INSECTICIDAL MANAGEMENT OF INSECT PESTS OF SESAMUM

THESIS

Submitted to
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
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By

DAFALE HARSHAL DINKARRAO

DEPARTMENT OF AGRICULTURAL ENTOMOLOGY,
POST GRADUATE INSTITUTE, AKOLA

DR. PANJABRAO DESHMUKH KRISHI VIDYAPEETH,
KRISHINAGAR PO, AKOLA (MS) 444104

Enrolment Number - EE/1008 **2012**

DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of the Thesis entitled **"INSECTICIDAL MANAGEMENT OF INSECT PESTS OF SESAMUM"** or part there of has neither been submitted for any other degree or diploma of any university, nor the data have been derived from any thesis / publication of any university or scientific organization. The source of materials used and all assistance received during the course of investigation have been duly acknowledged.

Place: Akola

Date: 31/05/2012

(Dafale Harshal Dinkarrao)

Enrolment No. EE/1008


153917
AKOLA

CERTIFICATE

This is to certify that, the thesis entitled **"INSECTICIDAL MANAGEMENT OF INSECT PESTS OF SESAMUM"** submitted in partial fulfilment of the requirement for the degree of "**Master of Science in Agricultural Entomology**" of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Dafale Harshal Dinkarrao** under my guidance and supervision.

The subject of thesis has been approved by the student's Advisory Committee.

Place: Akola
Date: 31/05/2012

(Dr. U.P. Barkhade)
Chairman
Advisory Committee

Countersigned

Associate Dean
Post Graduate Institute
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE INCLUDING EXTERNAL EXAMINER (AFTER VIVA–VOCE)

1. Chairman	Dr. U.P. Barkhade	
2. Member	Dr. U.S. Kulkarni	
3. Member	Dr. N.S.Satpute	
4. Member	Dr. S.S.Mane	
5. External Member	(Dr. P.K. Rathod)	

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(Dafale Harshal Dinkarrao)

Enroll. No. EE/1008

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(D) Abbreviations

%	-	per cent
CD	-	Critical difference
cm	-	Centimeter
CV	-	Coefficient of variation
DAE	-	Days after emergence
DAG	-	Days after germination
DAT	-	Days after treatment
EC	-	Emulsifiable concentrate
et al.	-	et alia (And others)
etc.	-	Etcetera
ETL	-	Economic threshold level
Fig.	-	Figure
g	-	gram
ha	-	Hectare
i.e.	-	id est (that is)
ICBR	-	Incremental cost benefit ratio
kg	-	kilogram
m	-	meter
ml	-	millilitre
No.	-	Number
NS	-	Non significant
NSE	-	Neem seed kernel extact
ppm	-	parts per million
q	-	Quintal
RBD	-	Randomized block design
Rs.	-	Rupees
SC	-	Soluble concentrate
SE(m)$\pm$	-	Standard error of mean
Sig.	-	Significant
SL	-	Soluble liquid
SP	-	Soluble powder
viz.	-	Videlicet (Namely)
WG	-	Wettable granules
WSC	-	Water soluble concentrate

(E) THESIS ABSTRACT

a)	Title of the thesis	:"INSECTICIDAL MANAGEMENT OF INSECT PESTS OF SESAMUM".
b)	Full name of student	: Dafale Harshal Dinkarrao
c)	Name and address of Major Advisor	: Dr.U.P.Barkhade Professor and Head Department of Agricultural Entomology and Registrar, Dr.PDKV, Akola.
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j)	Signature, Name and address of forwarding authority	:

Head
Department of Agricultural Entomology
Post Graduate Institute,
Dr. PDKV, Akola

Abstract

Sesamum is an important oilseed crop and is reported to be attacked by number of pests among which sesamum gall fly and capsule borer are major pests. Gall fly and capsule borer are internal feeders and needs to be managed in time to avoid heavy losses. So in the present study efforts were made to evaluate the efficacy of some

insecticides against insect pests of sesamum and to study the cost effectiveness of these treatments.

An experiment was carried out in Field of Department of Entomology, Dr. PDKV, Akola. The experiment was conducted in RBD with eight treatments replicated thrice. Sesamum variety AKT-64 was sown at 45cm X10cm spacing. The parameters used for evaluation were per cent infestation and grain yield. To study economics, ICBR of each treatment was worked out separately and compared.

The results revealed that on the basis of average per cent infestation of gall fly, treatments spinosad 45 SC (0.01%) followed by thiacloprid 48 SC (0.009%) and fenvalerate 20 EC (0.01%) were found to be most effective in order of merit. In case of capsule borer, treatments spinosad 45 SC (0.01%) followed by indoxacarb 14.5 SC (0.01%) and rynaxypyr 20 SC (0.01%) were found most effective.

As regards to the sesamum yield, spinosad 45 SC, indoxacarb 14.5 SC and fenvalerate 20 EC, were found to be most effective treatments recording yield of 737, 663 and 636 kg/ha respectively.

As far as economics of the treatments is concerned, fenvalerate 20 EC, thiacloprid 48 SC and spinosad 45 SC were emerged as most economic treatments recorded an ICBR of 1:11.91, 1:4.14 and 1:2.64 respectively.

From the farmers point of view, fenvalerate 20 EC, thiacloprid 48 SC and spinosad 45 SC were most effective in terms of net monitory returns.

From the seed production point of view, spinosad 45 SC, indoxacarb 14.5 SC and fenvalerate 20 EC were most effective in recording highest yield. However, though the fenvalerate 20 EC was found effective in terms of recording minimum per cent infestation of gall fly and capsule borer and recorded highest ICBR of 1:11.91.

CHAPTER I

INTRODUCTION

1.1 Background Information

Sesamum (*Sesamum indicum* L.) is considered to be oldest of the oilseed plant and is under cultivation in Asia from ancient times. In India, the antiquity of sesamum is known from the use of its seeds in the religious ceremonies and its mention in the old Hindu literature including Atherva Ved, Vishnu Puran, Kuatilay's Artha Shashtra (Arora and Reley, 1994). Sesamum is called as "Queen of Oilseeds" in the view of oil content and protein of very high quality and it has tremendous potential for export (Anonymous 2003 b).

Sesamum (2n = 26) belongs to the family pediliaceae which consist of about 16 genera and 60 species. Sesamum is self pollinated crop (Singh et al.. 1990) sesamum is cultivated for its seeds which contain 48 to 55 per cent oil of very high quality and 25 to 28 per cent protein. In India, seed is eaten fried or mixed with sugar. The oil is used for cooking and medicinal purpose.

Sesamum is grown on 7.8 million ha area in world with annual production of 3.84 million metric tones (Anonymous 2010b). The worldwide average yield of sesame seeds was 0.49 metric tonnes per hectare in 2010.In India, it is cultivated in all seasons viz. *kharif*, semi *rabi* and summer. In India annual production was 0.62 million tones (Anonymous 2010b). India ranks first in area (29%) and export (40%) while Myanmar ranks first in production of sesamum in world (Anonymous 2010a). In Maharashtra sesamum is cultivated on 1.34 lakh ha with 0.42 lakh tones production annually (Anonymous 2010).

Productivity of this crop is relatively low as compared to other oilseed crops. Hence there is a considerable scope for improving productivity.

The reasons of low productivity in Maharashtra are summarized as

1. It is mostly a rainfed crop, but it is grown in residual soil moisture condition in semi *rabi* conditions.
2. Use of low yielding strains
3. Poor crop management practices
4. Absence of crop protection measures
5. Crop is confined to marginal and submarginal lands
6. Often taken as mixed crop
7. The crop has not received adequate attention of the research and development agencies (Arora and Reley, 1994).

1.2 Importance of study

Sesamum is attacked by about 65 species of insect pests in different stages of plant growth. Amongst all, sesamum leaf webber and capsule borer (*Antigastra catalaunalis* Duponchel) Lepidoptera : Pyraustidae was considered to be most destructive pest, throughout India. Fletcher (1914) for the first time reported the occurrence of this pest on sesamum plants from South India.

A. catalaunalis is found all over the world where this crop is grown. It has been recorded from France, USSR, East and West Africa, Cyprus, Malta Syria, Aden, Srilanka, Myanmar, China, India, Egypt, Congo, Sumatra, Uganda and Israel (Weiss 1983).

Cheema and Singh (1987) reported 53 per cent less seed in the infested pods due to leaf webber and capsule borer (*Antigastra catalaunalis* Dup).

Another serious pest of sesamum is *Asphondylia sesami* Felt. (Diptera: Cecidomyiidae) commonly known as sesamum gall fly and is widely distributed in South part of country noticed during September, 1970 at Regional Station of Agricultural Research, Sumedhpur (Pali, U.P.) This appears to be the first report of this pest infestation to

sesamum in Rajasthan (Verma and Mathur, 1973). It is reported as a major pests from Maharashtra and Andhra Pradesh, as a moderate pests from Tamil Nadu and as a minor from Rajasthan . It is also reported that it causes serious damage to sesamum in South India (Madras), Andhra Pradesh and Gujarat (Singh 1990).

The spread of this pest is wide, being a polyphagous pest it is reported to cause substantial damage to many crops. The infestation by *Asphondylia sesami* Felt. was recorded about 99.23 per cent of the plants in the population from the plains of West Bengal and estimated loss in the yield due to the gall formation was calculated as 31.28 per cent (Range between 4.47 to 85.71 %) (Sengupta et al. 2002).

1.3 Objectives of study

Considering the above mentioned facts the present experiment was planned to study "Insecticidal management of insect pests of sesamum"

a) To find out the efficacy of different insecticides against insect pests of sesamum.

b) To find out economics of different treatments.

1.4 Scope and limitations

There is large scope for developing effective pest management approach because the indiscriminate use of insecticide disturb natural balance of pest and other enemies leading to resurgence of pest and pollution in crop ecosystem.

There was 53.1 per cent less seed in the infested pods due to leaf webber and capsule bore (*Antigastra catalaunalis* Dup.) (Cheema and Singh 1987).

Another serious pest of sesamum is gall fly the infestation by *Asphondylia sesami* Felt. was recorded about 99.23 per cent of the

plants in the population from the plains of West Bengal and estimated loss in the yield due to the gall formation was calculated as 31.28 per cent (4.47 to 85.71 %) (Sengupta et al. 2002).

Therefore the effective control method for the management of sesamum pests results in greater production of sesamum.

Limitation

Insect infestation fluctuates over seasons and locations depending on biotic and abiotic factors which affect the crop and its associated invertebrate fauna.

1.5 Hypothesis

In spite of its great importance as edible oilseed, the cultivation of sesamum is confined to marginal and submarginal lands under very poor agronomical practices resulted in low average yield. Diseases and pests take heavy toll of this crop plant production measures are generally not adopted which ultimately result in the crop being less remunerative, therefore constituting a major constraint in successful production.

The indiscriminate use of the pesticides has resulted into numerous problems. There is development of resistance in target and non target pests against insecticides, disrupting natural balance of the pest and its enemies, resurgence of the minor pest into major ones and adding population to ecosystems and causing hazard to human health.

Thus it is the need of the hour to evolve the new insecticides superior to existing one along with biopesticides which are ecofriendly and safer to non target insect.

CHAPTER II

REVIEW OF LITERATURE

The sesamum is extensively grown in Vidarbha and Marathwada region of the Maharashtra. The important pests infesting the crop in the state are sesamum gall fly, leaf roller, capsule borer and leaf eating caterpillar. Sesamum gall fly (*Asphondylia sesami* Felt.), leaf roller and capsule borer (*Antigastra catalaunalis* Dup.) occur regularly in the sesamum growing areas and damage the crop during seedling, flowering and maturity stages of the crop cause heavy losses due to their infestation. The efficacy of different insecticides has been tested by several workers against sesamum gall fly and sesamum capsule borer.

The comprehensive review is prepared by referring to the most important available literature to compare the results of present investigations with the previous work. The literature surveyed is presented below under different sub headings.

2.1 Occurrence, damage and losses due to major pests of sesamum

Jones and Jones (1964) reported that gall midges belong to order Diptera, sub order Nematocera and family Cecidomyiidae. They are minute flies with hairy wings and long antennae. When larvae feed attack all parts of plant giving rise to wide range of symptoms such as distortion, gall formation, when gall midge feeds on buds, flowers, capsules, it prevents seed formation.

Srivastava et al. (1985) stated that in spite of its great importance as edible oil seed the cultivation of sesamum is confined to marginal and submarginal lands under very poor agronomical practices resulted in low average yield.

Saxena and Jakhmola (1993) reported 10-60 per cent losses in yield due to *Antigastra catalaunalis* Dup.

Kumar and Goel (1994) studies on the bionomics and biology of *Antigastra catalaunalis* infestation of sesame observed in late September to mid October in UP, India causing 66.31 per cent seed loss per pod.

