>30.62</td>
<td>34.43</td>
<td>43.47</td>
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<td>77.63</td>
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<td>90.00</td>
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<td>(31.97)</td>
<td>(47.33)</td>
<td>(63.36)</td>
<td>(84.44)</td>
<td>(95.41)</td>
<td>(100.00)</td>
<td>(100.00)</td>
</tr>
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<td>7</td>
<td>Azadirachtin 0.00045%</td>
<td>16.74</td>
<td>22.23</td>
<td>32.99</td>
<td>42.51</td>
<td>54.74</td>
<td>63.08</td>
<td>66.08</td>
<td>90.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(8.29)</td>
<td>(14.31)</td>
<td>(29.65)</td>
<td>(45.66)</td>
<td>(66.68)</td>
<td>(79.50)</td>
<td>(83.57)</td>
<td>(100.00)</td>
</tr>
<tr>
<td>8</td>
<td>Azadirachtin 0.00075%</td>
<td>18.11</td>
<td>23.31</td>
<td>33.83</td>
<td>43.28</td>
<td>55.57</td>
<td>63.79</td>
<td>66.86</td>
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<td>(9.66)</td>
<td>(15.66)</td>
<td>(30.99)</td>
<td>(47.00)</td>
<td>(68.02)</td>
<td>(80.49)</td>
<td>(84.55)</td>
<td>(100.00)</td>
</tr>
<tr>
<td>9</td>
<td>Azadirachtin 0.001%</td>
<td>27.69</td>
<td>31.71</td>
<td>40.96</td>
<td>50.20</td>
<td>63.55</td>
<td>69.96</td>
<td>90.00</td>
<td>90.00</td>
</tr>
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<td></td>
<td>(21.60)</td>
<td>(27.62)</td>
<td>(42.98)</td>
<td>(59.03)</td>
<td>(80.16)</td>
<td>(88.26)</td>
<td>(100.00)</td>
<td>(100.00)</td>
</tr>
<tr>
<td></td>
<td>S. Em.±</td>
<td>1.43</td>
<td>1.30</td>
<td>1.38</td>
<td>1.57</td>
<td>2.09</td>
<td>3.14</td>
<td>2.22</td>
<td></td>
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<tr>
<td></td>
<td>C. D. at 5%</td>
<td>4.22</td>
<td>3.83</td>
<td>4.08</td>
<td>4.63</td>
<td>6.16</td>
<td>9.27</td>
<td>6.56</td>
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<td></td>
<td>C. V.%</td>
<td>10.35</td>
<td>7.89</td>
<td>6.26</td>
<td>5.70</td>
<td>5.94</td>
<td>7.75</td>
<td>4.79</td>
<td></td>
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</tbody>
</table>

*Angular transformation. Figures in parentheses are retransformed values. DAS: Days after spraying.
<table>
<thead>
<tr>
<th>Treat. No.</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Neem oil 0.5%</td>
</tr>
<tr>
<td>T2</td>
<td>Neem oil 1.0%</td>
</tr>
<tr>
<td>T3</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
</tr>
<tr>
<td>T4</td>
<td>Neem seed kernel extract (NSKE) 5%</td>
</tr>
<tr>
<td>T5</td>
<td>Neem leaf extract (NLE) 2%</td>
</tr>
<tr>
<td>T6</td>
<td>Neem leaf extract (NLE) 4%</td>
</tr>
<tr>
<td>T7</td>
<td>Azadirachtin (0.15% EC) 0.00045%</td>
</tr>
<tr>
<td>T8</td>
<td>Azadirachtin (0.15% EC) 0.00075%</td>
</tr>
<tr>
<td>T9</td>
<td>Azadirachtin (0.15% EC) 0.001%</td>
</tr>
<tr>
<td>T10</td>
<td>Control (water spray)</td>
</tr>
</tbody>
</table>
Fig. 3. Bio-efficacy of different neem formulations against Sesame leaf webber, A. cattalauensis under laboratory condition.
**Mortality at two day after spray**

The data on mortality of the insect larvae at two day after the treatments are presented in Table 6 and depicted in Fig. 3. The data revealed that mortality of the leaf webber was increased in all the neem products after the 2nd day of the treatments. The maximum mortality (34.61%) of the pest was found in the treatment of NSKE 5 per cent and it was at par with NLE 4 per cent and neem oil 1 per cent with the mortality of 31.97 and 29.6 per cent, respectively.

Treatments of azadirachtin 0.001 per cent and NSKE 3 per cent were resulted moderately toxic as it caused 27.62 and 19.92 per cent pest mortality, respectively.

The minimum 14.31 per cent mortality of the pest was recorded in the treatment of azadirachtin 0.00045 per cent and was found relatively the least toxic against the leaf webber. However, it was at par with the treatments of azadirachtin 0.00075 per cent, neem oil 0.5 per cent and NLE 2 per cent with the mortality of 15.66, 16.90 and 17.91 per cent, respectively.

**Mortality at three day after spray**

The data on mortality of the insect larvae on three day after spray are presented in Table 6 and depicted in Fig. 3. The data indicated that mortality of insect larvae was further increased by all the treatments on the 3rd day after spray application. The trend of effectiveness was similar as on 2nd day after the application. The treatment of NSKE 5 per cent recorded the significantly the highest pest mortality of 50.34 per cent. However, it was at par with the treatments of NLE 4 per cent and neem oil 1.0 per cent in which pest mortality of 47.33 and 44.99 per cent recorded, respectively.
Azadirachtin 0.001 per cent was found the moderately toxic treatment with the mortality of 42.98 per cent.

