Management of Major Arthropod Pests of Summer Okra

xzh"edkyhu fHk.Mh esa eq[; vkFkksZiksM uk'khdhVksa dk çcU/ku

VINAYAK N. JALGAONKAR

Thesis

Doctor of Philosophy in Agriculture

(Entomology)

2019

DEPARTMENT OF ENTOMOLOGY
RAJASTHAN COLLEGE OF AGRICULTURE
MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
UDAIPUR-313001 (RAJASTHAN)

Management of Major Arthropod Pests of Summer Okra

xzh"edkyhu fHk.Mh esa eq[; vkFkksZiksM uk'khdhVksa dk çcU/ku

Thesis

Submitted to the

MaharanaPratap University of Agriculture and Technology, Udaipur

in partial fulfillment of the requirements
for the degree of

Doctor of Philosophy in Agriculture

(Entomology)

By

VINAYAK N. JALGAONKAR

2019

Maharana Pratap University of Agriculture and Technology
Rajasthan College of Agriculture, Udaipur

CERTIFICATE - I

Date: / / 2019

This is to certify that **Mr**. **Vinayak N. Jalgaonkar** has successfully completed the comprehensive examination held on as required under the regulation for the degree of **Doctor of Philosophy in Agriculture**.

(Dr. M.K. Mahla)
Prof. & Head
Department of Entomology
Rajasthan College of Agriculture,
MPUAT, Udaipur

Maharana Pratap University of Agriculture and Technology
Rajasthan College of Agriculture, Udaipur

CERTIFICATE - II

Date: / /2019

This is to certify that this thesis **entitled "Management of Major Arthropod Pests of Summer Okra"** submitted for the degree of **Doctor of Philosophy** in Agriculture in the subject of **Entomology** embodies bonafide research work carried out by **Mr. Vinayak N. Jalgaonkar** under my guidance and supervision and that no part of this thesis has been submitted for any other degree. The assistance and help received during the course of investigation has been fully acknowledged. The draft of this thesis was also approved by the advisory committee on

(Dr. M.K. Mahla)
Prof & Head
Department of Entomology
Rajasthan College of Agriculture
MPUAT, Udaipur

(Dr. M.K. Mahla)
Major Advisor

(Dr. Anurabh Joshi)
Dean
Rajasthan College of Agriculture,
MPUAT, Udaipur

Maharana Pratap University of Agriculture and Technology
Rajasthan College of Agriculture, Udaipur

CERTIFICATE - III

Date: / /2019

This is to certify that this thesis entitled **"Management of Major Arthropod Pests of Summer Okra"** submitted by **Mr. Vinayak N. Jalgaonkar** to Maharana Pratap University of Agriculture and Technology, Udaipur in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Agriculture in the subject of **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 on his thesis has been was found satisfactory, we therefore, recommend that the thesis be approved.

(Dr. M.K. Mahla)
Major Advisor

(Dr. Mrs K.V. Naik)
Advisor

(Dr. R. Swaminathan)
Advisor

(Dr. Anurabh Joshi)
Advisor

(Dr. S.S. Sisodia)
DRI Nominee

External Examiner

(Dr. M. K. Mahla)
Head
Department of Entomology

Approved

(Dr. R. A. Kaushik)
Director, Resident Instructions
Maharana Pratap University of Agriculture & Technology, Udiapur (Raj.)

Maharana Pratap University of Agriculture and Technology
Rajasthan College of Agriculture, Udaipur

CERTIFICATE - IV

Date: / /2019

This is to certify that **Mr. Vinayak N. Jalgaonkar** Student of Doctor of Philosophy in Agriculture, **Department of Entomology**, Rajasthan College of Agriculture, Udaipur has made all the corrections / modifications in the thesis entitled **"Management of Major Arthropod Pests of Summer Okra"** which were suggested by the external examiner and the advisory committee in the oral examination held on 28/04/2016 The final copies of the thesis duly bound and corrected were submitted on date ………………. are enclosed herewith for approval.

(Dr. M.K. Mahla)
Prof & Head
Department of Entomology
Rajasthan College of Agriculture
MPUAT, Udaipur

(Dr. M.K. Mahla)
Major Advisor

(Dr. Anurabh Joshi)
Dean
Rajasthan College of Agriculture
MPUAT, Udaipur

ACKNOWLEDGEMENT

Today I reflect all the ways I am Thankful……

I thank you 'God' for all the blessing you showered upon me.

The success and final outcome of this project required a lot of guidance and assistance from many people and I am extremely privileged to have got this all along the completion of my project. All that I have done is only due to such supervision and assistance and I would not forget to thank them.

I feel privileged to express my sincere and deep sense of gratitude to my Honorable Major Advisor Dr. M.K. Mahla, Head, Department of Entomology, Rajasthan College of Agriculture, Udaipur for their keen interest, valuable suggestions and thorough guidance during the entire period of investigation and critically going through the manuscript.

I express my sincere gratitude to my Honorable Former Major Advisor Late Dr. O. P. Ameta, Ex. Head and Present Major Advisor Dr. B.S. Rana Professor, Department of Entomology, Rajasthan College of Agriculture, Udaipur for their keen interest, valuable suggestions and thorough guidance during the entire period of investigation.

I respect and owe my sincere thanks to my Co-major Advisor Dr. Mrs. K.V. Naik, Associate Professor, Department of Entomology, College of Agriculture, Dapoli for her valuable guidance, constant encouragement, constructive suggestions and utmost co-operation during the course of study.

I am thankful and fortunate enough to get support and guidance from the members of my Advisory Committee, Dr. R. Swaminathan, Retd. Professor and Head, Department of Entomology and Dr. S.S. Sisodia, Head, Extension and DRI Nominee, Rajasthan College of Agriculture for their valuable suggestions and support.

Similar, profound gratitude goes to Dr. S.R. Maloo, Ex. Dean; Dr. Anurabh Joshi, Dean and Dr. R.A. Kaushik, Director, Resident Instructions, Rajasthan College of Agriculture, MPUAT, Udaipur for giving me the opportunity and providing facilities for the study.

I express my deep sense of gratitude to Honourable Dr. Tapas Bhattacharya, Ex. Vice Chancellor, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli and Dr. U.V. Mahadakar, Ex Director of Research, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli for giving me the opportunity to do the Ph. D. studies. Also, I express my sincere thanks to all my University authorities for providing me the facilities.

Special mention goes to my enthusiastic and truly dedicated mentors. I wish to express my earnest gratitude to Dr. Anil Vyas, Dr. M. K. Mahela, Dr. K. C. Sharma, Dr. Hemant Swami, Dr. Lekha and Dr. N. L. Dangi, and all other staff members for their help. I also express my sincere thanks to the Head and other Professors of the Department of Entomology, College of Agriculture, Dapoli for their valuable suggestions.

I am also hugely appreciative to the staff members of Regional Agricultural Research Station, Karjat namely Ms. Suvidha, Ms. Sonal for their help in data recording and preparation of manuscript. Also, I am extremely thankful to Mr. Kiran Malshe, Assistant Professors of Horticulture for his help during research.

My sincere thanks are due to my colleagues Jhumar, Sugandh, Mukesh, Ms. Anusha, Ms. Saranya and Dr. Sonkamble for their continuous support during the course of my study. Also, I appreciate with thanks the help and assistance rendered to me by all those whose name could not be specially mentioned.

A special thanks to my family, words cannot express how grateful I am to them. I have no words to express my sense of gratitude and indebtedness to my parents. So, I bow my head before my beloved father, Late Shri. Narayan Rama Jalgaonkar, my loving mother Smt. Surekha Narayan Jalgaonkar, my parents who raised me with a love of science and supported me in all my pursuits. I am also thankful to my siblings Vandana, Vanita, Vidyadhar, Vaishali, their better half and their children (Vardhan & Vihan), for their inspiration and support. Your prayer for me was what sustained me thus far. I would also like to thank all of my friends who incented me to strive towards my goal.

At the end I would like to thank my wife Mrs. Poonam V. Jalgaonkar for her continued and unfailing love, support and understanding during my pursuit of Ph.D. degree that made the completion of thesis possible.

Thank you all for your encouragement.

Date:

Place: Udaipur **(Vinayak Narayan Jalgaonkar)**

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

1. INTRODUCTION

Vegetables structure the most imperative segment of our fair eating regimen. They are likewise considered as "Defensive nourishment" as they contain nutrients, minerals and dietary strands separated from protein, lipids and starches of organic esteem. Okra, *Abelmoschus esculentus* (L) Moench, is one of the real vegetable harvests in the tropical and subtropical areas of the world and is developed financially in West Africa, South East Asia, Southern United States, Brazil, Turkey, and Northern Australia. In India, it is broadly developed in West Bengal, Bihar, Orissa, Gujarat, Andhra Pradesh, Jharkhand, Chhattisgarh, Haryana and Maharashtra; possessing a zone of about 532.6 thousand hectares, with a creation of almost 6346.3 million tones and efficiency of 11.9 MT/hectare. In Maharashtra okra involves a territory of 23 thousand hectares, with profitability of 441.5 metric tons and efficiency of 10.5 MT/ha (NHM Database 2014).

Over India, its youthful delicate natural products are utilized as vegetable. They are additionally utilized in soups and stews. It can likewise be sun-dried, cured or canned for off season utilization. The roots and stems of okra are utilized for clearing the sugar stick juice while planning jaggery and sugar. Its ready dark or darker white-peered toward seeds are now and then broiled, ground and utilized as a substitute for espresso in Turkey .notwithstanding vegetable, okra has a few traits that could allow it to be utilized for different purposes. Leaves, buds and blossoms are consumable, dried seeds could give oil, protein vegetable curd and dried stem could fill in as wellspring of paper mash or fuel. Seeds in the wake of broiling are valuable against genitourinary disarranges and perpetual loose bowels.

Okra natural product is a decent wellspring of nutrient A, B and C. The substance of calcium in its natural products is extremely high (66 mg/100g of palatable bit) contrasted with that in other foods grown from the ground. At the correct eatable stage, okra cases are a decent wellspring of protein, sugars and minerals like Ca, Fe, P and so forth. It is an astounding wellspring of iodine. It is healthfully rich when contrasted with tomato, egg plant and the vast majority of cucurbits. Okra contains exceptional fiber which brings sugar levels in blood leveled out, giving sugar amount worthy to the insides. Adhesive found in okra is in charge of washing without end dangerous substances and terrible cholesterol, which stacks the liver. The fiber content in okra is likewise a profitable supplement for digestive system miniaturized scale living beings. This guarantees appropriate digestive system usefulness. It guarantees recuperation from mental and mental conditions like, sorrow and general shortcoming. It is a viable solution for ulcers and joint soundness. It is utilized to neutralize the acids. Because of its basic starting point, it likewise watches the mucous layers of the stomach related framework by covering them with extra layer. It is also connected for pneumonic aggravations, entrail disturbances and sore throat. As indicated by Indian inquires about, okra is a mind boggling swap for human blood plasma. So as to guard the significant substances, it is important to cook okra as in a matter of seconds as could be allowed, preparing it either with steam, or on low warmth.

The yield is invaded by an assortment of irritations all through its development of insect like jassids (*Amrasca biguttula biguttula* Ishida), white flies (*Bemisia tabaci Gennadius*), flea beetle (*Podagrica bowringi* Baly), shoot and fruit borer (*Earias vittella* Fabricius and *Earias insulana* Boisduval), aphids (*Aphis gossypii* Glover) and mite (*Tetranychus urticae koch*). Sowing date has an imperative bearing on the creepy crawly bother wealth; once in a while the late sown harvest may flop totally because of the shoot and organic product borer pervasion, as it is the most genuine and ruinous vermin in numerous parts of India (Mandal *et al*., 2006). The effect of sowing dates on the populace elements of *Earias spp*. on okra was concentrated by Gautam *et al* (2013), Kaur *et al* (2013) and Sharma et al (2010) in various parts of India, anyway comparative investigations are needing from Maharashtra. It has been accounted for to cause 61.32 percent harm to foods grown from the ground percent loss of natural product yield (Brar *et al*., 1994).

Countless have been accounted for to successfully control arthropod bothers in okra, yet the unpredictable and nonsensical utilization of pesticides at high dosages has brought about improvement of a few issues like ecological contamination, bug spray opposition, bug resurgence, lingering poisonous quality, wellbeing perils, devastation of the characteristic adversaries, pollinators and other non-target living beings. It is thusly important to work out procedures including safe assortments, appropriate planting dates and fresher pesticide particles lethal to arthropod bugs even at lower dosages together with being protected to the normal adversaries present in agro-biological community.

Keeping these actualities in view, the present investigation has been proposed with the set targets, referenced prior, towards the executives of the nuisance complex of okra.

(i) To screen okra germplasm against major arthropod pests.

(ii) To analyse the impact of date of sowing on infestation by major arthropod pests.

(iii) To study the population dynamics of the major arthropod pests.

(iv) To evaluate some insecticides and bio-pesticides against major arthropod pests.

2. REVIEW OF LITERATURE

Okra, *Abelmoschus esculentus* (L.) Moench is one of the vital vegetable yield developed all through the nation. Among the different aphid aphids assaulting okra, jassid (*Amrasca biguttula biguttula* Ishida), aphid (*Aphis gossypii* Glover), whitefly (*Bemisia tabaci* Gennadius) and shoot and fruit borer (*Earias vittella* Fabricius) are the real creepy crawly bothers making significant damage the yield. The writing relating to various perspectives to the present examinations has been evaluated and introduced under after goals.

(i) To screen okra germplasm against major arthropod pests

(ii) To analyse the impact of date of sowing on infestation by major arthropod pests.

(iii) To study the population dynamics of the major arthropod pests.

(iv) To evaluate some insecticides and bio-pesticides against major arthropod pests.

(i) Screening of okra germplasm against major arthropod pests

Sdamagea and Jat (2009) assessed ten variety of okra against shoot and fruit borer and uncovered that Arka Anamika and Varsha Uphar demonstrated 25.20 and 29.00 per cent fruit invasion, individually on number premise and were sorted as less powerless. Though, Malav-31 and Parbhani Kranti were sorted as profoundly powerless and had 42.10 and 43.20 per cent fruit pervasion, individually on number premise. The rest of the variety *viz.*, Sagun, Selection-1, Seedtech-71, Kavery choice, Nidhi-98 and Super Pratik were arranged as modestly powerless and had 34.10, 32.10, 31.30, 35.90, 38.20 and 33.30 per cent fruit pervasion, individually on number premise.

Bangar *et al.* (2012) assessed 10 variety of okra under field conditions in Gujarat for protection from *E. vittella* and found that the variety AOL 05-1, Gujarat Okra - 2, AOL 08-2 were least helpless in summer season.

Bangar *et al.* (2012) screened okra against okra shoot fruit borer. *Earias vittella* (Fabticius) (Noctuidae: Lepidoptera) at Vegetable Research Station Farm, Anand Agricultural University, Anand During summer period of 2010. Out of ten genotypes/variety, "AOL-05-1" found very safe which recorded fundamentally lower number of hatchlings per plants, per cent shoot just as fruit damage. Genotype "AOL 08-5" recorded higher number of hatchlings per plant; per cent shoot just as fruit damage and was discovered generally powerless. Fiber and fiery debris content in fruits were essentially adversely corresponded with the pervasion of *E. vittella*. Irrelevant job of chlorophyll content in the fruits on pervasion of *E. vittella* was watched.

Bangar *et al.* (2012) screened ten unique genotypes/variety of okra for their powerlessness to *E. vittella* under field condition at principle Vegetable Research Station, Anand Agricultural University, Anand During summer 2010. Out of ten genotypes/variety, genotypes AOL-05-1, Gujarat Okra-1 and AOL 08-2 recorded essentially lower number of hatchlings per plant and per cent shoot just as fruit damage can be considered as less powerless genotypes, while genotypes AOL 03-1, AOL08-10, AOL 08-5 and Parbhani Kranti recorded higher larval population, shoot just as fruit damage were viewed as defenseless to *E. vittella*. Dampness content was altogether decidedly related with all the three parameters (larval population, shoot and fruit damage) of invasion, while fiber and fiery remains content were essentially adversely corresponded with the pervasion of *E. vittella*. It demonstrated lower dampness (%).

Patel *et al.* (2012) revealed that the okra cv. Arka Anamika bolstered least jassid population (2.03 jassids/leaf), which was at standard with GO-2 (2.05 jassids/leaf) and AOL-03-1 (2.07 jassids/leaf) variety, while the most extreme jassid population (4.71 jassids/leaf) was seen in Parbhani Kranti, which was at standard with Pusa Sawani (4.23 jassids.leaf).

Gonde *et al.* (2012) saw that the variety VRO 3 and Kashi Pragati were impervious to jassid pervasion. In appreciation of whitefly invasion, least pervasion was found in VRO 3 and VRO 4, while variety Bhendi Vaphy, IIVR 11, VRO 3, EMS 8-1 indicated least shoot pervasion. Fruit pervasion based on numbers was recorded most reduced in EMS 8-1 pursued by Punjab Padmini, VRO 3, Bhendi Vaphy, IIVR 11, IIVR 10, Kashi Pragati, EC 35638, IC 282273 and IC 282272.

Nataraja *et al.* (2015) screened distinctive okra genotypes/variety for their relative inclination to whitefly, B. tabaci (Gennadius); aphid, *A. gossypii* (Glover and jassid, *A. biguttula biguttula* (Ishida). The genotypes *viz.*, IC331217, IC332453 and IC342075 and variety, *viz.*, Manisha-211 and Arka Anamika were unimportantly favored over different genotypes/variety by whiteflies, aphids, and jassids.

Badiyala and Raj (2013) uncovered that the okra shoot pervasion changed between 1.78 to 2.24 per cent During first year and 0.82 and 1.56 per cent During second year, while the fruit invasion differed between 1.83 to 35.85 per cent and 1.23 to 29.64 per cent During individual years. Among ten okra variety screened for relative vulnerability to *E. vittella*, Tulsi and Varsha Uphar enrolled lower mean per cent fruit borer pervasion just as higher yield when contrasted with rest of the variety.

Kaur *et al.* (2013) assessed three variety of okra at Punjab Agriculture University, Ludhiana under field conditions and detailed that the low mean fruit pervasion was recorded on number and weight premise in Punjab– Padmini (18.09-18.68%) and Punjab - 8 (18.10-19.68%) separately and higher fruit invasion was recorded on number and weight premise in Punjab-7 (22.27-23.29%), individually.

Verma *et al.* (2013) did handle screening of twenty three genotypes of okra. It was uncovered that shoot and fruit pervasion was at its top during second week of October. Eight genotypes (HBT-3, HBT 13, HBT 32, HBT 33-2-1, HBT 51-1, HBT 12, HBT 49-12 1 and HBT 15) demonstrated fruit invasion under 25 per cent, 13 genotypes (Varsha Uphar, Hisar Naween, HBT36, HBT 1, HBT 32-1, HBT 35, HBT 35-1, HBT 41, HBT 45, HBT 55, HBT 56, HBT 69-1 and HBT6) indicated pervasion in the rang of 25.1 to 40.0 per cent and 2 genotypes (HBT 69 and HBT 6-7-1) demonstrated more than 40 per cent invasion.

Rehman *et al.* (2015) assessed seven okra variety *viz*., Taj Vendhi, BARI Dharos-1, Arka Anamika, Green Finger, Green Soft, OK-285 and Nabik against okra shoot and fruit borer. Among the seven variety, Taj Vendhi was the most prefered variety as the most astounding normal shoot (26%) and fruit (24%) pervasion were recorded. Despite what might be expected, Arka Anamika was discovered least prefered variety with most minimal shoot (10%) and fruit (11%) pervasions. Tolerably favored variety was OK-285, trailed by Green Soft and Green Finger. Inclination rank for okra shoot and fruit borer among seven okra variety was Taj Vendhi, OK-285, Green Soft, Green Finger, BARI Dharos-1, Nabik and Arka Anamika.

Rahman *et al.* (2015) announced that okra variety Arka Anamika was least favored by the shoot and fruit borer with 10 and 11 per cent invasion, though Taj Vendhi was prefered with 26 and 24 per cent pervasion.

Gadekar *et al.* (2015) screened ten variety of okra against sucking irritations and recorded Hissar Unnat and Varsha Uphar to be least powerless, Kashi Mohini (VRO-03) and Aprajita as very helpless, while Arka Abhay, A-4, Pusa Sawni, Arka Anamika, Parbhani Kranti and Hissar Naveen as tolerably defenseless to the assault of jassid and thrips, other than the variety Hissar Unnat, Varsha Uphar and Pusa Sawni were least vulnerable to whitefly. The variety A-4, Arka Abhay, Arka Anamika, Parbhani Kranti, Hissar Naveen, Kashi Mohini rose as reasonably vulnerable; though, Aprajita developed as exceptionally powerless against whitefly on okra.

(ii) Impact of date of sowing on major arthropod pests

A next to no data is accessible on insect pest of okra and its connection with date of sowing and climate parameters.

Dhamdhere *et al.* (1984), revealed that the invasion of *E. vittella* on okra shoot damage ran from 5.5 to 23.9 and 4.65 to 17.15 %, while on fruit 25.93 to 40.91 and 1.75 to 16.62% during *kharif* period of year 1980 and summer year 1983, individually. The temperature and dampness had no clear impact on the action of the irritation during *kharif* season however its movement expanded with increment in mugginess during summer season at Gwalior in Madhya Pradesh.

In Rajasthan, aphid showed up in third week of August and expanded with the expansion in relative stickiness. Nonetheless, it recorded 40.2 aphid/plant in fourth week of September and declined from that point (Pareek *et.al*, 1986).

Patel (1988) found that the aphid, *A. gossypii* began showing up after second week of sowing of the okra crop and expanded pointedly coming to larger amount after sixth and seventh week. Later on the population was declined during eighth and ninth week and again expanded after 10^{th} and eleventh week however then it diminished definitely. He further announced that in July sown yield, the aphid population was contrarily corresponded with greatest, least and normal temperature and daylight hours, while decidedly associated with morning, night and normal relative stickiness just as with precipitation and blustery days.

Kumar and Urs (1988) considered the occasional occurrence of shoot and fruit borer bother on okra during the time by sowing the harvest at month to month interim. They revealed that most noteworthy shoot and fruit damage was recorded after third to fifth week and 10^{th} to eleventh WAS. The invasion level on fruits differed from 8.4% to 73.2%. The examination likewise demonstrated significant positive connection between's the occurrence of the vermin and winning temperature. Relative dampness was observed to be adversely associated with irritation rate, where as precipitation did not demonstrated any connection.

Patel (1988) announced that there was no noteworthy connection between's *E. vittella* damage and climate parameters in summer okra, while during *kharif* significant positive relationship of shoot damage was recorded with least temperature (r = 0.813) and blustery day (r = 0.781).

As per Srinivasan *et al.* (1988) the occurrence of *A. biguttula biguttula* on okra was low from June to mid January in Karnataka. Among the different climate parameters dissected, just least temperature had a noteworthy positive connection with the aphid population, while, most extreme invasion of *A. biguttula biguttula* on okra was seen in the harvest sown in July. Be that as it may, misfortune in fruit yield was adversely associated with pervasion and the leaf damage.

Chaudhary and Dadheech (1989) from Udaipur revealed that the frequency of whitefly happened on summer okra crop following one month and bit by bit came to a (0.78 grown-up/leaf) on 43 DAS. Later nuisance population began declining.

Chaudhary and Dadheech (1989) found that *A. gossypii* showed up on the mid year okra 21 DAS. The irritation population step by step expanded and achieved a (2.89 aphids/leaf) on 43 days old harvest. Chaudhary and Dadheech (1989) reported that *A. biguttula biguttula* appeared on the summer okra 21 days after sowing. The population gradually increased and reached a peak (4.78 jassid nymphs / leaf) on 43 days old crop and thereafter the population started declining.

Chaudhary and Dadheech (1989) recorded the rate of fruit borer at fruit setting and came to its (57.1%) on about 10^{th} WAS on summer okra at Udaipur (Rajasthan).

Patel (1989b) saw that the whitefly population was at fluctuating dimension however it was most extreme after fourth week of sowing of okra crop During summer season. There was a second population top following 7 to about two months of sowing however later it forcefully declined and vanished. Further, there was huge negative relationship between's whitefly population and least temperature (r = - 0.6932), normal relative mugginess (r = - 0.7188) and evening relative dampness (r = - 0.5716).

Patel (1989b), found that the frequency of jassid initiated after second weekof sowing yet it was most elevated following eleven weeks and later the aphid population began declining. Further, the jassid population indicated significant positive connection with most extreme temperature (r = 0.9058), normal temperature (r= 0.7571) and daylight hours (r = 0.6166) while it was fundamentally adversely corresponded with least temperature (r = - 0.7682), evening relative stickiness (r = - 0.8210) and normal relative mugginess (r = - 0.8358). Essentially, the precipitation and blustery days additionally shown negative relationship with jassid population.

Mahal *et al.* (1994) examined the impact of mimicked introduction to regular invasion of *A. biguttula biguttula* at various harvest organizes on seed yield of okra concerning three sowing dates and two variety in Punjab. They found that early presentation to jassid invasion upto 15 DAG, particularly in ahead of schedule and ordinary sown harvests, brought about more prominent misfortunes in seed yield (37.55 and 42.38%) than in late sown harvest (20.39%), The misfortunes in right on time and typical sown yield were minimal (3.56 and 2.95%, individually) where the harvest was presented to jassid pervasion late in season at 35 DAG.

Kadivar (1995) saw that whitefly did not show up during summer season. Be that as it may, during *kharif* season the nuisance was seen after fourth week of sowing. The movement (5.86 to 6.45 whiteflies/leaf) was seen after 10th week of sowing. The rate of whitefly shown huge negative connection with least temperature on all the three variety, though it was essentially negative with morning relative moistness on Gujarat Okra-1 and Pusa Sawani variety of okra.

Pawar *et al.* (1996) in an analysis, sown okra crop on various dates begin from 15th May to first October at 15 days interim and watched lower rate (13.3 and 13.7 leaf containers/leaf, separately) on 15th May and 1st June sown harvest.

Okra crop sown on various dates (15th May, 25th May, 5th June, 15th June, 25th June, 5th July and 15th July) saw that crop sown on 15th May to 15th July and harvest development stages affected the jassid population essentially and found most defenseless at 50th DAS anyway top population was seen in 15th May sown yield. They further revealed diminishing pattern of jassid population with the headway of sowing time (Satpathy and Rai, 1998).

Ghosh *et al.* (1999) detailed that whitefly was missing During early period of plant development for example from center of May to June (nineteenth to twentieth standard week) on okra crop. Inception of population was recorded on first week of June (23rd standard week) which consistently expanded till the finish of yield developing season. The most elevated population was recorded (2.80 whiteflies per leaf) toward the finish of the period (fourth week of July for example 30th SMW). Least temperature indicated positive and huge connection (r = 0.990) with population of whitefly.

Ghosh *et al.* (1999) found that the number of inhabitants in aphid was started in center of June (24th standard week) and higher population (28th to 30th standard week) till June and came to top (39.85 aphids/leaf) during a week ago of July (30th standard week). A noteworthy positive relationship saw between aphid population and least temperature (r = 0.864) and positive non-significant connection (r = 0.364) with relative mugginess.

Ghosh *et al.* (1999) watched expanding pattern of Jassid, *A. biguttula biguttula* during rainstorm season and detailed population (21.36 jassids/leaf) in center of June (24th SMW) when temperature stayed around 37° C and 10 hours splendid daylight hours. A non-significant negative connection was seen between *A. biguttula biguttula* population and most extreme temperature (r = - 0.090), least temperature (r = - 0.018), while positive non-significant connection with relative dampness (r = 0.124).

Ghosh *et al.* (1999) announced that fruit borer, *E. vittella*, pervasion was not found at introductory fruiting stage, be that as it may, it seemed late During 28th May to third June and came to crest (32.22 %) during a week ago of July in West Bengal. Connection examines showed positive noteworthy relationship (r = 0.989) between fruit damage and least temperature, while positive non-significant relationship (r = 0.398) with relative dampness.

Rai and Satpathy (1999) watched expanding pattern of okra fruit borer damage with the headway of sowing time (15^{th} May, 25^{th} May, 5^{th} June, 15^{th} June, 25^{th} June, 5^{th} July and 15^{th} July), anyway most extreme fruit damage recorded in harvest sown in second week of July which was least in yield sown on 25th May yet greatest fruit yield got from yield sown in first week of June because of appropriate developing conditions.

Ahmed *et al.* (2000) contemplated the plenitude of *E. vittella* on okra crop in Pusa area of Bihar and revealed larval population (187.5) in products of okra cv. Parbhani Kranti in summer season During first fortnight of July at 29.9 ± 2.9 °C, 84 ± 5.1% R.H. what's more, 61.4 precipitation while the population was least (109.3) During second fortnight of May when the temperature (31.6 ± 7.7 °C) was similarly higher, R.H. (54 ± 2.1%) low and no precipitation. The larval population in fruits demonstrates significant positive relationship with min. temp. (r = 0.578), positive connection with morning (r = 0.774) and evening (r = 0.800) R. H. while negative connection with max. temp. (r = - 0.747) and precipitation demonstrated huge effect on the larval population as the coefficient of connection (r = 0.410) was huge.

Kumawat *et al.* (2000) revealed that the occurrence of whitefly on okra began in the fourth week of July and came to at crest during fourth week of September. Further, the population indicated huge relationship with least and most extreme temperature at Jobner (Rajasthan).

Kumawat *et al.* (2000) considered the regular rate of jassid population on okra at Jobner, Rajasthan. They found that the invasion of jassid began in the fourth week of July and it came to a top in 2ndweek of September.

Mandal *et al.* (2006) watched the jassid population on summer okra crop stayed dynamic all through harvest development period in both the years. Population begins showing up at beginning time of yield development in 10^{th} standard meteorological week (SMW) at that point expanded continuously during 13^{th} to 16^{th} SMW and accomplished top in 16^{th} SMW from that point began declining. Relationship considers demonstrated very noteworthy positive connection with most extreme temperature (r = 0.607) and huge positive connection with least temperature (r = 0.359) while non-huge negative connection with mean relative moistness (r = - 0.196) and positive relationship (r = 0.025) with night relative stickiness.

Mandal *et al.* (2007) reported *E. vittella* incidence in relation to different sowing dates. Sowing of crops during mid-February reduced incidence of pest.

Gautam *et al.* (2013) carried an experiment on non–pesticidal management of okra shoot and fruit borer *E. vittella*. by changing dates of sowing and observed that early sown crop *i.e.* on 1st March suffered less (27.80%) followed by crop sown on second date (17th March), recorded (31.20%) while, highest infestation (44.40%) was recorded on the late sown crop (2nd April).

Kaur *et al.* (2013) studied the influence of sowing dates and varieties of okra on incidence of shoot and fruit borer, *Earias sp.* under field conditions in Punjab and reported that early sowing *i.e.* second fortnight of May recorded low fruit infestation 12.00 and 14.17 per cent on number and weight basis, respectively and highest marketable yield(189.18 q/ha).

(iii) Population dynamics of the major arthropod pests

Ahmad *et al.* (2000) revealed top larval population of *E. viltella* in fruits okra During first fortnight of Jul at 29.0 + 2.9°C temperature, 84 + 5%, relative moistness and 61.4 mm precipitation, while least population During second fortnight of May when temperature was 31.6 +7.7°C, (54+ 2.1%) relative stickiness and no precipitation. Further, the base temperature portrayed noteworthy positive connection, anyway greatest temperature indicated negative relationship with the larval population of *E. vittella*.

