*Int.J.Curr.Microbiol.App.Sci* (2020) Special Issue-11: 2561-2569

*International Journal of Current Microbiology and Applied Sciences*
*ISSN: 2319-7706* **Special Issue-11 pp. 2561-2569**
Journal homepage: http://www.ijcmas.com

**Original Research Article**

# Bio-efficacy of Different Insecticides against of Major Defoliators on Soybean

**A. S. Sapekar, M. M. Sonkamble and Y. B. Matre***

Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani - 431 402, Maharashtra, India
**Corresponding author*

## A B S T R A C T

With a view to find out the relative bio-efficacy of different insecticides against major defoliators on soybean the field experiments was carried out at the farm of Cotton Research Scheme, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra during kharif season 2019, bio-efficacy of different insecticides against major defoliators on soybean and its management In efficacy experiment Flubendiamide 39.35% SC @ 3 ml superior insecticide amongst treatments which gives maximum protection against semilooper with 1.22 larvae / mrl and it was followed by Spinosad 45% SC @4 ml, Chlorantraniliprole 18.5% SC @ 3 ml and Lambda-cyhalothrin 5% CS @ 6 ml with larval population of 1.88, 2.28 and 2.51 larvae per mrl respectively. The maximum larval population of semilooper was recorded in untreated control regarding 5.58 larvae / mrl. Among the insecticide least effective treatments are Fenpropathrin 30% EC @ 5 ml, Cyanatraniliprole 10.26% OD @ 12 ml and Profenofos 50% EC @ 20 ml which recorded population of 3.34, 2.98 and 2.8 larvae per mrl respectively. Flubendiamide 39.35% SC @ 3 ml best insecticide amongst all treatments which gives maximum protection against tobacco leaf eating caterpillar with 0.82 larvae / mrl, and it was followed by Spinosad 45% SC @4 ml, Chlorantraniliprole 18.5% SC @ 3 ml and Lambda-cyhalothrin 5% CS @ 6 ml with larval population of 1.01, 1.22 and 1.31 larvae per mrl respectively. The highest population of Tobacco leaf eating caterpillar was recorded in untreated control regarding 2.53 larvae/mrl. Among the insecticide least effective treatments are Fenpropathrin 30% EC @ 5 ml, Cyanatraniliprole 10.26% OD @ 12 ml and Profenofos 50% EC @ 20 ml which recorded population of 1.82, 1.59 and 1.43 larvae per mrl respectively. Flubendiamide 39.35% SC @ 3 ml superior insecticide amongst all treatments which gives maximum protection against American bollwarm with 0.92 larvae / mrl, and it was followed by Spinosad 45% SC @4 ml, Chlorantraniliprole 18.5% SC @ 3 ml and Lambda-cyhalothrin 5% CS @ 6 ml which larval population of 1.12, 1.29 and 1.49 larvae per mrl respectively. The maximum larval population of american bollworm was recorded in untreated control 3.81 larvae / mrl. Among the insecticide least effective treatments are Fenpropathrin 30% EC @ 5 ml, Cyanatraniliprole 10.26% OD @ 12 ml and Profenofos 50% EC @ 20 ml which recorded population of 2.04, 1.84 and 1.68 larvae per mrl respectively. Flubendiamide 39.35% SC @ 3 ml best insecticide amongst all treatments which gives maximum protection against bihar hairy caterpillar 0.81 larvae / mrl, and it was followed by Spinosad 45% SC @4 ml, Chlorantraniliprole 18.5% SC @ 3 ml and Lambda-cyhalothrin 5% CS @ 6 ml with larval population of 0.94, 1.06 and 1.20 larvae per mrl respectively. The highest population of Tobacco leaf eating caterpillar was recorded in untreated control 3.78 larvae / mrl. Among the insecticide least effective treatments are Fenpropathrin 30% EC @ 5 ml, Cyanatraniliprole 10.26% OD @ 12 ml and Profenofos 50% EC @ 20 ml which recorded population of 1.67, 1.51 and 1.39 larvae per mrl respectively.