Significantly lower pest mortality of 29.65 per cent was recorded in the treatment of azadirachtin 0.00045 per cent. However, it was at par with the treatments of azadirachtin 0.00075 per cent, neem oil 0.5 per cent, NLE 2 per cent and NSKE 3 per cent in which the mortality of 30.99, 32.29, 33.29 and 35.29 per cent recorded, respectively.

**Mortality at four day after spray**

The data on mortality of sesame leaf webber four day after spray (Table 6 and Fig. 3) revealed that more than 50 per cent pest mortality was caused by all the treatments except treatments of azadirachtin 0.00045 and 0.00075 per cent and neem oil 0.5 per cent in which 45.56 to 48.33 per cent mortality was recorded. It was further revealed that significantly maximum pest mortality of 66.44 per cent was caused by the treatment of NSKE 5 per cent and it was at par with mortality caused by NLE 4 per cent, neem oil 1 per cent and azadirachtin 0.001 per cent with the mortality of 63.36 to 59.03 per cent.

Minimum pest mortality of 45.66 per cent was recorded in the treatment of azadirachtin 0.00045 per cent. However, it was at par with the treatments of azadirachtin 0.00075 per cent, neem oil 0.5 per cent, NLE 2 per cent and NSKE 3 per cent with the pest mortality of 47.00, 48.33, 49.33 and 51.34 per cent, respectively.

**Mortality at five day after spray**

The results on mortality of the insect larvae at five day after spray presented in Table 6 and graphically depicted in Fig. 3 revealed that the mortality of insect larvae was increased in all the treatments as compared to mortality at the 4 day after spray.
The maximum mortality (88.73%) was found in treatment of NSKE 5 per cent and it was at par with NLE 4 per cent and neem oil 1 per cent with the mortality of 84.44 and 82.42 per cent, respectively.

Azadirachtin 0.001 per cent was found the moderately toxic treatment with the mortality of 80.16 per cent.

The minimum mortality of 66.68 per cent was recorded in treatment of azadirachtin 0.00045 per cent followed by azadirachtin 0.00075 per cent, neem oil 0.5 per cent, NLE 2 per cent and NSKE 3 per cent which caused mortality of 68.02, 69.44, 70.37 and 72.41 per cent, respectively.

**Mortality at six day after spray**

The results on mortality of the insect larvae at the sixth day after spray are presented in Table 6 and graphically depicted in Fig. 3 revealed that the mortality of sesame leaf webber was further increased by all the treatments as compared to the mortality of the 5th day after spray. The trend of effectiveness was also similar as per mortality at the 5th day after spray. More than 90 per cent mortality was achieved in the treatments of NSKE 5 per cent, NLE 4 per cent and Neem oil 1 per cent. NSKE 5 per cent recorded the significantly the highest mortality of 97.59 per cent of the leaf webber. However, it was at par with the treatments of NLE 4 per cent and neem oil 1.0 per cent with the mortality of 95.41 and 92.69 per cent, respectively.

Significantly the lower mortality of 79.50 per cent was recorded in the treatment of azadirachtin 0.00045 per cent. However, it was at par with the treatments of azadirachtin 0.00075 per cent, neem oil 0.5 per cent, NLE 2 per cent, NSKE 3 per cent and azadirachtin 0.001 per cent with the mortality of 80.49, 81.53, 86.64, 87.48 and 88.26 per cent, respectively.
Mortality at seven day after spray

The mortality data recorded at the 7th day after spray of neem products (Table 6 and Fig. 3) revealed that cent per cent mortality was recorded in treatment NSKE 5 per cent, NSKE 3 per cent, NLE 4 per cent, neem oil 1 per cent and azadirachtin 0.001 per cent. Rest of the treatments caused mortality between 85.56 to 85.98 per cent.

Whereas, significantly the lower mortality of 83.57 per cent was recorded in the treatment of azadirachtin 0.00045 per cent. However, it was at par with the treatments of azadirachtin 0.00075 per cent, neem oil 0.5 per cent and NLE 2 per cent with the mortality of 84.55, 85.98 and 90.83 per cent, respectively.

Mortality at eight day after spray

The mortality of the insect larvae was increased on the 8th day after spray in neem oil 0.5 per cent, NLE 2 per cent, azadirachtin 0.00045 per cent and azadirachtin 0.00075 per cent in which, cent per cent mortality of the insect larvae was achieved.

The result of bio-efficacy of the neem products on the 2nd instar larvae of leaf webber, A. catalaunalis under laboratory condition revealed that 50 per cent pest mortality was achieved at three day on NSKE 5 per cent treated sesame twig. While, it was at 4 day after spray in neem oil 1 per cent, NSKE 3 per cent, NLE 2 per cent, NLE 4 per cent and azadirachtin 0.001 per cent. Further, it was found that the 50 per cent or more mortality of the insect larvae recorded at the 5 day after feeding on neem oil 0.5 per cent, azadirachtin 0.00045 per cent and azadirachtin 0.00075 per cent treated twigs. The mortality of insect larvae
continued to increased in all the treatments after its application. The cent per cent mortality on the 7th day was recorded due to neem oil 1 per cent, NSKE 3 per cent, NSKE 5 per cent, NLE 4 per cent and azadirachtin 0.001 per cent and on the 8th day due to NLE 2 per cent, azadirachtin 0.00075, 0.00045 per cent and neem oil 0.5 per cent.

Earlier, neem was found effective against *Callosobruchus chinensis* (Linn) by Kachare et al. (1994) and Singh (2005) against red slug caterpillar by Das et al. (2010) against bihar hairy caterpillar by Pande et al. (2010). Thus, the present findings are in confirmation with earlier workers.