Kumawat *et al.* (2000) considered the regular rate of jassid and whitefly on okra crop and their relationship with abiotic factors. The invasion of jassids and whitefly began from fourth week of July and came to its crest in the second and fourth long stretches of September, individually. They additionally detailed that most extreme temperature was altogether associated with whitefly thickness.

Pareek *et al.* (2001) contemplated the population development of shoot and fruit borer (*E. vitella* and *E. insulan*) in connection to key abiotic factors and detailed that the occurrence of shoot borer initiated in the fourth week of July and came to greatest in the second week of October. Fruit borer rate began in the principal week of September and persevered till last picking. The most extreme fruit borer pervasion was recorded in the third weekof October. The base temperature, relative mugginess and precipitation had significant negative connection with the population development of shoot and fruit borer.

The rate of shoot and fruit borer, *E. vittella* started in the fourth week of August (a month subsequent to sowing) by laying eggs on developing shoots. Damage to the shoots and fruits began in the most recent week of August and first week of September, separately. The number of eggs (5 eggs/5 plants), hatchlings (10.33 hatchlings/5plants) and damaged fruits (71.80% on number and 70.24 % on weight premise) were seen in the second weekof September, first weekof October and a week ago of September, separately (Dangi and Ameta, 2005).

Yadav *et al.* (2007) saw that the frequency of shoot and fruit borer initiated in the third week of August on multi week old plants on leafy foods until the fourth weekof October on 12 weeks old plants during both back to back years. The most extreme fruit damage in the year 2005 was seen in the third week of September.

Meena *et al.* (2010) contemplated the occurrence of shoot and fruit borer as blended population (*E. insulan* a and *E. vittella*) on okra (cv. Parbhani kranti) during *kharif* 2002 and 2003. Shoot invasion happened from the principal week of August to the gathering of yield, step by step expanded from 1.0 and 0.66 per cent to 23.0 and 25.0 per cent in the third week of October in 2002 and 2003, separately Minimum temperature and relative mugginess had a noteworthy negative connection with shoot pervasion. Fruit invasion started in the main week of September in both the years. The dimension of invasion step by step expanded as the yield developed, contacting with of 31.6 per cent as far as number and 29.7 per cent on a load premise in the year 2002 yet such figures were 34.0% and 31.0%, individually, in the year 2003. The most extreme and least temperature had negative relationship with fruit invasion.

Sdamagea *et al.* (2010) directed field tries different things with a view to watch the change of *E. vittella* population and its connection to winning climate conditions during *kharif* 2005 and 2006. The outcomes uncovered that borer rate started in the 29th standard metrological week. The invasion of shoot and fruit borer (91.6%) was seen in 45th standard week. The most extreme number (7.5 hatchlings/10 plants) was recorded in the 42nd standard week. The most extreme quantum of damaged fruits on number and weight premise was 54.3 and 54.7 per cent, separately when the harvest wound up 18 weeks old in 42nd standard week. Connection grid demonstrated that borer population was adversely corresponded with the mean temperature and mean relative stickiness however did not indicate relationship with precipitation as far as larval population and per centage of invaded plants.

Sdamagea and Jat (2010) considered the impact of key abiotic factors on the occurrence of shoot and fruit borer, *Earias sp.* plaguing okra crop. The pervasion initiated in the second week of August and came to top in the most recent week of September (27.47%) though on fruits, invasion began in the second week of September with top in the third week of October when it was 20.0°C least temperature and 52.0 per cent relative moistness. The pervasion of *Earias sp.* on shoots of okra had noteworthy negative connection with least temperature, relative mugginess and precipitation, while it delineated a non-huge relationship with most extreme temperature. The pervasion of *Earias sp.* on fruits had noteworthy positive connection with most extreme temperature in any case, it was negative with least temperature. In any case, such connection remained non noteworthy with relative stickiness and precipitation.

Meena *et al.* (2010) contemplated the regular rate and connection coefficient of jassid and whitefly populations with climate parameters in semi-dry district of Rajasthan during *Kharif* 2002 and 2003. Frequency of jassid (2.0 and 2.4 jassi per plant) began in first week of August and kept going till collecting in both the years, its population came to greatest (15.2 and 16.4 jassids per plant) in fourth and third weekof September in the year 2002 and 2003, separately. The number of inhabitants in whitefly (0.8 and 1.2 whitefly per plant) on okra was begun in the week of August and stayed dynamic all through the yield season and its population came to most extreme (6.2 and 8.6 whiteflies per plant) in fourth and third weekof September in the year 2002 and 2003, individually. The abiotic parameters (greatest and least temperature, relative dampness and precipitation) had non-noteworthy connection with the number of inhabitants in jassid and whitefly.

Nath *et al.* (2011) considered the biotic and abiotic factors that constrained the profitability of okra including creepy crawly aphids, *viz.*, jassis (*A. biguttula biguttula*), whitefly (B. tabaci), Helicoverpa armigera and red creepy crawly parasite (*Tetranychus sp.*) during the year 2005 and 2006. The high population of jassid was seen in the third (10.76 jassids/leaf) and fourth (8.96 jassids/leaf) week of August in the year 2005 and 2006, individually. The greatest dimension of whitefly population was recorded in the second (10.52 flies/leaf) and third (11.66 flies/leaf) week of August During the year 2005 and 2006, individually. Jassid and whilefly population indicated non-significant positive connection during both the year with temperature (most extreme, least and normal), precipitation, sun sparkle hours and relative moistness. The most elevated population of red insect mite, were recorded as 3789 vermin/leaf in 40th SW during the year 2005 and 40.83 aphids/leaf in 39th SW During the year 2006. Temperature indicated noteworthy negative connection while RH, precipitation and sun sparkle hours portrayed non-huge relationship.

Aziz *et al.* (2011) detailed beneficial outcome between the fruit pervasion of okra by *Earias sp.* what's more, greatest, least and normal temperatures, though, the relative moistness and precipitation applied, negative impact independently just as on total premise. The shoot pervasion of okra was observed to be emphatically associated with most extreme and normal temperatures and contrarily corresponded with the relative mugginess, precipitation based on a normal of two years of studies. Based on the two years normal abiotic factors, brought about 67 and 55.50% foods grown from the ground invasion, individually.

Singh *et al.* (2013) detailed that the occurrence of leafhopper started from second week in the date of sowing for example the fourth week of August and the population was recorded during the fourth week of September.

Singh *et al.* (2013) saw that the okra crop was plagued with sucking creepy crawly bothers, *viz.*, whitefly (B. tabaci), leafhopper (*A. biguttula biguttula*) and aphid (*A. gossipii*) during the year 2008. The aphid population demonstrated negative relationship with least and mean temperature, precipitation and most extreme and least relative mugginess however such connection was certain with greatest temperature and coccinellids. Whitefly and leafhopper population demonstrated negative connection with greatest, least and temperature and most extreme and least relative stickiness, while positive relationship with precipitation.

Badiyala and Raj (2013) examined the regular occurrence of shoot and fruit borer, *E. vittella* swarming okra crop thus for two seasons. The most extreme fruit invasion just as larval population per fruit was seen in the third to fourth week of August During the two seasons. The shoot pervasion differed between 1.78% to 2.24% during first year and 0.82% to 1.5% during second year, while the fruit invasion fluctuated between 1.83% to 35.85% and 1.23% to 29.64% during the particular years.

Dabhi *et al.* (2013) decided the population elements of shoot and fruit borer, *E. vittella* in summer and *kharif* okra in connection to abiotic factors for two sequential years 2005-06 and 2006-07. The pervasion of fruits saw in the 13th, 15th and 29th and 32nd MSW during summer and *kharif* season, separately. They additionally detailed most extreme and least temperature had significant negative impact, while morning and night relative dampness indicated huge beneficial outcome on fruit damage during *kharif* season. In any case, per cent fruit damage indicated noteworthy positive contact with brilliant daylight hours, temperatures (Maximum and least) and vapor weight deficiency (morning and night) during summer season.

Yadav (2015) considered the regular frequency of shoot and fruit borer during two sequential years for example 2013 and 2014. The damage of this nuisance on shoot began in the second and third week of August (1.40 and 2.50%) and bit by bit expanded and came to its (10.60 and 11.20%) during the third and fourth week of September in the year 2013 and 2014 separately. The most extreme and least temperature and relative moistness had non huge relationship with shoot damage, while precipitation had negative noteworthy connection with shoot borer invasion during the year 2013. Shoot borer invasion had non noteworthy relationship with all the abiotic factors during the year 2014. The fruit damage started in the 34th SMW, During both the long stretches of study, for example 6.00 and 5.20% on number premise, separately which step by step expanded and achieved its 30.00 and 32.70 per cent in the third week of November During both the time of study. The invasion of borer on fruits displayed negative significant impact with most extreme temperature, least temperature and mean relative dampness, while it was non-huge with precipitation during 2013. Comparable pattern was clear in the second year of experimentation.

(iv) Bioefficacy of insecticides and bio-pesticides against major arthropod pests

Masuda and Kikuchi (1992) studied the pathogensity of two isolates of *V. lecanii i.e.* MG-V1-45 and MG-V1-18 isolate against *A. gossypii* under laboratory condition. MG-V1-45 was more pathogenic to nymphs and adults of *A. gossypii* than MG-V1-18. The difference was especially evident in the nymphal stage at a concentration of 104-106 conidia/ml. Mortality caused by two isolates were almost same (96-100%) at high concentrations of 107 and 108 conidia/ml.

Bhalala *et al.* (2006) assessed the bio-viability of thiamethoxam 25 WG, endosulfan 35 EC and monocrotophos 36 SL against the sucking irritation complex of okra. The treatment of thiamethoxam 25 WG at higher doses (50 and 37.5 g a.i./ha) was discovered best aginst aphid, jassid, whitefly and vermin, be that as it may, monocrotophos was found at standard for controlling whiteflies and aphids. The attractive fruit yield was higher in the treatment of thiamethoxam.

Gosalwad *et al.* (2009) assessed the viability of some fresher aphid sprays against sucking aphids of okra during the year 2004 and 2005. The treatment imidacloprid 17.8 SL at 40 g a. I./ha was discovered compelling in the two years, trailed by imidacloprid 17.8 SL at g a.i./ha and acetamiprid 20 SP at 40 g a.t/ha treatment in the administration of jassids, aphids, whitefly and treks.

Dhanalakshmi and Mallapur (2010) uncovered that, the aftereffects of Emamectin benzoate 5 SG @ 0.2 g/l was the most unrivaled treatment by chronicle the least per cent fruit damage (7.82%) and brought about most elevated great fruit yield (47.02 q/ha). The following viable treatments included Spinosad 45 SC @ 0.1 ml/l (9.19% damage with 45.94 q/ha yield) and Indoxacarb 14.5 SC @ 0.3 ml/l (10.74% damage with 43.03 q/ha yield). Among various more up to date atoms, Emamectin benzoate, Spinsoad and Acetamiprid demonstrated very protected to regular adversaries. Imidacloprid 200SL @ 0.5 ml/l, Fenazaquin 10EC @ 1.0 ml/l and Oxydemeton methyl 25EC @ 1.5 ml/l were somewhat dangerous while, Indoxacarb was generally increasingly damageful.

Nath and Sinha (2011) led a field preliminary utilizing okra cultivar Arka Anamika with six treatment and a control against aphid complex of okra. Two foliar sprays were led one was of neonicotinoids *viz.*, thimethoxam @25g a.i./ha in initial four treatment while it was of acetamiprid @20 g a.i./ha in other two treatments. In second spray, two measurements of every aphid spray, *viz.*, triazophos (350 and 700 g a.i./ha), deltamethrin (10 and 20g a.i./ha) and their enlisted blends, triazophos+deltamethrin (360 and 720 g a.i./ha) were surveyed. Results uncovered that neonicotinoids were compelling against leafhopper and whitefly in all treatments during first spray. All treatments were powerful against leafhopper and whiteflies During second spray aside from treatments with low portion of triaxophos (350g a.i./ha) and deltamethrin (10g a.i./ha), which were not compelling against whiteflies.

Shinde *et al.* (2011) uncovered that spinosad 0.005 per cent was a compelling aphid spray to control the shoot and fruit borer in okra, trailed by indoxacarb 0.01 per cent and profenophos 0.08 per cent. The most astounding yield of okra was seen in spinosad @ 0.005 per cent. The most elevated steady proportion was recorded by the use of spinosad @ 0.005 per cent pursued by profenophos @ 0.08 per cent.

Dabhi *et al.* (2012) tried different aphid sprays against okra shoot and fruit borer, *E. vittella* in *kharif* season. Among different aphid sprays, indoxacarb @ 0.0075 per cent was observed to be fundamentally better over whatever is left of aphid sprays in controlling fruit damage. Altogether most extreme yield of attractive okra fruits was recorded from the plot sprayed with indoxacarb.

Harischandra Naik *et al.* (2012) announced that V. lecanii @ 2.5 g/l was predominant than the M. anisopliae @ 2.5 g/l for controlling aphid population and comparable to B. bassiana 26 @ 2.5 g/l. If there should be an occurrence of leafhopper, most extreme control and prevalence was found in B. bassiana @ 2.5 g/l was keeping pace with different mycopathogens like V.lecanii @ 2.5g/l and M. anisopliae @ 2.5g/l. V. lecanii @ 2.5 g/l was keeping pace with B. bassiana @ 2.5 g/l and essentially better than the M. anisopliae @ 2.5g/l in lessening the whitefly population.

Rohini *et al.* (2012) assessed the fipronil 5 SC @ 2 ml/lit and imidacloprid 17.8 SL @ 0.4, l/lit were discovered compelling against jassid, while, thimethoxam 5 SG @ 0.2 g/lit was successful against whitefly on cotton.

Anand *et al.* (2013) assessed viability of six more up to date aphid sprays against sucking creepy crawly bothers on okra. The thiamethoxam and acetamiprid brought about the viable administration of leafhopper, while, spiromesifen was discovered extremely viable against whitefly pursued by thaimethoxam and acetamiprid.

Parmar *et al.* (2013) assessed pesticides *viz.*, the Deltamethrin (0.0028%), Alphamethrin (0.01 %), Deltamethrin + Triazophos (0.036%), Ethion + Cypermethrin (0.045%), Profenophos (0.1%), Imidacloprid (0.0053%) and Acetamiprid (0.02%) against irritation complex of okra at Anand (Gujarat) During summer and *kharif* 2009-10. Imidacloprid and Acetamiprid demonstrated the best against aphid, A.gossypii, leafhopper, *A. biguttula* biguttula and whitefly, *B.tabaci*, likewise Deltamethrin + Triazophos was demonstrated successful against B. tabaci. Ethion + Cypermethrin, Imidacloprid and Acetamiprid demonstrated altogether the best against red aphid, Tetranychus I. urticue on okra, Deltamethrin + Triazophos and Deltamethrin alone were found respectably viable. Among the aphid sprays assessed, essentially low damage because of shoot and fruit borer, *E. vittella* was enrolled in the plots treated with Profenophos and Deltamethrin.

Umrao *et al.* (2013) uncovered that the treatments were discovered viable in limiting fruit pervasion over control and Indoxacarb was turned out to be the best one among every one of the treatments. After 10th day of first, second and third spraying, invasion was 14.47, 2.68 and 5.68 per cent, separately. While Neemarin was lesser powerful having higher fruit pervasion of 47.38, 30.53 and 33.52 per cent, individually over control after 10th day of first, second and third spraying. The yield of okra fruits demonstrated that

Indoxacarb recorded the most astounding new fruit yield for example 7.00 kg per plot (58.33 q/ha) with 42.86 per cent expanded yield when contrasted with control.

Dhaka and Prajapati (2013) uncovered that the treatment indoxacarb 14.5 SC @ 0.5 lit/ha yielded most reduced shoot and fruit damage in okra and recorded 1.67 per cent and 3.33 per cent, separately. The following best all together were carbosulfan 25 EC, lambda-cyhalothrin 5 EC, cartap hydrochloride 50 SP, profenophos 50 EC, cypermethrin 20 EC, neemarin 1500 ppm and B. thuringiensis with yield of 89.26, 86.79, 83.73, 80.96, 78.86, 73.50 and 69.30 kg/ha, individually.

Umrao *et al.* (2013) uncovered that indoxacarb was the best treatment among all other, while neemarin was less compelling. Yield of okra fruits was most noteworthy from indoxacarb treatment.

Bajad *et al.* (2014) announced that cypermethrin 25 EC@ 0.05 per cent was observed to be the best in dealing with the fruit borer pervasion on okra pursued by indoxacarb 14.05 SC @ 0.007 per cent and spinosad 45 EC @ 0.015 per cent. The most elevated attractive fruit yield of okra (75.33q/ha) and steady money saving advantage proportion (1:16.49) was gotten from the treatment of cypermethrin 25 EC @ 0.05 per cent. The most monetarily practical treatment was cypermethrin 25 EC @ 0.05 per cent (75.33q/ha) trailed by acephate 75 SP @ 0.05 per cent (74.05 q/ha) and spinosad 45 SC @0.015 per cent (72.66q/ha).

Ghule *et al.* (2014) assessed the adequacy of seven biorational aphid sprays *viz.*, Bacillus thuringiensis var. kurstaki, emamectin 27 benzoate, spinosad, chlorofenapyr, B. bassiana, Neem and V. lecanii against *E. vittella*. Two years mean information concerning impact of various treatments against *E. vittella* invasion at 15 days interim for each spray, uncovered that altogether least shoot and fruit pervasion with treatment spinosad 45SC@ 50 g a.i/ha (5.62%) trailed by chlorfenapyr @ 100 g a.i/ha (6.16%), emamectin benzoate 5 SG @ 12 g a.i./ha (6.89), B. thuringiensis @1000 ml/ha (7.56%), B. bassiana @ 300 g a.i./ha (8.30%), V. lecanii @ 1000 ml/ha (8.64%) and neem 10000 ppm @ 3 g a.i./ha (9.37%).

Laichattiwar and Meena (2014) directed the field test to assess the viability of different aphid sprays against okra shoot and fruit borer, *E. vittella*. The examination uncovered that emamectin benzoate @ 0.36 gm/l was best trailed by spinosad @ 0.5ml/l and novaluron @1ml/l in controlling fruit damage. Altogether most extreme yield of okra fruit was recorded from the plot sprayed with emamectin benzoate (89.16 q/ha) trailed by spinosad (85.0 q/ha) and novaluron (77.50 q/ha).

Nenavati and Kumar (2014) uncovered that cypermethrin 25 EC @ 0.05 per cent, chlorpyriphos 20 EC @ 0.05 per cent and spinosad 45 SC @ 0.005 per cent were observed to be best, the shoot damage in okra crop was 5.3, 6.2 and 6.8 per cent, individually. Least per centage of fruit damage in okra was seen with 28 EC cypermethrin 25 EC (8.2%), chlorpyriphos 20 EC (11.5%) and spinosad 45 SC (12.7%).

Patil *et al.* (2014) detailed that the foliar spray of thiamethoxam 25 WG @ 0.006% was discovered the best against aphids, trailed by lambda Cyhalothrin 5 EC @ 0.004%. While, thiamethoxam 25 WG @ 0.006% was viable against leafhoppers population pursued by thiamethoxam 25 WG @ 0.008%. Likewise in the event of whitefly the powerful treatment recorded was thiamethoxam 25 WG @ 0.006%. The prescribed portions of aphid sprays were discovered more viable than different dosages.

Kamble *et al.* (2014) tried different aphid sprays, and discovered Indoxacarb 14.5 SC + Acetamiprid 7.7 SC @ 400 ml/ha, Profenophos 40 EC + Cypermethrin 4 EC@1000 ml/ha and Chlorpyriphos 50 EC + Cypermethrin 5 EC @ 1000 ml/ha to be the best in lessening the fruit invasion on number premise just as weight premise which was 15.65 to 14.80 and 16.25 to 15.24%, individually as against 32.14 and 31.31% in the control. The essentially most noteworthy yield (124.44 q/ha) of solid fruits was recorded in Indoxacarb 14.5 SC + Acetamiprid 7.7 SC pursued by Profenophos 40 EC + Cypermethrin 4 EC (114.52 q/ha) and Chlorpyriphos 50 EC + Cypermethrin 5 EC (112.70 q/ha). The most elevated gradual advantage cost proportion (12.45) was enlisted by Indoxacarb 14.5 SC + Acetamiprid 7.7 SC pursued by Profenophos 40 EC + Cypermethrin 4 EC (11.07) and Chlorpyriphos 50 EC + Cypermethrin 5 EC (9.66).

Gadekar *et al.* (2014) assessed the bioefficacy of nine aphid sprays and botanicals against jassid and whitefly overrunning okra. The thiamethoxam (0.005%) was discovered best pursued by acetamiprid (0.004%) and acephate (0.05%) against jassid, though, acetamiprid (0.004%) demonstrated, best aphid sprays pursued by thiamethoxam (0.005%) and acephate (0.05%) against whitefly. The organic azadirachtin (0.5%) demonstrated least viable followd by NSKE (5%) and datura remove (5%) against both jassid and whitefly. The treatment of fipronil (0.01%), dimethoate (0.03%) and ethion (0.05%) existed in moderate gathering of their adequacy against sucking nuisances of okra. The greatest yield (68.87 q/ha) was recorded with thiamethoxam pursued by acetamiprid (66.76 q/ha) and acephate (65.85q/ha). The base yield was gotten in NSKE (46.23q/ha) and azadirachtin (50.37 q/ha). The greatest B:C proportion of 47.67 was processed in aceramiprid, while, least B:C proportion 4.42 was acquired in azadirachtin.

Meena *et al.* (2014) assessed the bio-adequacy of some fresher aphid sprays/biopesticides against significant creepy crawly aphids of okra. The imidacloprid

(0.005%) was found ost compelling against jassid and whitefly pursued by thiamethoxam (0.005%), deltaphos (0.036%) and spinosad (0.0068%). Bacillus thurigiensis (0.012%) demonstrated least compelling pursued by azadirachin (5ml/l) and NSKE (5.0%). The treatments of preofenophos (0.05%) and endosulfan (0.035%) positioned in center request of their viability. Every one of the aphid sprays expanded the yield of attractive fruits essentially over control.

Rana (2014) assessed four portions of PII 504 20 SG for example 20, 25, 30 and 60 g a.i./ha alongside imidacloprid 17.8 SL @22.5 ml a.i./ha, acetamiprid 20 SP @20 g a.i./ha and thiamethoxam 25 WG 25 g a.i./ha against sucking creepy crawly aphids of okra During 2012-13 and 2013-14. The outcomes demonstrated that the two use of PII 504 20 SG @ 30 g a.i/ha was found altogether best pursued by imidacloprid, thiamethoxam and acetamiprid against aphid, jassid and whitefly population.

Deotale *et al.* (2015) uncovered that the treatment NSE (5%) rotated with cypermethrin (0.007%) recorded least shoot pervasion (7.54%), fruit invasion (14.72%) and recorded most extreme (85.87 q/ha) yield of attractive fruits. The following best treatment was T. chilonis 1.5 lakh/ha with 8.50 per cent shoot invasion, 15.80 per cent fruit pervasion and 83.80 q/ha yield, trailed by treatment of cut-out of shoots + NSE 5 per cent recorded 8.7 per cent shoot pervasion, 22.52 per cent fruit pervasion and recorded 79.84 q/ha yield of attractive fruits.

Begum and Patil (2016) studies on the efficacy of newer insecticides as foliar application revealed that, imidacloprid 17.8 SL @ 40 g a.i./ ha was the most effective treatment indicating reduction in population of leafhoppers, aphids, whiteflies and thrips was 89.9, 93.1, 91.0 and 90.65 per cent, respectively and recorded maximum fruit yield of 52.2 q/ha with 97.72 per cent increase in fruit yield over untreated control. It was followed by imidacloprid 17.8 SL @ 15 g a.i./ha, thiamethoxam 25 WG, acetamiprid 20 SP and fipronil 5 % SC. All the treatments, except spinosad 45 SC were effective in controlling sucking pest population in okra and all the treatments were observed to be significantly superior over untreated control.

Ghosh *et al.* (2016) conducted a field trial to assess the bio-efficacy of different doses of thiamethoxam 25%WG and check, Wiloxam against sucking pests like Jassids, Aphids and Whiteflies of okra. The crop protected by higher doses of Thiamethoxam 25%WG 25, 50and 75gm a.i./ha proved its superiority over the lower dose (15gm a.i/ha) and standard check, Willoxam. The results indicate a reduction of 83.35% and 96.67% population of Jassids, 92.95% and 99.47% population of aphids 12 and 83.80% and 96.67% population of whiteflies respectively in first and second spray with thiamethoxam 25%WG @ 75g a.i./ha though it is at par with thiamethoxam 25% WG @ 25g and 50g a.i,/ha. However, considering the cost of inputs, it would be better to suggest thiamethoxam 25%WG @ 25ga.i./ha for the better management of these target pests of okra.

3. MATERIALS AND METHODS

3.1. Location of Experiment

All the field tests were done at the Regional Agriculture Research Station, Karjat, Dist. Raigad, Maharashtra. Dr .BSKKV, Dapoli, Dist. Ratnagiri, Maharashtra.

3.2 Details of experimental layout

The material and technique received and materials utilized for leading different examinations to satisfy the destinations in the present investigation are advised here under

3.2.1 Screening of okra germplasm against major arthropod pests

A factually planned field explore was spread out in uniform estimated plots in Randomized Block Design at Regional Agriculture Research Station, Karjat (M.S). The column to line and plant to plant dispersing for okra was kept up at 45 cm and 30 cm separately. Sowing of okra was done in the first seven day stretch of February in the year 2016 and 2017. The subtleties of the investigation are given beneath.

Experimental details:

Crop : Okra

Variety : 8

Design : RBD

Season : Summer season crop

Spacing : 45 cm X 30 cm

Plot size : 2.5 m X 3.00 m

Varietal details

T_1 = Varsha Upahar	T_2 = Akola Bahar
T_3 = Phule Utakarsh	T_4 = GOA-5
T_5 = Arka Anamika	T_6 = Panjab Padmini
T_7 = Parbhani Kranti	T_8 = Akola 107

3.3 Varietal susceptibility to major insect pests

Eight varieties *viz*., Arka Anamika, Akola 10, Akola Bahar, Phule Utakarsh, GOA-5, Parbhani Kranti, Panjab, Padmini, and Varsha Upahar (as a check) were screened for their relative susceptibility to **major arthropod pests** under field conditions during summer season of year 2016 & 2017. Each variety was grown in a gross plot of 2.5 X 3.00 m with three replications and 45 X 30 cm spacing at Regional Agriculture Research Station, Karjat (M.S). All the recommended agronomical practices were adopted for raising the crop. The plot of these varieties was kept unsprayed with any insecticide throughout the crop season.

3.3.1 Method of recording observations

For evaluating the relative susceptibility of various varieties to major arthropod pests under field conditions the following methodology was used for recording observations.

3.3.1.1 Sucking pests

Observations on population of sucking pests particularly jassid, *A. biguttula biguttula biguttula*, aphid, *A.gossypi* and whitefly, *B. tabaci* were recorded by counting the number of nymph of jassids and nymph and adults of aphid and whitefly at weekly interval from randomly selected three leaves (one each from top, middle and lower canopy of the plant) of five randomly selected plants in each net plot. The counts were continued from 1st week after germination to harvest of the crop for each plot. The data thus obtained were converted to average population per leaf and subjected to statistical analysis.

3.3.1.2 Shoot and fruit borer, *E. vittella*

The observations on shoot infestation and flower bud infestation were recorded from five randomly selected plants from each plot. There was no shoot infestation and flower bud infestation was minor. The observations on fruit infestation were recorded from five randomly selected plants from each plot. Total number of fruits, healthy fruits and infested fruits were recorded from five randomly selected plants from each treatment. The per cent infestation was worked out on the basis of healthy and infested fruits on number basis. The data was converted into per cent infested fruit and analysed statistically.

3.3.1.3 Yield

The yield of marketable fruits was recorded by picking each from different varieties. The yield data were subjected to statistical analysis.

3.4 Impact of date of sowing on major arthropod pests

Field tests were tested in two progressive seasons in the year 2016 and 2017 summer season. Okra crop was sown at 3 diverse sowing dates (third week of January, first week of February and third week of February).

Population in connection to sowing period was done for significant arthropod infestation of okra *viz.*, jassid, *A. biguttula biguttula*, aphid, *A.gossypi*, whitefly, *B. tabaci* and shoot and organic product borer, *E. vittella* under field conditions.

The plots were kept unsprayed all through the yield season. So as to decide the impact of sowing periods on *population* change of bugs, the variety Varsha upahar was sown amid summer season at Regional Agriculture Research Station, Karjat (M.S). The subtleties of sowing dates are referenced beneath.

3.4.1 Details of the experiment

Spacing	:	45 X 30cm
Net plot size	:	2.50 X 3.00 m
Design	:	Randomized block design
Replications	:	3
Treatments (sowing dates)	:	Date of Sowing 1st - 26/01/2016 & 2017
		Date of Sowing 2nd – 09/02/2016 & 2017
		Date of Sowing 3rd - 24/02/2016 & 2017

3.4.2 Method of recording observations

3.4.2.1 Sucking pests

Observations on sucking pests were recorded at weekly interval from randomly selected three leaves (one each from top, middle and lower canopy of the plant) from randomly selected five plants in each net plot. The counts were continued from one week after germination to harvest of the crop from each plot.

3.4.2.2 Shoot and fruit borer, *E. vittella*

The observations on shoot infestation and flower bud infestation were recorded from five randomly selected plants from each plot. There was no shoot infestation and flower bud infestation was minor. The observations on fruit infestation were recorded from five randomly selected plants from each plot. Total number of fruits, healthy fruits and infested fruits were recorded from five randomly selected plants of each treatment. The per cent infestation was worked out on the basis of healthy and infested fruits on number basis. The data was converted into per cent infested fruit and analysed statistically.

3.4.3 Effect of weather parameters on population of insect pests

In order to study the instantaneous effect of weather parameters on population fluctuation of sucking pests and *E. vittella*, the data were correlated with physical factors of environment *viz*., bright sunshine hours (BSS), wind speed (WS), rainfall (RF), maximum temperature (Max T), minimum temperature (Min T), morning humidity (RH1), evening humidity (RH2) .

3.5 Population dynamics of the major arthropod pests

To study the **Population dynamics of the major arthropod pests** *viz.*, shoot and fruit borer, jassids, aphid, and whitefly a field study was undertaken at Regional Agriculture Research Station, Karjat (M.S).

3.5.1 Experimental details

Okra crop variety Varsha Upahar was sown on 26th of January, 2016 and 26th of January, 2017 for the **Population dynamics of the major arthropod pests.**

Experimental details:

Crop	:	Okra
Variety	:	Varsha Upahar
Season	:	Summer season crop
Spacing	:	45 cm X 30 cm
Plot size	:	2.5 m X 3.0 m

3.5.1.1 Method of recording observations

To study the **Population dynamics of the major arthropod pest** *viz.,* shoot and fruit borer, jassids, aphid, and whitefly under field conditions the following methodology was used for recording observations.

3.5.1.2 Sucking pests

Observations on population of sucking pests particularly jassid, *A. biguttula biguttula biguttula*; aphid, *A.gossypi* and whitefly, *B. tabaci* were recorded by counting the number of nymph of jassids and nymph and adults of aphid and whitefly at weekly interval from randomly selected three leaves (one each from top, middle and lower canopy of the plant) of five randomly selected plants in each net plot. The counts were continued from one week after germination to harvest of the crop for each plot. The data thus obtained were converted to average population per leaf and subjected to statistical analysis.

