*J. Exp. Zool. India* Vol. 23, No. 2, pp. 1085-1089, 2020 | www.connectjournals.com/jez | *ISSN 0972-0030*

# EFFICACY OF NEWER INSECTICIDAL MOLECULES AGAINST DEFOLIATORS IN SUNFLOWER

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**(Received 21 February 2020, Revised 12 April 2020, Accepted 21 April 2020)**

**ABSTRACT : Studies on the field efficacy of newer molecules against defoliators [*Spilarctia obliqua* Walker, *Thysanoplusia orichalcea* (Fabricius) and *Spodoptrea litura* Fab.] in sunflower was carried out during *kharif* 2018. Two need-based foliar applications of insecticides at 45 and 65 days after sowing were given. All the treatments rendered significant suppression of defoliator insect pests compared to untreated control. Among the newer molecule treatments minimum population was recorded in chlorantraniliprole 18.5 SC @ 0.2 ml/l, cyantraniliprole 10.26 OD @ 0.3 ml/l and spinetoram 11.7 SC @ 0.5 ml/l, which were significantly superior in recording the lowest population and the next best treatment were fipronil 5 SC @ 1.0 ml/l, chlorfenapyr 10 SC @ 2.0 ml/l and lambda-cyhalothrin 5 EC @ 1.0 ml/ and were found significantly superior over by tolfenpyrad 15 EC @ 2.0 ml/l treated plot. The treatment chlorantraniliprole 18.5 SC @ 0.2 ml/l, cyantraniliprole 10.26 OD @ 0.3 ml/l recorded highest yield and net profit.**

***Key words :*** Chlorantraniliprole, cyantraniliprole, newer molecules, spinetoram, sunflower.

## INTRODUCTION

Sunflower (*Helianthus annuus* L.) is popularly known as "Surajmukhi" or "Sooryakanthi". In *Helianthus* genus there are 65 different species in which 14 species are annual plants (Andrew *et al*, 2013), it belongs to Order Asterales, Family: Asteraceae (Compositae). It is one of the important annual vegetable oilseed crops. Sunflower is originated in the southern part of USA and Mexico. In 3000 B.C. Native Americans domesticated this crop. By the Russian Federation in the late 1800s the sunflower crop was introduced, where it became a food crop. Sunflower has a wide range of applications in different fields such as the production of vegetable oil, in medicine, as feed stack, fuel and for aesthetic view. The allelopathic nature of sunflower is helpful to reduce the weed population.

Sunflower stands in the third position, after soybean and groundnut in the total production, among oilseed crops throughout the world. In India, the sunflower is cultivated in an area of 0.58 million hectares (m ha) with a total production of 0.43 m t and average productivity of 736 kg/ha. Karnataka, Maharashtra and Andhra Pradesh are the major sunflower producing states in India. It has cultivated in Karnataka over an area of 0.35 m ha with 0.26 m t production and 579 kg per ha productivity (Anonymous, 2017). It is a rich source of edible oil (40-52%) with good anti-cholesterol properties because of the presence of polyunsaturated fatty acids (55-65% linoleic acid and 20-30% oleic acid) (Joksimovic *et al*, 2006) and good nutritive value having 19.8 g protein, 51.1 g fat, 17.9 g carbohydrates and 28 g calcium for every 100 g of seed.

The productivity of sunflower crop is showing a declining trend in recent years, because of the fast spread of commercial crops like cotton, maize. The potential of the crop is exploited much in the being itself and therefore the country has lower yield level in the world because of many biotic and abiotic stresses. Within the biotic stresses, susceptibility to insect pests and diseases is one of the most important constraints. It serves as a host for a wide array of insect species. Though 251 insects and an acarine species have been reported on sunflower worldwide, sunflower crop has its own unique insect pest fauna based on the location (Rajamohan, 1976 and Rogers, 1992). Among them, nine are major pests and remaining as miner ones. Insect pests of sunflower are broadly classified as seedling pests, sucking pests, soil insects, defoliators and inflorescence pests (Basappa and Santhalakshmiprasad, 2005).

The defoliating insects are important pests of

sunflower (Rogers, 1992). In India 25 defoliator species of insect pests were reported to infest commercial growing sunflower crop, whereas in Karnataka they recorded the number of defoliator insect pests on sunflower at different phenological phases, of the crop, like cabbage semilooper, *Thysanoplusia orichalcea* Fabricius, tobacco cutworm, *Spodoptera litura* Fab., Bihar hairy caterpillar, *Spilarctia obliqua* Walker and the grasshoppers, *Attractomorpha crenulata* Fab. and *Cyrtacanthacris ranacea* (Stoll)], the weevils, *Myllocerus discolor* Fab., *M. dentifer* Fab., *M. viridanus* Fab. and *Ptochus ovulum* Fab. and the beetles, *Monolepta signata* Fab. *Aulocophora foveicollis* Lucas (Rajanna, 1995; Bilapate and Chakravarthy, 1999 and Jagadish *et al*, 2005). The loss in seed yield per hectare due to defoliators in a rain-fed sunflower crop was up to 58.06 per cent (Suhas *et al*, 1996). Considering the seriousness of the defoliator insect pests on sunflower crop which is grown in north Karnataka region and many newer molecules of insecticides for the pest management are available in different crops so that the present investigation was undertaken to understand about the defoliator insect pests in sunflower ecosystem and to develop management strategies with the above mention objective.