### 4.3 Bio-efficacy of the neem products against sesame leaf webber, *A. catalaunalis* under field condition

The bio-efficacy of different neem products (Table 1) was evaluated against sesame leaf webber under field condition at Dry Farming Research Station, Targhadia (Rajkot). The first application of the neem products was given when the pest population reached at the ETL and second at the 15 day later. The mortality of sesame leaf webber was recorded on two, five and ten day after spray application.

#### 4.3.1 Mortality after 1st application

**On the 2 day**

The data presented in Table 7 and depicted in Fig. 4 on mortality of leaf webber recorded at two day after first spray revealed that the treatment of NLE 4 per cent caused maximum pest mortality of 77.06 per cent and it was at par with the mortality (71.47%) caused by NSKE 5 per cent.

Azadirachtin 0.00075 per cent, NSKE 3 per cent, NLE 2 per cent, neem oil 1.0 per cent and azadirachtin 0.001 per cent were in the next effective group of treatments caused 64.26, 57.29,
57.17, 57.13 and 57.13 per cent pest mortality, respectively on the 2nd day after the spray application.

The minimum mortality of 10.69 per cent was caused by azadirachtin 0.00045 per cent followed by neem oil 0.5 per cent in which, 28.61 per cent mortality was recorded.

**On the 5 day**

The data presented in Table 7 and depicted in Fig. 4 on mortality of sesamum leaf webber recorded at five day after first spray application indicated that the treatment of NLE 4 per cent caused the maximum pest mortality of 91.78 per cent and it was at par with the mortality (90.27% and 83.53%) caused by NSKE 5 per cent and azadirachtin 0.00075 per cent.

Neem oil 1.0 per cent, NLE 2 per cent, azadirachtin 0.001 per cent and NSKE 3 per cent were the next effective group of treatments caused 81.24, 80.34, 79.73 and 79.24 per cent pest mortality, respectively.

The minimum pest mortality (60.75% and 62.46%) was caused by the treatments of neem oil 0.5 per cent and azadirachtin 0.00045 per cent.

**On the 10 day**

The data presented in Table 7 and depicted in Fig. 4 on mortality of leaf webber recorded at ten days after the first spray of application indicated that the treatment of NLE 4 per cent caused the maximum pest mortality of 93.06 per cent and it was at par with the treatments of azadirachtin 0.001 per cent (91.64%) and NSKE 5 per cent (91.54%).

Neem oil 1.0 per cent, NLE 2 per cent, azadirachtin 0.00075 per cent and NSKE 3 per cent were in the next effective group of treatments which caused 83.42, 83.34, 79.50 and 75.94 per cent pest mortality, respectively.
Table 7. Bio-efficacy of the neem products against sesame leaf webber, *A. catalaunalis* (first spray)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment</th>
<th>Per cent mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2 DAS</td>
</tr>
<tr>
<td>1</td>
<td>Neem oil 0.5%</td>
<td>32.33*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(28.61)</td>
</tr>
<tr>
<td>2</td>
<td>Neem oil 1.0%</td>
<td>49.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(57.13)</td>
</tr>
<tr>
<td>3</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
<td>49.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(57.29)</td>
</tr>
<tr>
<td>4</td>
<td>Neem seed kernel extract (NSKE) 5%</td>
<td>57.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(71.47)</td>
</tr>
<tr>
<td>5</td>
<td>Neem leaf extract (NLE) 2%</td>
<td>49.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(57.17)</td>
</tr>
<tr>
<td>6</td>
<td>Neem leaf extract (NLE) 4%</td>
<td>61.38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(77.06)</td>
</tr>
<tr>
<td>7</td>
<td>Azadirachtin 0.00045%</td>
<td>19.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10.69)</td>
</tr>
<tr>
<td>8</td>
<td>Azadirachtin 0.00075%</td>
<td>53.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(64.26)</td>
</tr>
<tr>
<td>9</td>
<td>Azadirachtin 0.001%</td>
<td>49.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(57.13)</td>
</tr>
<tr>
<td>10</td>
<td>S. Em.±</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>C. D. at 5%</td>
<td>5.16</td>
</tr>
<tr>
<td></td>
<td>C. V.%</td>
<td>8.39</td>
</tr>
</tbody>
</table>

*Angular transformation.

Figures in parentheses are retransformed values.

**DAS**: Days after spraying.
<table>
<thead>
<tr>
<th>Treat. No.</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Neem oil 0.5%</td>
</tr>
<tr>
<td>T2</td>
<td>Neem oil 1.0%</td>
</tr>
<tr>
<td>T3</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
</tr>
<tr>
<td>T4</td>
<td>Neem seed kernel extract (NSKE) 5%</td>
</tr>
<tr>
<td>T5</td>
<td>Neem leaf extract (NLE) 2%</td>
</tr>
<tr>
<td>T6</td>
<td>Neem leaf extract (NLE) 4%</td>
</tr>
<tr>
<td>T7</td>
<td>Azadirachtin (0.15% EC) 0.00045%</td>
</tr>
<tr>
<td>T8</td>
<td>Azadirachtin (0.15% EC) 0.00075%</td>
</tr>
<tr>
<td>T9</td>
<td>Azadirachtin (0.15% EC) 0.001%</td>
</tr>
<tr>
<td>T10</td>
<td>Control (water spray)</td>
</tr>
</tbody>
</table>
The significantly minimum pest mortality of 47.84 per cent was caused by azadirachtin 0.00045 per cent followed by neem oil 0.5 per cent (25 ALV dosage).

The bio-efficacy of the neem products in the field indicated that the neem leaf extract (NEL) 10 per cent and NEL 3 per cent at 0.001 per cent.