3.5.1.3 Shoot and fruit borer, *E. vittella*

The observations on shoot infestation and flower bud infestation were recorded from five randomly selected plants from each plot. There was no shoot infestation and flower bud infestation was minor. The observations on fruit infestation were recorded from five randomly selected plants from each plot. Total number of fruits, healthy fruits and infested fruits were recorded from five randomly selected plants of each treatment. The per cent infestation was worked out on the basis of healthy and infested fruits on number basis. The data was converted into per cent infested fruit and analysed statistically.

3.5.1.4 Yield

The yield of marketable fruits was recorded at each picking from different varieties. The yield data were subjected to statistical analysis.

3.6 Bioefficacy of insecticides and bio-pesticides against major arthropod pests

A statistically designed field experiment was laid out in uniform sized plots in Randomized Block Design at Regional Agriculture Research Station, Karjat (M.S) during *summer* season of year 2016 and 2017 with a view to test the bioefficacy of some **insecticides and bio-pesticides against major arthropod pests** infesting okra. The details of the experiment are given below.

3.6.1 Experimental site

The experiment was carried out at Regional Agriculture Research Station, Karjat (M.S).during *summer* season of year 2016 and 2017.

3.6.2 Preparation of experimental plot

After harvest of previous crop, the field was ploughed twice followed by clod crushing and harrowing to bring soil to a fine tilth. The experimental plot was laid out with two replications and fourteen treatments for first objective and three replications and ten treatments for second objective, of gross plot size of 2.5 ×3.0 m for each treatment. The flat beds were prepared in each plot for growing okra.

3.6.3 Information about experimental material

3.6.3.1 Seeds

The seed of okra variety Varsha upahar was used.

3.6.3.2 Manures

Organic manure in the form of F.Y.M. @ 20 t/ha was applied in the soil before last harrowing so that it could be mixed well in the soil.

3.6.3.3 Fertilizers

The recommended dose of fertilizers, 100 Kg N_2O, 50 Kg P_2O_5 and 50 Kg K_2O/ha was applied in the form of straight fertilizers through urea (46.4 per cent N), single super phosphate (16 per cent P_2O_5) and muriate of potash (60 per cent K_2O) to each plot. Nitrogen was applied in 3 split doses, 1/3rd N at the time of sowing and 2/3rd dose of N at 30 and 60 days after sowing while phosphorus and potassium was applied as basal dose.

Variety	:	Varsha Upahar
Plot size	:	2.5 m X 3.0 m
Sowing date	:	9th January, 2016 and 2017
Spacing	:	45 cm X 30 cm
Design	:	Randomized Block Design
No. of replications	:	Three
Treatments	:	Seven

Treatments Details:

Treat.	**1st spray**	**2nd spray**	**3rd spray**	**4th spray**
T1	Clothianidin 50% WG @ 60 g/ha	Flubendiamide 39.35% SC @ 125 ml / ha	Azadirachtin5% @ 500 ml / ha	*Beauveria bassiana* @ $1x10^8$ cfu/ g
T2	Flonicamid 50 % WG @ 150 g/ha	Emamectin benzoate 5%SG @ 170g /ha	*B.t.*@ 1kg/ ha	*Beauveria bassiana* @ $1x10^8$ cfu/ g
T3	Thiamethoxam 25%WG @ 100 g/ha	Thiodicarb75%WP @1000 g / ha	*B.t.*.@ 500 g/ ha	*Verticillium lecani* @ $1x10^8$ cfu/ g
T4	Tolfenpyrad 15% EC @1000 ml/ha	Deltamethrin2.8% EC @ 400 ml / ha	*Beauveria bassiana* @ $1x10^8$ cfu/g	Spinosad@ 170 g / ha
T5	Spiromesifen 22.9 % SC @ 500 ml/ha	Thiodicarb75%WP @1000 g / ha	Emamectin benzoate 5%SG @ 170g /ha	Flubendiamide39.35% SC @125 ml / ha
T6	Azadirachtin5% @ 500 ml / ha	*Verticillium lecani* @ $1x10^8$ cfu/ g	*B.t.*.@ 500 g/ ha	*Beauveria bassiana* @ $1x10^8$ cfu/ g
T7		Untreated Check		

3.6.3.4 Method and time of insecticide application

Actual quantity of spray material required per plot was calibrated prior to each spray using water alone. The spraying was done with manually operated knapsack sprayer. The desired concentration of various insecticides were prepared on the basis of per centage of active ingredient present in respective trade product and applied in respective plots thoroughly in form of fine droplets using high volume spray. The sprayer was washed off thoroughly after completion of spraying in each treatment.

The first spray could not be given due to absence of shoot borer infestation. Therefore, first application of insecticides was given at the time of initiation of flowering and subsequent two more sprays were given at an interval of 15 days thereafter.

3.6.4.1 Method of recording observations

3.6.4.2 Shoot and fruit borer

The pre count observations were recorded 1 day prior to treatment and post treatment observations were recorded 3, 7 and 14 days after each spray.

Observations on the incidence or infestation were recorded by following standard method as described below.

Initially the observations were recorded on shoot infestation. Later, the observations were recorded both on shoots as well as flower buds and fruits.

The observations on shoot infestation and flower bud infestation were recorded from five randomly selected plants from each plot. There was no shoot infestation and flower bud infestation was minor. The observations on fruit infestation were recorded from five randomly selected plants from each plot. Total number of fruits, healthy fruits and infested fruits were recorded from five randomly selected plants of each treatment. The per cent infestation was worked out on the basis of healthy and infested fruits on number basis. The data was converted into per cent infested fruit and analysed statistically.

The per cent infestation was worked out on the basis of healthy and infested fruits on number basis. The weight of healthy and infested fruits from ten randomly selected plants were recorded at each observation and converted was into per cent infested fruit and analysed statistically.

3.6.4.3 Sucking pest complex

Aphids

Observations on incidence of aphids were recorded on three leaves; each representing the top, middle and bottom of five randomly selected plants in each plot. The first observation was recorded 1 day prior to treatment as a pre treatment count and post treatment observations were recorded at 3rd, 7th, and 14th days after each spraying. Data thus obtained were analysed statistically and presented.

Jassids

Observations on incidence of jassids were recorded on three leaves, i.e. each at top, middle and bottom canopy of five randomly selected plants in each plot. The first observation was recorded 1 day prior to treatment as a pre treatment count and post treatment observations were recorded on 3rd, 7th, and 14th days after each spraying. Data thus obtained were analysed statistically and presented.

Whiteflies

Observations on the population of whiteflies were recorded with the help of rectangular plastic cage, the four sides of which were lined by a carbon paper. The top was kept transparent without the carbon paper. The first observation was recorded 1 day prior to treatment as a pre treatment count and post treatment observations were recorded at 3rd, 7th, and 14th days after each spraying. Data thus obtained were analysed statistically and presented.

3.6.4.4 Yield data

The yield obtained from the blocks of various modules/treatments was recorded separately after categorizing it into damaged and healthy. Data thus obtained was converted to yield in quintals / ha for each module /treatment and analysed statistically.

4. RESULTS

It was expected among arthropods pest, mites happen to be major pest on okra during summer season. Over the two year of study it was observed that mite population was not recorded on the variety Varsha Upahar on which population dynamic studies carried out. Likewise, in the varietal screening trial also none of the varieties infested by mites from available literature *Tetranychus urticae Koch* known to okra.

4.1 Screening of different okra germplasm against major arthropod pests

None of the variety was found to be completely without the infestation of the major insect pest. However some of them were preferred while other were less preferred.

Summer season 2016

Results of the field experiment conducted during summer season of the year 2016 and 2017 at Regional Agricultural Research Station, Karjat (Maharashtra) to screen different okra germplasm reaction against major arthropod pests are mentioned below:-

4.1.1 Jassid, *A. biguttula biguttula*

The Data on mean jassid population recorded from various genotypes/ varieties of okra, uncovered that, among nine genotypes/variety of okra, none of the cultivars were observed to be free from the invasion of jassid. The jassid population extended from 14.46 to 27.15. The most extreme jassid population was found in variety Akola 107 (27.15 jassid), though variety Punjab Padmini indicated less jassid population (14.46). Cultivars *viz.*, Arka Anamika, Akola bahar, Parbhani Kranti, Phule Utkarsha, GOA - 5, Varsha Uphar, recorded 15.12, 17.56, 18.78, 19.95, 20.94 and 21.84 jassid, respectively. It was uncovered that every one of the cultivars were observed to be infested to jassid invasion (Table - 1 and Fig. 1).

4.1.2 Aphid, *A. gossypii*

The Data on mean aphid population recorded from various genotypes/varieties of okra uncovered that, among nine genotypes/variety of okra none of the cultivars were observed to be free from the invasion of aphid. Among nine genotypes/variety of okra the aphid population extended from 8.67 to 19.47. The greatest aphid population was found in variety Varsha Upahar (19.47 Aphid), while variety Akola 107 demonstrated less aphid population (8.67). Cultivars *viz.*, Punjab Padmini, Parbhani Kranti, Arka Anamika, Akola bahar, Phule Utkarsha and GOA - 5 recorded 13.18, 14.67, 14.98, 16.24, 16.40 and 17.24 aphid, respectively. It was uncovered that every one of the cultivars were observed to be helpless to aphid pervasion (Table - 1 and Fig. 1).

4.1.3 Whitefly, *B. tabaci*

The Data on mean whitefly population recorded from various genotypes/variety of okra uncovered that, among nine genotypes/variety of okra, none of the cultivars were observed to be free from the invasion of whitefly. Among nine genotypes/variety of okra the whitefly population extended from 3.26 to 6.94. The most extreme whitefly population was found in variety Arka Anamika (6.94 whitefly), while variety Punjab Padmini indicated least whitefly population (3.26). The Cultivars *viz.*, GOA - 5, Parbhani Kranti, Phule Utkarsha, Akola bahar, Varsha Upahar and Akola 107 recorded 5.06, 5.53, 5.75, 6.32, 6.77 and 6.94 whitefly, respectively (Table - 1 and Fig. 1).

Table 1: Screening of different okra germplasm against sucking insect pests of okra year 2016

S. No.	Genotypes/ varieties	Average number of jassid/leaf	Average number of aphid/leaf	Average number of whitefly/leaf
1	T_1 = Varsha Upahar	21.84 (4.77)	19.47 (4.52)	8.67 (3.10)
2	T_2 = Akola Bahar	17.56 (4.30)	16.24 (4.15)	3.22 (2.05)
3	T_3 = Phule Utakarsh	19.95 (4.57)	16.40 (4.17)	7.90 (2.98)
4	T_4 = GOA-5	20.94 (4.68)	17.24 (4.27)	6.97 (2.82)
5	T_5 = Arka Anamika	15.12 (4.01)	14.98 (3.99)	8.13 (3.2)
6	T_6 = Punjab Padmini	14.46 (3.93)	13.18 (3.76)	6.94 (2.81)
7	T_7 = Parbhani kranti	18.78 (4.44)	14.67 (3.95)	8.36 (3.05)
8	T_8 = Akola 107	27.15 (5.30)	8.67 (3.10)	7.21 (2.86)
	Mean	19.48 (4.50)	15.11 (3.99)	7.18 (2.86)
	S.Em. $\pm$	0.04	0.06	0.06
	CD	0.13	0.19	0.18

*Figures in parentheses are √n+1 transformed values

4.1.4 Shoot and fruit borer, *E. vittella*

4.1.4.1 Shoot damage

The Data on mean shoot damage recorded from various genotypes/variety of okra uncovered that, among nine genotypes/variety of okra, none of the cultivars were observed to be free from the pervasion of shoot damage. The per cent shoot damage by this nuisance fluctuated from 12.98 to 26.81 per cent. It shows the differing reaction of the considerable number of variety/genotypes to shoot damage. The base shoot damage was recorded on variety Akola Bahar (12.98 per cent), though the greatest damage was recorded on Punjab Padmini (26.81 per cent). The Cultivars *viz.*, Phule Utkarsha, Varsha Upahar, GOA - 5, Arka Anamika, Akola 107, and Parbhani Kranti, recorded 15.89, 19.85, 22.00, 22.51, 22.95 and 24.37 per cent damage, respectively (Table - 2 and Fig. 2).

4.1.4.2 Fruit damage

A nearby examination of the information on per cent fruit damage recorded from 24.42 to 36.38 per cent on various genotypes/variety. The variety Akola Bahar recorded less (24.42 per cent) fruit damage when contrasted with rest of alternate variety. The most extreme fruit damage was recorded in the variety Parbhani Kranti (36.38 per cent). The Cultivars *viz.*, Phule Utkarsha, Varsha Upahar, Akola 107, Punjab Padmini, GOA - 5 and Arka Anamika recorded 27.64, 28.59, 31.86, 32.82 and 34.57 per cent fruit damage, respectively. Among eight genotypes/variety of okra none of the cultivars was observed to be free from the pervasion of fruit damage (Table - 2 and Fig. 2).

Summer -2017

4.1.5 Jassid, *A. biguttula biguttula*

The Data on mean jassid population recorded from various genotypes/variety of okra uncovered that, among nine genotypes/variety of okra none of the cultivars were observed to be free from the pervasion of jassid. The jassid population went from 11.32 to 24. 58%. The most noteworthy jassid population was found in variety

Parbhani Kranti (24. 58 jassid), though variety GOA-5 indicated less jassid population (11.32). Cultivars *viz.*, Arka Anamika, Akola bahar, Parbhani Kranti, Phule Utkarsha, GOA - 5, Varsha Uphar, recorded 13.95, 14.98, 17.93, 18.57, 18.88 and 20.47 jassid, respectively. It was uncovered that every one of the cultivars were observed to be powerless to jassid invasion (Table - 3 and Fig. 3).

Table 2: Screening of different okra germplasm against Shoot and fruit borer, *E. vittella*) (Year 2016)

S. No.	Genotypes/varieties	Mean damage per centage	
		Shoot damage (%)	Fruit damage (%)
1.	T_1 = Varsha Upahar	19.85 (26.42)	28.59 (32.27)
2.	T_2 = Akola Bahar	12.98 (21.05)	24.42 (29.60)
3.	T_3 = Phule Utakarsh	15.89 (23.42)	27.64 (31.69)
4.	T_4 = GOA-5	22.00 (27.97)	34.57 (35.97)
5.	T_5 = Arka Anamika	22.51 (28.32)	33.02 (35.06)
6.	T_6 = Punjab Padmini	26.81 (31.18)	32.82 (34.94)
7.	T_7 = Parbhani kranti	24.37 (29.53)	36.38 (37.05)
8.	T_8 = Akola 107	22.95 (28.59)	31.86 (34.33)
	Mean	20.92 (27.06)	31.16 (33.86)
	SE $\pm$	0.08	0.23

	CD	0.24	0.70

*Figures in parentheses are arcsine transformed values

4.1.6 Aphid, *A. gossypii*

The Data on mean aphid population recorded from various genotypes/variety of okra uncovered that, among nine genotypes/variety of okra, none of the cultivars were observed to be free from the pervasion of aphid. Among nine genotypes/variety of okra the aphid population went from 12.39 to 17.56. The most noteworthy aphid population was found in variety Akola 107(17.56Aphid), while variety Punjab Padmini indicated less aphid population (12.39). Cultivars *viz.*, Punjab Padmini, Parbhani Kranti, Arka Anamika, Akola bahar, Phule Utkarsha and GOA - 5 recorded 12.98, 12.98, 13.60, 14.28 and 15.38 aphid, respectively. It was uncovered that every one of the cultivars were observed to be infested to aphid pervasion (Table - 3 and Fig. 3).

4.1.7 Whitefly, *B. tabaci*

The Data on mean whitefly population recorded from various genotypes/variety of okra uncovered that, among nine genotypes/variety of okra, none of the cultivars were observed to be free from the invasion of whitefly. Among nine genotypes/variety of okra the whitefly population ran from 3.26 to 6.97. The most extreme whitefly population found in variety Arka Anamika (6.97 whitefly), while variety Punjab Padmini indicated least whitefly population (3.26). The Cultivars *viz.*, GOA - 5, Parbhani Kranti, Phule Utkarsha, Akola bahar, Varsha Upahar and Akola 107 recorded 5.06, 5.53, 5.75, 6.32, 6.77 and 6.94 whitefly, respectively. It was uncovered that every one of the cultivars were observed to be infested to whitefly pervasion (Table - 3 and Fig. 3).

Table 3: Screening of different okra germplasm against sucking insect pests of okra (Year 2017)

S. No.	Genotypes/varieties	Average number of jassid/leaf	Average number of aphid/leaf	Average number of whitefly/leaf
1.	T_1 = Varsha Upahar	18.57 (4.42)	14.28 (3.90)	6.77 (2.78)
2.	T_2 = Akola Bahar	18.88 (4.45)	13.21 (3.76)	6.32 (2.70)
3.	T_3 = Phule Utakarsh	20.47	12.98	5.75

		(4.63)	(3.73)	(2.59)
4.	T_4 = GOA-5	11.32 (3.50)	15.38 (4.04)	5.06 (2.46)
5.	T_5 = Arka Anamika	13.95 (3.86)	12.98 (3.73)	6.97 (2.82)
6.	T_6 = Punjab Padmini	17.93 (4.35)	12.39 (3.65)	3.26 (2.06)
7.	T_7 = Parbhani kranti	24.58 (5.05)	13.60 (3.82)	5.53 (2.55)
8.	T_8 = Akola 107	14.98 (3.99)	17.56 (4.30)	6.94 (2.81)
	Mean	17.59 (4.28)	14.05 (3.87)	5.83 (2.60)
	S.Em.±	0.06	0.09	0.06
	CD	0.18	0.29	0.20

Figures in parentheses are √n+1 transformed values

4.1.8. Shoot and fruit borer, *E. vittella*

4.1.8.1 Shoot damage

The Data on mean shoot damage recorded from various genotypes/variety of okra uncovered that, among nine genotypes/variety of okra, none of the cultivars were observed to be free from the invasion of shoot damage. The per cent shoot damage differed from 16.75 to 24.54 per cent. It shows the changing reaction of the considerable number of variety/genotypes to shoot damage. The base shoot damage was recorded on variety Akola Bahar (16.75 per cent), while the most extreme damage was recorded on Punjab Padmini (26.81 per cent). The Cultivars *viz.*, Phule Utkarsha, Varsha Upahar, GOA - 5, Arka Anamika, Akola 107, and Parbhani Kranti, recorded 17.31, 18.14, 19.96, 20.26, 20.90 and 21.05 per cent damage respectively (Table - 4 and Fig. 4).

4.1.8.2 Fruit damage

A nearby examination of the information on per cent organic fruit damage uncovered that the invasion of natural fruit damage extended from 21.29 to 31.59 per cent on various genotypes/variety. The variety Akola Bahar recorded less damage (21.29 per cent) to fruits when contrasted with rest of alternate variety. The most extreme natural fruit damage was recorded in the variety Parbhani Kranti (31.59 per cent). The Cultivars *viz.*, Phule Utkarsha, Varsha Upahar, Akola 107, Punjab Padmini, GOA - 5 and Arka Anamika recorded 26.20, 27.81, 29.32, 29.43, 29.76 and 31.01 per cent damage respectively. Among eight genotypes/variety of okra none of the cultivars was observed to be free from the pervasion of organic fruit damage (Table - 4 and Fig. 4).

Table 4: Screening of different okra germplasm against Shoot and fruit borer, *E. vittella* (Year 2017)

S. No.	Genotypes/varieties	Mean damage per centage	
		Shoot damage (%)	Fruit damage (%)
1.	T_1 = Varsha Upahar	18.14 (25.18)	26.20 (30.79)
2.	T_2 = Akola Bahar	16.75 (24.12)	27.81 (31.82)
3.	T_3 = Phule Utakarsh	17.31 (24.58)	29.76 (33.02)
4.	T_4 = GOA-5	21.05 (27.28)	31.59 (34.14)
5.	T_5 = Arka Anamika	20.26 (26.71)	31.01 (33.83)
6.	T_6 = Punjab Padmini	24.54 (29.67)	29.32 (32.77)
7.	T_7 = Parbhani kranti	20.90 (27.20)	29.43 (32.83)
8.	T_8 = Akola 107	19.96 (26.78)	21.29 (27.48)
	Mean	19.86 (26.44)	28.30 (32.09)

	S.Em. ±	0.36	0.11
	CD	1.12	0.33

*Figures in parentheses are arcsine transformed values

4.2 Impact of date of sowing on infestation by major arthropod pests

4.2.1 Jassid

Summer 2016

The information on population of jassid was recorded from okra crop sown on three diverse sowing dates during summer season 2016. The population was seen from fourth week after all the sowing dates. In early sowing date the frequency was recorded in scope of 2.27 jassid/3 leaves to 21.93 jassid/3 leaves. The most extreme population of jassid was recorded in sixth week in the date of sowing for example 21.93 jassid/3 leaves. In customary sowing date the occurrence was seen in scope of 1.26 jassid/3 leaves to 15.29 jassid/3 leaves and the pinnacle population of jassid/3 leaves was recorded in sixth week in the date of sowing i.e 15.29 jassid/3 leaves. Though in late sowing date the frequency was seen in scope of 2.86 jassid/3 leaves to 25.13 jassid/3 leaves with the pinnacle of 25.13 jassid/3 leaves in seventh week in the date of sowing. On the premise normal information of every one of the three sowing dates the information demonstrated that the population was recorded most extreme on the late sowing harvest (25th Feb), while the least population was recorded on the ordinary sowing crop (10^{th} Feb), contrasted with the other sowing dates (Table-5 and Fig.5).

Summer 2017

The information on population of jassid was recorded from okra crop sown on three distinctive sowing dates During summer season 2017 and the frequency was seen from fourth week after all the sowing dates. In early sowing date the frequency was recorded in scope of 1.67 jassid/3 leaves to 18.44 jassid/3 leaves. The greatest population of jassid was recorded in seventh week subsequent to sowing i.e 18.44 jassid/3 leaves. In customary sowing date the occurrence was seen in scope of 0.86 jassid/3 leaves to 13.86 jassid/3 leaves. The pinnacle population of jassid/3 leaves was recorded in seventh week in the date of sowing for example 13.86 jassid/3 leaves. Though in late sowing date the frequency was seen in scope of 1.97 jassid/3 leaves to 20.34 jassid/3 leaves with the pinnacle of 20.34 jassid/3 leaves in seventh week in the date of sowing. Based by and large information of every one of the three sowing dates the information demonstrated that the population was recorded greatest in the late sowing harvest (25th Feb), while the most reduced population was recorded in the customary sowing crop (10th Feb), contrasted with the other sowing dates (Table-6 and Fig.6).

4.2.2 Aphid

Summer 2016

Concerning aphid population the occurrence of aphid was recorded on okra crop sown on three diverse sowing dates During summer season year 2016 and the rate was seen from fourth week after all the sowing dates. In early sowing date the occurrence was recorded in scope of 0.86 aphid/3 leaves to 18.62 aphid/3 leaves. The greatest population of aphid was recorded in seventh week subsequent to sowing for example 18.62 aphid/3 leaves. In ordinary sowing date the rate was seen in scope of 0.20 aphid/3 leaves to 15.04 Aphid/3 leaves. The pinnacle population of aphid/3 leaves was seen in seventh week in the date of sowing for example 15.04 aphid/3 leaves. While in late sowing date the occurrence was seen in scope of 1.13 aphid/3 leaves to 21.90 aphid/3 leaves with the pinnacle of 21.90 aphid/3 leaves in seventh week in the date of sowing. Based by and large information of each of the three sowing dates the information demonstrated that the population was recorded most extreme in the late sowing harvest (25th Feb), while the least population was recorded in the standard sowing crop (10th Feb), contrasted with the other sowing dates.

Summer 2017

With respect to aphid population the occurrence of aphid was recorded from okra crop sown on three distinctive sowing dates During summer period of year 2017 from fourth week after all the sowing dates. In early sowing date the rate was recorded in scope of 0.91 aphid/3 leaves to 18.66 aphid/3 leaves. The most extreme population of aphid was recorded in eleventh week in the date of sowing for example 18.66 aphid/3 leaves. In ordinary sowing date the occurrence was seen in scope of 0.36 aphid/3 leaves to 12.06 aphid/3 leaves. The pinnacle population of aphid was seen in eleventh week in the date of sowing for example 12.06 aphid/3 leaves. While in late sowing date the frequency was seen in scope of 1.29 aphid/3 leaves to 20.93 aphid/3 leaves with the pinnacle of 20.93 aphid/3 leaves in seventh week subsequent to sowing. Based all things considered information of each of the three sowing dates the information demonstrated that the population was recorded most extreme in the late sowing harvest (25th Feb), while the least population was recorded in the standard sowing crop (10^{th} Feb), contrasted with the other sowing dates.

4.2.3 Whitefly

Summer 2016

With respect to whitefly population the rate of nuisance was recorded from okra crop sown on three diverse sowing dates during summer period of year 2016 from fourth week after all the sowing dates. In early sowing date the frequency was recorded in scope of 0.33 whitefly/3 leaves to 10.33 whitefly/3 leaves. The most elevated population of whitefly was recorded in eighth week in the date of sowing for example 10.33 whitefly/3 leaves. In normal sowing date the occurrence was seen in scope of 0.12 whitefly/3 leaves to 6.26 whitefly/3 leaves. The pinnacle population of whitefly/3 leaves was recorded in eighth week in the date of sowing for example 6.26 whitefly/3 leaves. Though in late sowing date the occurrence was recorded in scope of 0.86 whitefly/3 leaves to 11.89 whitefly/3 leaves with the pinnacle of 11.89 whitefly/3 leaves in eighth week subsequent to sowing. Based all things considered information of every one of the three sowing dates the information showed that the number of inhabitants in whitefly was recorded most extreme in the late sowing harvest (25th Feb), though it was low in the customary sowing crop (10^{th} Feb), contrasted with the other sowing dates.

Summer 2017

On account of whitefly population the frequency of nuisance was recorded from okra crop sown on three distinctive sowing dates during summer period of year 2017 from fourth week after all the sowing dates. In early sowing date the rate was recorded in scope of 0.21 whitefly/3 leaves to 11.93 whitefly/3 leaves. The most astounding population of whitefly was recorded in eleventh week in the date of sowing for example 11.93 whitefly/3 leaves. In standard sowing date the rate was seen in scope of 0.08 whitefly/3 leaves to 8.27 whitefly/3 leaves. The pinnacle population of whitefly/3 leaves was recorded in eleventh week subsequent to sowing for example 8.27 whitefly/3 leaves. While in late sowing date the frequency was recorded in scope of 0.35 whitefly/3 leaves to 13.56 whitefly/3 leaves with the pinnacle of 13.56 whitefly/3 leaves in eleventh week subsequent to sowing. Based by and large information of each of the three sowing dates the information demonstrated that the number of inhabitants in whitefly was recorded greatest in the late sowing harvest (25th Feb), though it was low in the customary sowing crop (10^{th} Feb), contrasted with the other sowing dates.

Table 5: Effect of different dates of sowing against okra Jassid, Aphid, Whitefly and Shoot and fruit borer, during the year 2016

Week	Average number of Jassid /leaf Crop sown on			Average number of Aphid/leaf Crop sown on			Average number of Whitefly/leaf Crop sown on		
	26th Jan.	10th Feb.	25th Feb.	26th Jan.	10th Feb.	25th Feb.	26th Jan.	10th Feb.	25th Feb.
I Week	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
II Week	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
III Week	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
IV Week	2.27 (1.80)	1.26 (1.5)	2.86 (1.96)	0.86 (1.36)	0.20 (1.09)	1.13 (1.45)	0.33 (1.15)	0.12 (1.05)	0.86 (1.36)
V Week	5.33 (2.51)	3.30 (2.01)	6.52 (2.74)	2.20 (1.78)	1.07 (1.43)	2.50 (1.87)	1.27 (1.50)	0.86 (1.36)	1.70 (1.40)
VI Week	12.43 (3.66)	6.52 (2.74)	12.07 (3.61)	5.25 (2.50)	4.07 (2.25)	6.33 (2.70)	2.87 (1.96)	1.83 (1.68)	3.10 (2.02)
VII Week	16.09 (4.13)	8.27 (3.04)	18.40 (4.40)	8.73 (2.95)	6.27 (2.69)	9.16 (3.18)	3.68 (2.16)	2.27 (1.80)	4.80 (2.40)

VIII Week	18.62 (4.42)	12.07 (3.61)	20.93 (4.68)	12.07 (3.61)	10.56 (3.40)	13.60 (3.82)	4.27 (2.29)	2.58 (1.89)	5.31 (2.51)
IX Week	21.93 (4.18)	15.29 (4.03)	22.67 (4.86)	15.96 (4.11)	12.43 (3.66)	18.07 (4.36)	5.33 (2.51)	3.55 (2.13)	7.90 (2.98)
X Week	18.07 (4.36)	13.56 (3.81)	25.13 (5.11)	18.62 (4.42)	15.04 (4.00)	21.90 (4.78)	8.65 (3.10)	4.22 (2.28)	9.36 (3.30)
XI Week	13.60 (3.82)	9.97 (2.44)	17.13 (4.25)	16.60 (4.19)	10.75 (3.42)	18.62 (4.42)	10.33 (3.36)	6.26 (2.69)	11.89 (3.59)
XII Week	7.16 (2.85)	5.03 (2.45)	12.40 (3.66)	10.04 (3.32)	6.33 (2.70)	13.50 (3.80)	9.01 (3.16)	3.55 (2.13)	10.57 (3.40)
XIII Week	5.03 (2.45)	2.80 (1.94)	8.89 (3.14)	7.16 (2.85)	2.56 (1.88)	9.45 (3.23)	6.14 (2.67)	2.19 (0.92)	7.05 (2.83)
XIV Week	2.86 (1.96)	0.33 (1.15)	4.80 (2.40)	4.07 (2.25)	0.87 (1.36)	6.20 (2.68)	2.27 (1.80)	1.38 (1.54)	4.80 (2.40)
S.Em. ±	0.04	0.03	0.04	0.05	0.04	0.03	0.04	0.04	0.09
CD (p=0.05)	0.12	0.08	0.13	0.14	0.12	0.09	0.13	0.12	0.26

*Figures in parentheses are √n+1 transformed values

Table 6: Effect of different dates of sowing against okra Jassid, Aphid, Whitefly and Shoot and fruit borer, during the year 2017

Week	Average number of Jassid /leaf Crop sown on			Average number of Aphid/leaf Crop sown on			Average number of Whitefly/leaf Crop sown on		
	26th Jan.	10th Feb.	25th Feb.	26th Jan.	10th Feb.	25th Feb.	26th Jan.	10th Feb.	25th Feb.
I Week	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
II Week	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
III Week	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
IV Week	1.67 (1.63)	0.86 (1.36)	1.97 (1.72)	0.91 (1.38)	0.36 (1.16)	1.29 (1.51)	0.21 (1.1)	0.08 (1.03)	0.35 (1.16)
V Week	2.41 (1.84)	1.27 (1.50)	2.86 (1.96)	1.60 (1.61)	0.63 (1.27)	2.50 (1.87)	1.05 (1.43)	0.97 (1.40)	1.47 (1.57)
VI Week	3.80 (2.19)	2.25 (1.80)	4.03 (2.24)	2.20 (1.78)	1.27 (1.50)	3.40 (2.09)	2.23 (1.79)	1.30 (1.51)	2.66 (1.91)
VII Week	6.52 (2.74)	4.29 (2.30)	8.84 (3.13)	3.80 (2.19)	2.80 (1.94)	5.59 (2.56)	3.50 (2.12)	2.50 (1.87)	4.03 (2.24)

VIII Week	10.26 (3.30)	6.59 (2.75)	12.40 (3.66)	6.59 (2.75)	3.57 (2.13)	8.27 (3.04)	4.80 (5.80)	3.97 (2.22)	5.27 (2.50)
IX Week	16.20 (4.14)	10.13 (3.33)	18.66 (4.43)	9.65 (3.26)	5.16 (2.48)	11.6 (3.54)	6.27 (2.69)	4.07 (2.25)	7.21 (2.86)
X Week	18.44 (4.40)	13.86 (3.85)	20.34 (4.61)	14.27 (3.9)	8.89 (3.14)	16.01 (4.12)	4.63 (2.37)	6.52 (2.74)	10.64 (3.41)
XI Week	15.47 (4.05)	10.26 (3.35)	16.86 (4.22)	18.66 (4.43)	12.06 (3.61)	20.93 (4.89)	11.93 (3.59)	8.27 (3.04)	13.56 (3.81)
XII Week	9.63 (3.26)	6.52 (2.74)	11.93 (3.59)	10.67 (3.41)	7.30 (2.88)	13.33 (3.78)	8.89 (3.14)	6.59 (2.75)	9.57 (3.25)
XIII Week	5.59 (2.56)	3.20 (2.04)	7.30 (2.88)	8.10 (2.66)	4.29 (2.30)	7.21 (2.18)	4.29 (2.30)	2.86 (1.96)	5.03 (2.45)
XIV Week	3.40 (2.09)	1.10 (1.44)	4.29 (2.30)	3.20 (2.04)	1.96 (1.72)	4.03 (2.24)	2.25 (1.80)	1.20 (1.48)	2.80 (1.94)
S.Em. ±	0.06	0.07	0.08	0.09	0.05	0.02	0.10	0.03	0.05
CD (p=0.05)	0.18	0.21	0.23	0.27	0.14	0.06	0.29	0.09	0.14

*Figures in parentheses are √n+1 transformed values

4.2.4 Shoot and fruit borer

Summer 2016

In the year 2016, the information on shoot and natural fruit damage showed that, inception of shoot and organic fruit damage was seen at fifth week on harvest, sown on 26th January, 10th February and 25th February. During the trimming season the shoot and organic fruit damage shifted from 9.15 to 29.76 per cent. The most elevated damage was recorded on seventh WAS in all sowing dates for example 24.56, 26.20 and 29.76 per cent damage respectively. The most astounding shoot and natural fruit damage was recorded on late sown harvest (25th Feb-29.76 per cent), though the least damage was recorded on early sown yield (26th Jan - 9.15 per cent). From that point the shoot and organic fruit damage was diminished (Table-7 and Fig. 11).