**Keywords**

Soybean, bio-efficacy, insecticides, tobacco leaf eating caterpillar, S. litura, insecticides etc

## Introduction

Soybean is a wonder crop of twentieth century. It is two dimensional crops as it contains about 40 percent high quality protein and 20-22 percent oil besides minerals and vitamins. It ranks first among the oilseeds in the world as well as in India. In India it is grown on 101.56 Lakh ha with the production of 83.50 Lakh metric tons and an average yield of 822 kg per ha. Soybean accounts more than is 34.48 lakh ha total area under cultivation with production of 29.0 Lakh metric tons and productivity 841 kg per ha in Maharashtra, (Anonymous, 2017) [1]. Average yield of Soybean is much lower than global average yield and major reason for this low yield is attack of insect pest. In Marathwada region of Maharashtra, about 19 different species of insect pests have been reported on soybean. The important ones are leaf miner (*Aproaerema modicella*, Deventer), stem fly (*Melanagromyza sojae*, Zehntner), girdle beetle (*Obereopsis brevis*, Gahan), leaf eating caterpillar (*Spodoptera litura*, Fabricius) and green semilooper (*Chrysodeixisacuta*) (Munde, 1982) [2]. These insect are causing appreciable loss to the crop therefore growing resistant varieties is the better option which can help to minimize the cost of pest management. Present investigation was undertaken to screen some of the promising soybean cultivar lines for their resistance against major pests of soybean.

India ranks fifth in area of soybean in the world after USA, Brazil, Argentina and China. Soybean has become an important oilseed crop in India in a very short period with 107.61 lakh ha area under its cultivation during *kharif* 2019-20. According to the first advance estimates, Govt. of India, soybean production is estimated at 93.06 lakh tonnes during *kharif* 2019-20. In India, soybean during 2019-20 was 107.61 lakh hectares with 93.06 lakh tonnes as against 108.39 lakh hectares with 109.33 during 2018-19. Among the states, Maharashtra stand second in sowing area 37.36 lakh ha with 39.41 lakh tonnes production after Madhya Pradesh area 51.95 and 40.10 production followed by Rajasthan, Karnataka and Andhra Pradesh 9.62, 3.30 and 1.78 area and 6.56, 2.69, 1.50 respectively (sopa.org).

The tobacco caterpillar, *Spodoptera litura* (Fab) is a serious and regular pest in soybean. It damages soybean from mid August to October in *kharif* and from November to March in *rabi*. After damaging the leaves, they start feeding on younger parts, subsequently damaging 30 to 50 per cent of the pods. Heavy infestation of leaf miner plant growth retards reduces pod number and grains become shrivelled. Consequently, reduces yield up to 50%. (www.ikisan.com).

## Materials and Methods

In order to study bio-efficacy of different insecticides against major defoliators on soybean and its management, the crop was sown at cotton research scheme, VNMKV, Parbhani *kharif* season 2019. The soybean crop variety MAUS-162 Soybean was cultivated and with all recommended package of practices recommended by VNMKV, Parbhani for raising the crop except insect-pest management grown in plot size of 5.2 x 3.5m keeping 45x5 cm spacing between row to row and plant to plant. Method of recording observations: the observation were recorded at weekly interval on 1. Defoliators: Observations on number of larvae of lepidopteran pests were recorded at three places of one meter row length (mrl). 2. Leaf miner: The ten plants were randomly selected from experimental plot. Number of leaflets, and number of larvae per plant were recorded.3 Girdle beetle: One meter row length was marked at 3 places. Healthy and

girdled plants were counted and percent infestation was calculated at the time of harvest.4.Stem fly**:** Seedling mortality – Total number of plants and number of plants succumbed to stem fly infestation /m at 3 places were recorded on 7-10 DAG and seedling mortality was expressed in percentage.5**.**Stem tunneling – Plant height and length of stem tunneled in 10 plants at physiological maturity were measured and expressed in percentage. Observations on defoliators were recorded one day before spraying and 3, 7 and 14 days after spraying at no. of larvae per meter row on 5 randomly selected rows from each net plot.