Ahuja and Bhaketia (1995) reported that sesamum is attacked by a large number of insect pests. Out of which important one are *Antigastra catalaunalis, Asphondylia sesami, Orisius albicinctus and Spilosoma obliqua.*

Hubeishan (1995) conducted field trials at the Kod Research Station, Yemen, to study the effect of planting dates on sesame infestation with *Asphondylia sesami* and *Antigastra catalaunalis.* A significant effect of planting dates on pod infestation was observed for insect infestation levels. There was a reduction in yield of 18.7 kg/ha for every 1 per cent increase in insect infestation level.

Sengupta et al. (2002) recorded the infestation by *Asphondylia sesami* Felt. about 99.23 per cent of the plants in the population from the plains of West Bengal and estimated loss in the yield due to the gall formation was calculated as 31.28 per cent (4.47 to 85.71 %).

Bhaduria et al. (2002) evaluated twenty sesamum cultivars for response of high gallfly (*Asphondylia sesami* Felt) pressure during the *kharif* season in 1987, in India. At 45 days after sowing, per cent capsule damage was calculated and found to range from 13.50 per cent in Thilithma to 64.40 per cent in C50.

Fedotova (2003) described sixty four species of gall midges of the genus *Asphondylia* in the palaerctic region.

Kumar et al. (2009) recorded that sesame gall fly *Asphondylia sesami,* flower beetle, *Oxycetomia dispar,* sesame bud fly *Dasyneura*

sesami and blister beetle were active from flowering to capsules formation stage of crop growth and peak infestation was at 37th standard week during 2006 and 2007. The surface grass hopper (*Chrotogonus trachyterous)* and til leaf webber and capsule borer (*Antigastra catalaunalis*) were recorded from seedling to harvesting stages of crop growth and peak infestation was recorded at 35th standard week.

2.2 Management of major pest of sesamum with insecticides

Hubeishan (1989) conducted field trials in Yemen Democratic Republic during 1982-83 and 1983-84 to evaluate the effectiveness of some insecticides against the cecidomyiid *Asphondylia sesami* and pyralid *Antigastra catalaunalis* on sesamum. The insecticides were methidathion (supracide 40 EC), Diazinon (basudin 60 EC), Fenvalerate (sumudin 20EC), dimethoate 30 EC and carbaryl 50 WP. All the treatments except dimethoate, significantly reduced the infestation of both insects and increased in yield. Diazinon and fenvalerate were most effective.

David et al. (1990) conducted field studies in Tamil Nadu, India. Fenvalerate was the most effective compound in reducing damage caused by *Asphondylia capsici* on chilli, followed by monocrotophos, phorate, cypermethrin, fenpropathrin, phosalone, carbofuron, HCH, dimethoate, neem oil, garlic extract, NSKE, diflubenzuron and TIS PH 70-23 (of unsaturated composition).

Hubeishan (1991) reported that all the insecticides except dimethoate significantly reduced the infestation of both insect and increased yield where as the diazinon and fenvalerate gave the most effective control of *Asphondylia sesami* and *Antigastra catalaunalis* respectively.

Sawada (1991) also reported that three sprays of fenitrothion or fenvalerate applied of 15 days interval starting from 10 days after the

beginning of flowering or 2 sprays of the same components at an interval of 20 days reduced the damage to 8-15 per cent levels.

Thompson et al. (1996) reviewed the technical properties of spinosad a secondary metabolite of *Saccharopolyspora spinosa*. The active ingredient in this first naturalyte insect control product, results of trials and is importance in insect management was briefly reviewed.

Tomar (1998) conducted field experiment at Bilaspur, MP, India during *kharif* of 1995-96 to calculate efficacy of endosulfan, fenvalerate, multineem (neem extract), carbaryl, acephate and Dipel (Btk) for controlling okra petiole maggots, *Melanagromyza hibisci* (Diptera) infesting okra. Endosulfan gave the largest percentage reduction in leaf infestation, larval reduction, pupae followed by carbaryl and fenvalerate whereas Dipel and acephate were less effective.

Gahbiche and Aoun (1999) found that in order to attempt an integrated pest management programme using biological products against leaf miner (Diptera) which are becoming important pests in protected crops, the efficacy of spinosad was tested on field population of *Liriomyza trifolii* (Diptera) in pepper cultivation. On both leaf miner larvae and pupae spinosad showed significant effect and persistency effect (15 days with a efficiency of 75 per cent on pupae). Besides it did not give any adverse effect on larval parasitoids of the leaf miner.

Leader and Dutton (2002) conducted field trials from 2001 and showed that the foliar application of spinosad can control thrips in lecks and salad onions as well as caterpillar pests in head and flowering cabbage and Brussels sprouts. Spinosad exhibits a favourable environment and mammalian toxicity profile and excellent safety to beneficial insects. It is selectively active against Lepidoptera, Diptera, Thysanoptera, Coleoptera and Hymenoptera.

Salas et al. (2002) evaluated the systemic insecticides imidacloprid 35 per cent and thiamethoxam 25 per cent as pre-

planting applications for control of citrus leafminer, *Phyllocnistis citrella* (Lepidoptera) on lemons in Las Tolitas, Argentina. Applications gave complete control of the leafminer for a prolonged time. Control of other insects was also observed.

Samspon et al. (2002) studied the ecology and control for the little understood, blueberry bud infesting gall midge *Dasineura oxycoccana* in Missisipi, USA during 1999-2000. Prebloom application of malathion would be effective larvicide. A microbial based alternative to malathion, spinosad, induced average mortality of 46 per cent in 24 hrs. was effective as phosmet (50 % mortality in 24 hrs.) for *Dasineura oxycoccana* control.

Singh et al. (2002) tested four insecticides viz., chlorpyriphos 20 EC at 0.16 and 0.25 kg a.i./ha ,fenvalerate 20 EC at 0.02 and 0.04 kg a.i./ha, monocrotophos 36 SL at 0.27 and 0.45kg a.i./ha and endosulfan 35 EC at 0.25 and 0.35 kg a.i./ha sprayed twice at the primordial stage and 20 days thereafter. All the insecticidal treatment significantly reduced linseed gall midge (Diptera) incidence compared to the control during both year. The minimum incidence (7.58%) was recorded in the plot treated with fenvalerate at 0.04 kg a.i./ha. The highest grain yield (9.87q/ha) was recorded in plots treated with 0.04 kg a.i. fenvalerate/ha followed by plots treated with 0.02 kg a.i. fenvalerate/ha (8.59 q/ha). Fenvalerate treatment at 0.02 and 0.04 kg a.i./ha were most economical with cost benefit ratio of 1:18.56 and 1:19.09, respectively.

Flye (2003) reported Laser (Spinosad) as the first insecticide proposed for a new class of insect control products, the naturalytes, spinosad has been shown to be highly active against insect species belonging to Lepidoptera, Diptera, Hymenoptera, Thysanoptera and a few Coleopteran. Spinosad may be used to control pests in both agricultural and horticultural environment. Due to its very low effective use rate, safety to environment, mammals spinosad was registered under U.S. Environmental protection Agency's reduced risk

programme. Laser provides user with unique package of desirable features, highly effective against many pests species.

For controlling leaf eating caterpillar, leaf rolling insect, jassids and gall midges on sesamum, fenthion 50 EC, 500ml or endosulfan 35 EC, 700 ml or quinolphos 25 EC, 1000 ml or carbaryl 50 WP, 2 kg or fenvalerate 20 EC, 250 ml/ha. In 500 liter is recommended for spraying (Anonymous, 2003a).

For management of sesamum gall fly, two sprayings of fenvalerate 0.001 per cent at 35 and 50 days after sowing followed by endosulfan 0.07 per cent and dimethoate 0.05 per cent were found most effective. Similarly, for management of capsule borer, NSE 5 per cent was recommended among all neem products tested in addition to earlier recommended insecticides (Anonymous, 2003b).

Reissig (2003) conducted field trials and laboratory bioassays to compare effectiveness of new insecticides i.e. imidacloprid, thiodicarb, pyriproxyfen, spinosad, thiacloprid and thiamethoxam against apple maggots. The activity ranking of the compound in reducing oviposition was imidacloprid > thiamethoxam >thiacloprid > spinosad > thiodicarb > pyriproxyfen.Thiacloprid was the only material that consistently controlled apple maggot (Diptera) fruit infestation in field.

Tescari et al. (2004) reported Laser as a new suspension containing the active ingredient spinosad and two metabolites from *Saccharopolyspora spinosa*. This formulation is highly active against common pest of strawberry and many small fruits including species from Lepidoptera, Diptera. Hymenoptera, Thysanoptera and Coleoptera it is characterized with low effective use rate safety to environment mammals and beneficial insects.

Thakare et al. (2005) conducted field trials on sesamum for three years during 2000-01 to 2002-03 at Oilseed Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to evaluate the efficacy

of some botanicals in comparison with synthetic insecticides against sesamum gallfly. Out of eleven botanicals and synthetic insecticides evaluated for the management of sesamum gallfly, treatment viz. fenvalerate 0.01% followed by endosulfan 0.07 per cent and dimethoate 0.05 per cent were found most effective and economical. The highest ICBR (1:10.60) was recorded in treatment fenvalerate 0.01per cent, followed by endosulfan 0.07 per cent (1:5.07). Dimethoate 0.05 per cent (1:4.78) and NSE 5 per cent (1:4.02). Lowest ICBR (1:0.46) was recorded in treatment neem oil 3 per cent hence fenvalerate 0.01 per cent or endosulfan 0.07 per cent or dimethoate 0.05 per cent are suggested for control of sesamum gallfly. The maximum yield (647 kg/ ha) was recorded in tretment due to fenvalerate 20 EC,0.01 %.

Rao et al.(2007) conducted experiment at ICRISAT to evaluate efficacy of new chemicals against legume pod borer, *Maruca vitrata* (Geyer) (Lepidoptera) in pigeonpea.The chemical evaluation study consisted of five treatments; spinosad 45 SC, indoxacarb 14.5 SC, monocrotophos 36 EC, *Metarhizium* 1 x 10^8 CFU/g and control.Spinosad and indoxacarb found superior over monocrotophos and *Metarhizium* in the mangement of this pest and recorded highest yield.

Deshmukh (2009) in his investigation to find out the efficacy of insecticides and botanicals on major pests of *sesamum indicum* reported that minimum average per cent infestation of gall fly and capsule borer at 7 and 14 days after treatment was found in spinosad 45 SC (0.001 %) followed by fenvalerate 20 EC (0.01%) and endosulfan 35 EC (0.07%).

Shamshad (2010) conducted field experiment in Faizabad, Uttar Pradesh, India to investigate the efficacy of some botanical and synthetic insecticides against *A. sesami* on sesame. The treatments were: neem [*Azadirachta indica*] seed kernel extract (NSKE) at 5%, neem leaf extract (NLE) at 2%, mahua [*Madhuca longifolia*] oil (MO) at

2%, neem oil (NO) at 2%, Nimbecidine at 0.15%, endosulfan 35 EC at 0.07%, fenvalerate 20 EC at 0.01% and control (untreated). Fenvalerate was found most effective, followed by endosulfan, NSKE, NLE, NO, Nimbecidine and MO during kharif 2006 and 2007 at 3 DAT.

Ghosh et al.(2010) conducted field experiment during 2006-2007 to find out efficacy of spinosad 45 SC against tomato fruit borer (*H.armigera* Hub) (Lepidoptera) along with quinalphos 25% EC, Lambda-cyhalothrin 5%EC, cypermethrin 10 EC.It was found that spinosad was effective against *H. armigera* on tomato at 73 to 84 g.a.i./ha than quinalphos. Lambda- cyhalothrin and cypermethrin and recorded highest fruit yield without borer infestation.

Sinha et al.(2010) conducted experiment at field of entomology I.A.R.I.,New Delhi to find out bioefficacy and persistance of indoxacarb on *Solanum melongena*.Indoxacarb was found to be effective in controlling shoot and fruit borer (Lepidoptera) of brinjal.The effectiveness of indoxacarb was also reflected in yield of brinjal fruits.

Ramoliyo et al.(2010) evaluated bioefficacy of insecticides against sawfly,*Athalia lugens proxima* (Klug) (Lepidoptera) on radish at Junagadh during 2007-08.Nine insecticidal treatment were evaluated.The result showed that the spinosad 0.007% is highly effective with higest radish yield.

Naik et al.(2010) conduct field experiments to evaluate different insecticides against cardamum shoot fly (Diptera) at Zonal Agricultural Research Station, Mudigera during 2005-2006 to 2007-2008. Among organic insecticides tested, thiamethoxam recorded minimum infestation followed by quinalphos as standard check,neem cake and NSKE compared to other treatments like fish oil and nimbecidine.

Chowdary et al.(2010) conducted field experiment to evaluate the efficacy of rynaxypyr 20 SC against okra fruit and shoot borer,*Earias vitella* (Fab) (Lepidoptera) during 2009-2010.Among the

newer insecticide molecules evaluated,rynaxypyr 20 SC @30 g.a.i./ha and rynaxypyr 20 SC @ 20 g.a.i./ha were superior in recording less larval populations,lower fruit damage and higher fruit yield, followed by spinosad @ 56 g.a.i./ha,emamectin benzoate @ 15 g.a.i./ha and flubendiamide @ 45 g.a.i./ha.