The data presented in Table 5 and Fig. 4. Bio-efficacy of different neem formulations against sesame leaf weaver, A. cataudella after first spray.

Fig. 4. Bio-efficacy of different neem formulations against sesame leaf weaver, A. cataudella after first spray.

Per cent mortality

0 to 2 day after spray

2 to 5 day after spray

5 to 10 day after spray

10 to 15 day after spray

15 to 20 day after spray

20 to 25 day after spray

25 to 30 day after spray

30 to 35 day after spray

35 to 40 day after spray

40 to 45 day after spray

45 to 50 day after spray

50 to 55 day after spray

55 to 60 day after spray

60 to 65 day after spray

65 to 70 day after spray

70 to 75 day after spray

75 to 80 day after spray

80 to 85 day after spray

85 to 90 day after spray

90 to 95 day after spray

95 to 100 day after spray

100.00

90.00

80.00

70.00

60.00

50.00

40.00

30.00

20.00

10.00

0.00
The significantly minimum pest mortality of 47.84 per cent was caused by azadirachtin 0.00045 per cent followed by neem oil 0.5 per cent (75.31% mortality).

The bio-efficacy of the neem products in the field indicated that more than 90 per cent control of the sesame leaf webber at ten day after application was achieved by the application of NSKE 5 per cent, NLE 4 per cent and azadirachtin 0.001 per cent.

### 4.3.2 Mortality after 2nd application

**On the 2 day**

The data presented in Table 8 and depicted in Fig. 5 on mortality of leaf webber recorded at the two days after second spray application revealed that the treatment of NLE 4 per cent caused the significantly maximum pest mortality of 78.31 per cent and it was at par with the mortality (72.79%) caused by NSKE 5 per cent.

Azadirachtin 0.00075 per cent, NSKE 3 per cent, neem oil 1.0 per cent, NLE 2 per cent and azadirachtin 0.001 per cent were in the next effective group of treatments which caused 65.53, 58.67, 58.43, 58.43 and 58.39 per cent pest mortality, respectively.

The significantly minimum mortality of 11.51 per cent was caused by azadirachtin 0.00045 per cent followed by neem oil 0.5 per cent and caused 29.89 per cent pest mortality.

**On the 5 day**

The data presented in Table 8 and depicted in Fig. 5 on mortality of sesame leaf webber recorded at the five day after second spray application indicated that the treatment of NLE 4 per cent caused the significantly maximum pest mortality of 93.07 per cent of the pest and it was at par with the mortality
Table 8. Bio-efficacy of the neem products against sesame leaf webber, *A. catalaunalis* (second spray)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment</th>
<th>Per cent mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2 DAS</td>
</tr>
<tr>
<td>1</td>
<td>Neem oil 0.5%</td>
<td>33.14*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(29.89)</td>
</tr>
<tr>
<td>2</td>
<td>Neem oil 1.0%</td>
<td>49.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(58.43)</td>
</tr>
<tr>
<td>3</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
<td>49.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(58.67)</td>
</tr>
<tr>
<td>4</td>
<td>Neem seed kernel extract (NSKE) 5%</td>
<td>58.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(72.79)</td>
</tr>
<tr>
<td>5</td>
<td>Neem leaf extract (NLE) 2%</td>
<td>49.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(58.43)</td>
</tr>
<tr>
<td>6</td>
<td>Neem leaf extract (NLE) 4%</td>
<td>62.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(78.31)</td>
</tr>
<tr>
<td>7</td>
<td>Azadirachtin 0.00045%</td>
<td>19.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(11.51)</td>
</tr>
<tr>
<td>8</td>
<td>Azadirachtin 0.00075%</td>
<td>54.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(65.53)</td>
</tr>
<tr>
<td>9</td>
<td>Azadirachtin 0.001%</td>
<td>49.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(58.39)</td>
</tr>
</tbody>
</table>

*Angular transformation.

Figures in parentheses are retransformed values.

**DAS:** Days after spraying.
<table>
<thead>
<tr>
<th>Treat. No.</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Neem oil 0.5%</td>
</tr>
<tr>
<td>T2</td>
<td>Neem oil 1.0%</td>
</tr>
<tr>
<td>T3</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
</tr>
<tr>
<td>T4</td>
<td>Neem seed kernel extract (NSKE) 5%</td>
</tr>
<tr>
<td>T5</td>
<td>Neem leaf extract (NLE) 2%</td>
</tr>
<tr>
<td>T6</td>
<td>Neem leaf extract (NLE) 4%</td>
</tr>
<tr>
<td>T7</td>
<td>Azadirachtin (0.15% EC) 0.00045%</td>
</tr>
<tr>
<td>T8</td>
<td>Azadirachtin (0.15% EC) 0.00075%</td>
</tr>
<tr>
<td>T9</td>
<td>Azadirachtin (0.15% EC) 0.001%</td>
</tr>
<tr>
<td>T10</td>
<td>Control (water spray)</td>
</tr>
</tbody>
</table>
Fig. 5. Bio-efficacy of different neem formulations against sesame leaf weevil, A. calandrae, after second spray.
(92.42% and 85.73%) caused by NSKE 5 per cent and azadirachtin 0.00075 per cent.

Neem oil 1.0 per cent, azadirachtin 0.001 per cent, NLE 2 per cent and NSKE 3 per cent were in the next effective group of treatments which caused 83.10, 82.60, 82.34 and 81.17 per cent pest mortality, respectively.

The significantly minimum pest mortality 62.58 per cent was caused by neem oil 0.5 per cent followed by azadirachtin 0.00045 per cent (64.02%).