## Results and Discussion

### Bio-efficacy of different insecticides against Semilooper (*G. gemma, A. janata and C. acuta*) infesting on soybean

All insecticidal treatments found effective over untreated control. Pooled mean of semilooper14 DAS population was gradually increases slightly as compared to 7 days of larval population. From the data present in table 1 it was observed that Flubendiamide 39.35% SC @ 3 ml is superior insecticide amongst treatments which gives maximum protection recording 1.22 larvae / mrl and then followed by Spinosad 45% SC @ 4 ml, Chlorantraniliprole 18.5% SC @ 3 ml and Lambda-cyhalothrin 5% CS @ 6 ml which recorded larval population 1.88, 2.28 and 2.51 larvae per mrl respectively. The maximum larval population of semilooper was recorded in untreated control recording 5.58 larvae / mrl. Among the insecticides least effective treatments are, Fenpropathrin 30% EC @ 5 ml, Cyanatraniliprole 10.26% OD @ 12 ml and Profenofos 50% EC @ 20 ml which recorded 3.34, 2.98 and 2.8 larval population per mrl respectively. Chaudhary and Meghwal (2012)[3] reported that *Chrysodeixisacuta* Walker minimum larval population (0.46 larva/mrl) was observed with Methomyl 40 SP 1.0 kg/ha followed by Spinosad 45 SC @ 187.5 ml/ha (0.50 larva/mrl) as compared to untreated control (3.38 larva/mrl). Ahirwar *et al.,* (2013) studied the control of larval population of *Chrysideixis acuta* Spinosad 45 SC exhibited significantly higher yield as compared to control. Sonkamble *et al.,* (2018)[4] studied that semilooper of soybean recorded spraying of Spinosad 45 SC @ 0.4 ml/lit significantly maximum reduction of population followed by chlorantraniliprole 18.5 EC at 3, 7 and 14 days respectively during both the years at first and second spraying. Present finding are in line with the findings of above workers.

### Bio-efficacy of different insecticides against larval population of *S. lituraon* soybean

All insecticidal treatments found effective over untreated control. Pooled mean of Tobacco leaf eating caterpillar 14 DAS population was gradually increases slightly as compared to 7 days of larval population. From the data presented in table 2. it was observed that Flubendiamide 39.35% SC @ 3 ml is superior insecticide amongst all treatments which gives maximum protection recorded 0.82 larvae / mrl. It was followed by Spinosad 45% SC @ 4 ml, Chlorantraniliprole 18.5% SC @ 3 ml and Lambda-cyhalothrin 5% CS @ 6 ml with recorded larval population 1.01, 1.22 and 1.31 larvae per mrl respectively. The maximum population of Tobacco leaf eating caterpillar was recorded in untreated control 2.53 larvae / mrl. Among the insecticides least effective treatments are, Fenpropathrin 30% EC @ 5 ml, Cyanatraniliprole 10.26% OD @ 12 ml and Profenofos 50% EC @ 20 ml which recorded population 1.82, 1.59 and 1.43 larvae per mrl respectively. Sonkamble *et al.,* (2018)[4]studied tobacco caterpillar of soybean recorded spraying of Spinosad 45

SC @ 0.4ml/lit significantly maximum reduction of population followed by chlorantraniliprole 18.5 EC at 3, 7 and 14 days respectively during both the years at first and second spraying. *S. litura* after first spray having minimum population of 0.29 larva/mrl, respectively and in after second spray 0.20larva/ meter row length was recorded.

Lakshman *et al.,* (2017)[5] results found that maximum percentage of larval reduction of *S. litura* was in flubendiamide 480SC @ 150 ml/ha followed by spinosad 48SC @ 150 ml/ha. Patil *et al.,* (2014) studied the management of *Spodoptera litura* (Fabricius) infesting soybean. Insecticides used in experiment chlorantraniliprole (30 g.ai/ha), Spinosad (75 g.ai/ha) and Profenofos 50 % EC @ 500 g.ai/ha were found effective.