Sharma and Kaushik (2010) conducted field trials at the Research farm of Department of Entomology,C.C.S.Haryana Agricultural University, Hisar (India) during 2006 and 2007.Seven insecticides comprising spinosad,a bioinsecticide and six chemical insecticides namely emamectin benzoate, cypermethrin, quinalphos, endosulfan, lambda cyhalothrin and chlorpyrifos were tested against insect pest and natural enemies inhibiting eggplant.Spinosad 45 SC was most effective against shoot and fruit borer (Lepidoptera),affording the minimum damage on shoots, flower buds and fruits and getting the maximum fruit yield and highest cost-benefit ratio.

Ahmed and Prasad (2011) reported that indoxacarb @ 55 g.a.i./ha can be considered as an optimum dose for the management of fruit borers on chillies and recorded higher yield.The indoxacarb entirely different from the other class of chemicals can effectively check lepidopteran pests which have developed resistance to most of the older classes of insecticides and fit well in insecticide resistance programmes.

Shinde et al.(2011) conducted field experiment at Department of Agricultural Entomology,College of Agriculture,Latur, during *kharif* 2007 to calculate bioefficacy of different insecticides against major pest of okra.Spinosad 0.005 per cent followed by indoxacarb 0.01 per cent and profenofos 0.08 per cent were the most effective insecticides in controlling okra shoot and fruit borer (Lepidoptera).The highest incremental cost benefit ratio was recorded by the application of spinosad @ 0.005 per cent followed by profenofos @0.08 per cent.

Weifeng et al.(2011) conducted field trials to evaluate effects of several pesticides on pest of sesame.The indoxacarb 15 per cent and phoxim 40 per cent was found most effective to control bollworms, and the control effect were still up to 100 per cent at 14 day after spray.Result also indicated that 5 per cent chlorantraniliprole (Rynaxypyr) and 15 per cent idoxacarb had better integrated control effecacy against insect with chewing mouth parts.

Taggar et al.(2011) evaluated bio-efficacy of seven insecticides viz.,quinalphos 25 EC,carbaryl 50 WP, indoxacarb 14.5 SC, acephate 75 SP, endosulfan 35 EC,chlorpyrifos 20 EC and dichlorvos 76 wsc was evaluated against tobacco caterpillar,*Spodoptera litura* (Fab.) on soybean crop in three field experiments during *kharif* 2005.In all the three experiments, indoxacarb 14.5 SC @ 500 ml/ha proved most effective in controlling the pest at 3 and 7 days after spray, followed by acephate 75 SP @ 2.0 kg/ha.The highest mean grain yield was also recorded in the treatment indoxacarb 14.5 SC, followed by acephate 75 SP.

Dhaka et al. (2011) conducted field experiment to determine the comparative efficacy of insecticides i.e. lambda cyhalothrin 5 EC, carbosulfan 25 EC,indoxacarb 14.5 SC,bifenthrin 20 EC,novaluran10 EC, spinosad 45 SC and endosulphan 35 EC, Bt and neemarin 150 ppm on pea against pod borer,*Etiella zinckenella* (Treitschke) during *rabi* 2009-10 and 2010-11.Indoxacarb 14.5 SC @ 0.5 l/ha was found most effective against pod borer in minimizing the number.

2.3 Effect of insecticides on yield of sesamum

Singh et al. (2002) reported highest grain yield (9.87q/ha) in plots treated with 0.04 kg a.i.fenvalerate/ha followed by plots treated with 0.02 kg a.i.fenvalerate/ha (8.59 q/ha). Fenvalerate treatment at 0.02 and 0.04 kg a.i./ha were most economical with cost benefit ratio of 1:18.56 and 1:19.09, respectively.

Thakare et al.(2005) recorded highest ICBR (1:10.60) in treatment fenvalerate 0.01 per cent, followed by endosulfan 0.07 per cent (1:5.07), dimethoate 0.05 per cent (1:4.78) and NSE 5 per cent (1:4.02).The maximum yield (647 kg/ ha) was recorded in treatment due to fenvalerate 20 EC(0.01 %).

Deshmukh (2009) reported that spinosad 45 SC,fenvalerate 20 EC and endosulfan 35 EC were found to be most effective treatments recording yield of 681,613 and 588 kg/ha, respectively.The higest ICBR 1:10.65 was recorded in spinosad 45 SC followed by fenvalerate 20 EC (1:9.60) and endosulfan 35 EC (1:6.24).

CHAPTER III

MATERIAL AND METHODS

A field experiment was conducted to evaluate the efficacy of different insecticides for management of sesamum gall fly (*Asphondylia sesami*) and sesamum capsule borer (*Antigastra catalaunalis*) at Entomological Research Field, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif* season of 2011-12. Eight treatments along with untreated control were evaluated in the experiment. The materials used and methods adopted during the course of investigation are given below.

3.1 Materials

For conducting this experiment material like sesamum seed (AKT-64) land, fertilizer, chemical insecticides, botanical insecticides, nylon string, tape, pegs, weighing balance, labour, bullocks, sprayers, measuring cylinder, bucket etc were used.

The detailed information about chemical insecticides used in this experiments are given in Appendix-I.

3.2 Methods

3.2.1 Details of the field used for experimentation

The experiment was conducted on field of Department of Agricultural Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in *Kharif* 2011-12. The soil was medium to deep black. The layout of plan for the experiment is illustrated in fig. 1.

3.2.2 Details of experiment

1. Design : Randomized Block Design (RBD)
2. Season : *Kharif* 2011-12

3. No. of treatments : 08
4. Replications : 03
5. Total no. of plots : 24
6. Crop and variety : *Sesamum indicum* and AKT-64
7. Fertilizer dose : 25:25:0 Kg NPK /ha
8. Plot size
    a) Gross plot size : 4.5 mx 3.0 m =13.5 m^2
    b) Net plot size : 3.6 mx 2.8 m =10.08 m^2
9. Spacing
    a) Row to Row : 45 cm
    b) Plant to plant : 10 cm
10. Date of sowing : 9th July 2011
11. Date of emergence : 14th July 2011

3.2.3 Details of treatments

Name of treatment, concentration of spray solution used are given in the following table. The details regarding source of supply,trade name and moleculer formulae of the insecticides used as treatments in the present investigations have been given in Appendix-I.

Table 1 : Details of treatments

Sr. No.	Name of treatment	Concentration of spray solution
1	Thiamethoxam 25 WG	0.005%
2	Spinosad 45 SC	0.01%
3	Indoxacarb 14.5 SC	0.01%
4	Thiacloprid 48 SC	0.009%
5	Fenvalerate 20 EC	0.01%
6	Triazophos 40 EC	0.1%
7	Rynaxypyr 20 SC	0.01%
8	Untreated control	-

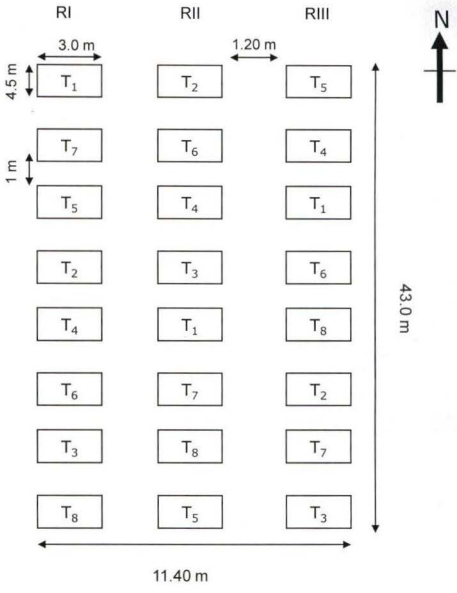


Fig. 1: Plan of layout

3.2.4 Cultural operations

3.2.4.1 Preparatory tillage

Field was brought to optimum tilth condition by repeated harrowing. Then field was cleaned by picking stubbles of previous crop. Before sowing, the layout was made on the field in accordance with experimental design with the help of measuring tape, rope and wooden pegs,as shown in fig.1.

3.2.4.2 Sowing

The sowing was done in marked plots on 09-07-2011 by seed drill method with a seed rate of 2.5 kg/ha. As the seeds of sesamum are very fine, it was added with fine sand in equal proportion to have uniform distribution of seeds in sowing.

3.2.4.3 Thinning

Thinning was done when the crop was 15-20 days old keeping plant to plant distance 10 cm approximately.

3.2.4.4 Application of fertilizers

The fertilizers were applied @ 25:25:0 Kg NPK/ha. Half dose of nitrogen and full dose of phosphorus was applied at the time of sowing and remaining half dose of nitrogen was applied one month after sowing.

3.2.4.5 Intercultural operations

Hoeing and weeding operation were carried out to keep the field clean by removing weeds to conserve soil moisture.

3.2.5 Preparation of spray solution

The spray solution of desired concentration was freshly prepared on the field before application. The required quantity of water for spraying each plot was estimated by spraying plane water on

Plate No. 1 View of experimental plot

untreated control plot. The required quantity of chemicals for each respective treatment was worked out and spray solution was prepared by mixing them in water thoroughly. Quantity of spray solution was updated as per the growth stages of the crop.

Spray solution of desired concentration was prepared by using following formula

$$V = \frac{C \times A}{\% \text{ a.i.}}$$

Where,

V = Volume of commercial insecticide (ml or g)

C = Concentration of required solution (%)

A = Quantity of spray solution required (L)

% a.i. = Per cent active ingredient in commercial product

3.3.1 Time and method of application of treatments

The treatments were applied twice on the crop starting with the first application 30 days after sowing of crop followed by second application after 15 days of first application of treatments.

The knapsack sprayer was used for spraying operation. After each treatment application the sprayer was washed thoroughly with clean water. Every care was taken to minimize drift and contamination of the adjacent plot at the time of spraying.

3.3.2 Recording of observations

The observations were recorded after 3,7,10 and 14 days of first and second application of treatments for infestation of gall fly and capsule borer, respectively. For this purpose five plants from each treatment plots were randomly selected. Observations on total number of fruiting bodies (buds,flowers and capsules) on the plant and those

damaged by gall fly and capsule borer were recorded seperately,from which per cent infestation of gall fly and capsule borer were computed.

The population of other pests were meager hence these are not considered for analysis.

3.3.3 Post harvest observations

The yield of sesamum from each net plot was recorded to confirm the efficacy of different treatments.

3.3.4 Economics of the treatments

The yield data from each treatment plot were used to calculate economics of the spraying. The cost of insecticides and the cost of spray application i.e. labour charges prevailing during the course of investigations were taken into considerations to work out the cost of each treatment per hectare. Similarly, income obtained from the sale of grains as per the prevailing market rates was also calculated for each treatment to work out the incremental cost:benefit ratio (ICBR).

3.3.5 Statistical analysis

The field data collected during the course of experimentation were subjected to statistical analysis as per the statistical design used, in order to test level of significance among the various treatments as per Gomez and Gomez (1984).

CHAPTER IV

RESULTS AND DISCUSSION

In the present study on "Insecticidal management of insect pests of sesamum" eight treatments consists of Thiamethoxam 25 WG (0.005%), Spinosad 45 SC (0.01%), Indoxacarb 14.5 SC (0.01%), Thiacloprid 48 SC (0.009%), Fenvalerate 20 EC (0.01%), Triazophos 40 EC (0.1%), Rynaxypyr 20 SC (0.01%) and control were evaluated for their efficacy against major pests of sesamum i.e. gall fly and capsule borer. The per cent infestation of gall fly and capsule borer was observed after 3,7,10 and 14 days from spray application. The trial was laid out as per RBD as shown in Fig. 1. The trial was conducted during half season of 2011-12.

The per cent infestation of the pest in each treatment was worked out. Then data were transformed into corresponding arc sin and square root values and it was subjected to statistical analysis. The efficacy of the above mentioned insecticides was evaluated on the basis of minimum per cent infestation of *Asphondylia sesami* and *Antigastra catalaunalis* after 3,7,10 and 14 days from spray and the results are presented in Table 2 to 9 .

4.1 Effect of treatments on average per cent infestation of *Asphondylia sesami* Felt.

4.1.1 Three days after first spray.

The data presented in Table 2 and depicted in Fig. 2 indicated that all the treatments were significantly superior over the untreated control in recording minimum per cent infestation of *A. sesami* at 3 days after first spraying. The treatment with spinosad 45 SC recorded significantly minimum per cent infestation (1.68 %) and was at par with thiacloprid 48 SC (1.86%) and fenvalerate 20 EC (2.47%) and found significantly superior over rest of all treatments.