Yield

Considering the yield information during summer 2016 of harvest sown on various sowing dates. The harvest sown on 10th February recorded higher yield (3885 kg/ha) of attractive fruits contrasted with 26th January (3520 kg/ha) and 25th February (3211 kg/ha) sown harvest, respectively (Table-8 and Fig.13).

Summer 2017

During the year 2017 the information on shoot and natural fruit damage demonstrated that, inception of shoot and organic fruit damage was seen at fifth WAS on yield, sown on 26th January, 10th February and 25th February. During the trimming season the shoot and natural fruit damage differed from 8.06 to 31.01 per cent. The most astounding damage was recorded on ninth WAS in all sowing dates for example 28.80, 27.64 and 31.01 per cent damage respectively. The most elevated shoot and natural fruit damage was recorded on late sown harvest on (25th Feb. – 31.01%) while the most minimal damage was recorded on early sown harvest (26th Jan. - 8.06%) (Table-7 and Fig. 12).

Yield

Considering the yield information during summer 2017 of harvest sown on various sowing dates in connection to the yield of okra fruits. The harvest sown on 10thFebruary gave higher yield (3640 kg/ha) of attractive natural products contrasted with 26th January (3331 kg/ha) and 25th February (3190 kg/ha) sown yield, respectively (Table-8 and Fig.13).

Table 7: Effect of different dates of sowing against okra Shoot and fruit borer, *E. vittella*

Week	Year 2016			Year 2017		
	Mean per cent fruit infestation			Mean per cent fruit infestation		
	26th Jan.	10th Feb.	25th Feb.	26th Jan.	10th Feb.	25th Feb.
I week	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
II week	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
III week	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
IV week	9.15 (17.56)	10.81 (19.19)	15.89 (23.42)	8.06 (16.43)	9.52 (17.95)	12.74 (20.88)
V week	14.71 (22.55)	16.63 (24.04)	18.14 (25.18)	10.42 (18.81)	13.56 (21.56)	15.71 (23.34)
VI week	20.19 (26.64)	21.23 (27.42)	24.54 (29.67)	13.56 (21.56)	15.24 (22.95)	18.94 (25.77)
VII week	24.56	26.20	29.76	17.58	19.26	20.39

	(29.67)	(30.79)	(33.02)	(24.73)	(25.99)	(26.78)
VIII week	28.45 (32.20)	30.73 (33.65)	33.31 (35.24)	22.81 (28.52)	24.54 (29.67)	26.54 (30.98)
IX week	23.98 (29.27)	33.02 (35.06)	36.38 (37.05)	26.13 (30.72)	29.32 (32.77)	31.01 (33.83)
X week	30.66 (33.58)	36.71 (37.29)	39.56 (38.54)	24.50 (29.67)	26.10 (30.72)	27.31 (31.50)
XI Week	19.01 (25.84)	26.10 (30.72)	32.82 (34.94)	28.80 (32.46)	27.64 (31.76)	30.29 (33.34)
XII Week	13.05 (21.13)	17.04 (24.35)	22.81 (28.52)	19.00 (25.84)	18.04 (25.10)	21.82 (27.83)
XIII Week	10.80 (19.19)	13.68 (21.64)	17.25 (24.50)	12.80 (12.80)	13.25 (21.30)	15.16 (22.87)
S.Em. ±	0.06	0.04	0.06	0.09	0.06	0.06
CD (p=0.05)	0.19	0.12	0.17	0.26	0.17	0.17

*Figures in parentheses are arcsine transformed values

Table 8: Effect of sowing dates on yield of okra

Sowing date	Yield (kg /ha) Year 2016	Yield (kg /ha) Year 2017
26th January	3520	3331
10th February	3885	3640
25th February	3211	3190

4.3 Study the population dynamics of the major arthropod pests

The perception on the rate of Shoot and fruit borer, sucking irritations for example jassid, aphid and whitefly on okra were recorded in summer period of the year 2016 and 2017, results relating to rate are introduced in Table 9 to 10 and delineated in Fig. 14 to 15.

4.3.1 Incidence of sucking pests

4.3.1.1 Jassid

In the summer period of the year 2016, okra crop was sown during first week of February. The number of inhabitants in jassid extended from 7.28/3 leaves in a week ago of May to 32.66/3 leaves in forward week of April. The frequency was seen till the finish of the harvest time frame (a week ago of May). The jassid population steadily expanded and achieved its pinnacle of 32.66 in Fourth week of April. From that point continuous abatement in population was watched.

During summer period of the year 2017 Okra crop was sown during first week of February. The number of inhabitants in jassid extended from 4.38/3 leaves in a week ago of May to 26.33/3 leaves in Fourth week of April. The occurrence was seen till the finish of the harvest time frame (a week ago of May). The jassid population continuously expanded and achieved its pinnacle of 26.33 in Fourth week of April. From that point progressive decline in population was watched.

4.3.1.2 Correlation coefficient study between jassid population and weather parameters

In summer 2016 the information on relationship coefficient consider between irritation population and climate parameters demonstrated that RHE (- 0.721), indicated exceedingly significant negative connection, while MinT (- 0.125), RHM (- 0.053) demonstrated negative connection with aphid movement though, Max T (0.638), BSS (0.403), demonstrated noteworthy positive relationship, with jassid population (Table - 11).

During the year 2017, the information on relationship coefficient examine between irritation population and climate parameters demonstrated that BSS (- 0.164), MinT (- 0.051) and RHE (- 0.392) indicated negative connection with vermin movement though, MaxT (0.265), RHM (0.345) indicated positive connection, with jassid population (Table - 12).

4.3.1.3 Aphid

In the summer period of the year 2016, okra crop was sown during first weekof February. The number of inhabitants in aphid extended from 5.28 aphid/3 leaves in a week ago of May to 22.10 aphid/3 leaves in fourth week of April. The frequency was seen till the finish of the yield time frame (a week ago of May). The aphid population bit by bit expanded and achieved its pinnacle of 26.10 aphid in fourth week of April. From that point slow abatement in population was watched.

During summer period of the year 2017, okra crop was sown during first week of February. The number of inhabitants in aphid went from 3.62 aphid/3 leaves in a week ago of May to 24.22 aphid/3 leaves fourth week of April. The rate was seen till the finish of the harvest time frame (a week ago of May). The aphid population progressively expanded and achieved its pinnacle of 24.22 in third week of April. From that point slow reduction in population was watched.

4.3.1.4 Correlation coefficient study between aphid population and weather parameters

In summer during the year 2016 the information on relationship coefficient think about between aphid population and climate parameters demonstrated that RHE (- 0.749), indicated exceedingly huge negative connection, while MinT (- 0.078) and RHM (- 0.078) demonstrated negative relationship with irritation movement though, MaxT (0.619) and BSS (0.433) demonstrated noteworthy positive connection, with aphid population (Table - 11).

During the year 2017, the information on relationship coefficient consider between nuisance population and climate parameters demonstrated that BSS (- 0.316) and RHE (- 0.195) indicated negative connection with vermin action though, MaxT (0.362), RHM (0.493) demonstrated huge positive relationship, while MaxT (0.362) and MinT (0.161) demonstrated positive relationship with aphid population (Table - 12).

4.3.1.5 Whitefly

During the summer period of the year 2016, okra crop was sown during first week of February. The number of inhabitants in whitefly extended between 2.68 whitefly/3 leaves in first week of March to 9.12 whitefly/3 leaves in fourth week of April. The frequency was seen till the finish of the harvest time frame (a week ago of May). The whitefly population step by step expanded and achieved its pinnacle of 9.12 whitefly in fourth week of April. From that point progressive diminishing in population was watched.

During summer period of the year 2017, okra crop was sown during first week of February. The number of inhabitants in whitefly ran between 1.48 whitefly/3 leaves in a week ago of May to 10.80 whitefly/3 leaves in third week of April. The frequency was seen till the finish of the yield time frame (a week ago of May). The whitefly population bit by bit expanded and achieved its pinnacle of 24.22 in third week of April. From that point, continuous decline in population was watched.

4.3.1.6 Correlation coefficient study between whitefly population and weather parameters

In summer of the year 2016 the information on relationship coefficient think about between nuisance population and climate parameters demonstrated that RHE (- 0.683), indicated exceedingly noteworthy negative connection, while RHM (- 0.216) indicated negative relationship with aphid action though, MaxT (0.723), indicated significant positive connection while BSS (0.313) demonstrated positive connection with whitefly population (Table - 11).

During the year 2017, on relationship coefficient examine between vermin population and climate parameters demonstrated that BSS (- 0.544) indicated noteworthy negative connection with nuisance movement though RHM (0.607), MaxT (0.431), demonstrated huge positive relationship while MinT (0.397) indicated positive relationship with whitefly population the information (Table - 12).

4.3.1.7 Shoot and fruit borer

During the summer period of the year 2016, okra crop was sown during first week of February. The per cent damage of Shoot and fruit borer ran from 6.38 per cent in first week of March to 23.63 per cent in fourth week of April. The occurrence was seen till the finish of the yield time frame (a week ago of May). The Shoot and fruit borer rate step by step expanded and achieved its pinnacle of 23.63 per cent in third week of April. From that point progressive diminishing in occurrence was watched.

During summer period of the year 2017, okra crop was sown during first week of February. The per cent damage of Shoot and fruit borer extended from 4.76 per cent in first week of March to 24.48 per cent in fourth week of April. The rate was seen till the finish of the yield time frame (a week ago of May). The Shoot and fruit borer step by step expanded and achieved its pinnacle of 24.48 per cent in fourth week of April. From that point slow diminishing in rate was watched.

4.3.1.8 Correlation coefficient study between Shoot and Fruit population and weather parameters

In summer 2016 the information on connection coefficient think about between irritation population and climate parameters demonstrated that RHE (- 0.546) indicated exceedingly noteworthy negative relationship, while RHM (- 0.364) demonstrated negative connection with vermin action though, MaxT (0.753), demonstrated huge positive relationship, with Shoot and Fruit pervasion (Table - 11).

During 2017, the information on relationship coefficient think about between vermin population and climate parameters demonstrated that BSS (- 0.700) indicated significant negative connection while MinT (0.649), MaxT (0.519) and RHM (0.668) demonstrated noteworthy positive connection though RHE (0.341) demonstrated positive connection with Shoot and fruit borer invasion (Table - 12).

The test aftereffects of examinations did on the assessment of aphid sprays and bio-pesticides in correlation with untreated check under field conditions against real arthropods pervading okra are talked about and displayed in this section.

Table 9: Weekly population /per cent Infestation of major insect pest of okra during summer season year 2016

Insect pest/natural enemies	**Date of observation (mean population/plant)**													
	4/3/16	**11/3/16**	**18/3/16**	**25/3/16**	**1/4/16**	**8/4/16**	**15/4/16**	**22/4/16**	**29/4/16**	**5/5/16**	**12/5/16**	**19/5/16**	**26/5/16**	**Average**
Jassid	10.89	15.29	18.86	20.93	22.36	26.33	29.68	32.66	27.23	20.93	16.60	12.26	7.28	20.10
Aphid	8.89	9.65	12.07	15.29	18.44	20.93	24.59	26.10	23.83	18.12	10.24	7.21	5.28	15.43
Whitefly	2.68	3.54	5.83	6.97	6.40	7.29	8.47	9.12	8.26	7.81	5.67	4.27	2.86	6.09
Shoot and fruit borer	6.38	8.00	10.51	13.99	16.75	17.04	19.76	23.63	18.14	16.80	15.50	12.38	9.05	14.46

Table 10: Weekly population /per cent Infestation of major insect pest of okra during summer season year 2017

Insect pest/natural enemies	**Date of observation (mean population/plant)**													
	1/3/17	**8/3/17**	**15/3/17**	**22/3/17**	**29/3/17**	**5/4/17**	**12/4/17**	**19/4/17**	**26/4/17**	**3/5/17**	**10/5/17**	**17/5/17**	**24/5/17**	**Average**
Jassid	12.07	14.27	16.36	19.56	20.93	21.44	24.06	26.33	20.12	18.66	12.06	9.47	4.38	16.90
Aphid	7.30	10.96	11.60	14.26	16.20	20.93	22.36	24.22	20.93	16.20	12.44	8.43	3.62	14.57
Whitefly	2.86	3.20	4.16	6.23	6.47	7.26	8.29	10.80	9.69	8.48	7.33	5.21	1.48	6.27
Shoot and fruit borer	4.76	5.91	8.06	10.55	12.92	14.6	19.26	21.29	24.48	20.86	17.33	15.33	8.72	14.16

Table 11: Correlation between weather parameter and major arthropod pests infesting okra year 2016

	Maximum(I)	**Minimum(I)**	**R.H. (I)**	**R.H. (II)**	**Sunshine**	**Jassid**	**Aphid**	**White fly**	**Shoot and fruit borer**
Maximum(I)	1								
Minimum(I)	0.125689	1							
R.H. (I)	-0.43712	-0.57267	1						
R.H. (II)	-0.68031	0.399516	0.135104	1					
Sunshine	0.077654	-0.58271	0.172391	-0.64497	1				
Jassid	0.638296	-0.12552	-0.05312	-0.7218	0.403918	1			
Aphid	0.619214	-0.07838	-0.07841	-0.74993	0.433194	0.976603	1		
Whitefly	0.723451	0.049667	-0.21672	-0.68381	0.313412	0.945254	0.931898	1	
Shoot and fruit borer	0.753765	0.274935	-0.36418	-0.54631	0.106063	0.892434	0.882629	0.930006	1

Table 12: Correlation between weather parameter and major arthropod pests infesting okra 2017

	Maximum(I)	**Minimum(I)**	**R.H. (I)**	**R.H. (II)**	**Sunshine**	**Jassid**	**Aphid**	**White fly**	**Shoot and fruit borer**
Maximum(I)	1								
Minimum(I)	0.58278	1							
R.H. (I)	0.205294	0.722239	1						
R.H. (II)	0.243713	0.844036	0.643145	1					
Sunshine	-0.54028	-0.76561	-0.61787	-0.5592	1				
Jassid	0.26581	-0.0515	0.345837	-0.392	-0.16457	1			
Aphid	0.362745	0.161429	0.493429	-0.19522	-0.31652	0.944266	1		
Whitefly	0.431754	0.397632	0.607678	0.04286	-0.54442	0.798417	0.903951	1	
Shoot and fruit borer	0.519555	0.649153	0.668944	0.341988	-0.70097	0.532682	0.730889	0.908924	1

4.4 Evaluation of some insecticides and bio-pesticides against major arthropod pests

The test after effects of examinations did on the assessment of aphid sprays and bio-pesticides in correlation with untreated check under field conditions against real arthropods pervading okra are talked about and displayed in this section.

4.4.1 Efficacy of different treatments against sucking pests of okra during the year 2016

4.4.1.1 Jassid

The information on the viability of different treatments in lessening the jassid population after first and second spraying are outfitted in Table 13 and Fig. 16.

4.4.1.1.1 First spray

There was no noteworthy distinction in the jassid population on one day before burden of various treatments and population was recorded in the scope of 20.47 to 22.87 jassid/3 leaves. The jassid population was uniform in every one of the treatments previously spray. Every one of the aphid sprays were fundamentally better over untreated examination than 14 DAS. At 3 DAS, the base jassid population/3 leaves was recorded in the treatment T2 FlonicDuring half WG (5.41 jassid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The plummeting request of different treatments dependent by and large number of jassid/3 leaves was T5 (6.32) > T6 (6.32) > T3 (7.21) > T1 (7.23) >> T4 (7.54) > T7 untreated check (29.58). After 7 DAS, the base jassid population/3 leaves was recorded in the treatment T2 FlonicDuring 50 % WG (1.56 jassid population/3 leaves) among different treatments. Notwithstanding, it was at standard with all other treatment aside from untreated check. The normal number of jassid/3 leaves in different treatments was T5 (2.12) > T6 (2.12) > T1 (2.51) > T3 (2.58) > T4 (3.26) > T7 untreated check (32.45). At 14 DAS, the pattern of jassid population was watched expanding, the base jassid population/3 leaves was recorded in the treatment T2 FlonicDuring half WG (10.31 jassid population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The normal number of jassid/3 leaves in different treatments was T5 (10.80) > T3 (13.21) > T6 (13.36) > T4 (14.11) > T1 (14.92) > T7 untreated check (35.36) respectively.

4.4.1.1.2 Second spray

The jassid population was uniform in every one of the treatments previously spray as treatment contrast was non-significant. Every one of the aphid sprays were essentially better than untreated examination to 14 DAS. After 3 DAS, the treatment T2 Emamectin benzoate 5% SG was recorded least jassid (2.14 jassid population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The pattern of viability of different treatments dependent by and large number of jassid/3 leaves was T5 (2.43) > T3 (3.18) > T4 (4.03) > T6 (4.17) > T1 (4.41) > T7 untreated check (24.73). At 7 DAS, the base jassid population/3 leaves was recorded in the treatment T2 Emamectin benzoate 5% SG (0.88 jassid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of jassid/3 leaves in different treatments recorded was T5 (0.90) > T4 (2.10) > T1 (2.21) > T3 (2.43) > T6 (2.90) > T7 untreated check (26.98) respectively. After 14 DAS, the pattern of jassid population was watched expanding, the least jassid population/3 leaves was recorded in the treatment T2 Emamectin benzoate 5% SG (3.30 jassid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of jassid/3 leaves in different treatments watched asT5 (3.89) > T1 (4.11) > T3 (5.12) > T4 (5.72) > T6 (6.05) > T7 untreated check (28.22).

Results acquired from normal information showed that every one of the treatments were altogether better over untreated check. Treatment T2 (1stspray T2 FlonicDuring 50 % WG and second Emamectin benzoate 5% SG was recorded least jassid population (6.94) and it was at standard with all other treatment aside from untreated check. The pattern of treatments according to their viability to untreated check jassid/3 leaves population was T5 (7.31) trailed by T3, T1, T6, T4, and T7 (Untreated check) respectively (Table 19 and Fig. 22).

4.4.2 Efficacy of different treatments against sucking pests of okra during the year 2017

4.4.2.1 Jassid

The data on the efficacy of various treatments in reducing the jassid population after first and second spraying are furnished in Table 14 and Fig. 17.

4.4.2.1.1 First spray

There was no huge distinction in the jassid population at one day before before inconvenience of various treatments and population was recorded in the scope of 34.67 to 39.00 jassid/3 leaves. The jassid population was watched uniform in every one of the treatments previously spray. Every one of the aphid sprays were altogether better than untreated examination to 14 DAS. After 3 DAS, the base jassid population/3 leaves was recorded in the treatment T4 Tolfenpyrad 10% EC (13.28 jassid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The sliding request of different treatments dependent by and large number of jassid/3 leaves was T1 (13.60) > T3 (13.60) > T6 (14.46) > T2 (14.80) > T5 (15.40) > T7 untreated check (57.20). At 7 DAS, the least jassid population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (3.80 jassid population/3 leaves) among different treatments and it was at standard with all other treatment aside from untreated check. The normal number of jassid/3 leaves in different treatments was T3 (4.20) > T2 (4.40) > T4 (5.20) > T1 (5.80) > T6 (6.80) > T7 untreated check (67.22). After 14 DAS, the expanding pattern of jassid population was watched, the base jassid population/3 leaves was recorded in the treatment T4 Tolfenpyrad 10% EC (12.20 jassid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of jassid/3 leaves in different treatments was recorded as T3 (18.68) > T2 (21.40) > T6 (21.80) > T5 (23.93) > T1 (24.66) > T7 untreated check (89.80).

4.4.2.1.2 Second spray

The jassid population was uniform in every one of the treatments previously spray. Every one of the aphid sprays were altogether better over untreated examination than 14 DAS. After 3 DAS, the treatment T2 Emamectin benzoate 5% SG was recorded least jassid (3.98 jassid population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The pattern of viability of different treatments dependent all things considered number of jassid/3 leaves was T5 (4.18) > T3 (4.68) > T1 (5.33) > T4 (5.72) > T6 (6.02) > T7 untreated check (31.78). After 7 DAS, the base jassid population/3 leaves was recorded in the treatment T2 Emamectin benzoate 5% SG (0.11 jassid population/3 leaves) among different treatments. Not with standing, it was at standard with all other treatment aside from untreated check. The normal number of jassid/3 leaves in different treatments recorded was T3 (0.22) > T4 (0.68) > T5 (0.98) > T6 (1.18) > T1 (1.22) > T7 untreated check (36.98), respectively. At 14 DAS, the pattern of jassid population was watched expanding, the least jassid population/3 leaves was recorded in the treatment T2 Emamectin benzoate 5% SG (0.38 jassid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of jassid/3 leaves in different treatments saw as T3 (0.98) > T4 (1.32) > T6 (1.68) > T5 (2.11) > T1 (2.38) > T7 untreated check (42.68) respectively.

Results derived from normal information showed that every one of the treatments were fundamentally better over untreated check. Treatment T3 (first spray T3 Thiamethoxam 25 %WG and second spray Thiodicarb75%WP was recorded least jassid population (12.12) and it was at standard with all other treatment aside from untreated check. The pattern of treatments according to their adequacy to untreated check jassid/3 leaves population was T3 and T1 (13.91) trailed by T4, T2, T5, T6 and T7 (Untreated check) respectively (Table 20 and Fig. 23).

4.4.4.1 Efficacy of different treatments against sucking pests of okra during the year 2016

4.4.4.1.1 Aphid

The data on the efficacy of various treatments in reducing the aphid population after first and second spraying are furnished in Table 15 and Fig. 18.

4.4.4.1.2 First spray

There was no significant distinction in the aphid population at one day before before burden of various treatments and population was recorded in the scope of 15.88 to 20.55 aphid/3 leaves. The aphid population was uniform in every one of the treatments previously spray. Every one of the aphid sprays were fundamentally better over untreated examination than 14 DAS. At 3 DAS, the base aphid population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (10.05 aphid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The diving request of different treatments dependent all things considered number of aphid/3 leaves was T4 (10.32) > T1 (10.60) > T6 (10.85) > T3 (11.32) > T2 (12.45) > T7 untreated check (22.60). After 7 DAS, the base aphid population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (3.42 aphid population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The normal number of aphid/3 leaves in different treatments was T1 (3.89) > T4 (4.18) > T6 (4.22) > T3 (5.02) > T2 (5.58) > T7 untreated check (24.38). At 14 DAS, the pattern of aphid population was watched expanding, the base aphid population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (10.54 aphid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of aphid/3 leaves in different treatments was T4 (11.30) > T6 (12.03) > T3 (12.36) > T1 (12.45) > T2 (13.62) and T7 untreated check (27.38), respectively.

4.4.4.1.3 Second spray

The aphid population was uniform in every one of the treatments previously spray. Every one of the aphid sprays were altogether better over untreated examination than 14

DAS. After 3 DAS, the treatment T5 Spiromesifen 22.9 % SC was recorded least aphid (6.32 aphid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The pattern of adequacy of different treatments dependent by and large number of aphid/3 leaves was T1 (6.94) > T6 (8.25) > T2 (8.36) > T3 (8.36) > T4 (8.56) > T7 untreated check (19.22). At 7 DAS, the base aphid population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (0.80 aphid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of aphid/3 leaves in different treatments recorded was T1 (1.11) > T2 (1.66) > T3 (2.19) > T6 (2.30) > T4 (2.80) > T7 untreated check (20.68) respectively. After 14 DAS, the pattern of aphid population was watched expanding, the least aphid population/3 leaves was recorded in the treatment T2 Emamectin benzoate 5% SG (2.00 aphid population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The normal number of aphid/3 leaves in different treatments saw as T5 (2.90) > T1 (3.30) > T3 (3.60) > T6 (4.00) > T4 (4.40) > T7 untreated check (21.50).

Results acquired from normal information of two years demonstrated that every one of the treatments were altogether better over untreated check. Treatment T5 (first spray T5 Spiromesifen 22.9% SC and second spray Thiodicarb 75% WP) was recorded least aphid population (8.27) and it was at standard with all other treatment aside from untreated check. The pattern of treatments according to their adequacy to untreated check aphid/3 leaves population was T2 (10.05) trailed by T1, T4, T3, T6 and T7 (Untreated check), respectively (Table 19 and Fig. 24).

4.4.5.1 Efficacy of different treatments against sucking pests of okra during the year 2017

4.4.5.1.1 Aphid

The data on the efficacy of various treatments in reducing the aphid population after first and second spraying are furnished in Table 16 and Fig. 19.

4.4.5.1.2 First spray

There was no huge distinction in the aphid population at one day before before burden of various treatments and population was recorded in the scope of 17.38 to 26.98 aphid/3 leaves. The aphid population was uniform in every one of the treatments previously spray as treatment contrast was non-huge. Every one of the aphid sprays were essentially better than untreated examination to 14 DAS. At 3 DAS, the base aphid population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (5.07 aphid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The diving request of different treatments dependent by and large number of aphid/3 leaves was T3 (5.47) > T4 (5.68) > T1 (6.68) > T6 (7.22) > T2 (8.33) > T7 untreated check (33.52). After 7 DAS, the base aphid population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (3.18 aphid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of aphid/3 leaves in different treatments was T4 (4.27) > T2 (4.68) > T6 (5.22) > T1 (5.28) > T3 (6.80) > T7 untreated check (37.18). At 14 DAS, the pattern of aphid population was watched expanding, the base aphid population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (22.27 aphid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of aphid/3 leaves in different treatments was T3 (23.68) > T2 (24.27) > T6 (24.60) > T1 (25.87) > T4 (26.68) and T7 untreated check (45.98).

4.4.5.1.3 Second spray

The aphid population was uniform in every one of the treatments previously spray as treatment contrast was non-huge. Every one of the aphid sprays were fundamentally better than untreated examination to 14 DAS. After 3 DAS, the treatment T5 Thiodicarb 75% WP was recorded least aphid (4.32 aphid population/3 leaves) among different treatments. Notwithstanding, it was at standard with all other treatment aside from untreated check. The pattern of adequacy of different treatments dependent all things considered number of aphid/3 leaves was T1 (5.98) > T4 (6.18) > T3 (6.19) > T6 (6.68) > T2 (7.32) > T7 untreated check (28.32). After 7 DAS, the base aphid population/3 leaves was recorded in the treatment T5 Thiodicarb 75 % WP (0.18 aphid population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The normal number of aphid/3 leaves in different treatments recorded was T1 (0.32) > T3 (0.68) > T4 (0.89) > T6 (1.01) > T2 (1.28) > T7 untreated check (37.18) respectively. After 14 DAS, the pattern of aphid was watched expanding, the least aphid population/3 leaves was recorded in the treatment T5 Thiodicarb 75 % WP (2.00 aphid population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of aphid/3 leaves in different treatments saw as T1 (3.18) > T2 (3.72) > T3 (4.68) > T6 (4.98) > T4 (5.18) > T7 untreated check (45.98).

Results got from normal information of two years showed that every one of the treatments were essentially better over untreated check. Treatment T3 (first spray T3 Thiomethaxon 25% WG and second spray Thiodicarb 75% WP) was recorded least aphid population (9.78) and it was at standard with all other treatment aside from untreated check. The pattern of treatments according to their adequacy to untreated check aphid/3 leaves population was T1 (11.64) trailed by T6, T2, T5, T4 and T7 (Untreated check), respectively (Table 20 and Fig. 25).

4.4.6.1 Efficacy of different treatments against sucking pests of okra during the year 2016

4.4.6.1.1 Whitefly

The data on the efficacy of various treatments in reducing the whitefly population after first and second spraying are furnished in Table 17 and Fig. 20.

4.4.6.1.2 First spray

There was no noteworthy distinction in the whitefly population at one day before burden of various treatments and population was recorded in the scope of 9.22 to 10.80 whitefly/3 leaves. The whitefly population was watched uniform in every one of the treatments previously spray as treatment contrast was non-noteworthy. Every one of the aphid sprays were altogether better than untreated examination to 14 DAS. After 3 DAS, the base whitefly population/3 leaves was recorded in the treatment T1 Clothianidin half WG (2.10 whitefly population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The dropping request of different treatments dependent by and large number of whitefly/3 leaves was T5 (2.16) > T4 (2.18) > T2 (2.93) > T6 (3.20) > T3 (3.22) > T7 untreated check (11.60). At 7 DAS, the least whitefly population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (0.51 whitefly population/3 leaves) among different treatments and it was at standard with all other treatment aside from untreated check. The normal number of whitefly/3 leaves in different treatments was T1 (0.98) > T4 (1.02) > T2 (1.17) > T3 (1.58) > T6 (1.78) > T7 untreated check (12.98). After 14 DAS, the expanding pattern of whitefly population was watched, the base whitefly population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (3.67 whitefly population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The normal number of whitefly/3 leaves in different treatments was recorded as T1 (3.87) > T6 (5.06) > T2 (5.53) > T3 (5.65) > T4 (5.75) > T7 untreated check (15.18).