**On the 10 day**

The data presented in Table 8 and depicted in Fig. 5 on mortality of leaf webber recorded ten day after second spray indicated that the treatment of NLE 4 per cent caused the significantly maximum pest mortality of 94.49 per cent and it was at par with the treatments of azadirachtin 0.001 per cent and NSKE 5 per cent which caused 93.54 per cent and 93.16 per cent mortality, respectively.

Neem oil 1.0 per cent, NLE 2 per cent and azadirachtin 0.00075 per cent were in the next effective group of treatments which caused 85.30, 84.87 and 81.36 per cent mortality, respectively.

NSKE 3 per cent and neem oil 0.5 per cent gave the pest mortality of 77.58 and 76.96 per cent, respectively and were found moderately effective against the pest.

The significantly minimum mortality of 49.62 per cent was caused by azadirachtin 0.00045 per cent.

Thus, the results of the two spraying of the neem products against the sesame leaf webber revealed that NSKE 5 per cent, NLE 4 per cent and azadirachtin 0.001 per cent were found more effective treatments against the pest as compared to other
treatments they caused more than 90 per cent pest mortality in the field. The lower dose of NSKE (3%) and NLE (2%) was also found good in the effectiveness as they caused more than 83 per cent pest mortality.

Earlier, the effectiveness of neem leaf extract and neem seed kernel extract against leaf webber has been reported by Nath et al. (2002), Ahuja and Kalyan (2003), Gupta (2003) and Ahirwar et al. (2008). Thus, the results obtained in the present investigation are in close agreement with the findings of the earlier workers.

4.3.3 Capsules damage due to sesame leaf webber in the various neem product (Plate 5)

The data presented in Table 9 and depicted in Fig. 6 revealed that the capsule damage due to the sesame leaf webber, A. catalaunalis under different treatments of the neem products were significantly low over control and varied from 3.61 to 13.62 per cent.

The significantly minimum capsules damage of 3.61 per cent was recorded in the crop treated with NSKE 5 per cent and it was statistically at par with azadirachtin 0.001 per cent and caused 4.84 per cent damage of capsules.

NLE 4 per cent and NSKE 3 per cent were in the next effective group of treatments against the leaf webber with the capsule damage of 6.07 and 7.86 per cent, respectively.

Azadirachtin 0.00075 per cent, NLE 2 per cent and azadirachtin 0.00045 per cent recorded the capsule damage of 8.53, 9.76 and 10.99 per cent, respectively and were found the moderately effective treatments.
Table 9. Sesame capsules damaged due to the leaf webber in various neem products

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment</th>
<th>Per cent capsules damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>Neem oil 0.5%</td>
<td>21.65*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(13.62)</td>
</tr>
<tr>
<td>T₂</td>
<td>Neem oil 1.0%</td>
<td>20.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(12.39)</td>
</tr>
<tr>
<td>T₃</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
<td>16.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(7.86)</td>
</tr>
<tr>
<td>T₄</td>
<td>Neem seed kernel extract (NSKE) 5%</td>
<td>10.96</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.61)</td>
</tr>
<tr>
<td>T₅</td>
<td>Neem leaf extract (NLE) 2%</td>
<td>18.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(9.76)</td>
</tr>
<tr>
<td>T₆</td>
<td>Neem leaf extract (NLE) 4%</td>
<td>14.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6.07)</td>
</tr>
<tr>
<td>T₇</td>
<td>Azadirachtin 0.00045%</td>
<td>19.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10.99)</td>
</tr>
<tr>
<td>T₈</td>
<td>Azadirachtin 0.00075%</td>
<td>16.98</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(8.53)</td>
</tr>
<tr>
<td>T₉</td>
<td>Azadirachtin 0.001%</td>
<td>12.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.84)</td>
</tr>
<tr>
<td>T₁₀</td>
<td>Control</td>
<td>28.39</td>
</tr>
<tr>
<td></td>
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<td>(22.61)</td>
</tr>
</tbody>
</table>

*Angular transformation.

Figures in parentheses are retransformed values.
<table>
<thead>
<tr>
<th>Treat. No.</th>
<th>Treatements</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Neem oil 0.5%</td>
</tr>
<tr>
<td>T2</td>
<td>Neem oil 1.0%</td>
</tr>
<tr>
<td>T3</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
</tr>
<tr>
<td>T4</td>
<td>Neem seed kernel extract (NSKE) 5%</td>
</tr>
<tr>
<td>T5</td>
<td>Neem leaf extract (NLE) 2%</td>
</tr>
<tr>
<td>T6</td>
<td>Neem leaf extract (NLE) 4%</td>
</tr>
<tr>
<td>T7</td>
<td>Azadirachtin (0.15% EC) 0.00045%</td>
</tr>
<tr>
<td>T8</td>
<td>Azadirachtin (0.15% EC) 0.00075%</td>
</tr>
<tr>
<td>T9</td>
<td>Azadirachtin (0.15% EC) 0.001%</td>
</tr>
<tr>
<td>T10</td>
<td>Control (water spray)</td>
</tr>
</tbody>
</table>
Fig. 6. Per cent capsule damage to sesamum due to leaf webber, *A. catalaunalis* in different treatments.
Neem oil 1.0 per cent and neem oil 0.5 per cent proved to be the least effective treatments against the pest with 12.39 and 13.62 per cent capsule damage, respectively.

Significantly the maximum capsule damage of 22.61 per cent was recorded in the control plot.

Thus, the minimum capsule damage (3.61%) was recorded in NSKE 5 per cent followed by azadirachtin 0.001 per cent, NLE 4 per cent and NSKE 3 per cent in which 5 to 8 per cent damaged capsules recorded.