**Bio-efficacy of different insecticides against larvalpopulation of *H. armigera*on Soybean**

Data presented in table no. 15 all insecticidal treatments found effective over untreated control. Pooled mean of American bollworm 14 DAS population was gradually increases slightly as compared to 7 days of larval population. From the data presented in table 3, it was observed that Flubendiamide 39.35% SC @ 3 ml superior insecticide amongst all treatments which gives maximum protection recording 0.92 larvae / mrl, and it was followed by Spinosad 45% SC @ 4 ml, Chlorantraniliprole 18.5% SC @ 3 ml and Lambda-cyhalothrin 5% CS @ 6 ml which recorded larval population 1.12, 1.29 and 1.49 larvae per mrl respectively. The maximum larval population of American bollworm was recorded in untreated control recording 3.81 larvae / mrl. Among the insecticides least effective treatments are, Fenpropathrin 30% EC @ 5 ml, Cyanatraniliprole 10.26% OD @ 12 ml and Profenofos 50% EC @ 20 ml which recorded 2.04, 1.84 and 1.68 larval population per mrl respectively. Sinha (2009)[6] Flubendiamide 480 SC standard checks against *H. armigera* on soybean crops he found that Flubendiamide 480 SC when applied twice @ 90 g a.i./ha was most effective.

**Bio-efficacy of different insecticides against larval population Bihar hairy caterpillar *(Spilosoma oblique)* on Soybean**

All insecticidal treatments found effective over untreated control. Pooled mean of bihar hairy caterpillar 14 DAS population was gradually increases slightly as compared to 7 days of larval population. From the data presented in table 4 it was found that Flubendiamide 39.35% SC @ 3 ml is best insecticide amongst all treatments which gives maximum protection 0.81 larvae / mrl. It was followed by Spinosad 45% SC @ 4 ml, Chlorantraniliprole 18.5% SC @ 3 ml and Lambda-cyhalothrin 5% CS @ 6 ml which recorded larval population 0.94, 1.06 and 1.20 larvae per mrl respectively. The maximum population of bihar hairy caterpillar was recording in untreated control regarding 3.78 larvae / mrl.

Among the insecticides least effective treatments are, Fenpropathrin 30% EC @ 5 ml, Cyanatraniliprole 10.26% OD @ 12 ml and Profenofos 50% EC @ 20 ml which recorded 1.67, 1.51 and 1.39 larval population per mrl respectively. Mishra *et al.,* (2017)[7]found that Flubendiamide 48 SC most effective treatment against *S. oblique* followed by Indoxacarb 14.5 SC followed by Spinosad 45 SC. Patidar and Kumar (2018)[8] recorded that Chlorantraniliprole 18.5% SC and Flubendiamide 39.35% SC found most effectives on larval population of *S. oblique.* Present finding are in line with the findings of above workers.

**Table.1** Pooled mean of semilooper

| Sr. No | Treatment | Dose /10 lit. water | First spray mean | Second spray mean | Pooled mean |
|---|---|---|---|---|---|
| T1 | Fenpropathrin 30% EC | 5 | 3.86 (2.20) | 2.82 (1.94) | 3.34 (2.07) |
| T2 | Lambda-cyhalothrin 5% CS | 6 | 3.11 (2.01) | 1.91 (1.69) | 2.51 (1.85) |
| T3 | Spinosad 45% SC | 4 | 2.4 (1.83) | 1.36 (1.51) | 1.88 (1.67) |
| T4 | Profenofos 50% EC | 20 | 3.29 (2.05) | 2.31 (1.80) | 2.8 (1.92) |
| T5 | Cyanatraniliprole 10.26% OD | 12 | 3.47 (2.10) | 2.49 (1.85) | 2.98 (1.97) |
| T6 | Flubendiamide 39.35% SC | 3 | 2.07 (1.73) | 1.22 (1.46) | 1.22 (1.59) |
| T7 | Chlorantraniliprole 18.5% SC | 3 | 2.89 (1.95) | 1.67 (1.61) | 2.28 (1.78) |
| T8 | Water spray | - | 6.44 (2.72) | 4.73 (2.38) | 5.58 (2.55) |
| | **SE(m) ±** | | 0.21 | 0.16 | 0.18 |
| | **C. D.** | | 0.64 | 0.50 | 0.57 |
| | **C.V. (%)** | | 10.56 | 12.83 | 11.69 |