4.4.6.1.3 Second spray

The whitefly population was uniform in every one of the treatments previously spray as treatment distinction was non-noteworthy. Every one of the aphid sprays were essentially better than untreated examination to 14 DAS. After 3 DAS, the treatment T5 Thiodicarb 75 % WP was recorded least whitefly (1.59 whitefly population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The pattern of viability of different treatments dependent all things considered number of whitefly/3 leaves was T1 (1.79) > T4 (2.49) > T6 (2.87) > T3 (2.88) > T2 (2.93) > T7 untreated check (18.65). After 7 DAS, the base whitefly population/3 leaves was recorded in the treatment T5 Thiodicarb 75 % WP (0.79) whitefly population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of whitefly/3 leaves in different treatments recorded was T1 (0.82) > T2 (1.41) > T4 (1.47) > T3 (1.50) > T6 (1.69) > T7 untreated check (19.77) respectively. At 14 DAS, the pattern of whitefly population was watched expanding, the least whitefly population/3 leaves was recorded in the treatment T5 Thiodicarb 75% WP (1.01 whitefly population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The normal number of whitefly/3 leaves in different treatments saw as T1 (1.87) > T4 (2.00) > T3 (2.01) > T6 (2.21) > T6 (2.40) > T7 untreated check (21.00) respectively.

Results acquired from the normal information of two year demonstrated that every one of the treatments were essentially better over untreated check. Treatment T5 (first spray T5 Spiromesifen 22.9 % SC and second spray Thiodicarb 75% WP) was recorded least whitefly population (3.33) and it was at standard with all other treatment aside from untreated check. The pattern of treatments according to their adequacy to untreated check whitefly/3 leaves population was T2 (4.42) trailed by T1, T4, T3 and T6 and T7 (Untreated check), respectively (Table 19 and Fig. 26).

4.4.7.1 Efficacy of different treatments against sucking pests of okra during the year 2017

4.4.7.1.1 Whitefly

The data on the efficacy of various treatments in reducing the whitefly population after first and second spraying are furnished in Table 18 and Fig. 21.

4.4.7.1.2 First spray

There was no significant distinction in the whitefly population at one day before inconvenience of various treatments and population was recorded in the scope of 7.00 to 8.67 whitefly/3 leaves. The whitefly population was watched uniform in every one of the treatments previously spray. Every one of the aphid sprays were altogether better over untreated examination than 14 DAS. After 3 DAS, the base whitefly population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (1.20 whitefly population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The plummeting request of different treatments dependent overall number of whitefly/3 leaves was T1 (1.58) > T6 (2.18) > T4 (2.68) > T4(2.72) > T2 (3.33) > T7 untreated check (15.68). At 7 DAS, the least whitefly population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (0.22 whitefly population/3 leaves) among different treatments and it was at standard with all other treatment aside from untreated check. The normal number of whitefly/3 leaves in different treatments was T1 (0.38) > T2 (0.90) >T6 (0.98) > T4 (1.15) > T6 (1.68) > T7 untreated check (17.33). After 14 DAS, the expanding pattern of whitefly population was watched, the base whitefly population/3 leaves was recorded in the treatment T5 Spiromesifen 22.9% SC (4.05 whitefly population/3 leaves) among different treatments. Nonetheless, it was at standard with all other treatment aside from untreated check. The normal number of whitefly/3 leaves in different treatments was recorded as T1 (4.32) > T6 (7.68) > T3 (8.92) > T2 (9.22) > T4 (9.28) > T7 untreated check (19.68).

4.4.7.1.3 Second spray

The whitefly population was uniform in every one of the treatments previously spray. Every one of the aphid sprays were fundamentally better over untreated examination than 14 DAS. After 3 DAS, the treatment T5 Thiodicarb 75 % WP SC was recorded least whitefly (0.68 whitefly population/3 leaves) among different treatments. In any case, it was at standard with all other treatment aside from untreated check. The pattern of adequacy of different treatments dependent by and large number of whitefly/3 leaves was T1 (0.98) > T6 (1.33) > T4 (1.62) > T2 (1.68) > T3 (1.98) > T7 untreated check (7.68). At 7 DAS, the base whitefly population/3 leaves was recorded in the treatment T4 Deltamethrin 2.8% EC (0.08 whitefly population/3 leaves) among different treatments. Be that as it may, it was at standard with all other treatment aside from untreated check. The normal number of whitefly/3 leaves in different treatments recorded was T1 (0.11) >T5 (0.33) > T6 (0.33) > T2 (0.68) > T3 (0.72) > T7 untreated check (10.38) respectively. At 14 DAS, the pattern of whitefly population was watched expanding, the least whitefly population/3 leaves was recorded in the treatment T1 Flubendi Duringe 39.35 SC (0.68 whitefly population/3 leaves) among different treatments. Nonetheless, it was at standard with all other treatment aside from untreated check. The normal number of whitefly/3 leaves in different treatments saw as T5 (0.78) > T3 (0.98) > T2 (0.98) > T4 (1.08) > T6 (1.11) > T7 untreated check (11.98) respectively.

Results got from normal information of two year demonstrated that every one of the treatments were fundamentally better over untreated check. Treatment T1 (Clothianidin half WG first spray and second spray T1 Flubendimide 39.35 SC) was recorded least whitefly population (1.87) and it was at standard with all other treatment aside from untreated check. The pattern of treatments according to their viability to untreated check whitefly/3 leaves population was T3 (3.26) trailed by T5, T6, T4, T2 and T7 (Untreated check) respectively (Table 20 and Fig. 27).

Table 13: Efficacy of some insecticide and bio-pesticides against Jassid population recorded at different intervals during the year 2016

S. No.	Treatment	Pre count	Mean reduction of Jassid population days after sprays					
			1st spray			2nd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.35% SC @12 ml / ha	21.21 (4.71)	7.23 (2.86)	2.51 (1.87)	14.92 (3.98)	4.41 (2.34)	2.21 (1.79)	4.11 (2.26)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 170g /ha	22.60 (4.85)	5.41 (2.53)	1.56 (1.60)	10.31 (3.36)	2.14 (1.77)	0.88 (1.37)	3.30 (2.07)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	20.47 (4.63)	7.21 (2.86)	2.58 (1.89)	13.21 (3.76)	3.18 (2.04)	2.43 (1.85)	5.12 (2.47)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC@ 400 ml / ha	22.57 (4.85)	7.54 (2.92)	3.26 (2.06)	14.11 (3.88)	4.03 (2.24)	2.10 (1.76)	5.72 (2.59)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	22.87 (4.88)	6.32 (2.70)	2.12 (1.76)	10.80 (3.43)	2.43 (1.85)	0.90 (1.37)	3.89 (2.21)
T_6	1st spray- Azadirachtin5%@ 500 ml / ha 2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g	21.84 (4.77)	6.32 (2.70)	2.12 (1.76)	13.36 (3.78)	4.17 (2.27)	2.90 (1.97)	6.05 (2.65)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check	21.25 (4.71)	29.58 (5.52)	32.45 (5.78)	35.36 (6.02)	24.73 (5.07)	26.98 (5.28)	28.22 (5.40)

	S.Em.±	0.24	0.19	0.21	0.30	0.25	0.24	0.25
	CD (p=0.05)	0.75	0.57	0.66	0.94	0.77	0.75	0.76

*Figures in parentheses are √n+1 transformed values

Table 14: Efficacy of some insecticide and bio-pesticides against Jassid population recorded at different intervals during the year 2017

S. No.	Treatment	Pre count	Mean reduction of Jassid population days after sprays					
			1st spray			2nd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.35% SC @125 ml / ha	36.67 (6.13)	13.60 (3.82)	5.80 (2.60)	24.66 (5.06)	5.33 (2.51)	1.22 (1.48)	2.38 (1.83)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 170g /ha	37.33 (6.19)	14.80 (3.97)	4.40 (2.32)	21.40 (4.73)	3.98 (2.23)	0.11 (1.05)	0.38 (1.17)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	38.33 (6.27)	13.60 (3.82)	4.20 (2.28)	18.68 (4.43)	4.68 (2.38)	0.22 (1.10)	0.98 (1.40)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC@ 400 ml / ha	39.00 (6.32)	13.28 (3.77)	5.20 (2.48)	12.20 (4.81)	5.72 (2.59)	0.68 (1.29)	1.32 (1.52)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	35.33 (6.02)	15.40 (4.04)	3.80 (2.19)	23.93 (4.99)	4.18 (2.27)	0.98 (1.40)	2.11 (1.76)
T_6	1st spray- Azadirachtin5%@ 500	34.67 (5.97)	14.46 (3.93)	6.80 (2.79)	21.80 (4.77)	6.02 (2.64)	1.18 (1.47)	1.68 (1.63)

	ml / ha 2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g							
T_7	1st spray- Untreated Check 2nd spray- Untreated Check	35.80 (6.06)	57.20 (7.62)	67.22 (8.25)	89.80 (9.50)	31.78 (5.72)	36.98 (6.16)	42.68 (6.60)
	S.Em.±	0.20	0.25	0.32	0.26	0.22	0.27	0.27
	CD (p=0.05)	0.62	0.76	0.99	0.79	0.69	0.83	0.84

*Figures in parentheses are √n+1 transformed values

Table 15: Efficacy of some insecticide and bio-pesticides against Aphid population recorded at different intervals during the year 2016

S. No.	Treatment	Pre count	Mean reduction of Aphid population days after sprays					
			1st spray			2nd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.35% SC @12 ml / ha	18.95 (4.46)	10.60 (3.40)	3.89 (2.21)	12.45 (3.67)	6.94 (2.81)	1.11 (1.45)	3.30 (2.07)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 170g /ha	20.55 (4.53)	12.45 (3.66)	5.58 (2.56)	13.62 (3.82)	8.36 (3.05)	1.66 (1.63)	2.00 (1.73)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	19.47 (4.52)	11.32 (3.50)	5.02 (2.45)	12.36 (3.65)	8.36 (3.05)	2.19 (1.78)	3.60 (2.14)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC@ 400 ml / ha	17.93 (4.35)	10.32 (3.36)	4.18 (2.27)	11.30 (3.50)	8.56 (3.09)	2.80 (1.94)	4.40 (2.32)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	15.88 (4.45)	10.05 (3.32)	3.42 (2.10)	10.54 (3.39)	6.32 (2.70)	0.80 (1.34)	2.90 (1.97)
T_6	1st spray- Azadirachtin5%@ 500 ml / ha 2nd spray- *Verticillium lecani* @ 1x10^8 cfu/ g	18.85 (4.45)	10.85 (3.40)	4.22 (2.28)	12.03 (3.60)	8.25 (3.04)	2.30 (1.81)	4.00 (2.23)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check	19.54 (4.53)	22.60 (4.85)	24.38 (5.03)	27.38 (5.32)	19.22 (4.49)	20.68 (4.65)	21.50 (4.74)

	S.Em.±	0.26	0.42	0.26	0.16	0.23	0.38	0.39
	CD (p=0.05)	0.79	1.31	0.79	0.51	0.71	1.17	1.21

*Figures in parentheses are √n+1 transformed values

Table 16: Efficacy of some insecticide and bio-pesticides against Aphid population recorded at different intervals during the year 2017

S. No.	Treatment	Pre count	Mean reduction of Aphid population days after sprays					
			1st spray			2nd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha	22.80 (4.87)	6.68 (2.77)	5.28 (2.52)	25.87 (5.18)			
	2nd spray- FlubendiDuringe39.35 SC @125 ml / ha					5.98 (2.64)	0.32 (1.14)	3.18 (2.04)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha	22.73 (4.87)	8.33 (3.05)	4.68 (2.38)	24.27 (5.02)			
	2nd spray- Emamectin benzoate5%SG @ 170 /ha					7.32 (2.88)	1.28 (1.50)	3.72 (2.17)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha	17.38 (4.28)	5.47 (2.54)	6.80 (2.79)	23.68 (4.96)			
	2nd spray- Thiodicarb75%WP @1000 g / ha					6.19 (2.68)	0.89 (1.37)	4.68 (2.38)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha	20.20 (4.60)	5.68 (2.58)	4.27 (2.29)	26.68 (5.26)			
	2nd spray- Deltamethrin2.8% EC(400 ml / ha					6.18 (2.67)	0.18 (1.08)	5.18 (2.48)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha	21.93 (4.78)	5.07 (2.46)	3.18 (2.04)	22.27 (4.82)			
	2nd spray- Thiodicarb75%WP @1000 g / ha					4.32 (2.30)	0.68 (1.29)	2.00 (1.73)

T_6	1st spray- Azadirachtin5%@ 500 ml / ha 2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g	19.73 (4.55)	7.22 (2.86)	5.22 (2.49)	24.60 (5.05)	6.68 (2.77)	1.01 (1.41)	4.98 (2.44)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check	26.98 (4.74)	33.52 (6.06)	37.18 (6.57)	45.98 (8.45)	28.32 (5.87)	37.18 (6.17)	45.98 (6.85)
	S.Em.±	0.26	0.16	0.19	0.19	0.14	0.18	0.27
	CD (p=0.05)	0.81	0.50	0.58	0.60	0.43	0.56	0.85

*Figures in parentheses are √n+1 transformed values

Table 17: Efficacy of some insecticide and bio-pesticides against Whitefly population recorded at different intervals during the year 2016

S. No.	Treatment	Pre count	Mean reduction of Whitefly population days after sprays					
			1st spray			2nd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.35 SC @125 ml / ha	10.80 (3.43)	2.10 (1.76)	0.98 (1.40)	3.87 (2.2)	1.79 (1.67)	0.82 (1.34)	1.87 (1.69)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 170 /ha	10.33 (3.36)	2.93 (1.98)	1.17 (1.47)	5.53 (2.55)	2.93 (1.98)	1.41 (1.55)	2.40 (1.84)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	9.77 (3.28)	3.22 (2.05)	1.58 (1.60)	5.65 (2.57)	2.88 (1.96)	1.50 (1.58)	2.01 (1.73)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC(400 ml / ha	9.36 (3.21)	2.18 (1.78)	1.02 (1.42)	5.75 (2.59)	2.49 (1.86)	1.47 (1.57)	2.00 (1.73)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	9.22 (3.19)	2.16 (1.77)	0.51 (1.34)	3.67 (2.16)	1.59 (1.60)	0.79 (1.33)	1.01 (1.41)

T_6	1st spray- Azadirachtin5%@ 500 ml / ha 2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g	10.01 (3.31)	3.20 (2.06)	1.78 (1.66)	5.06 (2.46)	2.87 (1.96)	1.69 (1.64)	2.21 (1.79)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check	9.55 (3.24)	11.6 (3.54)	12.98 (3.73)	15.18 (4.02)	18.65 (4.43)	19.77 (4.55)	21.00 (4.69)
	S.Em.±	0.20	0.34	0.36	0.39	0.29	0.32	0.31
	CD (p=0.05)	0.60	1.03	1.11	1.20	0.89	0.99	0.95

*Figures in parentheses are √n+1 transformed values

Table 18: Efficacy of some insecticide and bio-pesticides against Whitefly population recorded at different intervals during the year 2017

S. No.	Treatment	Pre count	Mean reduction of Whitefly population days after sp					
			1st spray			2nd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.35% SC @125 ml / ha	7.54 (2.92)	1.58 (1.60)	0.38 (1.17)	4.32 (2.30)	0.98 (1.40)	0.11 (1.05)	0 (1
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 170g /ha	7.50 (2.91)	3.33 (2.08)	1.68 (1.63)	9.22 (3.19)	1.68 (1.63)	0.68 (1.29)	0 (1
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / h	8.67 (3.10)	2.68 (1.91)	0.90 (1.37)	8.92 (3.14)	1.98 (1.72)	0.72 (1.31)	0 (1
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC@ 400 ml ha	7.00 (2.82)	2.72 (1.92)	1.11 (1.45)	9.28 (3.20)	1.62 (1.61)	0.08 (1.03)	0 (1
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 g / h	7.50 (2.91)	1.20 (1.48)	0.22 (1.10)	4.05 (2.24)	0.68 (1.29)	0.33 (1.15)	1 (1
T_6	1st spray- Azadirachtin5%@ 500 ml / ha 2nd spray- *Verticillium lecani*@ $1x10^8$ cfu/	8.33 (3.05)	2.18 (1.78)	0.98 (1.40)	7.68 (2.94)	1.33 (1.52)	0.33 (1.15)	1 (1
T_7	1st spray- Untreated Check 2nd spray- Untreated Check	8.17 (3.02)	15.98 (4.12)	17.33 (4.28)	19.68 (4.54)	7.68 (3.31)	10.38 (3.37)	1 (3
	S.Em.±	0.21	0.18	0.29	0.30	0.21	0.27	0
	CD (p=0.05)	0.64	0.57	0.89	0.93	0.66	0.83	0

*Figures in parentheses are √n+1 transformed values

Table 19: Efficacy of some insecticide and bio-pesticides against Jassid, Aphid and Whitefly average population recorded at different intervals during the year 2016

S. No.	Treatment	Average Population of Jassid after		Over all mean Population	Average Population of Aphid after		Over all mean Population	Average Population of White flies after		Over all mean Population
		1st spray	2nd spray		1st spray	2nd spray		1st spray	2nd spray	
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.35% SC @125 ml / ha	11.47 (3.36)	5.69 (2.50)	8.58 (2.93)	11.47 (3.44)	7.19 (2.65)	9.33 (3.05)	4.44 (2.20)	3.06 (1.91)	3.75 (2.06)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 170g /ha	9.97 (3.09)	3.91 (2.10)	6.94 (2.60)	13.05 (3.64)	7.04 (2.64)	10.05 (3.14)	4.99 (2.34)	3.85 (2.12)	4.42 (2.23)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	10.87 (3.29)	5.52 (2.47)	8.20 (2.88)	12.04 (3.53)	7.35 (2.75)	9.70 (3.14)	5.06 (2.38)	3.60 (2.07)	4.33 (2.23)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC@ 400 ml / ha	11.87 (3.43)	6.08 (2.56)	8.98 (3.00)	10.93 (3.37)	8.17 (2.90)	9.55 (3.14)	4.58 (2.25)	3.47 (2.04)	4.03 (2.15)
T_5	1st spray- Spiromesifen 22.9	10.53	4.08 (2.15	7.31 (2.67)	9.97 (3.32	6.56 (2.54	8.27 (2.93)	3.89 (2.12	2.76 (1.82	3.33 (1.97)

	% SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	(3.19)	)		)	)		)	)	
T_6	1st spray- Azadirachtin5%@ 500 ml / ha 2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g	10.91 (3.25)	6.30 (2.63)	8.61 (2.94)	11.49 (3.43)	8.01 (2.85)	9.75 (3.14)	5.01 (2.37)	3.73 (2.10)	4.37 (2.24)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check	29.66 (5.51)	25.22 (5.11)	27.44 (5.31)	23.48 (4.93)	19.71 (4.54)	21.60 (4.74)	12.33 (3.63)	19.03 (4.47)	15.68 (4.05)
	S.Em.±	0.35	0.33	0.34	0.38	0.36	0.37	0.22	0.30	0.26
	CD (p=0.05)	1.05	1.03	1.04	1.16	1.11	1.14	0.68	0.93	0.81

*Figures in parentheses are √n+1 transformed values

Table 20: Efficacy of some insecticide and bio-pesticides against Jassid, Aphid and Whitefly average population recorded at different intervals during the year 2017

S. No.	Treatment	Average Population of Jassid after		Over all mean Population	Average Population of Aphid after		Over all mean Population	Average Population of White flies after		Over all mean Population
		1st spray	2nd spray		1st spray	2nd spray		1st spray	2nd spray	
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe 39.35% SC @125 ml / ha	20.18 (4.40)	7.64 (2.64)	13.91 (3.52)	15.16 (3.84)	8.11 (2.63)	11.64 (3.24)	3.25 (1.94)	0.49 (1.21)	1.87 (1.58)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 170g /ha	19.48 (4.30)	5.42 (2.18)	12.45 (3.24)	14.19 (3.68)	8.75 (2.85)	11.47 (3.27)	5.43 (2.45)	1.05 (1.42)	3.24 (1.94)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	18.70 (4.20)	5.54 (2.26)	12.12 (3.23)	12.08 (3.42)	7.47 (2.64)	9.78 (3.03)	5.29 (2.38)	1.23 (1.48)	3.26 (1.93)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8 % EC@ 400 ml / ha	17.42 (4.35)	6.85 (2.49)	12.14 (3.42)	14.21 (3.68)	8.98 (2.82)	11.60 (3.25)	5.03 (2.35)	0.89 (1.35)	2.96 (1.85)

T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 g / ha	19.62 (4.31)	6.40 (2.46)	13.01 (3.39)	15.19 (3.90)	7.82 (2.70)	11.51 (3.30)	3.45 (2.00)	1.80 (1.33)	2.63 (1.67)
T_6	1st spray- Azadirachtin5% @ 500 ml / ha 2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g	19.43 (4.37)	6.90 (2.55)	13.17 (3.46)	14.19 (3.74)	8.72 (2.86)	11.46 (3.30)	4.79 (2.29)	0.92 (1.37)	2.86 (1.83)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check	62.51 (7.86)	34.31 (5.91)	48.41 (6.89)	35.92 (6.46)	34.62 (6.04)	35.27 (6.25)	15.29 (3.99)	10.01 (3.43)	12.65 (3.71)
	S.Em.±	0.35	0.42	0.39	0.38	0.45	0.42	0.35	0.23	0.29
	CD (p=0.05)	1.07	1.30	1.19	1.17	1.39	1.28	1.07	0.70	0.89

*Figures in parentheses are √n+1 transformed values

Table 21: Efficacy of some insecticide and bio-pesticides against Jassid, Aphid and Whitefly average population recorded at different intervals during the year 2016 and 2017

S.N.	Treatment	Average Population of Jassid after		Over all mean Population	Average Population of Aphid after		Over all mean Population	Average Population of White flies after		Over all mean Population
		1st spray	2nd spray		1st spray	2nd spray		1st spray	2nd spray	
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha	15.83	6.67	11.25	13.32	7.65	10.49	3.85	1.78	2.82
	2nd spray- FlubendiDuringe 39.35% SC @125 ml / ha	(3.88)	(2.57)	(3.23)	(3.64)	(2.64)	(3.14)	(2.07)	(1.56)	(1.82)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha	14.73	4.67	9.70	13.62	7.90	10.76	5.21	2.45	3.83
	2nd spray- Emamectin benzoate 5% SG @ 170g /ha	(3.70)	(2.14)	(2.92)	(3.66)	(2.75)	(3.21)	(2.40)	(1.77)	(2.09)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha	14.79	5.53	10.16	12.06	7.41	9.74	5.18	2.42	3.80
	2nd spray- Thiodicarb 75% WP @1000 g / ha	(3.75)	(2.37)	(3.06)	(3.48)	(2.70)	(3.09)	(2.38)	(1.78)	(2.08)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha	14.65	6.47	10.56	12.57	8.58	10.58	4.81	2.18	3.50
	2nd spray- Deltamethrin 2.8% EC @ 400 ml / ha	(3.89)	(2.53)	(3.21)	(3.53)	(2.86)	(3.20)	(2.30)	(1.70)	(2.00)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha	15.08	5.24	10.16	12.58	7.19	9.89	3.67	2.28	2.98
	2nd spray- Thiodicarb 75% WP @1000 g / ha	(3.75)	(2.31)	(3.03)	(3.61)	(2.62)	(3.12)	(2.06)	(1.58)	(1.82)
T_6	1st spray- Azadirachtin 5% @ 500 ml / ha	15.17	6.60	10.89	12.84	8.37	10.61	4.90	2.33	3.62
	2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g	(3.81)	(2.59)	(3.20)	(3.59)	(2.86)	(3.23)	(2.33)	(1.74)	(2.04)
T_7	1st spray- Untreated Check	46.09	29.77	37.93	29.70	27.17	28.44	13.81	14.52	14.17
	2nd spray- Untreated Check	(6.69)	(5.51)	(6.10)	(5.70)	(5.29)	(5.50)	(3.81)	(3.95)	(3.88)
	S.Em. ±	0.35	0.38	0.37	0.38	0.41	0.40	0.29	0.27	0.28
	CD (p=0.05)	1.06	1.17	1.12	1.17	1.25	1.21	0.88	0.82	0.85

*Figures in parentheses are √n+1 transformed values

4.4.9.1 Efficacy of different treatments against Shoot and fruit borer of okra, during the year 2016

4.4.9.1.1 Number basis

The information on the viability of different treatments in diminishing the Shoot and fruit borer per cent invasion after first, second and third spray are outfitted in Table 22 and Fig. 31.

4.4.9.1.2 First spray

There was no huge contrast in the per cent Shoot and fruit borer per cent pervasion on one day before inconvenience of various treatments and invasion was recorded in the scope of 28.80 to 34.57 per cent Shoot and fruit borer per cent pervasion. The per cent Shoot and fruit borer per cent pervasion was watched uniform in every one of the treatments previously spray. Every one of the aphid sprays were fundamentally better than untreated examination to 14 DAS. After 3 DAS, the base Shoot and fruit borer per cent invasion was recorded in the treatment T1 Clothianidin half WG (21.09 per cent) among different treatments. The treatment T5 and T2 (22.50 per cent) was the following best treatment pursued by T4, T3, T6 and untreated check to limit Shoot and fruit borer per cent invasion. At 7 DAS, the least Shoot and fruit borer per cent pervasion was recorded in the treatment T5 Spiromesifen 22.9% SC (14.51 per cent) among different treatments. The treatment T1 (14.62 per cent) was the second best treatment pursued by T2 (16.55 per cent), T4, T3, T6 and untreated check to limit Shoot and fruit borer per cent invasion. At 14 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Spiromesifen 22.9% SC (16.47 per cent) among different treatments. The treatment T1 (17.33 per cent) was the second best treatment pursued by T2 (18.87 per cent), T4, T3, T6 and untreated check to limit Shoot and fruit borer per cent invasion.

4.4.9.1.3 Second spray

The Shoot and fruit borer per cent invasion was uniform in every one of the treatments previously spray. Every one of the aphid sprays were altogether better than untreated examination to 14 DAS. After 3 DAS, the treatment T5 Thiodicarb 75% WP was recorded least Shoot and fruit borer per cent pervasion (10.81 per cent) among different treatments and it was at standard with treatment T1 (11.74 per cent). The following best treatment was T2 (12.34 per cent) trailed by T4, T3, T6 and untreated check to limit the Shoot and fruit borer per cent pervasion. At 7 DAS, the least Shoot and fruit borer per cent pervasion was recorded in the treatment T5 Thiodicarb 75% WP (6.16 per cent) among different treatments. The treatment T1 (6.63 per cent) was the second best treatment pursued by T2 (7.39 per cent), T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent invasion. At 14 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Thiodicarb 75% WP (7.39 per cent) among different treatments and it was at standard with treatment T1 (8.33 per cent). The following best treatment was T2 (9.11 per cent) trailed by T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent invasion.

4.4.9.1.4 Third spray

The Shoot and fruit borer per cent pervasion was uniform in every one of the treatments previously spray. Every one of the aphid sprays were altogether better than untreated examination to 14 DAS. After 3 DAS, the treatment T5 Emamectin Benzoate 5% SG was recorded least Shoot and fruit borer per cent pervasion (6.16 per cent) among different treatments and it was at standard with treatment T1 (6.63 per cent). The following best treatment was T2 (7.39 per cent) trailed by T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent invasion. At 7 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Emamectin Benzoate 5% SG (4.38 per cent) among different treatments and it was at standard with the treatment T1 (4.45 per cent). The following best treatment was T2 (6.16 per cent) trailed by T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent invasion. At 14 DAS, the least Shoot and fruit borer per cent pervasion was recorded in the treatment T1 Azadiractin (6.63 per cent) among different treatments and it was at standard with treatment T5 (7.39 per cent). The following best treatment was T2 (8.33 per cent) trailed by T3 (9.38 per cent) was at standard, T4, T6 and untreated check to limit Shoot and fruit borer per cent pervasion.

Results acquired from normal information of two years showed that every one of the treatments were essentially better over untreated check. Treatment T5 (Spiromesifen 22.9 % SC first spray, second spray Thiodicarb 75% WP and third spray Emamectin benzoate 5 % SG) was recorded least Shoot and fruit borer per cent invasion and it was at standard with all other treatment aside from untreated check. The pattern of treatments according to their adequacy to untreated check Shoot borer pervasion. Shoot and fruit borer per cent invasion was T1 (14.80) trailed by T2, T4, T3, T6 and T7 (Untreated check), respectively (Table 26 and Fig. 14).

4.4.10.1 Efficacy of different treatments against Shoot and fruit borer of okra

4.4.10.1.1 Weight Basis (2016)

The information on the adequacy of different treatments in lessening the Shoot and fruit borer per cent invasion after first and second spraying are outfitted in Table 23 and Fig. 32.

4.4.10.1.2 First spray

There was no huge contrast in the per cent Shoot and fruit borer per cent pervasion at one day before before inconvenience of various treatments and invasion was recorded in the scope of 30.91 to 36.68 per cent Shoot and fruit borer per cent invasion. The per cent Shoot and fruit borer per cent invasion was watched uniform in every one of the treatments previously spray as treatment distinction was non-significant. Every one of the aphid sprays were fundamentally better than untreated examination to 14 DAS. After 3 DAS, the base Shoot and fruit borer per cent invasion was recorded in the treatment T1 Clothianidin half WG (24.09 per cent) among different treatments. The treatment T5 (25.20 per cent) was the second best treatment pursued by T3 (25.48 per cent), T2 (26.14 per cent) was at standard, T6, T4 and untreated check to limit Shoot and fruit borer per cent pervasion. At 7 DAS, the least Shoot and fruit borer per cent invasion/3 leaves was recorded in the treatment T5 Spiromesifen 22.9 % SC (16.42 Shoot and fruit borer per cent pervasion/3 leaves) among different treatments and it was at standard with all other treatment aside from untreated check. The normal number of Shoot and fruit borer per cent invasion/3 leaves in different treatments was T1 (18.30) > T2 (19.68) > T3 (21.91) > T4 (24.82) > T6 (25.34) > T7 untreated check (39.67). At 14 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Spiromesifen 22.9 % SC (19.34 per cent) among different treatments. The treatment T1 (20.85 per cent) was the second best treatment pursued by T2 (21.23 per cent), T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent invasion.

4.4.10.1.3 Second spray

The Shoot and fruit borer per cent invasion was uniform in every one of the treatments previously spray as treatment contrast was non-significant. Every one of the aphid sprays were altogether better than untreated examination to 14 DAS. After 3 DAS, the treatment T5 Thiodicarb 75% WP was recorded least Shoot and fruit borer per cent pervasion (15.68 per cent) among different treatments and it was at standard with treatment T1 (16.42 per cent). The following best treatment was T2 (17.25 per cent) trailed by T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent pervasion. At 7 DAS, the least Shoot and fruit borer per cent pervasion was recorded in the treatment T5 Thiodicarb 75% WP (10.87 per cent) among different treatments. The treatment T1 (12.80 per cent) was the second best treatment pursued by T2 (14.44 per cent), T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent invasion. At 14 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Thiodicarb 75% WP (11.10 per cent) among different treatments. The treatment T1 (13.56 per cent) was the second best treatment pursued by T2 (15.25 per cent), T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent pervasion.