Ahuja and Kalyan (2003) reported that the commercial formulation neemgold (0.3%) was the most effective with minimum capsule damage (8.66%) followed by NSKE 5 per cent. Gupta (2003) also recorded lower capsule damaged (2.8%) by treatment of NSKE in cow urine. While, Ahirwar et al. (2008) revealed that NLE and NSKE (in cow urine) @ 30 ml/litre were highly effective and at par with endosulfan (0.07%) in reducing larval population and flower and capsule damage by A. catalaunalis larvae. Thus, the results obtained in present investigation are in close agreement with the findings of the earlier workers.

4.4 Yield and economics

4.4.1 Yield

The data summarized in Table 10 and depicted in Fig. 7 indicated that the crop treated with the two application of neem products produced significantly higher sesame yield over untreated-control. However, significantly the highest yield of 727 kg/ha (44.97% increase over control) was obtained from the crop treated with NSKE 5 per cent and it was statistically at par with the yield received from the treatment of azadirachtin 0.001 per cent (667 kg/ha, 40.03% increase), NLE 4 per cent (662 kg/ha,
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment</th>
<th>Yield (Kg/ha)</th>
<th>Yield increase over control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>Neem oil 0.5%</td>
<td>410</td>
<td>2.43</td>
</tr>
<tr>
<td>T₂</td>
<td>Neem oil 1.0%</td>
<td>505</td>
<td>20.79</td>
</tr>
<tr>
<td>T₃</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
<td>655</td>
<td>38.93</td>
</tr>
<tr>
<td>T₄</td>
<td>Neem seed kernel extract (NSKE) 5%</td>
<td>727</td>
<td>44.97</td>
</tr>
<tr>
<td>T₅</td>
<td>Neem leaf extract (NLE) 2%</td>
<td>630</td>
<td>36.50</td>
</tr>
<tr>
<td>T₆</td>
<td>Neem leaf extract (NLE) 4%</td>
<td>662</td>
<td>39.58</td>
</tr>
<tr>
<td>T₇</td>
<td>Azadirachtin 0.00045%</td>
<td>625</td>
<td>36.00</td>
</tr>
<tr>
<td>T₈</td>
<td>Azadirachtin 0.00075%</td>
<td>634</td>
<td>36.91</td>
</tr>
<tr>
<td>T₉</td>
<td>Azadirachtin 0.001%</td>
<td>667</td>
<td>40.03</td>
</tr>
<tr>
<td>T₁₀</td>
<td>Control</td>
<td>400</td>
<td>-</td>
</tr>
</tbody>
</table>

The data shows the yield of sesame in various neem products applied against leaf webber, A. cattalauonis during Kharif 2010.
39.58% increase) and NSKE 3 per cent (655 kg/ha, 38.93% increase).

Crop treated with azadirachtin 0.00075 per cent, NLE 2 per cent and azadirachtin 0.00045 per cent produced yield of 634 to 625 kg/ha (37 to 36% increased) and were at par with each other.

Neem oil 1.0 per cent gave the yield of 505 kg/ha (20.79% increase over control) and proved to be the moderately effective treatment.

Significantly the minimum yield of 410 kg/ha was recorded from the crop treated with neem oil 0.5 per cent and was at par with the yield received from untreated crop (400 kg/ha). Thus, this treatment found ineffective against sesame leaf webber.

Out of the two dose of neem oil evaluated against sesame leaf webber, the lower dose (0.5%) was found ineffective. While, the higher dose gave good protection against the pest and significantly yield increased over control.

### 4.4.2 Economics

The data on economics of two application of the different neem products against sesame leaf webber, *A. catalausalis* during *Kharif* 2010 are presented in Table 11 and depicted in Fig. 7.

Maximum net return of ₹ 14715/ha with C: B ratio 1: 12.26 was obtained from the treatment of NSKE 5 per cent, followed by azadirachtin 0.00075 per cent (₹ 12015/ha, C: B ratio 1: 5.72), NLE 2 per cent (₹ 11790/ha, C: B ratio 1: 23.58), NSKE 3 (₹ 11475/ha, C: B ratio 1: 14.34), azadirachtin 0.001 per cent (₹ 10530/ha, C: B ratio 1: 3.83), NLE 4 per cent (₹ 10350/ha, C: B ratio 1: 12.94) and azadirachtin 0.00045 per cent (₹ 10125/ha, C: B ratio 1: 7.55).
Table 11. Economics of the different neem formulations evaluated against sesame leaf webber, *A. catalaunalis* during *Kharif* 2010