*Figures in parenthesis are square root transformed value

**Table.2** Mean pooled of *S. litura* on soybean

| Sr. No | Treatment | Dose /10 lit. water | First spray mean | Second spray mean | Pooled mean |
|---|---|---|---|---|---|
| T1 | Fenpropathrin 30% EC | 5 | 1.93 (1.70) | 1.71 (1.64) | 1.82 (1.67) |
| T2 | Lambda-cyhalothrin 5% CS | 6 | 1.49 (1.56) | 1.13 (1.45) | 1.31 (1.50) |
| T3 | Spinosad 45% SC | 4 | 1.13 (1.44) | 0.89 (1.37) | 1.01 (1.40) |
| T4 | Profenofos 50% EC | 20 | 1.60 (1.60) | 1.27 (1.50) | 1.43 (1.55) |
| T5 | Cyanatraniliprole 10.26% OD | 12 | 1.76 (1.65) | 1.42 (1.55) | 1.59 (1.60) |
| T6 | Flubendiamide 39.35% SC | 3 | 0.87 (1.35) | 0.78 (1.32) | 0.82 (1.33) |
| T7 | Chlorantraniliprole 18.5% SC | 3 | 1.42 (1.55) | 1.02 (1.41) | 1.22 (1.48) |
| T8 | Water spray | - | 2.67 (1.90) | 2.4 (1.84) | 2.53 (1.87) |
| | **SE(m) ±** | | 0.11 | 0.10 | 0.10 |
| | **C. D.** | | 0.33 | 0.29 | 0.31 |
| | **C.V. (%)** | | 12.32 | 12.57 | 12.44 |

*Figures in parenthesis are square root transformed value

**Table.3** Mean pooled of *H. armigera* on Soybean

| Sr. No | Treatment | Dose /10 lit. water | First spray mean | Second spray mean | Pooled mean |
|---|---|---|---|---|---|
| T1 | Fenpropathrin 30% EC | 5 | 2.09 (1.75) | 2.00 (1.72) | 2.04 (1.73) |
| T2 | Lambda-cyhalothrin 5% CS | 6 | 1.60 (1.60) | 1.38 (1.53) | 1.49 (1.56) |
| T3 | Spinosad 45% SC | 4 | 1.20 (1.47) | 1.04 (1.41) | 1.12 (1.44) |
| T4 | Profenofos 50% EC | 20 | 1.73 (1.64) | 1.64 (1.61) | 1.68 (1.62) |
| T5 | Cyanatraniliprole 10.26% OD | 12 | 1.91 (1.70) | 1.78 (1.65) | 1.84 (1.67) |
| T6 | Flubendiamide 39.35% SC | 3 | 0.96 (1.38) | 0.89 (1.35) | 0.92 (1.36) |
| T7 | Chlorantraniliprole 18.5% SC | 3 | 1.40 (1.54) | 1.18 (1.46) | 1.29 (1.50) |
| T8 | Water spray | - | 3.20 (2.05) | 4.42 (2.32) | 3.81 (2.18) |
| | **SE(m) ±** | | 0.12 | 0.12 | 0.12 |
| | **C. D.** | | 0.37 | 0.37 | 0.37 |
| | **C.V. (%)** | | 12.30 | 11.71 | 12.00 |