Table 2 : Effects of treatments on infestation of sesamum gall fly *A. sesami* 3 days after first spray

Sr..No.	Treatments	Percent infestation of gallfly			Mean
		RI	RII	RIII	
1	T1- Thiamethoxam 25WG(@0.005%)	3.40 (1.84)*	3.00 (1.73)*	3.26 (1.81)*	3.22 (1.79)*
2	T2- Spinosad 45 SC (@0.01%)	2.29 (1.51)	1.46 (1.21)	1.30 (1.14)	1.68 (1.29)
3	T3-Indoxacarb 14.5 SC (@0.01%)	3.61 (1.90)	5.18 (2.28)	2.52 (1.59)	3.77 (1.92)
4	T4-Thiacloprid 48 SC (@0.009%)	1.98 (1.41)	1.93 (1.39)	1.66 (1.29)	1.86 (1.36)
5	T5-Fenvalerate 20 EC (@0.01%)	2.79 (1.67)	2.86 (1.69)	1.77 (1.33)	2.47 (1.56)
6	T6-Triazophos 40 EC (@0.1%)	3.88 (1.97)	3.57 (1.89)	2.55 (1.60)	3.33 (1.82)
7	T7-Rynaxypyr 20 SC (@0.01%)	3.07 (1.75)	2.50 (1.58)	5.81 (2.41)	3.79 (1.91)
8	T8-Untreated control	6.01 (2.45)	8.95 (2.99)	8.21 (2.87)	7.72 (2.77)
	'F' test				Sig.
	SE (m) ±				0.15
	C.D. (0.05)				0.46

(*Figures in the parenthesis are corresponding square root transformed values)

However, thiamethoxam 25 WG, triazophos 40 EC,rynaxypyr 20 SC and indoxacarb 14.5 SC recorded 3.22, 3.33, 3.79 and 3.77 per cent infestation, respectively and were found at par with each other and superior over control. Significantly maximum per cent infestation (7.72 %) was recorded in untreated control.

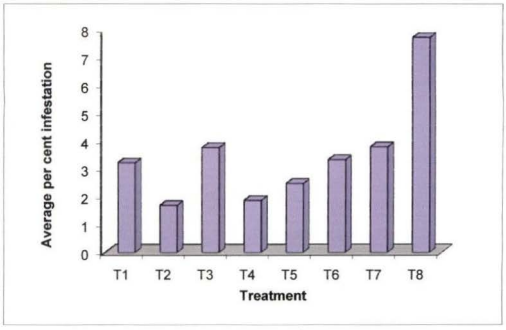


Fig. 2: Effects of treatments on infestation of sesamum gall fly *A. sesami* 3 days after first spray

T_1 - Thiamethoxam 25 WG @0.005 %

T_2 - Spinosad 45 SC @ 0.01 %

T_3 - Indoxacarb 14.5 SC @ 0.01 %

T_4 - Thiacloprid 48 SC @ 0.009 %

T_5 - Fenvalerate 20 EC @ 0.01 %

T_6 - Triazophos 40 EC @ 0.1 %

T_7 - Rynaxypyr 20 SC @ 0.01 %

T_8 - Untreated Control

Deshmukh (2009) reported that, spinosad 45 SC and fenvalerate 20 EC were recorded minimum average per cent infestation of sesamum gall fly at 7 and 14 days after treatment. However, Leader and Dutton (2002) and Flye (2003) indicated effectiveness of spinosad against insects including order Diptera.

In case of thiacloprid 48 SC the results could not be compared for want of literature. However, Reissig (2003) reported effectiveness of thiacloprid 48 SC against apple maggot (Diptera).

Thakare et al.(2005) and Shamshad (2010) noted that, fenvalerate 20 EC @0.01 % was found most effective in control of sesamum gall fly. Naik et al. (2010) reported minimum infestation of cardamum shoot fly (Diptera) with treatment thiamethoxam.

4.1.2 Seven days after first spray.

It is evident from the data presented in Table 3 and depicted in fig 3 that the data was found statistically significant with respect to infestation of gall fly at 7 days after first spray.

Among the various treatments spinosad 45 SC recorded significantly minimum per cent infestation (2.35%) and was at par with thiacloprid 48 SC (2.95%) and fenvalerate 20 EC (3.09%) and found significantly superior over rest of all treatments.

However, thiamethoxam 25 WG, triazophos 40 EC and indoxacarb 14.5 SC recorded 3.71, 4.64, and 4.82 per cent infestation, respectively and were found at par with each other and superior over rest of the treatments. Further, rynaxypyr 20 SC recorded (5.61%) infestation and found superior over control.

Significantly maximum per cent infestation (10.31%) was recorded in untreated control.

Table 3 : Effects of treatments on infestation of sesamum gall fly *A. sesami* 7 days after first spray

Sr..No.	Treatments	Percent infestation of gallfly			Mean
		RI	RII	RIII	
1	T1- Thiamethoxam 25WG(@0.005%)	4.30 (2.07)*	3.38 (1.84)*	3.44 (1.85)*	3.71 (1.92)*
2	T2- Spinosad 45 SC (@0.01%)	2.43 (1.56)	1.23 (1.11)	3.38 (1.84)	2.35 (1.50)
3	T3-Indoxacarb 14.5 SC (@0.01%)	3.24 (1.80)	5.69 (2.39)	5.54 (2.35)	4.82 (2.18)
4	T4-Thiacloprid 48 SC (@0.009%)	2.88 (1.70)	3.70 (1.92)	2.26 (1.50)	2.95 (1.71)
5	T5-Fenvalerate 20 EC (@0.01%)	2.90 (1.70)	2.68 (1.64)	3.69 (1.92)	3.09 (1.75)
6	T6-Triazophos 40 EC (@0.1%)	5.00 (2.24)	4.27 (2.07)	4.66 (2.16)	4.64 (2.15)
7	T7-Rynaxypyr 20 SC (@0.01%)	6.65 (2.58)	5.75 (2.40)	4.42 (2.10)	5.61 (2.36)
8	T8-Untreated control	9.97 (3.16)	10.46 (3.23)	10.50 (3.24)	10.31 (3.21)
	'F' test				Sig.
	SE (m) ±				0.13
	C.D. (0.05)				0.41

(*Figures in the parenthesis are corresponding square root transformed values)

Deshmukh (2009) stated that, spinosad 45 SC and fenvalerate 20 EC were recorded minimum average per cent infestation of sesamum gall fly at 7 and 14 days after treatment. However, Leader and Dutton (2002) and Flye (2003) indicated effectiveness of spinosad against insects including order Diptera.

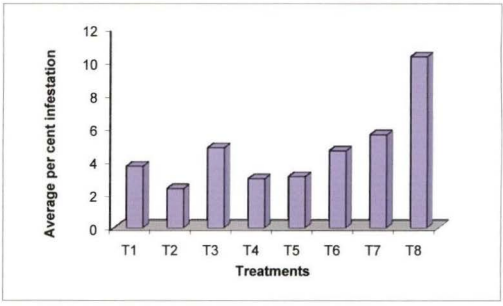


Fig. 3 : Effects of treatments on infestation of sesamum gall fly *A. sesami* 7 days after first spray

T_1 - Thiamethoxam 25 WG @0.005 %

T_2 - Spinosad 45 SC @ 0.01 %

T_3 - Indoxacarb 14.5 SC @ 0.01 %

T_4 - Thiacloprid 48 SC @ 0.009 %

T_5 - Fenvalerate 20 EC @ 0.01 %

T_6 - Triazophos 40 EC @ 0.1 %

T_7 - Rynaxypyr 20 SC @ 0.01 %

T_8 - Untreated Control

In case of thiacloprid 48 SC the results could not be compared for want of literature. However, Reissig (2003) reported effectiveness of thiacloprid 48 SC against apple maggot (Diptera).

Thakare et al.(2005) and Shamshad (2010) noted that, fenvalerate 20 EC @0.01 % was found most effective in control of sesamum gall fly. Naik et al. (2010) reported minimum infestation of cardamum shoot fly (Diptera) with treatment thiamethoxam.

4.1.3 Ten days after first spray.

The data presented in Table 4 and depicted in Fig. 4 revealed significant differences among the various treatments with respect to the per cent damage due to gall fly at 10 days after first spraying. All the treatments were significantly superior over control.

Among the various treatments spinosad 45 SC recorded significantly minimum per cent infestation (5.22%) and was at par with thiacloprid 48 SC (5.97%) and fenvalerate 20 EC (6.84%) and found significantly superior over rest of all treatments.

However, thiamethoxam 25 WG, triazophos 40 EC, indoxacarb 14.5 SC and rynaxypyr 20 SC recorded 7.14, 7.55, 8.19 and 8.36 per cent infestation, respectively and were found at par with each other and superior over control.

Significantly maximum per cent infestation (14.80%) was recorded in untreated control.

Deshmukh (2009) reported that, spinosad 45 SC and fenvalerate 20 EC were recorded minimum average per cent infestation of sesamum gall fly at 7 and 14 days after treatment. However, Leader and Dutton (2002) and Flye (2003) indicated effectiveness of spinosad against insects including order Diptera. In case of thiacloprid 48 SC the results could not be compared for want of literature. However, Reissig (2003) reported effectiveness of thiacloprid 48 SC against apple maggot (Diptera).

Table 4 : Effects of treatments on infestation of sesamum gall fly *A. sesami* 10 days after first spray

Sr..No.	Treatments	Percent infestation of gallfly			Mean
		RI	RII	RIII	
1	T1- Thiamethoxam 25WG(@0.005%)	6.52 (2.55)*	7.40 (2.72)*	7.50 (2.74)*	7.14 (2.67)*
2	T2- Spinosad 45 SC (@0.01%)	5.28 (2.30)	4.26 (2.06)	6.11 (2.47)	5.22 (2.28)
3	T3-Indoxacarb 14.5 SC (@0.01%)	7.75 (2.78)	9.16 (3.03)	7.66 (2.77)	8.19 (2.86)
4	T4-Thiacloprid 48 SC (@0.009%)	5.45 (2.33)	6.77 (2.60)	5.70 (2.39)	5.97 (2.44)
5	T5-Fenvalerate 20 EC (@0.01%)	7.75 (2.78)	6.71 (2.59)	6.05 (2.46)	6.84 (2.61)
6	T6-Triazophos 40 EC (@0.1%)	5.28 (2.30)	8.94 (2.99)	8.44 (2.91)	7.55 (2.73)
7	T7-Rynaxypyr 20 SC (@0.01%)	7.00 (2.65)	9.80 (3.13)	8.29 (2.88)	8.36 (2.89)
8	T8-Untreated control	13.32 (3.65)	14.17 (3.76)	16.92 (4.11)	14.80 (3.84)
	'F' test				Sig.
	SE (m) ±				0.11
	C.D. (0.05)				0.35

(*Figures in the parenthesis are corresponding square root transformed values)

Thakare et al.(2005) and Shamshad (2010) noted that, fenvalerate 20 EC @0.01 % was found most effective in control of sesamum gall fly. Naik et al. (2010) reported minimum infestation of cardamum shoot fly (Diptera) with treatment thiamethoxam.

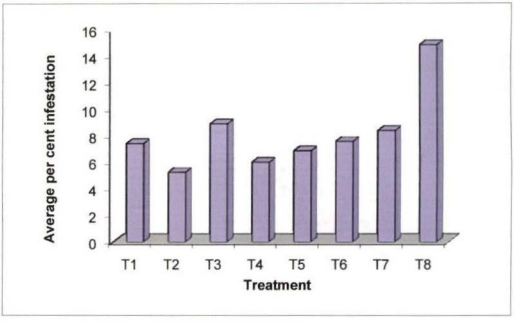


Fig. 4 : Effects of treatments on infestation of sesamum gall fly *A. sesam* 10 days after first spray

T_1 - Thiamethoxam 25 WG @0.005 %

T_2 - Spinosad 45 SC @ 0.01 %

T_3 - Indoxacarb 14.5 SC @ 0.01 %

T_4 - Thiacloprid 48 SC @ 0.009 %

T_5 - Fenvalerate 20 EC @ 0.01 %

T_6 - Triazophos 40 EC @ 0.1 %

T_7 - Rynaxypyr 20 SC @ 0.01 %

T_8 - Untreated Control

4.1.4 Fourteen days after first spray.

The data presented in Table 5 and depicted in Fig. 5 indicated that all the treatments were significantly superior over the untreated control in recording minimum per cent infestation of *A. sesami*. The treatment with spinosad 45 SC recorded significantly minimum per cent infestation (5.33 %) and was at par with thiacloprid 48 SC (6.53%) and found significantly superior over rest of all treatments.