4.4.10.1.4 Third spray

The Shoot and fruit borer per cent invasion was uniform in every one of the treatments previously spray as treatment distinction was non-huge. Every one of the aphid sprays were essentially better than untreated examination to 14 DAS. After 3 DAS, the treatment T5 Emamectin Benzoate 5% SG was recorded least Shoot and fruit borer per cent pervasion (7.81 per cent) among different treatments. The treatment T1 (9.87 per cent) was the second best treatment pursued by T2 (14.05 per cent), T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent pervasion. At 7 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Emamectin Benzoate 5% SG (5.08 per cent) among different treatments. The treatment T1 (6.32 per cent) was the second best treatment pursued by T2 (10.65 per cent), T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent pervasion. At 14 DAS, the least Shoot and fruit borer per cent pervasion was recorded in the treatment T5 Emamectin Benzoate 5% SG (3.48 per cent) among different treatments. The treatment T1 (4.71 per cent) was the second best treatment pursued by T2 (7.81 per cent), T3, T4, T6 and untreated check to limit Shoot and fruit borer per cent invasion.

Results got from normal information of two years showed that every one of the treatments were essentially better over untreated check. Treatment T1 (Clothianidin half WG first spray and second spray T1 Flubendimide 39.35 SC) was recorded least fruit borer per cent pervasion and it was at standard with all other treatment aside from untreated check. The pattern of treatments according to their viability to untreated check fruit borer per cent invasion pursued by T4, T6, T2 and T7 (Untreated check), respectively (Table 26 and Fig. 35).

4.4.11.1 Efficacy of different treatments against Shoot and fruit borer of okra during the year 2017

4.4.11.1.1 Number Basis

The information on the adequacy of different treatments in decreasing the Shoot and fruit borer per cent pervasion after first and second spraying are outfitted in Table 24 and Fig. 33.

4.4.11.1.2 First spray

There was no huge contrast in the per cent Shoot and fruit borer per cent invasion at one day before burden of various treatments and pervasion was recorded in the scope of 30.05 to 34.01 per cent Shoot and fruit borer per cent pervasion. The per cent Shoot and fruit borer per cent pervasion was watched uniform in every one of the treatments previously spray as treatment distinction was non-significant. Every one of the aphid sprays were altogether better than untreated examination to 14 DAS. After 3 DAS, the base Shoot and fruit borer per cent invasion was recorded in the treatment T4 Tolfenpyrad 15% EC (24.50 per cent) among different treatments and it was at standard with treatment T1 (25.40 per cent). The following best treatment was T5 (25.66 per cent), T3 (26.20 per cent) trailed by T6, T2 and untreated check to limit Shoot and fruit borer per cent pervasion. At 7 DAS, the least Shoot and fruit borer per cent pervasion was recorded in the treatment T1 Clothianidin 50 %WG (20.04 per cent) Shoot and fruit borer per cent invasion among different treatments and it was at standard with all other treatment aside from untreated check; the normal number of Shoot and fruit borer per cent invasion/3 leaves in different treatments was T5 (20.48) > T3 (22.50) > T6 (23.42) > T2 (23.50) > T4 (25.91) > T7 untreated check (35.00). At 14 DAS, the least Shoot and fruit borer per cent pervasion was recorded in the treatment T5 Spiromesifen 22.9% SC (21.10 per cent) among different treatments. The treatment T1 (21.34 per cent) was the second best treatment pursued by T4 (22.81 per cent), T3, T6, T2 and untreated check to limit Shoot and fruit borer per cent invasion among different treatments and it was at standard with all other treatment aside from untreated check.

4.4.11.1.3 Second spray

The Shoot and fruit borer per cent pervasion was uniform in every one of the treatments previously spray as treatment contrast was non-huge. Every one of the aphid sprays were fundamentally better than untreated examination to 14 DAS. After 3 DAS, the treatment T5 Thiodicarb 75% WP was recorded least Shoot and fruit borer per cent pervasion (12.11 per cent) among different treatments. The treatment T1 (12.77 per cent) was the second best treatment pursued by T2 (16.75 per cent), T4, T6, T3 and untreated check to limit Shoot and fruit borer per cent pervasion. At 7 DAS, the least Shoot and fruit borer per cent pervasion was recorded in the treatment T5 Thiodicarb 75% WP (10.00 per cent) among different treatments. The treatment T2 (14.02 per cent) was the second best treatment pursued by T1 (14.22 per cent), T6, T4, T3 and untreated check to limit Shoot and fruit borer per cent pervasion. At 14 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Thiodicarb 75% WP (12.25 per cent) among different treatments. The treatment T2 (16.25 per cent) was the second best treatment pursued by T1 (16.67 per cent), T6, T3, T4 and untreated check to limit Shoot and fruit borer per cent invasion.

4.4.11.1.4 Third spray

The Shoot and fruit borer per cent pervasion was uniform in every one of the treatments previously spray as treatment distinction was non-significant. Every one of the aphid sprays were fundamentally better than untreated examination to 14 DAS. After 3 DAS, the treatment T5 Emamectin Benzoate 5% SG was recorded least Shoot and fruit borer per cent pervasion (7.92 per cent) among different treatments. The treatment T1 (10.00 per cent) was the second best treatment pursued by T2 (11.81 per cent), T6, T3, T4 and untreated check to limit Shoot and fruit borer per cent invasion. At 7 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Emamectin Benzoate 5% SG (4.45 per cent) among different treatments. The treatment T5 (6.16 per cent) was the second best treatment pursued by T1 (7.39 per cent), T6, T3, T4 and untreated check to limit Shoot and fruit borer per cent pervasion. At 14 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Emamectin Benzoate 5% SG (6.16 per cent) among different treatments. The treatment T1 (7.39 per cent) was the second best treatment pursued by T2 (9.11 per cent), T6, T3, T4 and untreated check to limit Shoot and fruit borer per cent pervasion.

Results acquired from normal information of two years demonstrated that every one of the treatments were altogether better over untreated check. Treatment T5 (Spiromesifen 22.9% SC first spray and second spray Thiodicarb 75 % WP and third spray Emamectin Benzoate 5% SG) was recorded least fruit borer per cent invasion (14.03) and it was at standard with all other treatment aside from untreated check. The pattern of treatments according to their adequacy to untreated check Shoot and fruit borer per cent pervasion (Table 26 and Fig. 14).

4.4.12.1 Efficacy of different treatments against Shoot and fruit borer of okra 2017

4.4.12.1.1 Weight Basis

The information on the viability of different treatments in lessening the Shoot and fruit borer per cent invasion after first and second spraying are outfitted in Table 25 and Fig. 34.

4.4.12.1.2 First spray

There was no significant contrast in the per cent Shoot and fruit borer per cent pervasion on one day before before burden of various treatments and invasion was recorded in the scope of 33.85 to 38.16 per cent Shoot and fruit borer per cent infestationThe per cent Shoot and fruit borer per cent pervasion was watched uniform in every one of the treatments previously spray. Every one of the aphid sprays were altogether better than untreated examination to 14 DAS. After 3 DAS, the base Shoot and fruit borer per cent pervasion was recorded in the treatment T1 Clothianidine half WG (21.61 per cent) and it was at standard with the treatment T5 (22.44 per cent) and the following treatment was T4 (25.66 per cent) trailed by T2, T6, T3 and untreated check to limit Shoot and fruit borer per cent invasion. At 7 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T1 Clothianidin 50 % WG (17.33 per cent) among different treatments. The treatment T5 (18.71 per cent) was the second best treatment pursued by T4 (21.09 per cent), T2, T6, T3 and untreated check to limit Shoot and fruit borer per cent pervasion. At 14 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T1 Clothianidin 50 % WG (18.45 per cent) among different treatments and it was at standard with the treatment T5 (19.05 per cent). The following best treatment T4 (22.61 per cent) trailed by T2, T6, T3 and untreated check to limit Shoot and fruit borer per cent invasion.

4.4.12.1.3 Second spray

The Shoot and fruit borer per cent infestation was uniform in every one of the treatments previously spray as treatment contrast was non-noteworthy. Every one of the aphid sprays were altogether better than untreated examination to 14 DAS. After 3 DAS, the treatment T1 Flubendimide 39.35% SC was recorded least Shoot and fruit borer per cent invasion (12.11 per cent) among different treatments. The treatment T5 (12.77 per cent) was the second best treatment pursued by T4 (16.25 per cent), T6, T2, T3 and untreated check to limit Shoot and fruit borer per cent invasion. At 7 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T1 FlubendiDuringe 39.35% SC (8.33 per cent) among different treatments. The treatment T5 (9.11 per cent) was the second best treatment pursued by T6 (14.11 per cent), T4, T3, T2 and untreated check to limit Shoot and fruit borer per cent invasion. At 14 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T1 FlubendiDuringe 39.35% SC (9.15 per cent) among different treatments and it was at standard with the treatment T5 (10.00 per cent). The following best treatment was T3 (14.22 per cent) trailed by T4, T6, T2 and untreated check to limit Shoot and fruit borer per cent pervasion.

4.4.12.1.4 Third spray

The Shoot and fruit borer per cent pervasion was uniform in every one of the treatments previously spray. Every one of the aphid sprays were essentially better than untreated examination to 14 DAS. After 3 DAS, the treatment T1 Azadirachtin 5% was recorded least Shoot and fruit borer per cent pervasion (6.63 per cent) among different treatment and it was at standard with the treatment T5 (7.39 per cent). The following best treatment was T3 (11.31 per cent) trailed by T4, T6, T2 and untreated check to limit Shoot and fruit borer per cent invasion. At 7 DAS, the least Shoot and fruit borer per cent pervasion was recorded in the treatment T1 Azadirachtin 5% (4.45 per cent) among different treatments. The treatment T5 (6.63 per cent) was the second best treatment pursued by T3 (10.00 per cent), T4, T6, T2 and untreated check to limit Shoot and fruit borer per cent invasion. At 14 DAS, the least Shoot and fruit borer per cent invasion was recorded in the treatment T5 Emamectin Benzoate 5% SG (6.16 per cent) among different treatments. The treatment T1 (7.90 per cent) was the second best treatment pursued by T6 (11.31 per cent), T3, T4, T2 and untreated check to limit Shoot and fruit borer per cent invasion.

Results acquired from normal information of two years showed that every one of the treatments were fundamentally better over untreated check. Treatment T5 (Spiromesifen 22.9 % SC first spray and second spray Thiodicarb 75 % WP and third spray Emamectin Benzoate 5% SG) was recorded least fruit borer per cent pervasion (14.03) and it was at standard with all other treatment aside from untreated check (Table 26 and Fig. 35).

4.5 Yield of marketable Okra

The pooled information of summer 2016 on yield of attractive Okra uncovered that all the insecticidal treatments demonstrated fundamentally better than untreated check in creating attractive okra yield. Among different treatments, T5 (first spray Spiromesifen 22.9% SC @ 500 ml/ha, second spray Thiodicarb 75%WP @1000 g/ha, third spray Emamectin benzoate5%SG @ 170g/ha) recorded the most noteworthy yield (4085 kg ha1) and demonstrated better over rest of the treatments. The second best treatment was T1 (first spray Clothianidin half WG @ 60 g/ha, second spray FlubendiDuringe 39.35% SC @125 ml/ha, third spray Azadirachtin5%@ 500 ml/ha) which gave 3800 kg ha1 Okra yield, trailed by Treatment T3 (first spray Thiamethoxam 25 %WG @ 100 g/ha, second spray Thiodicarb75%WP @1000 g/ha, third spray B.t..@ 500 g/ha) (3768 kg/ha) and T4 (first spray Tolfenpyrad 15% EC @1000 ml/ha, second spray Deltamethrin 2.8% EC@ 400 ml/ha, third spray Beauveria bassiana @ 1x108 cfu/g) (3524 kg/ha). The most reduced fruit yield was recorded in T7 (first spray Untreated Check, second spray Untreated Check, third spray Untreated Check) (2080 kg/ha) (Table - 27 and Fig. 36).

The pooled information of summer 2017 on yield of attractive Okra uncovered that all the insecticidal treatments demonstrated essentially better than untreated check in creating attractive Okra yield. Among different treatments, T5 (first spray Spiromesifen 22.9% SC @ 500 ml/ha, second spray Thiodicarb 75%WP @1000 g/ha, third spray Emamectin benzoate 5% SG @ 170g/ha) recorded the most noteworthy yield (4503 kg ha1) and demonstrated better over rest of the treatments. The second best treatment was T1 (first spray Clothianidin 50 % WG @ 60 g/ha, second spray FlubendiDuringe39.35% SC @125 ml/ha, third spray Azadirachtin5%@ 500 ml/ha) which gave 4215 kg ha1 Okra yield, trailed by Treatment T3 (first spray Thiamethoxam 25 %WG @ 100 g/ha, second spray Thiodicarb75%WP @1000 g/ha, third spray B.t..@ 500 g/ha) (3960 kg/ha) and T4 (first spray Tolfenpyrad 15% EC @1000 ml/ha, second spray Deltamethrin 2.8% EC@ 400 ml/ha, third spray Beauveria bassiana @ 1x108 cfu/g) (3865 kg/ha). The least fruit yield was recorded in T7 (first spray Untreated Check, second spray Untreated Check, third spray Untreated Check) (2412 kg/ha). In view of the normal information of two years the treatment T5 (first spray Spiromesifen 22.9 % SC @ 500 ml/ha, second spray Thiodicarb 75%WP @1000 g/ha, third spray Emamectin benzoate 5%SG @ 170 g/ha) recorded the most astounding yield (4294 kg ha1) trailed by T1 (first spray Clothianidin 50 % WG @ 60 g/ha, second spray FlubendiDuringe39.35% SC @125 ml/ha, third spray Azadirachtin5% @ 500 ml/ha) which gave 4008 kg ha1 Okra yield and T3 (first spray Thiamethoxam 25 %WG @ 100 g/ha, second spray Thiodicarb75%WP @1000 g/ha, third spray B.t. @ 500 g/ha) (3864 kg/ha) (Table - 27 and Fig. 36).

Table 22: Efficacy of some insecticide and bio-pesticides against okra Shoot and fruit borer, *E. vittella* recorded at different intervals on Number basis year 2016

S. No.	Treatment	Pre count	Mean reduction of okra Shoot and Fruit (%) days after sprays								
			1st spray			2nd spray			3rd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.35 % SC @125 ml / ha 3rd spray- Azadirachtin5%@ 500 ml / ha	30.73 (33.65)	21.09 (27.28)	14.62 (22.38)	17.33 (24.58)	11.74 (20.00)	6.63 (14.89)	8.33 (16.74)	6.63 (14.54)	4.45 (12.11)	6.63 (16.89)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 170g /ha 3rd spray- *B.t.*@ 1kg/ ha	29.41 (32.83)	22.50 (28.32)	16.55 (23.97)	18.87 (25.70)	12.34 (20.53)	7.39 (15.68)	9.11 (17.56)	7.39 (15.68)	6.16 (14.30)	8.33 (16.74)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / ha 3rd spray- *B.t.*.@ 500 g/ ha	29.80 (33.09)	25.48 (30.26)	17.50 (24.73)	19.66 (26.28)	13.53 (21.56)	8.33 (16.74)	9.15 (17.56)	7.39 (15.68)	6.63 (14.89)	9.38 (17.76)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC@ 400 ml / ha 3rd spray- *Beauveria bassiana*@ 1x10^8 cfu/ g	30.00 (33.21)	24.42 (29.60)	17.30 (24.58)	19.34 (26.06)	13.05 (21.13)	9.11 (17.56)	10.00 (18.44)	8.68 (17.05)	7.16 (15.45)	9.57 (17.97)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500	28.80 (32.46	22.50 (28.32	14.51 (22.38	16.47 (23.89	10.81 (19.19	6.16 (14.30	7.39 (15.68	6.16 (14.30	4.38 (11.97	7.39 (15.68

	ml/ha 2nd spray- Thiodicarb75%WP @1000 g / ha 3rd spray- Emamectin benzoate5%SG @ 170g /ha	)	)	)	)	)	)	)	)	)	)
T_6	1st spray- Azadirachtin5%@ 500 ml / ha 2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g 3rd spray- *B.t.*.@ 500 g/ ha	34.57 (35.97)	27.20 (31.44)	19.66 (26.28)	21.04 (27.28)	14.51 (22.38)	10.00 (18.44)	12.25 (20.44)	10.00 (18.44)	8.33 (16.74)	10.38 (18.72)
T_7	1st spray- Untreated Check 2nd spray- Untreated Check 3rd spray- Untreated Check	31.16 (33.89)	32.55 (34.76)	33.68 (35.43)	36.04 (36.87)	36.68 (37.23)	36.55 (37.17)	36.20 (36.99)	35.30 (36.45)	35.68 (36.63)	36.20 (36.99)
	S.Em.±	0.34	0.32	0.42	0.31	0.23	0.41	0.18	0.26	0.22	0.28
	CD (p=0.05)	1.05	0.98	1.30	0.97	0.72	1.27	0.56	0.80	0.68	0.88

*Figures in parentheses are arcsine transformed values

Table 23: Efficacy of some insecticide and bio-pesticides against okra Shoot and fruit borer, *E. vittella* recorded at different intervals on Weight basis year 2016

S. No.	Treatment	Pre count	Mean reduction of okra Shoot and Fruit (%) days after sprays								
			1st spray			2nd spray			3rd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.35 SC @125 ml / ha 3rd spray- Azadirachtin5%@ 500 / ha	31.31 (34.02)	24.09 (29.33)	18.30 (25.33)	20.85 (27.13)	16.42 (23.89)	12.80 (20.96)	13.56 (21.56)	9.87 (18.24)	6.32 (14.54)	4.71 (12.52)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 170 /ha 3rd spray- *B.t.*@ 1kg/ h	32.82 (34.94)	26.14 (30.72)	19.68 (26.42)	21.23 (27.42)	17.25 (24.50)	14.44 (22.30)	15.25 (22.95)	14.05 (21.97)	10.65 (19.00)	7.81 (16.22)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / ha 3rd spray- *B.t.*.@ 500 g ha	30.91 (33.77)	25.48 (30.26)	21.91 (27.90)	24.55 (29.67)	20.85 (27.13)	17.25 (24.50)	19.75 (26.35)	16.31 (23.81)	12.15 (20.36)	10.65 (19.00)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC@ 400 ml / ha 3rd spray- *Beauveria bassiana*@ 1x10[8] cfu/	36.68 (37.23)	31.64 (34.20)	24.82 (29.87)	25.34 (37.23)	21.24 (27.42)	18.30 (25.33)	20.31 (26.78)	17.70 (24.88)	13.39 (21.30)	10.81 (19.19)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 g / ha 3rd spray- Emamectin benzoate5%SG @ 170 /ha	32.12 (34.51)	25.20 (30.13)	16.42 (23.89)	19.34 (26.06)	15.68 (23.26)	10.87 (19.19)	11.10 (19.46)	7.81 (16.22)	5.08 (12.92)	3.48 (10.63)
T_6	1st spray- Azadirachtin5%@ 500 / ha	36.31 (37.05)	30.01 (33.21)	25.34 (30.20)	28.81 (32.46)	23.06 (28.66)	20.31 (26.78)	23.10 (28.73)	19.85 (26.28)	14.29 (22.14)	11.78 (20.00)

	2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g 3rd spray- *B.t.*.@ 500 g/ ha										
T_7	1st spray- Untreated Check 2nd spray- Untreated Check 3rd spray- Untreated Check	34.73 (36.09)	35.35 (36.45)	39.67 (39.00)	44.19 (41.55)	42.55 (40.69)	42.98 (40.92)	41.24 (39.93)	38.67 (38.41)	38.06 (38.06)	39.06 (38.65)
	S.Em.±	0.37	0.58	0.41	0.31	0.24	0.29	0.42	0.41	0.37	0.27
	CD (p=0.05)	1.13	1.78	1.27	0.95	0.73	0.90	1.29	1.26	1.15	0.84

*Figures in parentheses are arcsine transformed values

Table 24: Efficacy of some insecticide and bio-pesticides against okra Shoot and fruit borer, *E. vittella* recorded at different intervals on Number basis year 2017

S. No.	Treatment	Pre count	Mean reduction of okra Shoot and Fruit (%) days after sprays								
			1st spray			2nd spray			3rd spray		
			3rd*DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.3 SC @125 ml / ha 3rd spray- Azadirachtin5%@ 50 ml / ha	32.82 (34.94)	25.40 (30.26)	20.04 (26.56)	21.34 (27.49)	12.77 (20.88)	14.22 (22.14)	16.67 (24.04)	10.00 (18.44)	6.16 (14.30)	7.39 (15.68)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%SG @ 17 /ha 3rd spray- *B.t.*@ 1kg/	34.01 (35.73)	27.81 (31.82)	23.50 (29.00)	25.63 (30.40)	16.75 (24.12)	14.02 (21.97)	16.25 (23.73)	11.81 (20.09)	7.39 (15.8)	9.11 (17.56)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 g / ha 3rd spray- *B.t.*.@ 500 ha	31.06 (33.83)	26.20 (30.79)	22.50 (28.32)	24.48 (29.60)	18.14 (25.18)	16.67 (24.04)	19.09 (25.84)	13.05 (21.13)	9.11 (17.56)	10.00 (18.44)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC 400 ml / ha 3rd spray- *Beauveria bassiana*@ 1x10^8 cfu	30.05 (33.21)	24.50 (29.67)	25.91 (27.90)	22.81 (28.52)	17.04 (24.35)	16.25 (23.73)	19.25 (25.99)	13.24 (21.30)	9.15 (17.56)	10.36 (18.72)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 g / ha 3rd spray- Emamectin benzoate5%SG @ 17 /ha	31.26 (33.96)	25.66 (30.40)	20.48 (26.85)	21.10 (27.35)	12.11 (20.36)	10.00 (18.44)	12.25 (20.44)	7.92 (16.32)	4.45 (12.11)	6.16 (14.30)
T_6	1st spray- Azadirachtin5%@ 50	33.06 (35.06)	27.21 (31.44)	23.42 (28.93)	24.54 (29.67)	17.31 (24.58)	16.23 (23.73)	18.82 (25.70)	12.25 (20.44)	8.76 (17.16)	9.15 (17.56)

	ml / ha 2nd spray- *Verticillium lecani*@ 1x10^8 cfu/ g 3rd spray- *B.t.*.@ 500 ha										
T_7	1st spray- Untreated Check 2nd spray- Untreated Check 3rd spray- Untreated Check	33.12 (35.12)	34.68 (36.03)	35.00 (36.27)	35.68 (36.63)	36.36 (37.05)	37.02 (37.47)	37.84 (37.94)	37.67 (37.82)	36.36 (37.05)	36.20 (36.99)
	S.Em.±	0.08	0.37	1.00	0.88	0.06	0.12	0.12	0.08	0.40	0.12
	CD (p=0.05)	0.26	1.13	3.07	2.72	0.17	0.37	0.37	0.25	1.23	0.37

*Figures in parentheses are arcsine transformed values

Table 25: Efficacy of some insecticide and bio-pesticides against okra Shoot and fruit borer, *E. vittella* recorded at different intervals on Weight basis year 2017

S. No.	Treatment	Pre count	Mean reduction of okra Shoot and fruit (%) days after sprays								
			1st spray			2nd spray			3rd spray		
			3rd* DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS	3rd DAS	7th DAS	14th DAS
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spr FlubendiDuringe39.3 SC @125 ml / ha 3rd spr Azadirachtin5%@ ml / ha	33.85 (35.55)	21.61 (27.69)	17.33 (24.58)	18.45 (25.40)	12.11 (20.36)	8.33 (6.74)	9.15 (17.56)	6.63 (14.89)	4.45 (12.11)	6.16 (14.30)
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emame benzoate5%SG @ 1 /ha 3rd spray- *B.t.*@ 1kg/	34.27 (35.79)	26.29 (32.71)	21.31 (27.49)	22.90 (28.59)	17.65 (24.80)	15.50 (23.19)	16.67 (24.04)	12.67 (20.79)	11.56 (19.82)	12.02 (20.44)
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spr Thiodicarb75%WP @1000 g / ha 3rd spray- *B.t.*.@ 500 ha	37.29 (37.58)	29.17 (32.65)	24.27 (29.47)	25.66 (30.40)	18.75 (25.62)	15.00 (22.79)	14.22 (22.14)	11.31 (19.64)	10.00 (18.44)	11.56 (19.82)
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spr Deltamethrin2.8% E 400 ml / ha 3rd spray- *Beauve bassiana*@ 1x10^8 cfu	36.96 (37.41)	25.66 (30.40)	21.09 (27.28)	22.61 (28.38)	16.25 (23.73)	14.22 (22.14)	15.50 (23.19)	12.02 (20.27)	10.64 (19.00)	11.76 (20.00)
T_5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spr Thiodicarb75%WP @1000 g / ha 3rd spray- Emame benzoate5%SG @ 1 /ha	35.91 (36.81)	22.44 (28.25)	18.71 (25.62)	19.05 (25.84)	12.77 (20.88)	9.11 (17.56)	10.00 (18.44)	7.39 (15.68)	6.63 (14.89)	7.90 (16.32)
T_6	1st spr Azadirachtin5%@	38.16 (38.12)	26.32 (30.85)	22.50 (28.32)	23.17 (28.73)	16.67 (24.04)	14.11 (22.06)	16.25 (23.73)	12.25 (20.44)	10.90 (19.28)	11.31 (19.64)

	ml / ha 2nd spray- *Verticilli lecani*@ 1x10^8 cfu/g 3rd spray- *B.t.*.@ 500 ha										
T_7	1st spray- Untreated Check 2nd spray- Untreated Check 3rd spray- Untreated Check	36.04 (36.87)	35.00 (36.27)	36.55 (37.17)	36.73 (37.29)	36.36 (37.05)	36.84 (37.35)	37.47 (37.70)	36.84 (37.35)	26.26 (37.05)	36.20 (36.99)
	S.Em.±	0.33	0.23	0.28	0.53	0.12	0.08	0.38	0.45	0.12	0.10
	CD (p=0.05)	1.03	0.70	0.86	1.65	0.35	0.24	1.18	1.38	0.36	0.30

*Figures in parentheses are arcsine transformed values

Table 26: Efficacy of some insecticide and bio-pesticides against okra Shoot and fruit borer, *E. vittella* recorded at different intervals on Weight basis and Number basis 2016 and 2017

S. No.	Treatment	Per cent infestation Shoot and fruit borer (Weight basis)			Over all mean Population	Per cent infestation Shoot and fruit borer (Number basis)			Over all mean Population
		1st spray	2nd spray	3rd spray		1st spray	2nd spray	3rd spray	
T_1	1st spray- Clothianidin 50 % WG @ 60 g/ha	23.23	13.96	7.61	14.93	22.49	13.63	8.29	14.80
	2nd spray- FlubendiDuringe 39.35% SC @125 ml / ha	(28.63)	(20.46)	(15.72)	(21.60)	(28.13)	(21.35)	(16.60)	(22.03)
	3rd spray- Azadirachtin 5% @ 500 ml / ha								
T_2	1st spray- FlonicDuring 50 % WG @ 150 g/ha	25.58	17.61	12.59	18.59	24.79	15.05	9.45	16.43
	2nd spray- Emamectin benzoate 5% SG @ 170g /ha	(30.52)	(24.73)	(20.66)	(25.30)	(29.73)	(22.47)	(17.69)	(23.30)
	3rd spray- *B.t.*@ 1kg/ ha								
T_3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha	27.41	19.51	13.25	20.06	24.59	16.14	10.48	17.07
	2nd spray- Thiodicarb 75% WP @1000 g / ha	(31.47)	(26.08)	(21.20)	(26.25)	(29.62)	(23.36)	(18.61)	(23.86)
	3rd spray- *B.t.*.@ 500 g/ ha								
T_4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha	28.10	19.23	14.02	20.45	24.30	15.86	10.93	17.03
	2nd spray- Deltamethrin 2.8% EC @ 400 ml / ha	(32.75)	(25.90)	(21.83)	(26.83)	(29.10)	(23.23)	(19.06)	(23.80)
	3rd spray- *Beauveria bassiana*@								

	1x10^8 cfu/ g								
T_5	1st spray-Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray-Thiodicarb 75% WP @1000 g / ha 3rd spray-Emamectin benzoate 5% SG @ 170g /ha	23.65 (28.89)	13.49 (21.34)	7.43 (15.57)	14.86 (21.93)	23.04 (28.48)	12.04 (19.96)	7.02 (15.10)	14.03 (21.18)
T_6	1st spray-Azadirachtin 5% @ 500 ml / ha 2nd spray-*Verticillium lecani*@ 1x10^8 cfu/ g 3rd spray- *B.t.*.@ 500 g/ ha	28.83 (32.37)	20.69 (26.90)	14.97 (22.53)	21.50 (27.27)	26.34 (30.76)	16.84 (24.03)	11.25 (19.41)	18.14 (24.73)
T_7	1st spray-Untreated Check 2nd spray-Untreated Check 3rd spray-Untreated Check	37.29 (37.59)	39.80 (39.07)	36.73 (38.17)	37.94 (38.28)	33.99 (35.63)	36.55 (37.17)	36.44 (37.11)	35.66 (36.64)
	S.Em.±	0.42	0.22	0.24	0.29	0.28	0.15	0.20	0.21
	CD (p=0.05)	1.28	0.68	0.74	0.90	0.85	0.46	0.62	0.64

*Figures in parentheses are arcsine transformed values

Table 27: Effectiveness of various insecticidal treatments on yield of okra during summer season 2016-17

Treatment		Yield of healthy okra fruits (kg /ha) 2016	Yield of healthy okra fruits (kg /ha) 2017	Average Yield (kg /ha)
T1	1st spray- Clothianidin 50 % WG @ 60 g/ha 2nd spray- FlubendiDuringe39.35% S @125 ml / ha 3rd spray- Azadirachtin5%@ 500 ml ha	3800	4215	4008
T2	1st spray- FlonicDuring 50 % WG @ 150 g/ha 2nd spray- Emamectin benzoate5%S @ 170g /ha 3rd spray- *B.t.*@ 1kg/ ha	3135	3645	3390
T3	1st spray- Thiamethoxam 25 %WG @ 100 g/ha 2nd spray- Thiodicarb75%WP @1000 / ha 3rd spray- *B.t.*.@ 500 g/ ha	3768	3960	3864
T4	1st spray- Tolfenpyrad 15% EC @1000 ml/ha 2nd spray- Deltamethrin2.8% EC@ 4(ml / ha 3rd spray- *Beauveria bassiana*@ 1x1 cfu/ g	3524	3865	3695
T5	1st spray- Spiromesifen 22.9 % SC @ 500 ml/ha 2nd spray- Thiodicarb75%WP @1000 / ha 3rd spray- Emamectin benzoate5%S @ 170g /ha	4085	4503	4294
T6	1st spray- Azadirachtin5%@ 500 ml ha 2nd spray- *Verticillium lecani*@ 1x1 cfu/ g	3100	3497	3299

	3rd spray- *B.t.*.@ 500 g/ ha			
T7	1st spray- Untreated Check 2nd spray- Untreated Check 3rd spray- Untreated Check	2080	2412	2246

5. DISCUSSION

The results of present investigation on “Management of major Arthropod Pests of Summer Okra” have been discussed in the light of available information and important conclusions have been drawn.

5.1 Screening of different okra germplasm against major arthropod pests

5.1.1 Jassid

Jassid population was recorded on the yield all through the development stages. Among nine genotypes/varieties of okra none of the varieties was observed to be free from the pervasion of jassid. The jassid population extended from 14.46 to 27.15. The most elevated jassid population was found in variety Akola 107 (27.15 jassid), while variety Punjab Padmini indicated less jassid population (14.46), In 2016, though in 2017, the jassid population went from 11.32 to 24.58. The most elevated jassid population was found in variety Parbhani Kranti (24.58 jassid), though variety GOA-5 indicated less jassid population (11.32). These discoveries are in close congruity with the discoveries of Patel *et al.* (2009), Gonde *et al.* (2012), and Gadekar *et al.* (2015).