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment</th>
<th>Insecticide used for 2 sprays (l or kg/ha)</th>
<th>Cost of application (₹/ha)*</th>
<th>Yield (kg/ha)</th>
<th>Gross return (₹/ha)**</th>
<th>Net return (₹/ha)</th>
<th>C: B ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neem oil 0.5%</td>
<td>5.00</td>
<td>950</td>
<td>410</td>
<td>18450</td>
<td>450</td>
<td>1: 0.47</td>
</tr>
<tr>
<td>2</td>
<td>Neem oil 1.0%</td>
<td>10.00</td>
<td>1700</td>
<td>505</td>
<td>22725</td>
<td>4725</td>
<td>1: 2.78</td>
</tr>
<tr>
<td>3</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
<td>30.00</td>
<td>800</td>
<td>655</td>
<td>29475</td>
<td>11475</td>
<td>1: 14.34</td>
</tr>
<tr>
<td>4</td>
<td>Neem seed kernel extract (NSKE) 5%</td>
<td>50.00</td>
<td>1200</td>
<td>727</td>
<td>32715</td>
<td>14715</td>
<td>1: 12.26</td>
</tr>
<tr>
<td>5</td>
<td>Neem leaf extract (NLE) 2%</td>
<td>20.00</td>
<td>500</td>
<td>630</td>
<td>29790</td>
<td>11790</td>
<td>1: 23.58</td>
</tr>
<tr>
<td>6</td>
<td>Neem leaf extract (NLE) 4%</td>
<td>40.00</td>
<td>800</td>
<td>662</td>
<td>28350</td>
<td>10350</td>
<td>1: 12.94</td>
</tr>
<tr>
<td>7</td>
<td>Azadirachtin 0.00045%</td>
<td>3.00</td>
<td>1340</td>
<td>625</td>
<td>28125</td>
<td>10125</td>
<td>1: 7.55</td>
</tr>
<tr>
<td>8</td>
<td>Azadirachtin 0.00075%</td>
<td>5.00</td>
<td>2100</td>
<td>634</td>
<td>30015</td>
<td>12015</td>
<td>1: 5.72</td>
</tr>
<tr>
<td>9</td>
<td>Azadirachtin 0.001%</td>
<td>6.70</td>
<td>2746</td>
<td>667</td>
<td>28530</td>
<td>10530</td>
<td>1: 3.83</td>
</tr>
<tr>
<td>10</td>
<td>Control</td>
<td>-</td>
<td>-</td>
<td>400</td>
<td>18000</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Labours charges @ ₹ 100/ha/spray. **The price of sesameum @ ₹ 45/kg.
<table>
<thead>
<tr>
<th>Treat. No.</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Neem oil 0.5%</td>
</tr>
<tr>
<td>T2</td>
<td>Neem oil 1.0%</td>
</tr>
<tr>
<td>T3</td>
<td>Neem seed kernel extract (NSKE) 3%</td>
</tr>
<tr>
<td>T4</td>
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</tr>
<tr>
<td>T5</td>
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</tr>
<tr>
<td>T6</td>
<td>Neem leaf extract (NLE) 4%</td>
</tr>
<tr>
<td>T7</td>
<td>Azadirachtin (0.15% EC) 0.00045%</td>
</tr>
<tr>
<td>T8</td>
<td>Azadirachtin (0.15% EC) 0.00075%</td>
</tr>
<tr>
<td>T9</td>
<td>Azadirachtin (0.15% EC) 0.001%</td>
</tr>
<tr>
<td>T10</td>
<td>Control (water spray)</td>
</tr>
</tbody>
</table>
Fig. 7. Economics of the different neem products evaluated against sesame leaf webber.
Neem oil 1.0 per cent gave relatively lower net returns of ₹ 4725/ha with C: B ratio 2.78.

The data on economics of two application of the neem products against the sesame leaf weber revealed that the maximum yield increase was 45 per cent with 90 per cent pest mortality and minimum capsule damaged was 3.61 per cent from the crop treated with NSKE 5 per cent which resulted in the highest net return of ₹ 14715/ha with C: B ratio 12.26. Further, it was found that the yield received from the crop treated with NSKE 5 per cent, NSKE 3 per cent, NLE 4 per cent and azadirachtin 0.001 per cent was statistically equal (Table 10). And the net return (₹ 11790/ha) with C: B ratio 23.58 was also higher from NLE 2 per cent and NSKE 3 per cent (₹ 11475/ha and 14.34). The C: B ratio was higher due to cost of half dose of NLE 2 per cent and NSKE 3 per cent as compared to its full doses i.e. NLE 4 per cent and NSKE 5 per cent.

Therefore, it can be clearly concluded that the two application of the neem products NSKE 3 to 5 per cent or NLE 2 per cent or azadirachtin 0.00075 per cent were found the most effective and economic for control of A. catalaunalis infesting sesame under the field condition at Tarahadia (Rajkot) during Kharif 2010. The first application of these neem products should be given when the pest population reach at the 5 larvae/ 20 plant (at ETL) and second at 15 day interval.
SUMMARY AND CONCLUSION

Sesame is an important oilseed crop of India. This crop is attacked by leaf webber, A. cattarhalea from germination to maturity causing severe damage to the crop. Efforts were therefore made to study the seasonal incidence and bio-efficacy of eco-friendly botanical pesticide i.e. neem products against leaf webber, A. cattarhalea infesting sesame during monsoon season 2010. The important conclusion emerged out from these investigations are summarized hereafter.

1. Seasonal incidence of A. cattarhalea was carried out at two locations, South Saurashtra Agro-climatic Zone - Terghadia (Rajkot) and North Saurashtra Agro-climatic Zone. The pest infestation was initiated at both the locations and the pest population continued to increase.

2. The highest pest population i.e. more larval/plant continued for five weeks (6 to 10 weeks after sowing) at Junagadh. While, it was only for one week (7th week after sowing) at Terghadia (Rajkot).

3. The pest population reached a peak during the 8th week after sowing (34th standard week) at Junagadh and one week earlier at Terghadia (Rajkot) and caused 89 per cent or more plant damage. The plant damage increased with increase in the pest population at both the location. Further, it was also found that the weather parameters which favored higher pest population were temperature maximum 31 to 32°C, minimum 25°C with relative humidity: morning maximum of 75 percent and 95 percent at Junagadh and Terghadia respectively.
CHAPTER V
SUMMARY AND CONCLUSION

Sesame is an important oilseed crop of India. The crop is attacked by leaf webber, *A. catalaunalis* from germination to maturity causing severe damage to the crop. Efforts were, therefore, made to study the seasonal incidence and bio-efficacy of eco-friendly botanical pesticide i.e. neem products against leaf webber, *A. catalaunalis* infesting sesame during Kharif season of 2010. The important conclusion emerged out from these investigations are summarized here after.