Figures in parenthesis are square root transformed value

**Table.4** Mean pooled of Bihar hairy caterpillar *(Spilosoma oblique)* on Soybean

| Sr. No | Treatment | Dose /10 lit. water | First spray mean | Second spray mean | Pooled mean |
|---|---|---|---|---|---|
| T1 | Fenpropathrin 30% EC | 5 | 1.62 (1.61) | 1.73 (1.65) | 1.67 (1.63) |
| T2 | Lambda-cyhalothrin 5% CS | 6 | 1.22 (1.48) | 1.18 (1.47) | 1.2 (1.47) |
| T3 | Spinosad 45% SC | 4 | 1.00 (1.41) | 0.89 (1.37) | 0.94 (1.39) |
| T4 | Profenofos 50% EC | 20 | 1.36 (1.52) | 1.42 (1.55) | 1.39 (1.53) |
| T5 | Cyanatraniliprole 10.26% OD | 12 | 1.44 (1.56) | 1.58 (1.60) | 1.51 (1.58) |
| T6 | Flubendiamide 39.35% SC | 3 | 0.91 (1.38) | 0.71 (1.30) | 0.81 (1.34) |
| T7 | Chlorantraniliprole 18.5% SC | 3 | 1.11 (1.45) | 1.02 (1.41) | 1.06 (1.43) |
| T8 | Water spray | - | 3.2 (2.04) | 4.36 (2.31) | 3.78 (2.17) |
| | **SE(m) ±** | | 0.11 | 0.1 | 0.10 |
| | **C. D.** | | 0.33 | 0.33 | 0.33 |
| | **C.V. (%)** | | 12.88 | 11.62 | 12.25 |

Figures in parenthesis are square root transformed value

**Table.5** Economics of different insecticides used for management of major defoliators on Soybean

| Tr. No | Treatments | Conc. | Yield (kg/ha) | Increase in yield over control (kg/ha) | Cost of treatment(Rs/ha) | | Total cost (Rs/ha) | Value of additional yield over untreated control (Rs/ha) | Net profit (Rs/ha) | ICBR | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cost of Insecticides for two spray (Rs/ha.) | Labour + Sprayer charges for three spraying | | | | | |
| T1 | Fenpropathrin 30% EC | 0.015 | 1600 | 480 | 450 | 1600 | 2050 | 18240 | 16190 | 1:7.89 | III |
| T2 | Lambda-cyhalothrin 5% CS | 0.003 | 1960 | 840 | 432 | 1600 | 2032 | 31920 | 29888 | 1:14.70 | I |
| T3 | Spinosad 45% SC | 0.010 | 2180 | 1060 | 7200 | 1600 | 8800 | 40280 | 31480 | 1:3.57 | VI |
| T4 | Profenofos 50% EC | 0.1 | 1800 | 680 | 1248 | 1600 | 2848 | 25840 | 22992 | 1:8.07 | II |
| T5 | Cyanatraniliprole 10.26% OD | 0.012 | 1760 | 640 | 13056 | 1600 | 14656 | 24320 | 9664 | 1:0.56 | VII |
| T6 | Flubendiamide 39.35% SC | 0.011 | 2260 | 1140 | 3900 | 1600 | 5500 | 43320 | 37820 | 1:6.87 | IV |
| T7 | Chlorantraniliprole 18.5% SC | 0.005 | 2040 | 920 | 5850 | 1600 | 7450 | 34960 | 27510 | 1:3.69 | V |
| T8 | Water spray | | 1120 | | | | | | | | |

### Effect of different insecticides on grain yield and incremental cost benefit ratio (ICBR) of soybean

The data presented in table regarding the yield of soybean grain revealed that the maximum yield obtained from plots treated Flubendiamide 39.35% SC @ 3 (2260 kg/ha), followed by Spinosad 45% SC @ 4 ml (2180 kg/ha), Chlorantraniliprole 18.5% SC @ 3 ml (2040kg/ha) and Lambda-cyhalothrin 5% CS @ 6 ml (1960kg/ha). Minimum yield obtained in untreated plots (1120kg/ha).