Patel *et al.* (2009) found that the variety MHOK-14 indicated least leaf container population (1.27/leaf) and greatest in variety PF-11.Gonde *et al.* (2012) recorded higher jassid population on variety Pusa Sawani though variety VRO 3 recorded least jassid population. Gadekar *et al.* (2015) found that Arka Abhay, A-4, Pusa sawani, Arka Anamika, Parbhani Kranti and Hissar Naveen are the reasonably helpless to the assault of jassid.

5.1.2 Aphid

Aphid population was recorded on the harvest all through the development stages. Among nine genotypes/varieties of okra none of the varieties was observed to be free from the pervasion of aphid. Among nine genotypes/varieties of okra the aphid population ran from 8.67 to 19.47. The most noteworthy aphid population was found in variety Varsha Upahar (19.47 aphid), though variety Akola 107 demonstrated less aphid population (8.67). In 2017, the aphid population extended from 12.39 to 17.56. The most elevated aphid population was found in variety Akola 107 (17.56 aphid), while variety Punjab Padmini demonstrated less aphid population (12.39). These discoveries are in close congruity with the discoveries of Patel *et al*. (2012) and Nataraja *et al.* (2015).

Patel *et al.* (2012) detailed that the base aphid population was in variety AOL-03-1 pursued by GO2. Nataraja *et al.* (2015) announced that the genotype IC331217, IC332453 and IC342075 and variety Manisha-211 and Arka Anamika were unimportantly favored over other genotype/variety by aphid.

5.1.3 Whitefly

Whitefly population was recorded on the harvest all through the development stages. Among nine genotypes/varieties of okra none of the varieties was observed to be free from the invasion of whitefly. The whitefly population went from 3.26 to 6.94. The greatest whitefly population was found in variety Arka Anamika (6.94 whitefly), though variety Punjab Padmini demonstrated least whitefly population (3.26). In year 2017, the whitefly population extended from 3.26 to 6.97. The greatest whitefly population was found in variety Arka Anamika (6.97 whitefly), while variety Punjab Padmini demonstrated least whitefly population (3.26). These discoveries are in close congruity with the discoveries of Patel *et al.* (2012), Gonde *et al.* (2012) Nataraja *et al.* (2015) and Gadekar *et al.* (2015).

Patel *et al.* (2012) detailed that the base whitefly population was in variety Pusa Sawani pursued by AOL 03-1, Arka Anamika and GO 2. Gonde *et al.* (2012) detailed that the most minimal invasion was found in VRO 3 and VRO 4. Nataraja *et al.* (2015) detailed that the genotype IC331217, IC332453 and IC342075 and variety Manisha-211 and Arka Anamika were insignificantly favored by whitefly over other genotype/variety. Gadekar *et al.* (2015) screened ten varieties and revealed that the varieties Hissar Unnat, Varsha Upahar and Pusa Sawani were least vulnerable to whitefly, while Aprajita rose as exceedingly defenseless against whitefly.

5.1.4 Shoot and fruit borer

Shoot borer

Among nine genotypes/varieties of okra none of the varieties was observed to be free from the pervasion of Shoot borer. The Shoot borer damage ran from 12.98 to 26.81 per cent. The base shoot damage was recorded on variety Akola Bahar (12.98 per cent), while the greatest damage was recorded on Punjab Padmini (26.81 per cent). In 2017, the per cent shoot damage by this aphid differed from 16.75 to 24.54 per cent. The base shoot damage was recorded on variety Akola Bahar (16.75 per cent), while the greatest damage was recorded on Punjab Padmini (26.81 per cent). If there should be an occurrence of Shoot borer none of the varieties was observed to be free from the invasion of Shoot borer.

Fruit borer

In the year 2016 the variety Akola Bahar recorded less damage (24.42 per cent) to fruits when contrasted with rest of alternate varieties. The greatest organic fruit damage was recorded in the varieties Parbhani Kranti (36.38 per cent). While in the year 2017, the variety Akola Bahar recorded less damage (21.29 per cent) to fruits when contrasted with rest of alternate varieties. The most extreme organic fruit damage was recorded in the varieties Parbhani Kranti (31.59 per cent). These discoveries are in close congruity with the discoveries of Banger *et al.* (2012), Gonde *et al.* (2012) Badiyala and Raj (2013), Kaur *et al.* (2013), and Rehman *et al.* (2015). Banger et al (2012), announced that, out of 10 varieties screened, the variety AOL 05-1, Gujarat Okra-2 AOL 08-2 were least vulnerable for fruit borer. Gonde *et al.* (2012) detailed that the most minimal invasion on number premise was recorded in EMS 8-1 pursued by Punjab Padmini and VRO 3. Badiyala and Raj (2013) uncovered that the variety Tulsi and Varsha Uphar recorded lower per cent fruit invasion.

Kaur *et al.* (2013) recorded low mean fruit pervasion (18.09-18.68% and 18.10-19.68%, fruit in number and weight premise, respectively) was seen in Punjab-Padmini and Punjab-8 as against Punjab-7 (22.27 - 23.29% fruit in number and weight premise). Rehman *et al.* (2015) screened seven varieties against Shoot and fruit borer and revealed that the variety Taj Vendhi was discovered most ideal variety having most astounding shoot just as fruit invasion.

5.2 Impact of date of sowing on infestation by major arthropod pests

5.2.1 Jassid

Jassid population was recorded on the harvest all through the development stages. Invasion inception in the harvest was seen from fourth week subsequent to sowing, on all the sowing dates with a mean population of 0.33 jassid/3 leaves to 25.13 jassid/3 leaves in the year 2016 and 2017.

The number of inhabitants in jassid in early sowing date ran from 2.27 jassid/3 leaves to 25.13 jassid/3 leaves, in standard sowing 0.33 jassid/3 leaves to 15.29 jassid/3 leaves and in late sowing 2.86 to 25.13 jassid/3 leaves In summer 2016, while in early sowing date ran from 1.67 jassid/3 leaves to 18.44 jassid/3 leaves, in ordinary sowing 0.86 jassid/3 leaves to 13.86 jassid/3 leaves and in late sowing 1.97 to 20.34 jassid/3 leaves In summer

2017. The vermin achieved its crest with a mean population of 25.13 and 20.34 jassid/3 leaves in the Xth week DAS In the year 2016 and 2017, respectively. These discoveries are in close similarity with the discoveries of Pawar *et al.* (1996), Rai *et al.* (1999), Ghosh *et al.* (1999) and Gautam *et al.* (2013). Pawar *et al.* (1996) revealed that the lower occurrences of jassid was seen on fifteenth May and first June crop. Rai *et al.* (1999) recorded higher jassid population on yield sown at second date (25thMay).

Ghosh *et al.* (1999) detailed that the population of jassid in center of June 24th (SWM). Gautam *et al.*, 2013 announced that the early sown yield recorded less pervasion, while late sown harvest recorded most astounding jassid invasion.

5.2.2 Aphid

Aphid population was recorded on the yield all through the development stages. Invasion started in the harvest from fourth week in the date of sowing on all the sowing dates with a mean population of 0.20 aphid/3 leaves to 21.90 aphid/3 leaves In the year 2016 and 0.36 to 20.93 aphid/3 leaves In the year 2017. The number of inhabitants in aphid in early sowing date was 0.86 aphid/3 leaves to 18.62 aphid/3 leaves, in standard sowing 0.20 aphid/3 leaves to 15.04 aphid/3 leaves and in late sowing 1.13 to 21.90 aphid/3 leaves In summer 2016, while in early sowing date it went from 0.91 aphid/3 leaves to 18.66 aphid/3 leaves, in ordinary sowing 0.36 aphid/3 leaves to 12.06 aphid/3 leaves and in late sowing 1.29 to 20.93 aphid/3 leaves In summer 2017. The irritation achieved its top with a mean population of 25.13 and 20.34 aphid/3 leaves in the 10^{th} week DAS In 2016 and eleventh week DAS In the year 2017. These discoveries are in close congruity with the discoveries of Patel (1988), Choudhary and Dadheech (1989), Ghosh *et al.* (1999). Patel *et al.* (1988) detailed that the lower rates of aphid was seen on July sown crop. Choudhary and Dadheech (1989) recorded higher aphid population on 43 days old yield. Ghosh *et al.* (1999) revealed the population of aphid in a week ago of July (30th SWM).

5.2.3 Whitefly

Whitefly population was recorded on the yield all through the development stages. Pervasion started in the harvest from fourth week subsequent to sowing on all the sowing dates with a mean population of whitefly 0.12 to 11.89 whitefly/3 leaves In the year 2016 and 0.08 to 13.56 whitefly/3 leaves in the year 2017, respectively. The number of inhabitants in whitefly in early sowing date was 0.33 whitefly/3 leaves to 10.33 whitefly/3 leaves, in normal sowing 0.12 whitefly/3 leaves to 6.26 whitefly/3 leaves and in late sowing

0.86 to 11.89 whitefly/3 leaves In summer 2016, while in early sowing date it went from was 0.21 whitefly/3 leaves to 11.93 whitefly/3 leaves, in standard sowing 0.08 whitefly/3 leaves to 8.27 whitefly/3 leaves and in late sowing 0.35 to 13.56 whitefly/3 leaves In summer 2017, respectively. The nuisance achieved its crest with a mean population of 11.89 and 13.56 whitefly/3 leaves in the eleventh week DAS In 2016 and 2017, respectively.

These discoveries are in close congruity with the discoveries of Choudhary and Dadheech (1989), Patel (1989b), Kadivar (1995), Ghosh *et al.* (1999) and Kumawat *et al.* (2000). Choudhary and Dadheech (1989) revealed that the greatest frequencies of whitefly was seen in late sown yield (43 DAS *i.e.* July sown harvest). Patel *et al.* (1989b) recorded higher whitefly population after fourth week of sowing on 43 days old yield. Kadivar (1995) watched the movement of whitefly after 10th week of sowing.

Ghosh *et al.* (1999) detailed the population of whitefly in a week ago of July (30th SWM). Kumawat *et al.* (2000) announced that the whitefly rates on okra began in the fourth week of July and achieved its crest In fourth week of September.

5.2.4 Shoot and fruit borer

Shoot and fruit borer per cent pervasion was recorded on the yield all through the development stages. Pervasion started in the harvest from fourth week in the date of sowing in all the sowing dates with a mean Shoot and fruit borer invasion 9.15 to 39.56 per cent In 2016 and 8.06 to 31.01 Shoot and fruit borer per cent pervasion in 2017 respectively. The Shoot and fruit borer per cent invasion in early sowing date was 9.15 to 30.66, in customary sowing 10.81.to 36.71 and in late sowing 15.89 to 39.56 per cent In summer 2016, while in early sowing date it was 8.06 to 28.80 per cent, in normal sowing 9.52 to 29.32 and in late sowing 12.74 to 31.01 per cent In summer 2017, respectively. The vermin achieved its crest with a mean per cent pervasion of 39.56 and 31.01 per cent damage in the Xth week DAS In 2016 and in the XI th week DAS 2017, respectively.

These findings are in close similarity with the discoveries of Rai and Satpathy (1999), Mandal *et al.* (2007), Gautam *et al.* (2013), and Kaur *et al.* (2013). Rai and Satpathy (1999) announced the most extreme damage of Shoot and fruit borer in late sown yield (25th June). Mandal *et al.* (2007) recorded most minimal Shoot and fruit borer damage in harvest sown in mid-February.

Gautam *et al.* (2013) watched the most minimal Shoot and fruit borer damage on early sowing dates, while the late sowing recorded greatest Shoot and fruit borer damage.

Kaur *et al.* (2013) announced the least Shoot and fruit borer damage in early sowing dates, while the late sowing recorded greatest Shoot and fruit borer damage.

5.3 Population dynamics of the major arthropod pests

5.3.1 Jassid

In summer year 2016 Jassid population was recorded on the harvest all through the development stages. The number of inhabitants in jassid ran from 7.28 jassid/3 leaves in a week ago of May to 32.66 in Fourth weekof April. While in the year 2017, the number of inhabitants in jassid ran from 4.38 jassid/3 leaves in a week ago of May and bit by bit expanded and achieved its of 26.33 in Fourth weekof April. The relationship of jassid with climate parameter was assessed with the assistance of connection coefficient. These discoveries are in close similarity with the discoveries of Patel *et al.* (2009) found that the variety MHOK-14 demonstrated least leaf container population (1.27/leaf) and most extreme in variety PF-11, Patel *et al.* (2012), Gonde *et al.* (2012),

Nataraja *et al.* (2015) and Gadekar *et al.* (2015). Patel *et al.* (2012), announced that the genotype Pusa sawani demonstrated most extreme Host plant weakness file, while Green miracle was relatively safe with least HPSI. Gonde *et al.* (2012) recorded higher jassid population on variety Pusa Sawani though variety VRO 3 recorded least jassid population. Nataraja *et al.* (2015) detailed that the genotype IC331217, IC332453 and IC342075 and variety Manisha-211 and Arka Anamika were unimportantly favored over other genotype/variety. Gadekar *et al.* (2015) found that Arka Abhay, A-4, Pusa Sawani, Arka Anamika, Parbhani Kranti and Hissar Naveen are moderately susceptible to attack of jassid.

5.3.2 Aphid

Aphid population was recorded on the crop throughout the growth stages. Among nine genotypes / varieties of okra none of the varieties was found to be free from the infestation of aphid. Among nine genotypes/varieties of okra the aphid population ranged from 8.67 to 19.47. The highest aphid population was found in variety Varsha Upahar (19.47 aphid), whereas variety Akola 107 showed less jassid population (8.67). Whereas in the year 2017, the aphid population ranged from 12.39 to 17.56. The highest aphid population was found in variety Akola 107 (17.56 aphid), whereas variety Punjab Padmini showed less aphid population (12.39). These findings are in close conformity with the findings of Patel *et al.* (2012) and Nataraja *et al.* (2015). Patel *et al.* (2012) reported that the minimum aphid population was in variety AOL-03-1 followed by GO2. Nataraja *et al.* (2015) reported that the genotype IC331217, IC332453 and IC342075 and variety Manisha-211 and Arka Anamika were negligibly preferred over other genotype / variety.

5.3.3 Whitefly

Whitefly population was recorded on the yield all through the development stages. Among nine genotypes/varieties of okra none of the varieties was observed to be free from the invasion of whitefly. The whitefly population extended from 3.26 to 6.94. The greatest whitefly population was found in variety Arka Anamika (6.94 whitefly), though variety Punjab Padmini indicated least whitefly population (3.26). Though in 2017, the whitefly population extended from 3.26 to 6.97. The most extreme whitefly population was found in variety Arka Anamika (6.97 whitefly), while variety Punjab Padmini indicated least whitefly population (3.26). These discoveries are in close similarity with the discoveries of Patel *et al.* (2012), Gonde *et al.* (2012) Nataraja *et al.* (2015) and Gadekar *et al.* (2015). Patel *et al.* (2012) announced that the base whitefly population was in variety Pusa Sawani pursued by AOL 03-1, Arka Anamika and GO 2. Gonde *et al.* (2012) detailed that the most reduced pervasion wasfound in VRO 3 and VRO 4. Nataraja *et al.* (2015) detailed that the genotype IC331217, IC332453 and IC342075 and variety Manisha-211 and Arka Anamika were insignificantly favored over other genotype/variety. Gadekar *et al.* (2015) screened ten varieties and detailed that the varieties Hissar Unnat, Varsha Upahar and Pusa Sawani were least helpless to whitefly, while Aprajita rose as profoundly powerless against whitefly.

5.3.4 Shoot and fruit borer

Among nine genotypes/varieties of okra none of the varieties was observed to be free from the invasion of Shoot borer. The Shoot borer damage ran from 12.98 to 26.81 per cent. The base shoot damage was recorded on variety Akola Bahar (12.98 per cent), though the most extreme damage was recorded on Punjab Padmini (26.81 per cent). While in 2017, the per cent shoot damage by this vermin shifted from 16.75 to 24.54 per cent. The base shoot damage was recorded on variety Akola Bahar (16.75 per cent), though the greatest damage was recorded on Punjab Padmini (26.81 per cent). If there should arise an occurrence of Stem borer none of the varieties was observed to be free from the invasion of Shoot borer. In 2016 the variety Akola Bahar recorded less damage (24.42 per cent) to fruits when contrasted with rest of alternate varieties. The most extreme organic fruit damage was recorded in the varieties Parbhani Kranti (36.38 per cent). Though in 2017, the variety Akola Bahar recorded less damage (21.29 per cent) to fruits when contrasted with rest of alternate varieties. The most extreme organic fruit damage was recorded in the varieties Parbhani Kranti (31.59 per cent). These discoveries are in close congruity with the discoveries of Banger *et al.* (2012), Gonde *et al.* (2012), Kaur *et al.* (2013) and Rehman *et al.* (2015). Banger *et al.* (2012), announced that out of 10 varieties screened, the variety AOL 05-1, Gujarat Okra-2 AOL 08-2 were least powerless for fruit borer. Gonde *et al.* (2012) announced that the least invasion on number premise was recorded most reduced in EMS 8-1 pursued by Punjab Padmini, VRO 3. Kaur *et al.* (2013) recorded low mean fruit invasion (18.09 - 18.68% and 18.10 - 19.68%, fruit number and weight premise, respectively) was seen in Punjab-Padmini and Punjab-8 as against Punjab-7 (22.27 - 23.29% fruit number and weight premise). Rehman *et al.* (2015) screened seven varieties against Shoot and fruit borer and revealed that the variety Taj Vendhi was discovered most best variety having most elevated shoot just as fruit invasion.

As to coefficient think about between irritation population and climate parameters in the year 2016 demonstrated that RHE (- 0.721), indicated exceptionally huge negative connection, though, MaxT (0.638), BSS (0.403), indicated huge positive relationship, with jassid population. While in the year 2017, the information demonstrated that BSS (- 0.164), MinT (- 0.051) and RHE (- 0.392) indicated negative relationship MaxT (0.265), RHM (0.345) indicated positive connection, with jassid population. As to coefficient examine between vermin population and climate parameters in 2016 demonstrated that RHE (- 0.749), indicated exceptionally noteworthy negative relationship, while, MaxT (0.619) and BSS (0.433) indicated huge positive connection, with aphid population. Though in the year 2017, the information demonstrated that BSS (- 0.316) and RHE (- 0.195) indicated negative relationship while, MaxT (0.362), RHM (0.493) indicated huge positive connection, while MaxT (0.362) and MinT (0.161) indicated positive connection with aphid population. As to coefficient consider between vermin population and climate parameters in the year 2016 demonstrated that RHE (- 0.683), indicated exceedingly significant negative relationship, though, MaxT (0.723), demonstrated huge positive connection while BSS (0.313) indicated positive connection with whitefly population. Though in 2017, the information demonstrated that BSS (- 0.544) indicated noteworthy negative relationship, though RHM (0.607), MaxT (0.431), demonstrated huge positive connection while MinT (0.397) indicated positive relationship with whitefly population. As to coefficient consider between vermin population and climate parameters in 2016 demonstrated that RHE (- 0.546) indicated exceptionally noteworthy negative relationship, though, MaxT (0.753), indicated significant positive connection, with Shoot and fruit invasion. Though in the year 2017, the information demonstrated that BSS (- 0.700) indicated huge negative connection, while MinT (0.649), MaxT (0.519) and RHM (0.668) indicated noteworthy positive relationship while RHE (0.341) indicated positive relationship with Shoot and fruit borer pervasion.

These above discoveries are in close similarity with the discoveries of Kumawat *et al.* (2000), Meena *et al.* (2010), Nath *et al.* (2011), Aziz *et al.* (2011), Boopathi and Pathak (2012), Singh et a.l (2013), Badiyala and Raj (2013) and Yadav *et al.* (2015). Kumawat *et al.* (2000) revealed that the invasion of jassid and whitefly began from fourth week of July and achieved its top in the second and fourth week of September, respectively. They likewise announced that most extreme temperature was fundamentally related with whitefly thickness. Meena *et al.* (2010) detailed that Shoot invasion happened from the primary week of August of the gathering of harvest and it step by step expanded from 1.0 and 0.66 per cent to 23.0 and 25.0 per cent in the third week of October in 2002 and 2003, respectively. Least temperature and relative stickiness had a huge negative connection with shoot invasion, while the dimension of fruit pervasion step by step expanded as the harvest developed, contacting the of 31.6 per cent as far as number and 29.7 per cent on a load premise in 2002 however such figures were 34.0% and 31.0%, respectively in 2003 while the most extreme and least temperature had negative relationship with fruit invasion.

5.4 Bioefficacy of insecticides and bio-pesticides against major arthropod pests

5.4.1 Jassid

In the present investigation based on the average mean reduction in the population of jassid, indicated that all the treatments were significantly superior over control. Treatment T2 (1st spray T2 Flonic in 50% WG and 2nd Emamectin benzoate 5% SG) was recorded with minimum jassid population (9.70) and it was at par with all other treatment except control.

5.4.2 Aphid

With respect to aphid information dependent on the normal mean decrease in the number of inhabitants in aphid showed that every one of the treatments were altogether better over control. Treatment T3 (first spray T3 Thiomethaxon 25% WG and second spray Thiodicarb 75% WP) was recorded with least aphid population (9.74) and it was at standard with all other treatment aside from control.

5.4.3 Whitefly

If there should arise an occurrence of whitefly information dependent on the normal mean decrease in the number of inhabitants in whitefly shown that every one of the treatments were altogether better over control. Treatment T1 (Clothianidin 50 % WG first spray and second spray T1 Flubendimide 39.35 SC) was recorded having least whitefly population (2.82) and it was at standard with all other treatment aside from control.

5.4.4 Shoot and fruit borer per

With respect to Shoot and fruit borer, information dependent on the normal mean decrease in the number of inhabitants in Shoot and fruit borer showed that every one of the tratments were altogether better over control. Treatment T5 (Spiromesifen 22.9% SC first spray, second spray Thiodicarb 75% WP and third spray Emamectin benzoate 5% SG) was recorded having least Shoot and fruit borer per cent infestation and it was at standard with all other treatment aside from control.

The finding of present examination are in close concurrence with the earlier work of Bhalala *et al.* (2006), Dhanalakshmi and Mallapur (2010), Shinde *et al.* (2011), Rohini *et al.* (2012), Anand *et al.* (2013), Bajad *et al.* (2014), Patil *et al.* (2014), Kamble *et al.* (2014), Gadekar *et al.* (2014), Bhalala *et al.* (2006) assessed the bio-viability of thiamethoxam 25 WG and endosulfan 35 EC and monocrotophos 36 SL against the sucking vermin complex of okra. The treatment of thiamethoxam 25 WG at higher measurements (50 and 37.5 g a.i./ha) was discovered best against aphid, jassid, whitefly. Dhanalakshmi and Mallapur (2010) revealed that, the Emamectin benzoate 5 SG @ 0.2 g/l was discovered most unrivaled treatment by chronicle the least per cent organic fruit damage (7.82%) and brought about most astounding great fruit yield (47.02 q/ha). The following successful treatment included Spinosad 45 SC @ 0.1 ml/l (9.19% damage with 45.94 q/ha yield). It uncovered that Emamectin benzoate 5 SG at 15 g a.i./ha was the best treatment recording low larval population of E. vittella and furthermore yielding most elevated at the two areas.

Shinde *et al.* (2011) uncovered that the spinosad 0.005 per cent was a powerful aphid spray to control the Shoot and fruit borer in okra, trailed by indoxacarb 0.01 per cent and profenophos 0.08 per cent. The most noteworthy yield of okra was seen in spinosad @ 0.005 per cent. The aphid sprays fipronil 5 SC @2 ml/lit and imidacloprid 17.8 SL @0.4, l/lit were discovered viable against jassid, while, thimethoxam 5 SG @0.2 g/lit was successful against whitefly on cotton, (Rohini *et al.* 2012),

Be that as it may, this treatment was at standard with its most minimal portion of 6.75 g a.i. /ha and the check. Bajad *et al.* (2014) detailed that cypermethrin 25 EC@ 0.05 per cent was discovered best in dealing with the fruit borer invasion on okra pursued by indoxacarb 14.05 SC @ 0.007 per cent and spinosad 45 EC @ 0.015 per cent. The most noteworthy attractive fruit yield of okra (75.33q/ha) and steady money saving advantage proportion (1:16.49) was gotten from the treatment of cypermethrin 25 EC @ 0.05 per cent.

Patil *et al.* (2014) announced that the foliar spray of Thiamethoxam 25 WG @ 0.006% was discovered the best against aphid, trailed by lambda Cyhalothrin 5 EC @ 0.004%. While, Thiamethoxam 25 WG @ 0.006% was powerful against leafhoppers and whitefly population. The prescribed dosages of aphid sprays were discovered more powerful than different portions. Kamble *et al.* (2014) detailed that the aphid sprays, Indoxacarb 14.5 SC + Acetamiprid 7.7 SC@400 ml/ha, Profenophos 40 EC + Cypermethrin 4 EC@1000 ml/ha and Chlorpyriphos 50 EC + Cypermethrin 5 EC@1000 ml/ha to be the savvy in decreasing the fruit pervasion on number premise just as on weight premise was 15.65% to 14.80% and 16.25% to 15.24%, respectively as against 32.14% and 31.31% in the control.

Gadekar (2015), assessed the bioefficacy of nine aphid sprays and botanicals against jassid and whitefly overrunning okra. The thiamethoxam (0.005%) was discovered best pursued by acetamiprid (0.004%) and acephate (0.05%) against jassid, while, acetamiprid (0.004%) demonstrated, best aphid sprays pursued by thiamethoxam (0.005%) and acephate (0.05%) against whitefly. The natural azadirachtin (0.5%) demonstrated least successful pursued by NSKE (5%) and Datura separate (5%) against both jassid and whitefly. The imidacloprid (0.005%) was discovered best against jassid and whitefly pursued by thiamethoxam (0.005%), deltaphos (0.036%) and spinosad (0.0068%) while, Bacillus thurigiensis (0.012%) demonstrated the least viable pursued by azadirachin (5ml/l) and NSKE (5.0%).

6. SUMMARY

The present investigations entitled “Management of Major Arthropod Pests of Summer Okra" was conducted during summer 2016 and 2017 at RARS, Karjat, M.S., Dr. BSKKV, Dapoli, Dist. Ratnagiri, M.S.

Among nine genotypes/varieties of okra, none of the varieties was observed to be free from aphid pervasion in the both year. The normal of two years jassid population went from 14.54 to 21.68%. The most astounding jassid population was found in variety Parbhani Kranti (21.68 jassid); though, variety Arka Anamika indicated less jassid population (14.54). In the event of aphid population went from 12.79 to 16.88. The most elevated aphid population was found in variety Varsha Upahar (16.88 aphid); though, variety Punjab Padmini indicated less aphid population (12.79). With respect to population it's gone from 4.77 to 7.72. The most extreme whitefly population was found in variety Varsha Uphar (7.72 whitefly); while, variety Akola Bahar indicated least whitefly population (4.77). The per cent shoot damage by shoot and fruit borer differed from 14.87 to 25.68 per cent. It shows the shifting reaction of the considerable number of varieties/genotypes to shoot damage. The base shoot damage was recorded on variety Akola Bahar (14.87 per cent); though, the most extreme damage was recorded on Punjab Padmini (25.68 per cent). The per cent fruit damage (Table - 3 and Fig. 8) uncovered that the fruit damage ran from 26.12 to 33.08 per cent on various genotypes/varieties. The variety Akola Bahar recorded less damage (26.12 per cent) to fruits when contrasted with rest of alternate varieties.

Among nine genotypes/varieties of okra screened against the significant arthropods pervading okra, out of that none of the varieties was observed to be free from nuisance invasion in the both year. Concerning population the information dependent by and large of two years showed that the jassid population went from 14.54 to 21.68 (jassid/3 leaves). The most extreme jassid population was recorded on Parbhani Kranti (21.68 jassid/3 leaves) while; the base jassid population was recorded on Arka Anamika (14.54 jassid/3 leaves). If there should arise an occurrence of aphid the population extended from 12.79 to 16.88 (aphid/3 leaves). The greatest aphid population was recorded on Varsha Upahar (16.88 aphid/3 leaves) while, the base aphid population was recorded on Punjab Padmini (12.79 aphid/3 leaves). Concerning whitefly the population extended from 12.79 to 16.88 (whitefly/3 leaves). The most extreme whitefly population was recorded on Varsha Upahar (7.22 whitefly/3 leaves); though, the base whitefly population was recorded on Akola Bahar (4.77 whitefly/3 leaves). If there should be an occurrence of the shoot borer damage the per cent invasion extended from 14.87 to 25.68 per cent. The most extreme per cent invasion was recorded on Punjab Padmini (25.68 per cent); though, the base per cent pervasion was recorded on Akola Bahar (14.87 per cent). As to damage the per cent invasion went from 26.12 to 33.08 per cent. The greatest per cent pervasion was recorded on GOA-5 (33.08 per cent) while; the base per cent invasion was recorded on Varsha Upahar (27.40 per cent).

The impact of date of sowing test was led in two progressive seasons for example 2016 and 2017 during summer season. Okra crop was developed at 3 diverse sowing dates (third week of January, first week of February and third week of February). Thinking about the normal information of two years, the occurrence of jassid was recorded most extreme population 22.74 jassid/3 leaves in Xth week in the date of sowing in late sowing though it was recorded least in standard sowing for example 1.06 jassid/3 leaves in IVth week in the date of sowing. If there should arise an occurrence of aphid the greatest population was recorded 19.78 aphid/3 leaves in XIth week in the date of sowing in late sown harvest. Though, it was recorded least in customary sowing for example 0.28 aphid/3 leaves in IVth week in the date of sowing. As to whitefly the most extreme population was recorded 12.73 whitefly/3 leaves XIth week in the date of sowing in late sown yield. Though it was recorded least in customary sowing for example 0.10 aphid/3 leaves in IVth week subsequent to sowing. If there should arise an occurrence of shoot and fruit borer the greatest shoot and fruit borer pervasion was recorded 33.70 per cent in IXth week in the date of sowing in late sown yield while and it was recorded least in IVth week for example 8.61 per cent in the date of sowing in early sown harvest.

With respect to population elements of the significant arthropods, the information dependent all things considered of two years demonstrated that the jassid population went from 5.83 to 29.50 (jassid/3 leaves). The most extreme jassid population was recorded in fourth week of April (29.50 jassid/3 leaves) while, the base jassid population was recorded in fourth week of May (5.83 jassid/3 leaves). If there should be an occurrence of aphid the population went from 4.45 to 25.16 (aphid/3 leaves). The most extreme aphid population was recorded in fourth week April (25.16 aphid/3 leaves) while, the base aphid population was recorded on fourth week of May (4.45 aphid/3 leaves). Concerning whitefly the population ran from 2.17 to 9.96 (whitefly/3 leaves). The most extreme whitefly population was recorded in fourth week of April (9.96 whitefly/3 leaves) while, the base whitefly population was recorded in first week of March (2.17 whitefly/3 leaves). If there should arise an occurrence of the shoot and fruit borer damage the per cent invasion went from 5.57 to 22.46 per cent. The greatest per cent pervasion was recorded in fourth week of April (22.46

per cent) though, the base per cent invasion was recorded in first week of March (5.57 per cent).