Table 5: Effects of treatments on infestation of sesamum gall fly *A. sesami* 14 days after first spray

Sr..No.	Treatments	Percent infestation of gallfly			Mean
		RI	RII	RIII	
1	T1- Thiamethoxam 25WG(@0.005%)	8.89 (2.98)*	7.59 (2.75)*	9.34 (3.06)*	8.61 (2.93)*
2	T2- Spinosad 45 SC (@0.01%)	4.24 (2.06)	5.14 (2.27)	6.62 (2.57)	5.33 (2.30)
3	T3-Indoxacarb 14.5 SC (@0.01%)	8.26 (2.87)	9.27 (3.04)	9.82 (3.13)	9.12 (3.02)
4	T4-Thiacloprid 48 SC (@0.009%)	6.56 (2.56)	5.59 (2.36)	7.44 (2.73)	6.53 (2.55)
5	T5-Fenvalerate 20 EC (@0.01%)	5.88 (2.42)	10.83 (3.29)	7.00 (2.65)	7.90 (2.79)
6	T6-Triazophos 40 EC (@0.1%)	9.12 (3.02)	8.34 (2.89)	8.48 (2.91)	8.65 (2.94)
7	T7-Rynaxypyr 20 SC (@0.01%)	7.59 (2.75)	10.64 (3.26)	9.89 (3.14)	9.37 (3.05)
8	T8-Untreated control	16.46 (4.06)	14.36 (3.79)	17.13 (4.14)	15.98 (4.00)
	'F' test				Sig.
	SE (m) ±				0.13
	C.D. (0.05)				0.40

(*Figures in the parenthesis are corresponding square root transformed values)

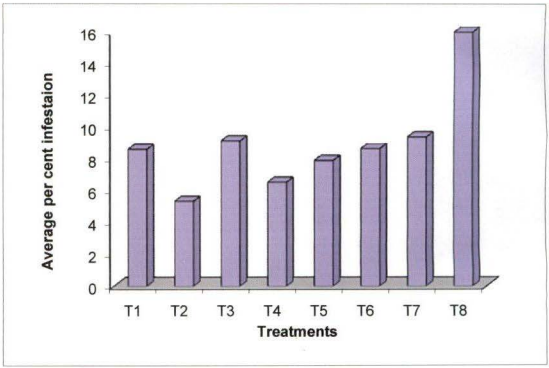


Fig. 5 : Effects of treatments on infestation of sesamum gall fly A *sesami* 14 days after first spray

T_1 - Thiamethoxam 25 WG @0.005 %

T_2 - Spinosad 45 SC @ 0.01 %

T_3 - Indoxacarb 14.5 SC @ 0.01 %

T_4 - Thiacloprid 48 SC @ 0.009 %

T_5 - Fenvalerate 20 EC @ 0.01 %

T_6 - Triazophos 40 EC @ 0.1 %

T_7 - Rynaxypyr 20 SC @ 0.01 %

T_8 - Untreated Control

However, fenvalerate 20 EC(7.90%) was found at par with thiamethoxam 25 WG (8.61%), triazophos 40 EC (8.65%), indoxacarb 14.5 SC (9.12%) and rynaxypyr 20 SC (9.37%) and found superior over control.

Significantly maximum per cent infestation (15.98%) was recorded in untreated control.

Deshmukh (2009) reported that, spinosad 45 SC and fenvalerate 20 EC were recorded minimum average per cent infestation of sesamum gall fly at 7 and 14 days after treatment. However, Leader and Dutton (2002) and Flye (2003) indicated effectiveness of spinosad against insects including order Diptera.

In case of thiacloprid 48 SC the results could not be compared for want of literature. However, Reissig (2003) reported effectiveness of thiacloprid 48 SC against apple maggot (Diptera).

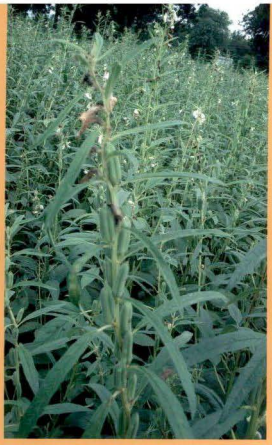
Thakare et al.(2005) and Shamshad (2010) noted that, fenvalerate 20 EC @0.01 % was found most effective in control of sesamum gall fly. Naik et al. (2010) reported minimum infestation of cardamum shoot fly (Diptera) with treatment thiamethoxam.

4.2 Effect of treatments on average per cent infestation of *Antigastra catalaunalis* Dup.

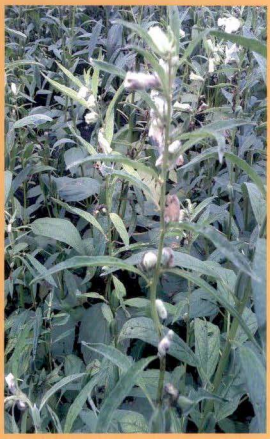
4.2.1 Three days after second spray

It is evident from the data presented in Table 6 and depicted in Fig.6 that the data was found statistically significant with respect to the infestation of *A. catalaunalis* at 3 days after second spray.

The treatment with spinosad 45 SC recorded significantly minimum per cent infestation (4.66%) followed by indoxacarb 14.5 SC (5.11%) and rynaxypyr 20 SC (5.28%) and found significantly superior over rest of all treatments.



Treatment - T2



Treatment - T8

Plate No. 2 Comparison between treated and untreated plot

Table 6: Effects of treatments on infestation of sesamum capsule borer *A. catalaunalis* 3 days after second spray

Sr..No.	Treatments	Per cent infestation of capsule borer			Mean
		RI	RII	RIII	
1	T1-Thiamethoxam 25WG (@0.005%)	8.17 (2.86)*	7.37 (2.71)*	8.90 (2.98)*	8.15 (2.85)*
2	T2-Spinosad 45 SC (@0.01%)	3.96 (1.99)	4.42 (2.10)	5.61 (2.37)	4.66 (2.15)
3	T3-Indoxacarb 14.5 SC (@0.01%)	4.39 (2.10)	5.89 (2.43)	5.04 (2.24)	5.11 (2.26)
4	T4-Thiacloprid 48 SC (@0.009%)	7.06 (2.66)	7.35 (2.71)	8.78 (2.96)	7.73 (2.78)
5	T5-Fenvalerate 20 EC (@0.01%)	5.14 (2.27)	5.71 (2.39)	9.71 (3.12)	6.85 (2.59)
6	T6-Triazophos 40 EC (@0.1%)	6.50 (2.55)	6.68 (2.58)	7.71 (2.78)	6.96 (2.64)
7	T7-Rynaxypyr 20 SC (@0.01%)	5.36 (2.32)	4.13 (2.03)	6.35 (2.52)	5.28 (2.29)
8	T8-Untreated control	12.50 (3.54)	13.87 (3.72)	15.20 (3.90)	13.86 (3.72)
	'F' test				Sig.
	SE (m) ±				0.09
	C.D. (0.05)				0.28

(*Figures in the parenthesis are corresponding square root transformed values)

Further, treatments fenvalerate 20 EC (6.85%), triazophos 40 EC (6.96%), thiacloprid 48 SC (7.73%) and thiamethoxam 25 WG (8.15%) were found at par with each other and significantly superior over control. Significantly maximum per cent infestation (13.86%) was recorded in untreated control.

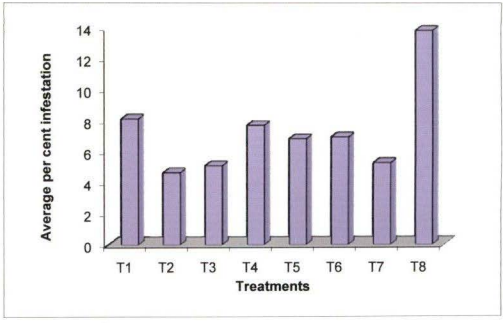


Fig. 6: Effects of treatments on infestation of sesamum capsule borer *A. catalaunalis* 3 days after second spray

T_1 - Thiamethoxam 25 WG @0.005 %

T_2 - Spinosad 45 SC @ 0.01 %

T_3 - Indoxacarb 14.5 SC @ 0.01 %

T_4 - Thiacloprid 48 SC @ 0.009 %

T_5 - Fenvalerate 20 EC @ 0.01 %

T_6 - Triazophos 40 EC @ 0.1 %

T_7 - Rynaxypyr 20 SC @ 0.01 %

T_8 - Untreated Control

Deshmukh (2009) reported that, spinosad 45 SC and fenvalerate 20 EC were recorded minimum average per cent infestation of sesamum capsule borer at 7 and 14 days after treatment. However, Leader and Dutton (2002), Flye (2003) and Tascari et al.(2004) reported the effectiveness of spinosad against insects including order Lepidoptera.

Rao et al. (2007) stated that, spinosad 45 SC and indoxacarb 14.5 SC was found most effective against Legume pod borer (Lepidoptera).

Weifeng et al. (2011) reported that, indoxacarb and rynaxypyr found effective in control of sesamum bollworms. However, Dhaka et al. (2011) reported effectiveness of indoxacarb against pea pod borer (Lepidoptera). Chowdary et al. (2010) reported superiority of rynaxypyr 20 SC against okra fruit and shoot borer (Lepidoptera). Findings of these workers are in line with the present investigation.

4.2.2 Seven days after second spray

It is evident from the data presented in Table 7 and depicted in Fig.7 that all the treatments were significantly superior over the untreated control in recording minimum per cent infestation of *A. catalaunalis.*

The treatment with spinosad 45 SC recorded significantly minimum per cent infestation (4.98%) followed by indoxacarb 14.5 SC (5.22%) and rynaxypyr 20 SC (5.51%) and found significantly superior over rest of all treatments.

Further, treatments fenvalerate 20 EC (6.58%), triazophos 40 EC (6.80%), thiacloprid 48 SC (7.53%) and thiamethoxam 25 WG (8.10%) were found at par with each other and significantly superior over control.

Significantly maximum per cent infestation (16.49%) was recorded in untreated control.

Table 7: Effects of treatments on infestation of sesamum capsule borer *A. catalaunalis* 7 days after second spray

Sr..No.	Treatments	Per cent infestation of capsule borer			Mean
		RI	RII	RIII	
1	T1-Thiamethoxam 25WG (@0.005%)	6.70 (2.59)*	8.79 (2.96)*	8.82 (2.97)*	8.10 (2.84)*
2	T2-Spinosad 45 SC (@0.01%)	5.48 (2.34)	4.78 (2.19)	4.67 (2.16)	4.98 (2.23)
3	T3-Indoxacarb 14.5 SC (@0.01%)	5.08 (2.25)	4.28 (2.07)	6.30 (2.541)	5.22 (2.28)
4	T4-Thiacloprid 48 SC (@0.009%)	7.00 (2.65)	7.45 (2.73)	8.13 (2.85)	7.53 (2.74)
5	T5-Fenvalerate 20 EC (@0.01%)	6.87 (2.62)	7.48 (2.73)	5.39 (2.32)	6.58 (2.56)
6	T6-Triazophos 40 EC (@0.1%)	7.54 (2.75)	6.95 (2.64)	5.90 (2.43)	6.80 (2.60)
7	T7-Rynaxypyr 20 SC (@0.01%)	5.78 (2.40)	4.54 (2.13)	6.22 (2.49)	5.51 (2.34)
8	T8-Untreated control	15.24 (3.90)	16.34 (4.04)	17.89 (4.23)	16.49 (4.06)
	'F' test				Sig.
	SE (m) ±				0.11
	C.D. (0.05)				0.32

(*Figures in the parenthesis are corresponding square root transformed values)

Deshmukh (2009) reported that, spinosad 45 SC and fenvalerate 20 EC were recorded minimum average per cent infestation of sesamum capsule borer at 7 and 14 days after treatment. However, Leader and Dutton (2002), Flye (2003) and Tascari et al.(2004) reported the effectiveness of spinosad against insects including order Lepidoptera.

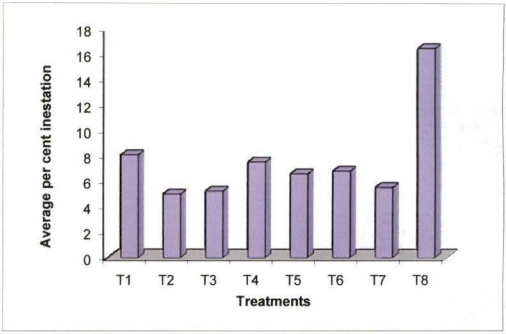


Fig. 7: Effects of treatments on infestation of sesamum capsule borer *A. catalaunalis* 7 days after second spray

T_1 - Thiamethoxam 25 WG @0.005 %

T_2 - Spinosad 45 SC @ 0.01 %

T_3 - Indoxacarb 14.5 SC @ 0.01 %

T_4 - Thiacloprid 48 SC @ 0.009 %

T_5 - Fenvalerate 20 EC @ 0.01 %

T_6 - Triazophos 40 EC @ 0.1 %

T_7 - Rynaxypyr 20 SC @ 0.01 %

T_8 - Untreated Control

Rao et al. (2007) stated that, spinosad 45 SC and indoxacarb 14.5 SC was found most effective against Legume pod borer (Lepidoptera). Weifeng et al. (2011) reported that, indoxacarb and rynaxypyr found effective in control of sesamum bollworms. However, Dhaka et al. (2011) reported effectiveness of indoxacarb against pea pod borer (Lepidoptera). Chowdary et al. (2010) reported superiority of rynaxypyr 20 SC against okra fruit and shoot borer (Lepidoptera). Findings of these workers are in line with the present investigation.

4.2.3 Ten days after second spray

It is evident from the data presented in Table 8 and depicted in Fig.8 that all the treatments were significantly superior over the untreated control in recording minimum per cent infestation of *A. catalaunalis* at 10 days after spraying.