5.1 Seasonal incidence of sesame leaf webber, *A. catalaunalis*

The study on seasonal abundance of sesame leaf webber was carried out at two different location i.e. at Junagadh in South Saurashtra Agro-climatic Zone and at Targhadia (Rajkot) in North Saurashtra Agro-climatic Zone. The pest infestation was initiated within a week after sowing the crop and remained continue upto the crop maturity at both the location. However, the higher pest population i.e. more larvae/ plant continued for five week (6 to 10 week after sowing) at Junagadh. While, it was only for one week (7th week after sowing) at Targhadia (Rajkot). The pest population reached at a peak during the 8th week after sowing (34th standard week) at Junagadh and one week early at Targhadia (Rajkot) and caused 89 per cent or more plant damage. The plant damage increased with increase in the pest population at both the location. Further, it was also found that the weather parameters which favoured higher pest population at both the location were temperature maximum 31 to 32°C and minimum 25°C with relative humidity, morning (maximum) 87 to
92 per cent and evening (minimum) 71 to 78 per cent, sunshine hours 2 to 3 with rainfall 31 to 38 mm in 2 to 3 rainy days in a week.

5.2 **Bio-efficacy of the neem products against leaf webber, A. catalaunalis under laboratory condition**

The result of bio-efficacy of the neem products on the 2nd instar larvae of leaf webber, *A. catalaunalis* under laboratory condition revealed that 50 per cent pest mortality was achieved at the three day on NSKE 5 per cent treated sesame twig. While, it was at the 4 day after spray in neem oil 1 per cent, NSKE 3 per cent, NLE 2 per cent, NLE 4 per cent and azadirachtin 0.001 per cent. Further, it was found that the 50 per cent or more mortality of the insect larvae was recorded at the 5 day after feeding on neem oil 0.5 per cent, azadirachtin 0.00045 per cent and azadirachtin 0.00075 per cent treated twigs. The mortality of insect larvae continued to increase in all the treatments after its application. Thé cent per cent mortality on the 7 day was recorded due to neem oil 1 per cent, NSKE 3 per cent, NSKE 5 per cent, NLE 4 per cent and azadirachtin 0.001 per cent and on the 8th day due to NLE 2 per cent, azadirachtin 0.00075, 0.00045 per cent and neem oil 0.5 per cent.

5.3 **Bio-efficacy of the neem products against leaf webber, A. catalaunalis under field condition**

5.3.1 **Bio-efficacy**

The results of the two spraying of the neem products against the leaf webber revealed that NSKE 5 per cent, NLE 4 per cent and azadirachtin 0.001 per cent were found the most effective against the pest as they caused more than 90 per cent pest mortality in the field. The lower doses of NSKE (3%) and
NLE (2%) were also found good in effectiveness and caused more than 83 per cent pest mortality.

5.3.2 **Capsule protection**

The sesame crop treated with two application of NSKE 5 per cent and azadirachtin 0.001 per cent recorded significantly minimum capsule damaged (3.61 to 4.84%). The treatment of NLE 4 per cent, NSKE 3 per cent, azadirachtin 0.00075 per cent, NLE 2 per cent and azadirachtin 0.00045 per cent were in the next effective group of treatments with the capsule damage of 6.07 to 10.99 per cent. Neem oil 1.0 per cent and neem oil 0.5 per cent proved to be the least effective treatments with 12.39 to 13.62 per cent capsule damage. Maximum capsule damage of 22.61 per cent was recorded in the control plot.

5.4 **Yield and economics**

5.4.1 **Yield increased**

The sesame yield received (727 to 655 kg/ha) from crop treated with applications of NSKE 3 and 5 per cent, NLE 4 per cent and azadirachtin 0.001 per cent against leaf webber was 45 to 39 per cent increase over control (untreated crop). Further, it was also found that 37 to 36 per cent yield increase was recorded due to treatment of azadirachtin 0.00075 per cent, NLE 2 per cent and azadirachtin 0.00045 per cent (634 to 625 kg/ha). Neem oil 0.5 and 1.0 per cent gave the yield of 410 kg/ha and 505 kg/ha (2.43% and 20.79% increase over control) and proved to be the moderately effective treatment.

5.4.2 **Economics**

Maximum net return of ₹ 14715 to 11475 was obtained in the treatments of NSKE 5 per cent, azadirachtin 0.00075 per cent, NLE 2 per cent and NSKE 3 per cent. Azadirachtin 0.001 per cent, NLE 4 per cent and azadirachtin 0.00045 per cent
proved to be the next economic treatments with the net returns of ₹ 10125 to 10530. Neem oil 1.0 per cent gave the net returns of ₹ 4725. Whereas, neem oil 0.5 per cent with the net return of ₹ 450 was found the least economic treatment.

As far as the cost benefit ratio is concerned, NLE 2 per cent gave the maximum cost benefit ratio of 23.58 followed by NSKE 3 per cent (14.34), NLE 4 per cent (12.94) and NSKE 5 per cent (12.26). Azadirachtin 0.00045 per cent, azadirachtin 0.00075 per cent, azadirachtin 0.001 per cent and neem oil 1.0 per cent gave the cost benefit ratio of 1: 2.78 to 1: 7.55. Neem oil 0.5 per cent with the cost benefit ratio of 1: 0.47 was found the least economic treatment.

Thus, looking to the effectiveness and economics of the different neem formulations, it can be concluded that NSKE 3 to 5 per cent, NLE 2 to 4 per cent and azadirachtin 0.00045 per cent were found highly effective with 93 to 83 per cent pest mortality and economical treatments with 48 to 39 per cent increased yield with maximum net return for the control of the sesame leaf webber during Kharif 2010 at Targhadia (Rajkot).
REFERENCES