As to coefficient consider between aphid population and climate parameters in 2016 demonstrated that RHE (- 0.721), indicated exceedingly huge negative relationship, though, MaxT (0.638), BSS (0.403), indicated significant positive connection, with jassid population. Though in 2017, the information demonstrated that BSS (- 0.164), MinT (- 0.051) and RHE (- 0.392) demonstrated negative relationship MaxT (0.265), RHM (0.345) indicated positive connection, with jassid population. Concerning coefficient think about between vermin population and climate parameters in 2016 demonstrated that RHE (- 0.749), indicated exceptionally noteworthy negative relationship, though, MaxT (0.619) and BSS (0.433) demonstrated huge positive connection, with aphid population. Though in 2017, the information demonstrated that BSS (- 0.316) and RHE (- 0.195) indicated negative connection while, MaxT (0.362), RHM (0.493) indicated huge positive relationship, while MaxT (0.362) and MinT (0.161) demonstrated positive connection with aphid population. As to coefficient think about between vermin population and climate parameters in 2016 demonstrated that RHE (- 0.683), indicated exceedingly significant negative relationship, though, MaxT (0.723), indicated huge positive connection while BSS (0.313) demonstrated positive connection with whitefly population. Though, in 2017, the information demonstrated that BSS (- 0.544) indicated significant negative relationship; though, RHM (0.607), MaxT (0.431), indicated noteworthy positive connection while, Min T (0.397) demonstrated positive connection with whitefly population. As to coefficient contemplate between vermin population and climate parameters in 2016 demonstrated that RHE (- 0.546) indicated exceedingly significant negative connection, though, MaxT (0.753), demonstrated huge positive relationship, with Shoot and fruit invasion. Though in 2017, the information demonstrated that BSS (- 0.700) indicated noteworthy negative connection; while, MinT (0.649), MaxT (0.519) and RHM (0.668) indicated huge positive relationship; while, RHE (0.341) demonstrated positive relationship with shoot and fruit borer invasion.

Concerning adequacy of some aphid spray and biopestiside against real arthropods the Results got from normal information demonstrated that every one of the treatments were altogether better over control. Treatment T3 (first spray T3 Thiamethoxam 25 % WG and second spray Thiodicarb 75% WP was recorded least jassid population (12.12) and it was at standard with all other treatment aside from untreated check. Concerning normal information demonstrated that every one of the treatments were essentially better over control. Treatment T3 (first spray T3 Thiomethaxon 25% WG and second spray Thiodicarb 75% WP) was recorded least aphid population (9.78) and it was at standard with all other treatment aside from untreated check. In the event of whitefly the results acquired from normal information showed that every one of the treatments were fundamentally better over control. Treatment T1 (Clothianidin half WG first spray and second spray T1 Flubendimide 39.35 SC) was recorded least whitefly population (1.87) and it was at standard with all other treatment aside from untreated check.

The Shoot and fruit borer pervasion on weight premise normal information demonstrated that every one of the treatments were essentially better over control. Treatment T5 (Spiromesifen 22.9% SC first spray and second spray Thiodicarb 75% WP and third spray Emamectin Benzoate 5% SG) was recorded least fruit borer per cent pervasion (14.03) and it was at standard with all other treatment aside from untreated check. While number premise Results acquired from normal information showed that the Treatment T5 (Spiromesifen 22.9% SC first spray and second spray Thiodicarb 75% WP and third spray Emamectin Benzoate 5% SG) was recorded least fruit borer per cent pervasion (14.03) and it was at standard with all other treatment aside from untreated check. If there should arise an occurrence of yield the information dependent on the normal information of two years the treatment T5 (first spray Spiromesifen 22.9% SC @ 500 ml/ha, second spray Thiodicarb 75%WP @1000 g/ha, third spray Emamectin benzoate 5%SG @ 170 g/ha) recorded the most noteworthy yield (4294 kg ha1) trailed by T1 (first spray Clothianidin 50 % WG @ 60 g/ha, second spray FlubendiDuringe39.35% SC @125 ml/ha, third spray Azadirachtin5% @ 500 ml/ha) which gave 4008 kg/ha okra yield.

LITERATURE CITED

Ahmad, S., Gupta, S.C., Prakash, N. and Mandel, S.K. 2000. Weather factors and larval population of *Earias vitella* in summer sown okra. *Journal of Research, Birsa Agricutlural Univeristy,* **12** (2): 215-217.

Anand, G.K.; Sharma, R.K. Shankarganesh, K.; Sinha, S.R. and Sharma, K. (2013).Efficacy of newer insecticide against sucking insect pests of okra.*Indian Journal of Plant Protection*, **41** (2): 113-115.

Aziz, M.A., Hasan, M.U. and Ali, A. 2011. Impact of abiotic factors on incidence of fruit and shoot infestation of spotted bollworms *Earias* spp. on okra (*Abelmoschus esculentus L.) Pakistan Journal of Zoology,* **43** (5): 863-868.

Badiyala, A. and Raj, D. 2013. Seasonal incidence, varietal screening and management of shoot and fruit borer infesting okra in kangra valley of Himanchal Pradesh. *Indian Journal of Horticulture*, **70** (2): 304-308.

Bajad, V.V.; Singh, H.P. And Patil, S.C. 2014. Efficacy of chemical insecticides against shoot and fruit borer, *Earias vittella* (Fab.) on okra. *Trends in Bioscience* 7(14): 1644-1646.

Bangar, N.; Patel, Dhruve, J. 2012. Susceptibility against okra shoot and fruit borer, *Earias vittella* (Fabricius) *(Noctuidae: Lepidoptera)* in okra were carried out at Vegetable Research Station Farm, Anand Agricultural University, Anand. *Indian Journal Agriulture Biochemistry,* 25 (1): 76-79.

Begum Khajarumana and Patil Sarjerao, 2016, Evaluation of newer molecules of insecticides against sucking pest complex infesting okra, *Indian journal of applied research,* **6**(2): 30-34.

Bhalala, M.K.; Patel, B.H.: Patel, Bhatt, H.V. and Maghodia, A.B. 2006. Bioefficacy of thiamethoxam 25 WG and various recommended insecticides against sucking pest complex of okra *(Abelmoschus esculentus* (L.) Moench*). Indian Journal of Entomology,* **68**(3): 293-295.

Brar, K. S.; Arora, S. K. and Ghai, T. R. 1995. Resistance in okra to shoot and fruit borer, *Earias vittella* (Fabr.) and cotton jassid, *Amrasca biguttula biguttula* (Ish.). *Madras Agriculture Journal,* **82**(3): 231-232.

Chaoudhary, H.R. and Dadheech, L.N. 1989. Incidence of insect attacking okra and the avoidable losses caused by them .*Annals of Arid Zone,* **28** (3-4): 305-307.

Dabhi, M.V., Acharya, M.F., Koshiya, D. and Khanpara, A.V. 2012. Bio-efficacy of various insecticides against okra shoot and fruit borer, *Earias vittella* (Fab.). *AGRES-An International e-Journal,* **1**(1): 65-70.

Dabhi, M.V., Koshiya, D. and Korat, D.M. 2013. Effect of abiotic factors on population of aphid and damage by shoot fruit borer in okra during summer and kharif season at Anand in Gujrat .*Journal of Agrometeorolog*, **15**(1): 71-74.

Dhaka, S.S. and Prajapati, C.R. 2013. Management of okra fruit borer*, Earias vittella* Fab*.* with chemicals and biopesticides. *Progressive Research,* **8**(special): 186-189.

Dangi, P.R and Ameta, O.P. 2005. Incidence of okra fruit borer, *E.vitella. National Conference on Applied Entomology,* Sept. 26-28, 2005 held at Rajasthan College of Agriculture, Udaipur, pp. 84-85.

Detole, R.O., Lavhe, N.V., Patil, K.P and Navale, P. 2015. Eco friendly management of *Earias vittela* on okra. Pestology **39**(2): 23-26.

Dhamdhere, S.V.; Bahadur, and Misra, U.S. 1984. Studies on occurrence and succession of pests of okra at Gwaliar. *Indian Journal Plant Prot*ection, **12** (1): 9-12.

Dhanalakshmi, D.N. and Mallapur, C.P. 2010. Evaluation of new promising molecules against fruit borers in okra. *International Journal of Plant Protection*. **3**(2): 268-270.

Gadekar, S.D. 2014. Seasonal incidence and management of major sucking pests of okra, *Abelmoschus esculentus* (L.) Moench. Thesis, submitted to Swami Keshwanand Rajasthan Agricultural University, Bikaner (RaJournal).

Gadekar, S.D.; Acharya, V.S.; Sigh, V. and Verma, R. 2015. Bio-effiacy of insecticides and botanicals against major sucking pests of okra. International conference: Changing Scenario of Pest Problems in Agri-horti Ecosystem and their Management, Nov. 27-29, 2014 held at Rajasthan College of Agriculture, Udaipur, pp: 26.

Ghosh, J, Ghosh, S. K.; Chattarjee, H. and Senapati, S. K. 1999. Pest constraints of okra under Terai Region of West Bengal. *Indian Journal Ent,* **61**(4): 362-371.

Ghosh, J., Chaudhuri, N. and Roy, G., 2016. Bio-efficacy of Thiamethoxam 25%WG against sucking pests of okra under terai region of West Bengal*, International Journal of Science, Environment and Technology,* **5**(3): 1217-1225.

Gautam, H.K.; Singh, N. N.; Shingh, C. and Rai, A.B. 2013. Morphological and biochemical characters in fruit iv against okra shoot and fruit borer *(Earias vittella). Indian Journal of Entomogy*. **75**(3): 189-193.

Ghule, T.M.; Devi, L. L.; Senapati, A.K. and Chatarjee, M.L. 2014 Comparative efficacy of some bio rational insecticides for management of shoot and fruit borer *(E. vittella) on Okra. Indian Journal of Applied Research.,* **4**(9):7-10.

Gonde, A.D.; Ashwani Kumar; Raut, A.H.; Wargantiwar, R.K. and Phuke, D.P. 2012 .Screening varieties of okra *(Abelmoschus esculentus* (L.)Monech*)* against Important Insect Pest under agro climatic Condition of Allahabad (U.P.). *Trends in Biosciences,* **5**(3): 249.

Gosalwad, S.S. and Kawathekar, B.R. 2008. Efficacy of insecticides against okra fruit borer *(Earias vittella* fabricus*). Journal of Plant Protection and Environment*, **6**(2): 59-63.

Harichandra Naik, R. Devakumar, N. Gangadhar Eshawar Rao, N., Imaran Khan, H.S. and Subha, S. 2012. Performances of botanicals and fungal formulation for pest management in organic okra production system. *Journal of Biopesticides,* **5** (Supplementary): 12-16.

Kadivar, A. F. 1995. Population dymaics, varietal susceptibility and chemical control of pest complex of okra. M. Sc. (Agri.) Thesis, G.A.U., Sardar Krushinagar.

Kamble, P. P., Kulkarni, S. R. and Patil, S. K., 2014. Efficacy of newer combination insecticides against shoot and fruit borer, *Earias vittella* (Fabricius) on okra. *Pest Management in Horticultural Ecosystems,* **20**(2): 242-244.

Kaur, S.; Kaur, K.G. and Singh, S. 2013. Influence of sowing dates and varieties of okra on incidence of shoot and fruit borer, *Earias spp*. under field conditions in Punjab. *Insect Environment*. **19**(3).

Kumawat, R.L.; Pareek, B.L. and Meena, B.L. 2000. Seasonal incidence of jassid and whitefly on okra and their correlation with abiotic factors. *Annals of Biol*ogy, **16** (2): 167-169.

Kumar, K.K. and Urs, K. C. D. 1988. Population fluctuation of *Earias vittella* (Fabr.) on okra in relation to abiotic factors. *Indian Journal Plant Protection,* **16**(2): 137-142.

Laichattowar, M.A. and Meena, R.S. 2014. Efficacy of various insecticides against okra shoot and fruit borer, *Earias vittella* (Fab.) *Journal of Entomological Research,* **38**(2): 121-124.

Mahal, M.S.; Brar, L.S.; Singh, R. and Singh, B. (1994).Effect of simulated initiation of cotton jassid, *Amrasca biguttula biguttula* (Ishida) infestation at different at crop ages on seed yield of okra. *Journal Insect Science,* **6** (1): 60-63.

Mandal, S.K.; Sattar, A. and Gupta, S.C. 2006. Influence of meteorological parameters on the incidence of leaf hopper in okra at Pusa, Bihar. *Journal Agrometerology,* **8** (1): 126-129.

Mandal, S.K., Sah, S.B. and Gupta, S.C. 2007. Management of insect pests on okra with bio pesticides and chemicals. *Annals of Plant Protection Sciences*, **15**(1): 87-91.

Masuda, T. and Kikuchi, O. 1992. Pathogenecity of Verticillium lecanii osolates to aphid and whitefly. *Japanese Journal of Applied Entomology and Zoology*, **36**: 239-245.

Meena, N.K. and Kanwat, P.M. 2010. Studies on seasonal incidence and relative safety of pesticides against coccinellid beetles in okra ecosystem.*Journal of biological control,* **24**(2): 116-122.

Nath, L.; Prasad C.S.; Tiwari, G.N. and Kumar, A. 2011. Impact of weather parameters on major insect pests of okra prevailing western Uttar Pradesh. *Vegetos – An International Journal of Plant Research*, **24**(2): 152-156.

Nath V. and Sinha S.R. 2011. IPM in okra through neonicotinoids, insecticides and their mixtures. *Annals of Plant Protection Sciences* **19**(1): 33-36.

Nataraja, M.V., Chalam, M.S.V., Madhumathi, T. and Rao, V.S. 2015. Bio efficacy of new insecticide molecules against major pests of okra .*Indian Journal of Plant Protection,* **43**(2): 233-236.

Nenavati, R.N., and Kumar, A. 2014. Efficacy of certain insecticides and seasonal incidence of shoot and fruit borer*, Earias vittella* Fab. on Okra. Annals of Plant Protection Science. **22**(1): 95-97

Pareek, B.L.; Sharma, G.R. and Bhatnagar, K.N. 1986 .Seasonal incidence of major insect pests of okra in semi arid region of Rajasthan. *Annals of Arid Zone*, **25** (3): 222-224.

Pareek, B.L., Kumawat, R.L. and Patni, S.K. 2001. Effect of abiotic factors on the incidence of okra insect pests in semi-arid condition. *National conference: Plat Protection New Horizons in the Millennium held at Udaipur from Feb.,* 23-25: pp.7.

Parmar, K.D., Korat, D.M., Joshi, M.N., Patel, A.R. and Shah 2013. Relative bio-efficacy of insecticides/miticides against pest complex of okra. *Karnataka Journal of Agricultural Science,* **26**(3): 375-378.

Patel, B.S. 1988. Population dynamics and control of insect pests on okra (*Abelmoschus esculentus* L.) M. Sc. (Agri.) Thesis, G.A.U., Sardar Krushinagar.

Patel, H.M. 1989b. Biology of whitefly, *Bemisia tabaci (Genn.)* and population dynamics of insect pest on okra. M.Sc. (Agri.) Thesis, G.A.U., Sardar Krushinagar.

Patel, K.B.; Patel, M.B. and Patel, K.M. 2012. Reaction of various okra cultivars to

important sucking pests. *An International e-Journal,* **1** (3): 314-320**.**

Patil, S.R., Lande, G.K., Nikita, Awasthiand S. and Barkhade, U.P., 2014. Effect of different doses of newer insecticides against sucking pests of okra. *The Bioscan,* **9**(4):1597-1600.

Pawar, D.B.; Lawande, K.E. and Warade, S.D. 1996. Effect of different sowing dates on the incidence of leaf hopper, mite and fruit borer of okra. *Journal of Maharashtra Agriculture Universities,* **21**(3): 375-377.

Rai, S. and Satpathy, S. 1999. Influence of sowing date and insecticides on the incidence of jassid and fruit borer on okra. *Vegetable Science,* **26**(1): 74-77.

Rana, B.S. 2014. Studies on the effectiveness of some insecticides against insect pests of Bhindi, Abelmoschus esculentus (L.) Moench, M.Sc. Thesis, submitted to Mohanlal Sukhadia University, Udaipur.

Rohini 2012. Evaluated that fipronil 5 SC @2 ml/lit and imidacloprid 17.8 SL @ 0.4 l/lit were found effective against jassid, whereas, thimethoxam 5 SG @0.2 g/lit was effective against whitefly on cotton.

Rehman, A.U.; Muhammad, R. and Muhammad, W. 2015. Incidence and population dynamics of leaf Hopper, *Amrasca bigutulla bigutulla* (Cicadellidae: Homoptera) on four varieties of okra (*Abelmoschus esculentus*) crop in Multan, Pakistan. *Pakistan Journal of Zoology*, **47**(3): 763-767.

Satpathy, S. and Rai, S. 1998. Influence of sowing date and crop phenology on pest infestation in okra. *Vegetable Science,* **25** (2): 178-180.

Sharma, R. and Jat, B.L. 2010. Effect of abiotic factors on the incidence of shoot and fruit borer, *Earias spp*. on okra [*Abelmoschus esculentus* L.) Moench]. National Conference on plant Protection in Agriculture through Ecofriendly techniques and Traditional Farming Practices Feb. 18-20, 2010 at ARS, Durgapura, Jaipur, pp. 44.

Sharma, R. and B.L. Jat 2009. Screening of okra varieties for resistance against shoot and fruit borer, *Earias* spp. *Indian Journal of Plant Protection*, **37**(1/2): 178-180.

Sharma, R.P., Swaminathan, R. and Bhati, K.K. 2010.Seasonal incidence of fruit and shoot borer of okra along with climatic factors in Udaipur region of India. *Asian Journal of Agricultural Research,* **4**(4): 232-236.

Shinde, S.T., Shetgarm S.S. and Badgujar, A.G. 2011. Bio-efficacy of different insecticides against major pests of okra. *Journal of Entomological Research,* **35** (2): 133-137.

Singh, Y.; Jha, A.; Verma, S.; Misra, V.K. and Singh, S.S. 2013. Population dynamics of sucking insect pests and its natural enemies on okra agro-ecosystem in chitrakoot region. *African Journal of Agricultural Research*, **8**(28): 3814-3819.

Srinivasan, K.; Krishnakumar, N. K.; Ramchander, P. R. and Rao, G. S. P. 1988. Seasonal pattern of leaf hopper, *Amrasca biguttula biguttula* Ishida on okra in India. *Insect Science*, **9**(1): 58-88.

Umrao, R.S., Singh, S., Kunar, J, Singh, D.R. and Singh, D.K. 2013. Efficacy of novel insecticides against shoot and fruit borer, *Earias vitella* in okra crop. *Horticulture Flora Research Spectrum*, **2**(3): 251-245.

Verma, T. Dhankhar, S.K. and Sing, R. 2013. Screening of okra genotypes against leafhopper and shoot and fruit borer, *Annals of Agri-Bio Research*. **18**(2) : 247-249.

Yadav, J.B., Singh, R.S. and Tropathi, R.A. 2007. Effect of weather parameters on incidence of pest complex of okra. *Annals of Plant Protection Sciences*, **15**(2): 477-478.

Yadav, S.S. 2015. Management of major insect of okra, *Abelmoschus esculentus* (L.) Moench with special reference to biorational practices. Ph.D. Thesis submitted to S.K.N. Agriculture University, Jobner.

Management of Major Arthropod Pests of Summer Okra

Vinayak Narayan Jalgaonkar* **Dr. M. K. Mahla****

(Ph.D. Scholar) **(Major Advisor)**

ABSTRACT

Investigation on "Management of Major Arthropod Pests of Summer Okra" was conducted during summer 2016 and 2017 at RARS, Karjat, Dr. BSKKV Dapoli District Ratnagiri, Maharashtra. Among nine genotypes/ varieties of okra, none of the cultivars was found to be free from pest infestation in the both year. The highest jassids population was found in variety Parbhani Kranti (21.68 jassids); whereas, variety Arka Anamika showed less jassids population (14.54). The highest aphids population was found in variety Varsha Upahar (16.88 aphids); whereas, variety Punjab Padmini showed less aphids population (12.79). The maximum whitefly population was found in variety Varsha Uphar (7.72 whitefly); whereas, variety Akola Bahar showed minimum whitefly population (4.77). The minimum shoot damage was recorded on variety Akola Bahar (14.87 per cent), whereas the maximum damage was recorded on Punjab Padmini (25.68 per cent). The per cent fruit damage revealed that the infestated fruit damage ranged from 26.12 to 33.08 per cent on different genotypes/ varieties. The variety Akola Bahar recorded less damage (26.12 per cent) to fruits as compared to rest of the other varieties.

Okra crop was cultivated at 3 different sowing dates in year 2016 and 2017 during summer season (3rd week of January, 1st week of February and 3rd week of February).Considering the average data of two years, the incidence of jassids was recorded maximum population 22.74 jassids/ 3 leaves in 10th week after sowing in late sowing whereas it was recorded minimum in regular sowing *i.e.* 1.06 jassids/ 3 leaves in 4th week after sowing. In case of aphids the maximum population was recorded 19.78 aphids/ 3 leaves in 11th week after sowing in late sown crop. Regarding the whiteflies the maximum population was recorded 12.73 whitefly/3 leaves 11th week after sowing in late sown crop. In case of shoot and fruit borer the maximum shoot and fruit borer infestation was recorded 33.70 per cent in 9th week after sowing in late sown crop.

* Ph.D. Scholar, Department of Entomology, RCA, MPUAT, Udaipur (Raj.)
** Head., Department of Entomology, RCA, MPUAT, Udaipur (Raj.)

Regarding the population dynamics of the major arthopods, the maximum jassids, aphids whitefly population and shoot and fruit borer damage was recorded on fourth week of April (25.16 jassids / 3 leaves, 25.16 aphids / 3 leaves, 9.96 whitefly / 3 leaves and 22.46 per cent shoot and fruit borer damage, respectively). Regarding correlation coefficient study between pest population and weather parameters indicated that RHE and BSS showed highly significant negative correlation, whereas, MaxT (0.753), showed significant positive correlation, with Shoot and fruit infestation.

Regarding the efficacy of some insecticide and biopestiside against major arthropods all the treatments were significantly superior over control. Treatment T3 (1st spray Thiamethoxam 25% WG and 2nd spray Thiodicarb 75% WP was found effective treatment for management of aphids, jassids and whitefly whereas Treatment T5 (Spiromesifen 22.9% SC 1st spray and 2nd spray Thiodicarb 75% WP and 3rd spray Emamectin Benzoate 5% SG) was found effective for management of shoot and fruit borer infestation (weight as well as number basis).The maximum yield was also recorded in Treatment T5.

xzh"edkyhu fHk.Mh esa eq[; vkFkksZiksM uk'khdhVksa dk çcU/ku

fouk;d ukjk;.k tkyxkodj* ¼fo|kokpLifr 'kks/kdrkZ½

M,- ,e- ds- esgyk** ¼eq[; lykgdkj½

vuq{ksi.k

xzh"e _rq esa o"kZ 2016 ,oa 2017 esa vkj-,-vkj-,l- djtr] MkW- ckyklkgsc lkoar dksd.k Ñf"k fo|kihB nkiksyh egkjk"Vª esa ^^xzh"edkyhu fHk.Mh esa eq[; vkFkksZiksM uk'khdhVksa dk çcU/ku** ij vUos"k.k fd;k x;kA nksuksa o"kksZa eas fHk.Mh dh 9 fdLeksa esa ls dksbZ Hkh fdLe uk'khdhVksa ds vkØe.k ls eqDr ugha jghA fdLe ijHk.kh ØkfUr ij lokZf/kd tSflM ¼21-68½ tcfd fdLe vdkZ vukfedk ij lcls de tSflM ¼14-54½ çdksi ik;k x;kA fdLe o"kkZ migkj ij lokZf/kd ,fQM ¼16-88½ tcfd fdLe iatkc in~feuh ij lcls de ,fQM
¼12-79½ çdksi ns[kk x;kA fdLe o"kkZ migkj ij lokZf/kd lQsn eD[kh ¼7-72½ tcfd vkdksyk cgkj ij lcls de lQsn eD[kh ¼4-77½ dk çdksi ns[kk x;kA fHk.Mh fdLe vkdksyk cgkj esa lcls de ruk vkSj Qy Nsnd dhVd çdksi ¼14-87 çfr'kr½ tcfd iatkc in~feuh esa lokZf/kd ¼25-68 çfr'kr½ çdksi ntZ fd;k x;kA fHk.Mh dh fofHkUu fdLeksa Qy {kfr 26-12 ls 33-08 çfr'kr ntZ dh xbZA fHk.Mh fdLe vkdksyk cgkj esa vU; fdLeksa dh rqyuk esa de Qy {kfr ¼26-12 çfr'kr½ ntZ dh xbZA

fHk.Mh dh Qly o"kZ 2016 ,oa 2017 esa xzh"e _rq esa rhu fofHkUu le; ij cksbZ xbZ ¼tuojh dk rhljk lIrkg] Qjojh dk igyk lIrkg ,oa Qjojh dk rhljk lIrkg½A tSflM dh lokZf/kd la[;k ¼22-74 tSflM@3 iÙkh½ cqokbZ ds 10 lIrkg ckn tcfd lcls de la[;k ¼1-06 tSflM@3 iÙkh½ cqokbZ ds 4 lIrkg ckn ns[kh xbZA ,fQM dh lokZf/kd la[;k ¼19-78 ,fQM@3 iÙkh½ cqokbZ ds 11 lIrkg ckn ntZ dh xbZ tcfd

---

* fo|kokpLifr 'kks/kdrkZ] dhV foKku foHkkx] jktLFkku Ñf"k egkfo|ky;] ,e-ih-;w-,-Vh-] mn;iqj ¼jkt-½

** vkpk;Z] dhV foKku foHkkx] jktLFkku Ñf"k egkfo|ky;] ,e-ih-;w-,-Vh-] mn;iqj ¼jkt-½

lQsn eD[kh dh lokZf/kd la[;k ¼12-73 lQsn eD[kh@3 iÙkh½ cqokbZ ds 11 lIrkg ckn nsjh ls cqokbZ dh xbZ Qly esa ntZ dh xbZA ruk o Qy Nsnd dk lokZf/kd vkØe.k ¼33-70 çfr'kr½ nsjh ls cqokbZ dh xbZ Qly esa cqokbZ ds 9osa lIrkg i'pkr~ ns[kk x;kA

eq[; vkFkksZiksM+ uk'khdhVksa ds _rqfu"B vkiru ds Øe esa vçSyds pkSFks lIrkg esa tSflM ¼25-16 tSflM@3 iÙkh½] ,fQM ¼25-16 ,fQM@3 iÙkh½ rFkk lQsn eD[kh ¼9-96 lQsn eD[kh@3 iÙkh½ ntZ fd;k x;k tcfd QyNsnd }kjk dh x;h {kfr 22-46 çfr'kr ntZ dh xbZA 'kke dh visf{kr vkæZrk ,oa çdk'k vof/k dk uk'khdhVksa dh la[;k ij _.kkRed lglaca/k ik;k x;k tcfd ruk ,oa QysNnd ds lkFk vf/kdre rkieku dk /kukRed lglaca/k ik;k x;kA

fofHkUu dhVukf'k;ksa ,oa tSoihM+dukf'k;ksa dh çHkko'khyrk dk eq[; uk'khdhV vkFkksZiksM ij fd;k x;k v/;;u ;g n'kkZrk gS fd lHkh dhVuk'kh ,oa tSo ihM+duk'kh dk çHkko vuqipkfjr fu;a=.k ls vf/kd jgkA ,fQM] tSflM ,oa lQsn eD[kh ds çcU/ku gsrq FkkbfeFkksDtkse 25 çfr'kr MCY;w-th dk igyk fNM+dko ,oa Fkk;ksfMdkcZ 75 çfr'kr MCY;w-ih dk nwljk fNM+dko lcls T;knk çHkkoh tcfd LikbjksesflQsu 22-9 çfr'kr ,l-lh- dk igyk fNM+dko] Fkk;ksfMdkcZ 75 çfr'kr MCY;w-ih- dk nwljk fNM+dko ,oa bekesfDVu csUtks,V 5 çfr'kr ,l-th- dk rhljk fNM+dko ruk ,oa Qy Nsnd ds çcU/ku gsrq lcls mi;qDr ik;k x;k rFkk blh mipkj esa lcls T;knk mit çkIr gqbZA

Appendix I

Mean weekly weather data for *Summer season,* during, 2016 at Karjat

Week	Maximum(I)	Minimum(I)	R.H. (I)	R.H. (II)	Sunshine	Rainfall	Jassids	Aphid	Whitefly	Shoot & fruit borer
9th SMW	37.60	18.10	92.00	34.10	9.30	0.00	10.89	8.89	2.68	6.38
10th SMW	38.30	15.70	90.40	32.90	9.70	0.00	15.29	9.65	3.54	8.00
11th SMW	38.10	18.10	96.70	33.70	10.20	0.00	18.86	12.07	5.83	10.51
12th SMW	40.50	18.80	72.40	17.60	10.20	0.00	20.93	15.29	6.97	13.99
13th SMW	40.50	19.80	81.00	18.30	10.10	0.00	22.36	18.44	6.40	16.75
14th SMW	39.20	21.70	87.10	25.90	9.40	0.00	26.33	20.93	7.29	17.04
15th SMW	41.60	21.40	80.40	18.10	10.30	0.00	29.68	24.59	8.47	19.76

16th SMW	40.30	22.40	82.60	28.40	9.50	0.00	32.66	26.10	9.12	23.63
17th SMW	39.00	22.60	80.30	24.90	9.60	0.00	27.23	23.83	8.26	18.14
18th SMW	40.60	22.60	83.40	27.70	9.30	0.00	20.93	18.12	7.81	16.80
19th SMW	39.40	23.90	74.60	40.10	8.20	2.20	16.60	10.24	5.67	15.50
20th SMW	40.10	26.10	81.60	37.70	7.70	4.10	12.26	7.21	4.27	12.38
21st SMW	37.50	27.00	75.40	43.00	9.50	4.10	7.28	5.28	2.86	9.05

Appendix II

Mean weekly weather data for *Summer season,* during, 2017 at Karjat

Week	Maximum (I)	Minimum (I)	R.H. (I)	R.H. (II)	Sunshine	Rainfall	Jassids	Aphid	Whitefly	Shoot & fruit borer
9th SMW	40.00	16.20	60.10	12.70	8.90	0.00	12.07	7.30	2.86	4.76
10th SMW	36.10	16.80	64.30	21.70	9.10	0.00	14.27	10.96	3.20	5.91
11th SMW	37.00	17.40	63.30	15.40	9.30	0.00	16.36	11.60	4.16	8.06
12th SMW	35.80	19.40	69.40	18.00	8.90	0.00	19.56	14.26	6.23	10.55
13th SMW	41.60	24.30	70.60	29.90	7.50	0.00	20.93	16.20	6.47	12.92
14th SMW	38.70	21.80	73.60	26.00	8.10	0.00	21.44	20.93	7.26	14.60
15th SMW	42.90	22.70	65.90	18.30	8.10	0.00	24.06	22.36	8.29	19.26
16th SMW	41.40	23.50	72.90	24.90	7.80	0.00	26.33	24.22	10.80	21.29
17th SMW	39.10	23.20	70.90	26.00	7.30	0.00	20.12	20.93	9.69	24.48
18th SMW	40.30	25.20	72.70	32.40	5.70	0.00	18.66	16.20	8.48	20.86
19th SMW	40.40	25.60	67.90	30.60	7.10	0.00	12.06	12.44	7.33	17.33
20th SMW	39.20	24.20	69.90	38.10	8.60	0.00	9.47	8.43	5.21	15.33
21th SMW	39.60	26.30	69.60	37.70	7.80	0.00	4.38	3.62	1.48	8.72