The treatment with spinosad 45 SC recorded significantly minimum per cent infestation (5.59%) followed by indoxacarb 14.5 SC (5.73%) , rynaxypyr 20 SC (6.14%) and fenvalerate 20 EC (6.76%) and found significantly superior over rest of all the treatments.

Further, treatments triazophos 40 EC (8.03%), thiacloprid 48 SC (8.48%) and thiamethoxam 25 WG (8.59%) were found at par with each other and significantly superior over control.

Significantly maximum per cent infestation (18.39%) was recorded in untreated control.

Deshmukh (2009) reported that, spinosad 45 SC and fenvalerate 20 EC were recorded minimum average per cent infestation of sesamum capsule borer at 7 and 14 days after treatment. However, Leader and Dutton (2002), Flye (2003) and Tascari et al.(2004) reported the effectiveness of spinosad against insects including order Lepidoptera.

Table 8: Effects of treatments on infestation of sesamum capsule borer *A. catalaunalis* 10 days after second spray

Sr..No.	Treatments	Per cent infestation of capsule borer			Mean
		RI	RII	RIII	
1	T1-Thiamethoxam 25WG (@0.005%)	8.08 (2.84)*	9.03 (3.00)*	8.66 (2.94)*	8.59 (2.93)*
2	T2-Spinosad 45 SC (@0.01%)	5.17 (2.27)	6.75 (2.60)	4.84 (2.20)	5.59 (2.36)
3	T3-Indoxacarb 14.5 SC (@0.01%)	4.42 (2.10)	6.17 (2.48)	6.59 (2.57)	5.73 (2.38)
4	T4-Thiacloprid 48 SC (@0.009%)	8.26 (2.87)	7.81 (2.79)	9.38 (3.06)	8.48 (2.91)
5	T5-Fenvalerate 20 EC (@0.01%)	6.21 (2.49)	6.80 (2.61)	7.28 (2.70)	6.76 (2.60)
6	T6-Triazophos 40 EC (@0.1%)	7.03 (2.65)	8.13 (2.85)	8.93 (2.99)	8.03 (2.83)
7	T7-Rynaxypyr 20 SC (@0.01%)	7.42 (2.72)	6.75 (2.60)	4.24 (2.06)	6.14 (2.46)
8	T8-Untreated control	17.85 (4.22)	18.57 (4.31)	18.74 (4.33)	18.39 (4.29)
	'F' test				Sig.
	SE (m) ±				0.11
	C.D. (0.05)				0.33

(*Figures in the parenthesis are corresponding square root transformed values)

Rao et al. (2007) stated that, spinosad 45 SC and indoxacarb 14.5 SC was found most effective against Legume pod borer (Lepidoptera).

Weifeng et al. (2011) reported that, indoxacarb and rynaxypyr found effective in control of sesamum bollworms. However, Dhaka et al. (2011) reported effectiveness of indoxacarb against pea pod borer

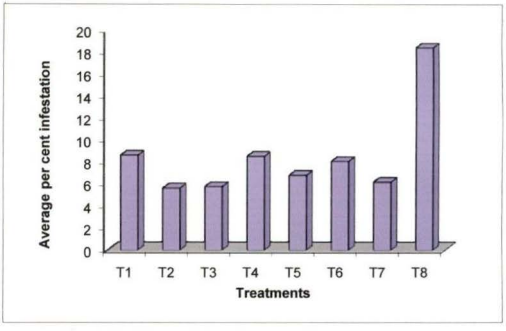


Fig. 8: Effects of treatments on infestation of sesamum capsule borer *A. catalaunalis* 10 days after second spray

T_1 - Thiamethoxam 25 WG @0.005 %
T_2 - Spinosad 45 SC @ 0.01 %
T_3 - Indoxacarb 14.5 SC @ 0.01 %
T_4 - Thiacloprid 48 SC @ 0.009 %
T_5 - Fenvalerate 20 EC @ 0.01 %
T_6 - Triazophos 40 EC @ 0.1 %
T_7 - Rynaxypyr 20 SC @ 0.01 %
T_8 - Untreated Control

(Lepidoptera). Chowdary et al. (2010) reported superiority of rynaxypyr 20 SC against okra fruit and shoot borer (Lepidoptera). Findings of these workers are in line with the present investigation.

4.2.4 Fourteen days after second spray

The data presented in Table 9 and depicted in Fig.9 indicate that all the treatments were significantly superior over the untreated control in recording minimum per cent infestation of *A. catalaunalis*.

Table 9: Effects of treatments on infestation of sesamum capsule borer *A. catalaunalis* 14 days after second spray

Sr..No.	Treatments	Per cent infestation of capsule borer			Mean
		RI	RII	RIII	
1	T1-Thiamethoxam 25WG (@0.005%)	9.55 (3.09)*	6.00 (2.45)*	9.84 (3.14)*	8.46 (2.89)*
2	T2-Spinosad 45 SC (@0.01%)	5.67 (2.38)	5.73 (2.39)	4.73 (2.17)	5.38 (2.32)
3	T3-Indoxacarb 14.5 SC (@0.01%)	5.88 (2.42)	7.01 (2.65)	5.36 (2.32)	6.08 (2.46)
4	T4-Thiacloprid 48 SC (@0.009%	8.07 (2.84)	7.44 (2.73)	9.33 (3.05)	8.28 (2.87)
5	T5-Fenvalerate 20 EC (@0.01%)	6.50 (2.55)	7.80 (2.79)	7.40 (2.72)	7.23 (2.69)
6	T6-Triazophos 40 EC (@0.1%)	8.83 (2.97)	7.82 (2.80)	8.26 (2.87)	8.30 (2.88)
7	T7-Rynaxypyr 20 SC (@0.01%)	7.24 (2.69)	6.08 (2.47)	6.10 (2.47)	6.47 (2.54)
8	T8-Untreated control	16.39 (4.05)	17.95 (4.24)	19.66 (4.43)	18.00 (4.24)
	'F' test SE (m) ± C.D. (0.05)				Sig. 0.11 0.35

(*Figures in the parenthesis are corresponding square root transformed values)

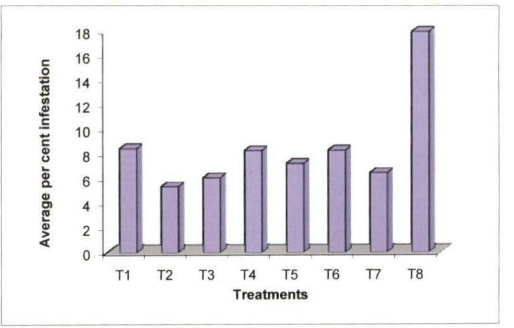


Fig. 9: Effects of treatments on infestation of sesamum capsule borer *A. catalaunalis* 14 days after second spray

T_1 - Thiamethoxam 25 WG @0.005 %

T_2 - Spinosad 45 SC @ 0.01 %

T_3 - Indoxacarb 14.5 SC @ 0.01 %

T_4 - Thiacloprid 48 SC @ 0.009 %

T_5 - Fenvalerate 20 EC @ 0.01 %

T_6 - Triazophos 40 EC @ 0.1 %

T_7 - Rynaxypyr 20 SC @ 0.01 %

T_8 - Untreated Control

Damage caused by gall fly

Damage caused by capsule borer

Plate No. 3 Damage caused by gall fly and capsule borer

The treatment with spinosad 45 SC recorded significantly minimum per cent infestation (5.38%) followed by indoxacarb 14.5 SC (6.08%) and rynaxypyr 20 SC (6.47%) and found significantly superior over rest of all the treatments.

Further, treatments fenvalerate 20 EC (7.23%), thiacloprid 48 SC (8.28%), triazophos 40 EC (8.30%) and thiamethoxam 25 WG (8.46%) were found at par with each other and significantly superior over control.

Significantly maximum per cent infestation (18.00%) was recorded in untreated control.

Deshmukh (2009) reported that, spinosad 45 SC and fenvalerate 20 EC were recorded minimum average per cent infestation of sesamum capsule borer at 7 and 14 days after treatment. However, Leader and Dutton (2002), Flye (2003) and Tascari et al.(2004) reported the effectiveness of spinosad against insects including order Lepidoptera.

Rao et al. (2007) stated that, spinosad 45 SC and indoxacarb 14.5 SC was found most effective against Legume pod borer (Lepidoptera). Weifeng et al. (2011) reported that, indoxacarb and rynaxypyr found effective in control of sesamum bollworms. However, Dhaka et al. (2011) reported effectiveness of indoxacarb against pea pod borer (Lepidoptera).

Chowdary et al. (2010) reported superiority of rynaxypyr 20 SC against okra fruit and shoot borer (Lepidoptera). Findings of these workers are in line with the present investigation.

4.3 Effect of various treatments on yield of Sesamum

The yield recorded from the various treatments is given in Table 10 and depicted in fig.10.

Table 10 : Effect of various treatments on yield of sesamum

Tr.No.	Treatments	Seed yield (Kg/ha)			Total	Yield (kg/ha)
		RI	RII	RIII		
T1	Thiamethoxam 25WG (@0.005%)	446	406	356	1208	402
T2	Spinosad 45 SC (@0.01%)	742	731	739	2212	737
T3	Indoxacarb 14.5 SC (@0.01%)	641	663	686	1990	663
T4	Thiacloprid 48 SC (@0.009%)	459	483	513	1455	485
T5	Fenvalerate 20 EC (@0.01%)	613	637	659	1909	636
T6	Triazophos 40 EC (@0.1%)	446	478	498	1422	474
T7	Rynaxypyr 20 SC (@0.01%)	502	746	627	1875	625
T8	Untreated control	329	353	321	1003	334
	'F' test SE (m)± C.D.(0.05)					27.90 84.62

The data indicated significant differences among the various treatments in respect to yield of sesamum. The highest yield (737 kg/ha) was obtained in the treatment due to spinosad 45 SC and it was at par with indoxacarb 14.5 SC recording 663 kg/ha yield. The treatments fenvalerate 20 EC and rynaxypyr 20 SC recorded (636 kg/ha) and (625 kg/ha), respectively and were found statistically at par with each other and significantly superior over control.

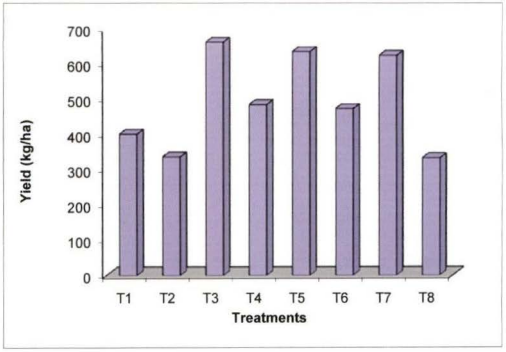


Fig. 10: Effect of various treatments on yield of sesamum

T_1 - Thiamethoxam 25 WG @0.005 %

T_2 - Spinosad 45 SC @ 0.01 %

T_3 - Indoxacarb 14.5 SC @ 0.01 %

T_4 - Thiacloprid 48 SC @ 0.009 %

T_5 - Fenvalerate 20 EC @ 0.01 %

T_6 - Triazophos 40 EC @ 0.1 %

T_7 - Rynaxypyr 20 SC @ 0.01 %

T_8 - Untreated Control

Further the treatments thiacloprid 48 SC (485 kg/ha) followed by triazophos 40 EC (474 kg/ha) and thiamethoxam 25 WG (402 kg/ha) were found statistically at par with each other and significantly superior over control.

Singh et al. (2002) reported highest yield of linseed (9.87 q/ha) in plots treated with fenvalerate 0.04 kg a.i. / ha and it was most economical treatment with cost benefit ratio of 1:19.09.

Thakare et al.(2005) recorded maximum yield of sesamum (647 kg/ha) with highest ICBR (1:10.60) in the treatment fenvalerate 0.01per cent.

Deshmukh (2009) in his investigation against gall fly and capsule borer reported that spinosad 45 SC,fenvalerate 20 EC and endosulfan 35 EC were found to be most effective treatments recording yield of 681,613 and 588 kg/ha respectively.The higest ICBR 1:10.65 was recorded in spinosad 45 SC followed by fenvalerate 20 EC (1:9.60) and endosulfan 35 EC (1:6.24)

4.4 Incremental cost benefit ratio of different treatments.

Considering the cost of inputs for different treatments and corresponding yield from the treatments, the incremental cost benefit ratio (ICBR) of all treatments were worked out at prevailing market rates and the data is presented in Table 11 and depicted in Fig.11.

The data revealed that the treatments with fenvalerate 20 EC (0.01%) emerged as the most economic one recording highest ICBR of 1: 11.91. It was followed by thiacloprid 48 SC (0.009%) and spinosad 45 SC (0.01%) recording ICBR of 1:4.14 and 1:2.64 respectively. Next economic treatments were indoxacarb 14.5 SC (0.01%), triazophos 40 EC (0.1%) and thiamethoxam 25 WG (0.005%) recorded ICBR 1:2.41, 1:1.67 and 1:1.06, respectively.