Among the insecticides treatments minimum yield are, Fenpropathrin 30% EC @ 5 ml, Cyanatraniliprole 10.26% OD @ 12 ml and Profenofos 50% EC @ 20 ml which recorded 1600kg/ha, 1760kg/ha and 1800kg/ha. Chaudhary *et al.*, (2013)[9]. Pooled seed yield data of *kharif* 2009 and 2010 further confirmed that treatment of Flubendiamide 480 SC @ 187.5 ml per ha was found maximum seed yield (1,962 kg/ha).

The economics of various insecticides (Table 5.) revealed that the highest (37820.00 Rs. /ha) net profit obtained in the treatment of Flubendiamide 39.35% SC followed by Spinosad 45% SC (31480.00 Rs./ha), Lambda-cyhalothrin 5% CS (29888.00 Rs. /ha), Chlorantraniliprole 18.5% SC (27510.00 Rs. /ha), Profenofos 50% EC (22992.00 Rs. /ha), Fenpropathrin 30% EC (16190.00 Rs. /ha) and Cyanatraniliprole 10.26% OD (9664.00 Rs. /ha).

Highest (1 :14.70) ICBR obtained from the plots treated Lambda-cyhalothrin 5% CS followed by Profenofos 50% EC (1 : 8.07), Fenpropathrin 30% EC (1: 7.89), Flubendiamide 39.35% SC (1 : 6.87), Chlorantraniliprole 18.5% SC (1 : 3.69) and Spinosad 45% SC (1 : 3.57). Cyanatraniliprole 10.26% OD treated plots noted (1: 0.56) ICBR.

### Acknowledgment

I am so lucky to have worked under the guidance of helpful personality Dr. M.M. Sonkamble My Guide and Assistant Professor, Department of Agril. Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. I would be more thankful to him for this excellent guide constant encouragement throughout the course of investigation.

### References

Anonymous (2019). Annual report, All India Coordinated Research Project on Soybean, VNMKV, Parbhani. pp.66-68.

Chaudhary, H. R., and Meghwal, H. P. (2012). Bioefficacy of rynaxypyr and spinosad against green semilooper, *Chrysodexis acuta* Walker on soybean. *Indian Journal of Entomology*, 74(4): 323-325.

Chaudhary, H. R., Chaman J., Meena, V. R., Meghwal, H. P., Meena, D. S., Mahawar, R. K., and Ali, M. (2013). Bio-efficacy and optimization of effective dose of flubendiamide against green semilooper (*Chrysodeixis acuta* Walker) on Soybean. *Soybean Research*, 11(2): 91-98.

Lakshman, S. S., Godke1, M. K., and Basappa, H. (2017). Efficacy of newer insecticides against *Spodoptera litura* in sunflower (*Helianthus annuus* L.). *Journal of Oilseeds Research*, 34(4): 259-260.

Mishra, S. K., Vikas G., and Saraf, R. K. (2017). Evaluating the efficacy of novel insecticides against Bihar hairy caterpillar, *Spilosoma obliqua* Walker (Lepidoptera: Arctiidae) in soybean crop. *International journal of plant protection*, 10(2): 241-246.

Munde D. R. (1982). Insect pests complex on soybean in Marathwada region. *Journal of Maharashtra Agricultural Universities.* 5(3): 259-261.

Patidar, G., and kumar, A. (2018). Efficacy of insecticides against *Bemisiatabaci* (Genn.) and *Spilosoma obilqua* (Wlk.) in black gram. *Indian journal of entomology*, 80(4): 1591-1595.

Sinha, D., Sahoo, A. K., and Sonkar, K. (2013). Bio-efficacy of Insecticides against Caterpillar Pests of Soybean Crop. *Research Journal of Agricultural* Science, 4: 609-611.

Sonkamble, M. M., Rana, B. S., and Dangi, N.L. (2018). Bio-efficacy of newer insecticides and neem derivatives against major insect pests of soybean. *Journal of Pharmacognosy and Phytochemistry*, 7(5): 356-361.