However, treatment with rynaxypyr 20 SC (0.01%) found comparatively less economic (1:0.41) as compared to the above treatments. Morever, treatment with spinosad 45 SC recorded maximum increment benefit of Rs.9938/ha this was followed by fenvalerate 20 EC (Rs. 9473/ha), indoxacarb 14.5 SC (Rs.7911/ha), thiacloprid 48 SC (Rs.4136/ha), triazophos 40 EC (Rs.3281/ha), rynaxypyr 20 SC (Rs. 2901/ha) and thiamethoxam 25 WG (Rs.1192/ha).

The above data indicated economics of different treatments in terms of incremental cost benefit Ratio (ICBR). The largest audience i.e. farmer are mostly interested in obtaining more benefit in terms of enhanced grain yield with very little expenses in plant protection. The data revealed that among the various treatments studied fenvalerate 20 EC (0.01%) was found to be most economic treatment recording highest ICBR of 1:11.91. It is followed by thiacloprid 48 SC (0.009 %) and spinosad 45 SC (0.01%) recording ICBR of 1:4.14 and 1: 2.64 respectively. Economically least effective treatment was Rynaxypyr 20 SC (0.01%) with ICBR of 1: 0.41 owing to its cost and moderate efficacy.

The findings of the present investigations are in conformity with the findings of Thakare et al. (2005) registering maximum yield of sesamum (647 kg/ha) with higest ICBR of 1:10.60 with fenvalerate 20 EC (0.01%). Morever, the earlier worker Deshmukh (2009) reported that spinosad 45 SC and fenvalerate 20 EC were found to be most effective treatments recording yield of 681 and 613 kg/ha, respectively.The higest ICBR 1:10.65 was recorded in spinosad 45 SC followed by fenvalerate 20 EC (1:9.60). These results are in agreement with results reported in the present investigations.

Table11. Yield and incremental cost benefit ratio for different treatment

Sr. No.	Treatments	Qty. of insecticide req./ha for 2 spray	Cost of treatment (Rs/ha)		Total cost (A)	Yield (kg/ha)	Increase yield over control (kg/ha)	Value of increased yield (Rs./ha) (B)	Increment benefit (C) (B-A)	ICBR (C/A)	Rank
			Cost of insecticide	Labour + sprayer charges							
1	Thiamethoxam 25 WG (@0.005 %)	0.200 kg.	460	660	1120	402	68	2312	1192	1:1.06	VI
2	Spinosad 45 SC (@0.01 %)	0.222 lit.	3104	660	3764	737	403	13702	9938	1:2.64	III
3	Indoxacarb 14.5 SC (@0.01%)	0.688 lit.	2615	660	3275	663	329	11186	7911	1:2.41	IV
4	Thiacloprid 48 SC (@0.009 %)	0.188 lit.	338	660	998	485	151	5134	4136	1:4.14	II
5	Fenvalerate 20 EC (@0.01 %)	0.500 lit.	135	660	795	636	302	10268	9473	1:11.91	I
6	Triazophos 40 EC (@0.1 %)	2.500 lit.	1125	660	1785	474	140	4760	2975	1:1.67	V
7	Rynaxypyr 20 SC (@0.01 %)	0.500 lit.	6333	660	6993	625	291	9894	2901	1:0.41	VII
8	Untreated Control	-	-	-		334	-	-	-	-	-

1. Thiamethoxam 25 WG– Rs 2300/kg
2. Spinosad 45 SC – Rs. 14000/lit
3. Indoxacarb 14.5 SC – Rs. 3800/lit
4. Thiacloprid 48 SC - Rs. 1800/lit
5. Fenvalerate 20 EC - Rs. 270/lit
6. Triazophos 40 EC - Rs. 450/lit
7. Rynaxypyr 20 SC - Rs. 12666/lit
8. Labour charges : Rs. 150/day,
9. Spray pump charge : Rs. 30/day
10. Market value of sesamum – Rs. 3400/qt

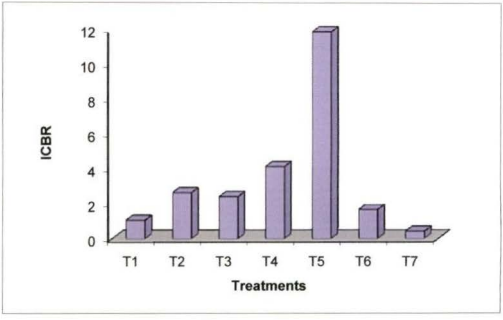


Fig. 11: Yield and incremental cost benefit ratio for different treatments

T_1 - Thiamethoxam 25 WG @0.005 %

T_2 - Spinosad 45 SC @ 0.01 %

T_3 - Indoxacarb 14.5 SC @ 0.01 %

T_4 - Thiacloprid 48 SC @ 0.009 %

T_5 - Fenvalerate 20 EC @ 0.01 %

T_6 - Triazophos 40 EC @ 0.1 %

T_7 - Rynaxypyr 20 SC @ 0.01 %

T_8 - Untreated Control

CHAPTER V

SUMMARY AND CONCLUSIONS

An experiment was carried out in field of Department of Agricultural Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in *Kharif* 2011-2012 to find out insecticidal management of insect pests of sesmum.

The treatments used in this study were Thiamethoxam 25 WG (0.005%), Spinosad 45 SC (0.01%), Indoxacarb 14.5 SC (0.01%), Thiacloprid 48 SC (0.009%), Fenvalerate 20 EC (0.01%), Triazophos 40 EC (0.1%), Rynaxypyr 20 SC (0.01%) and control.

The experiment was planned in RBD including eight treatments replicated thrice.

The sesamum variety used was AKT-64 with gross plot size of 4.5m x 3m and net plot size of 3.6m x 2.8m. The parameter on which the efficacy of various treatments was judged were per cent average infestation of gall fly and capsule borer, grain yield and incremental cost benefit ratio.

The observations were recorded after 3,7,10 and 14 days of first and second application of treatments for infestation of gall fly and capsule borer, respectively. For this purpose five plants from each treatment plots were randomly selected. Observations on total number of fruiting bodies (buds,flowers and capsules) on the plant and those damaged by gall fly and capsule borer were recorded seperately,from which per cent infestation of gall fly and capsule borer were computed. Post harvest observations i.e. the grain yield of each net plot were recorded to work out the efficacy of various treatments on yield basis and to calculate ICBR.

The data statistically analyzed after arc sin and square root transformations wherever applicable. The results obtained during the course of study are summarized as below along with the conclusions.

5.1 Efficacy of different insecticides against insect pests of Sesamum.

The various treatments tested were in same order of effectiveness at 3,7,10 and 14 days after spraying.

5.1.1 Sesamum gall fly, *Asphondylia sesami* Felt.

Application of spinosad 45 SC, 0.01 per cent was most effective treatment followed by thiacloprid 48 SC, 0.009 per cent and fenvalerate 20 EC, 0.01 per cent were found most effective in control of gall fly infestation.

5.1.2 Sesamum capsule borer, *Antigastra catalaunalis* Dup.

Application of spinosad 45 SC, 0.01 per cent was most effective treatment followed by indoxacarb 14.5 SC,0.01 per cent and rynaxypyr 20 SC 0.01 per cent were found most effective in controlling capsule borer infestation.

5.2 Effect of various treatments on yield of sesamum

The plot treated with spinosad 45 SC recorded maximum yield of sesamum i.e. (737 kg/ha) and it was at par with indoxacarb 14.5 SC recording 663 kg/ha yield. The treatments fenvalerate 20 EC and rynaxypyr 20 SC recorded (636 kg/ha) and (625 kg/ha) were found statistically at par with each other and significantly superior over control.

Further the treatments thiacloprid 48 SC followed by triazophos 40 EC and thiamethoxam 25 WG were found statistically at par with each other and significantly superior over control.

5.3 Incremental cost benefit ratio

Amongst the various treatments fenvalerate 20 EC (0.01%) emerged as the most economic one recording highest ICBR of 1: 11.91. It was followed by thiacloprid 48 SC (0.009%) and spinosad 45 SC (0.01%) recording ICBR of 1:4.14 and 1:2.64 respectively. Next economic treatments were indoxacarb 14.5 SC (0.01%) and triazophos 40 EC (0.1%) recorded ICBR 1:2.41 and 1:1.67 respectively. Further treatment thiamethoxam 25 WG (0.005%) was found economic recording ICBR of 1:1.06.

However, treatment with rynaxypyr 20 SC (0.01%) found comparatively less economic (1:0.41) as compared to the above treatments. Overall study indicated that chemical insecticides are most effective to manage the pest complex of sesamum with great net profit over control by application of only 2 to 3 sprayings.

From the present study following conclusions could be drawn

5.4 Conclusions

From the findings of the present, investigations, it is concluded that lowest average per cent infestation of gall fly was observed in spinosad 45 SC (0.01%) closely followed by thiacloprid 48 SC (0.009%) and fenvalerate 20 EC (0.01%) at 3,7,10 and 14 days after first spray. In case of capsule borer lowest average per cent infestation was observed in spinosad 45 SC (0.01%) closely followed by indoxacarb 14.5 SC (0.01%) and rynaxypyr 20 SC (0.01%) at 3,7,10 and 14 days after second spray.

The treatment spinosad 45 SC, indoxacarb 14.5 SC and fenvalerate 20 EC also ranked top in recording maximum yield. While the treatments fenvalerate 20 EC, thiacloprid 48 SC and spinosad 45 SC were most effective in recording highest ICBR. The treatments fenvalerate 20 EC, thiacloprid 48 SC and spinosad 45 SC were most

efficient in term of monitory return and also recorded minimum infestation of gall fly and capsule borer.

From the farmers point of view, they will seek for alternatives which will give highest monitory returns in terms of Rs/ha and these treatments were fenvalerate 20 EC,thiacloprid 48 SC and spinosad 45 SC followed by indoxacarb 14.5 SC and triazophos 40 EC. From the seed production point of view spinosad 45 SC, indoxacarb 14.5 SC and fenvalerate 20 EC were most effective in recording highest yield of sesamum.

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VITA

1. Name of student : Dafale Harshal Dinkarrao

2. Date of Birth : 25th April 1988

3. Name of College : Post Graduate Institute,
   Dr. PDKV, Akola,
   Maharashtra.

4. Residential address : Shivaji Nagar,Bhoyar
   Layout,Masala,Wardha
   Dist.Wardha
   Ph.no.9096539163

5. Academic qualifications

Sr. No.	Name of Degrees awarded	Year in which obtained	Division / Class	Name of awarding university	Subjects
1.	B.Sc. (Agriculture)	2010	First	Dr.PDKV, Akola	Agriculture

6. Field of Interest : Research and Development

7. Research paper published: Nil

Place: Akola

Date : 31 /05/ 2012

Signature of Student

APPENDIX-I

Details of insecticides

Sr. No.	Common name	Chemical name	Trade name	Supply source
1	Thiamethoxam 25 WG	3-(2-chloro- thiazol-S-ylemethyl)-5- methyl 1-3,5 oxadiaziam 4 ylidense-N-nitroamine	Actara	M/S Rallies India Ltd. Mumbai
2	Spinosad 45 SC	*Saccharopolyspora spinosa*	Spintar	De-Nocil crop protection Pvt.Ltd., Gujarat
3	Indoxacarb 14.5 SC	(3)-methyl 7 chloro-2, 5-dihydro 2 [(methoxy carbonyl)-4 trifluromethoxy phenyl amino carbonylindenol] 1, 2-e-1,3,4 oxadiazine 4 (a) (3II) carboxylate.	Avaunt	Dupont pesticides India Ltd. Mumbai
4	Thiacloprid 48 SC	Cyanamide, [3-[(6-chloro-3-pyridinyl)methyl]-2-thiazolidinylidene]	Calypso	Bayer CropScience
5	Fenvalerate 20 EC	a-cyano-me-phenoxyoenzyl-a-isopropylpchloro phenyl acephate	GT Fen	GTB Agro chemicals Pvt.Ltd., Raipur.
6	Triazophos 40 EC	0, O-diethyl o-(1-phenyl-1H-1, 2, 4-triazol-3-yl) phosphorothioate	Trizochem	Chemet crop science Pvt.Ltd.Ahmedabad,Gujrat
7	Rynaxypyr 20 SC	3-Bromo-N-[4-chloro-2methyl-6-[(methylamino)carbonyl]phenyl]-1-(3-chloro-2-pyridinyl)-1H - pyrazole-5-carboxamide	Coragen	E.I.DuPont India Pvt. Ltd.Gujrat

APPENDIX-II

Effect of various treatments on yield of sesamum per plot

(Net plot basis)

Tr.No.	Treatments	Seed yield (kg/plot)			Total	Mean (kg/plot)	Yield (kg/ha)
		RI	RII	RIII			
T1	Thiamethoxam 25WG, 0.005%	0.450	0.410	0.360	1.220	0.406	402
T2	Spinosad 45 SC,0.01%	0.748	0.737	0.745	2.230	0.743	737
T3	Indoxacarb 14.5 SC,0.01%	0.647	0.669	0.692	2.008	0.669	663
T4	Thiacloprid 48 SC,0.009%	0.463	0.487	0.517	1.467	0.489	4.85
T5	Fenvalerate 20 EC,0.01%	0.618	0.643	0.665	1.926	0.642	636
T6	Triazophos 40 EC,0.1%	0.45	0.482	0.502	1.434	0.478	474
T7	Rynaxypyr 20 SC,0.01%	0.506	0.752	0.632	1.890	0.630	625
T8	Untreated control	0.332	0.356	0.324	1.012	0.337	334
'F' test						Sig.	
SE (m)±						(0.028)	
C.D.(0.05)						(0.085)	

APPENDIX-III

Sr. No.	Spray no.	Days after sowing	Date of spraying
1	First	30	10-08-2011
2	Second	45	25-08-2011

Spraying details

Appendix IV

Table: Weekly weather Data for the Year 2011 recorded at Agromet. Observatory, Dr. PDKV, Akola

Weeks	Dates	Actual				2011										Normal				1971-2010	
		T MAX (°C)		T MIN (°C)		BSH (hrs)		WS (km/hr)		RH I (%)		RH II (%)		Evap (mm)		RF (mm)		CRF (mm)	Rainy Days
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A		N
1	1-7 Jan	*28.8*	25.1	*11.0*	8.8	*8.2*	3.2	4.4	1.1	*71*	*78*	*31*	*25*	*4.2*	3.7	*2.8*	0.0	0.0	*0.2*
2	8-14	*29.3*	27.4	*11.7*	7.0	*8.3*	7.3	4.4	0.5	*71*	*73*	*30*	*18*	*4.4*	3.8	*3.3*	0.0	0.0	*0.2*
3	15-21	*30.0*	29.3	*12.0*	9.9	*8.6*	6.4	4.5	1.3	*68*	*71*	*28*	*24*	*4.9*	4.8	*0.7*	0.0	0.0	*0.1*
4	22-28	*30.6*	31.2	*12.0*	12.3	*8.8*	5.5	4.6	0.6	*65*	*73*	*26*	*25*	*5.2*	4.3	*0.9*	0.0	0.0	*0.1*
5	29-4 Feb	*31.0*	31.5	*12.6*	13.8	*8.8*	4.8	4.9	1.0	*62*	*68*	*25*	*25*	*5.5*	5.4	*3.0*	0.0	0.0	*0.2*
6	5-11	*31.4*	32.7	*12.7*	13.3	*8.8*	6.4	5.0	1.3	*59*	*63*	*23*	*19*	*5.9*	6.1	*3.7*	0.0	0.0	*0.3*
7	12-18	*32.7*	32.9	*14.4*	16.4	*9.0*	6.0	5.4	2.4	*55*	*58*	*22*	*26*	*6.6*	6.8	*0.1*	0.0	0.0	*0.0*
8	19-25	*33.4*	30.9	*14.5*	15.7	*9.1*	6.5	5.7	2.3	*54*	*64*	*21*	*28*	*7.3*	6.7	*2.5*	3.7	3.7	*0.2*
9	26-4 Mar	*35.0*	33.5	*15.7*	18.0	*9.5*	6.3	6.1	1.9	*50*	*68*	*18*	*26*	*8.2*	6.7	*4.1*	3.0	6.7	*0.3*
10	5-11	*35.9*	36.4	*17.3*	18.6	*9.2*	7.2	6.1	3.7	*46*	*51*	*20*	*17*	*8.8*	8.1	*5.2*	0.0	6.7	*0.3*
11	12-18	*37.0*	36.5	*18.1*	15.3	*9.1*	8.7	6.3	1.9	*45*	*43*	*18*	*15*	*9.2*	9.1	*2.4*	0.0	6.7	*0.3*
12	19-25	*38.4*	38.7	*19.3*	22.2	*9.2*	7.6	6.4	3.8	*39*	*40*	*15*	*16*	*10.4*	11.5	*0.6*	0.8	7.5	*0.1*
13	26-1 Apr	*39.0*	39.0	*20.4*	19.0	*9.2*	8.4	6.9	3.2	*37*	*34*	*15*	*10*	*11.2*	11.3	*2.2*	0.0	7.5	*0.2*
14	2-8 Apr	*40.0*	37.7	*21.7*	22.0	*9.4*	7.1	7.3	5.5	*37*	*50*	*14*	*25*	*11.7*	12.2	*1.0*	24.8	32.3	*0.1*
15	9-15	*40.8*	38.7	*23.1*	23.3	*9.5*	7.4	8.4	2.4	*35*	*54*	*14*	*20*	*12.9*	11.1	*0.4*	0.0	32.3	*0.1*
16	16-22	*41.6*	40.4	*24.1*	25.5	*9.7*	7.8	8.6	4.6	*36*	*47*	*14*	*21*	*13.9*	13.0	*0.5*	0.0	32.3	*0.1*
17	23-29	*42.3*	39.9	*25.4*	23.1	*9.8*	7.9	9.0	3.6	*37*	*44*	*15*	*16*	*14.7*	12.5	*0.5*	4.0	36.3	*0.1*
18	30- 6 May	*42.6*	41.7	*26.6*	26.8	*9.4*	7.8	10.5	9.3	*39*	*47*	*15*	*21*	*15.5*	*16.4*	*0.8*	0.0	36.3	*0.1*
19	7-13	*42.6*	41.6	*27.1*	27.9	*9.7*	8.5	12.2	10.7	*42*	*50*	*17*	*20*	*16.2*	17.2	*1.3*	0.0	36.3	*0.1*
20	14-20	*42.5*	43.4	*27.7*	28.7	*9.4*	8.0	14.2	10.6	*47*	*43*	*19*	*19*	*16.8*	17.3	*2.8*	0.2	36.5	*0.4*
21	21-27	*42.1*	41.1	*27.8*	28.0	*9.5*	7.5	15.1	12.9	*50*	*58*	*20*	*29*	*16.9*	16.2	*3.8*	2.0	38.5	*0.4*
22	28-3 Jun	*41.7*	42.0	*27.8*	28.1	*9.4*	8.1	15.2	11.6	*53*	*55*	*23*	*24*	*16.2*	15.0	*6.3*	21.6	60.1	*0.4*
23	4-10	*40.2*	37.3	*26.9*	25.1	*8.4*	5.9	15.2	3.7	*62*	*75*	*30*	*40*	*14.0*	8.1	*16.8*	31.9	92.0	*1.0*
24	11-17	*38.0*	38.0	*25.7*	25.4	*7.1*	7.7	13.4	11.3	*69*	*66*	*40*	*33*	*11.1*	11.5	*43.6*	23.5	115.5	*1.7*
25	18-24	*35.5*	35.7	*25.0*	27.1	*5.8*	1.7	14.2	18.8	*74*	*66*	*48*	*42*	*9.2*	12.1	*43.5*	0.0	115.5	*2.0*
26	25-1Jul	*33.8*	33.1	*24.3*	24.8	*4.8*	0.7	12.8	11.9	*80*	*77*	*55*	*45*	*7.4*	7.2	*43.4*	17.2	132.7	*2.2*
27	2-8	*33.2*	34.6	*24.0*	25.0	*4.8*	3.0	12.0	8.2	*81*	*79*	*58*	*54*	*6.5*	7.3	*39.4*	43.7	176.4	*2.2*
28	9-15	*32.3*	31.4	*23.8*	23.8	*3.8*	2.4	11.2	11.3	*83*	*88*	*60*	*59*	*5.5*	5.1	*42.8*	26.4	202.8	*2.5*
29	16-22	*31.9*	30.4	*23.6*	24.0	*4.0*	0.8	10.4	7.8	*84*	*91*	*63*	*69*	*5.2*	4.4	*52.8*	58.1	260.9	*2.4*
30	23-29	*31.3*	29.8	*23.3*	23.8	*4.0*	2.8	10.8	4.8	*86*	*89*	*64*	*67*	*4.8*	3.6	*43.4*	26.0	286.9	*2.6*
31	30-5 Aug	*30.9*	30.9	*23.3*	24.1	*3.5*	3.8	10.6	8.0	*86*	*88*	*67*	*65*	*4.6*	4.9	*49.6*	17.5	304.4	*2.4*
32	6-12	*29.9*	30.5	*23.0*	23.7	*3.2*	1.0	10.9	6.1	*88*	*87*	*70*	*64*	*4.1*	3.6	*61.0*	8.5	312.9	*2.8*
33	13-19	*30.4*	30.1	*23.0*	23.3	*4.0*	3.0	12.4	3.6	*87*	*89*	*67*	*65*	*4.5*	4.1	*35.9*	47.6	360.5	*2.0*
34	20-26	*30.4*	31.3	*22.8*	23.4	*4.1*	4.0	11.9	3.6	*87*	*94*	*67*	*65*	*4.3*	4.3	*42.5*	18.9	379.4	*1.9*
35	27-2 Sep	*30.5*	28.5	*22.7*	23.2	*4.2*	0.8	9.3	4.7	*87*	*95*	*66*	*82*	*4.6*	3.3	*42.4*	46.6	426.0	*2.1*
36	3-9	*31.0*	29.8	*22.5*	23.2	*5.3*	3.1	8.6	3.3	*87*	*92*	*62*	*68*	*5.3*	3.3	*33.6*	63.1	489.1	*1.5*
37	10-16	*32.1*	29.9	*22.4*	23.4	*6.6*	5.0	8.0	2.6	*85*	*90*	*57*	*70*	*5.1*	4.3	*22.0*	21.5	510.6	*1.1*
38	17-23	*32.9*	30.9	*22.4*	22.5	*6.8*	6.1	6.4	5.0	*84*	*89*	*55*	*57*	*5.2*	4.7	*23.7*	3.5	514.1	*1.4*
39	24-30	*33.5*	32.7	*22.1*	22.5	*7.3*	5.7	5.1	3.8	*84*	*85*	*50*	*44*	*5.0*	5.0	*24.4*	0.0	514.1	*1.4*
40	1-7 Oct	*33.7*	34.9	*21.2*	21.3	*7.6*	7.7	4.8	1.4	*82*	*79*	*47*	*35*	*5.4*	6.1	*23.4*	0.0	514.1	*1.1*
41	8-14	*34.0*	35.5	*19.8*	21.0	*8.1*	5.8	4.5	1.5	*78*	*80*	*40*	*35*	*5.3*	5.6	*13.1*	0.8	514.9	*0.7*
42	15-21	*33.7*	35.7	*18.3*	20.1	*8.2*	5.6	4.6	1.0	*76*	*80*	*37*	*29*	*5.3*	5.4	*6.1*	0.9	515.8	*0.4*
43	22-28	*33.1*	34.6	*16.8*	15.9	*8.3*	7.4	4.4	1.7	*74*	*70*	*34*	*19*	*5.3*	6.0	*7.6*	0.0	515.8	*0.4*
44	29-4 Nov	*32.7*	32.9	*16.0*	15.3	*8.4*	7.3	4.1	2.1	*73*	*65*	*32*	*24*	*5.3*	6.6	*2.3*	0.0	515.8	*0.2*
45	5-11	*32.3*	33.8	*15.2*	14.7	*8.4*	8.2	3.9	1.1	*71*	*63*	*32*	*21*	*5.1*	5.5	*3.0*	0.0	515.8	*0.2*
46	12-18	*31.6*	33.5	*14.6*	14.6	*8.3*	7.8	3.9	0.8	*73*	*63*	*32*	*18*	*4.8*	5.4	*5.3*	0.0	515.8	*0.2*
47	19-25	*31.0*	32.0	*13.3*	12.9	*8.4*	7.9	3.7	1.5	*72*	*69*	*30*	*23*	*4.6*	5.8	*7.7*	0.0	515.8	*0.3*
48	26-2 Dec	*30.5*	31.4	*12.8*	15.4	*8.4*	6.5	3.6	1.1	*71*	*75*	*32*	*31*	*4.4*	5.1	*5.5*	0.0	515.8	*0.3*
49	3-9	*30.0*	31.6	*11.9*	13.9	*8.4*	7.7	3.8	0.8	*71*	*72*	*30*	*25*	*4.3*	4.6	*1.0*	0.0	515.8	*0.1*
50	10-16	*29.6*	29.9	*10.9*	11.4	*8.4*	7.9	3.6	0.8	*71*	*72*	*28*	*25*	*4.2*	5.0	*0.8*	0.0	515.8	*0.1*
51	17-23	*29.5*	29.6	*10.8*	11.3	*8.5*	7.4	3.8	1.2	*70*	*65*	*29*	*23*	*4.1*	4.7	*0.9*	0.0	515.8	*0.1*
52	24-31	*29.1*	29.5	*11.1*	11.4	*8.3*	6.5	4.5	0.9	*71*	*69*	*30*	*23*	*4.2*	4.5	*2.6*	0.0	515.8	*0.2*
														TOTAL RF January to Dec			515.8		4
														Total RF June to Dec			464.3		3