## MATERIALS AND METHODS

The experiment was conducted by growing popular sunflower hybrid KBSH-53 during *kharif* 2018 at the Main Agricultural Research Station, UAS, Dharwad to know the bio-efficacy of new insecticide molecules in the management of sunflower defoliator insect pests with special reference to Bihar hairy caterpillar. The field experiment was laid out in Randomized Block Design with three replications and eight treatments in plots, by maintaining a plot size of 3.0 × 3.0 m, leaving a gangway of one meter all around the plot, with a spacing of 60 × 30 cm. The crop was grown as per the recommended package of practices of UAS, Dharwad except for plant protection measures against target insects, the treatment details are given in Table 1.

The treatments were imposed with the help of high-volume knapsack sprayer using 650 liters of water spray fluid per hectare. The individual treatments were imposed twice at 45 days and 65 days old crop, when target insect pests, reached the ETL (Economic threshold level).

Observations were recorded on the number of sunflower defoliator caterpillars *viz., Spilarctia obliqua* and *Thysanoplusia orichalcea* from ten randomly selected and labeled plants from each treatment, at one day before and one, three and five days after first and second sprays *i.e*., at 45 and 65 days after sowing, respectively. Similarly, observations were also recorded on the number of sunflower defoliator caterpillars *viz., Spodoptera litura* from ten randomly selected and labeled plants from each treatment, at one day before and one, three, and five days after the second spray only *i.e*., at 65 days after sowing (since it appeared late in the crop).

Seed yield from each plot with respect to the treatments was recorded at harvest, and seed yield was expressed as q/ha, and also the cost economics of different treatments was computed.

## RESULTS AND DISCUSSION

### Management of Bihar hairy caterpillar, *Spilarctia obliqua*

The mean lowest larval population of *S. obliqua* was recorded in chlorantraniliprole 18.5 SC @ 0.2 ml/l (0.98 larvae/plant) and which was on par with cyantraniliprole 10.26 OD (1.16 larvae/plant) and spinetoram 11.7 SC @ 0.5 ml/l (1.41 larvae/plant)). The next best treatment was fipronil 5 SC @ 1.0 ml/l (1.79 larvae/plant). Among all the newer molecules the maximum population was recorded by tolfenpyrad 15 EC @ 2.0 ml/l (4.40 larvae/plant), during five days after spray (5 DAS). Similar trend was followed in second spray also, the chlorantraniliprole 18.5 SC @ 0.2 ml/l (0.77 larvae/plant), and which was on par with spinetoram 11.7 SC @ 0.5 ml/l (0.78 larvae/plant) and cyantraniliprole 10.26 OD (0.89 larvae/plant). All the treatments were found superior over untreated control (6.16 larvae/plant), (3.50 larvae/plant) during both sprays (Table 1). The present study is line with Muzammil *et al* (2017) evaluated new molecules and biopesticides on *S. obliqua*, they reported that the chlorantraniliprole 18.5 SC @ 0.15 ml/l and emamectin benzoate 5 SG @ 0.2 g/l were very effective in managing both *S. obliqua* which was on par with flubendiamide 480 SC @ 0.075 ml/l and spinosad 45 SC @ 0.15 ml/l. Ranjit (2015) evaluated new molecule against *S. obliqua*, under laboratory condition, rand reported that significantly highest larval mortality (90.33 to 96.16 %) of *S. obliqua* was noticed in chlorantraniliprole 20 SC 0.006 %, emamectin benzoate 5 WG 0.002 % and flubendiamide 20 WDG 0.006 % treatments, which was followed by flubendiamide 480 SC 0.0144 % (79.56 %) and spinosad 45 SC 0.014 % (75.71 %).

### Management of Green semilooper, *Thysanoplusia orichalcea* and *Spodoptera litura*

All the newer molecules were effective in reducing the larval population of *T. orichalcea* and *S. litura* over untreated control. Among the newer molecules

**Table 1 :** Efficacy of novel molecules against *Spiractia obliqua* under field condition during first and second sprays (*kharif* 2018).

| Treatments | Dosage | Number of larvae per plant at | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First spray (45 DAS) | | | | | Second spray (65 DAS) | | | | |
| | | 1 DBS | 1 DAS | 3 DAS | 5 DAS | Mean | 1 DBS | 1 DAS | 3 DAS | 5 DAS | Mean |
| Chlorantraniliprole 18.5 SC | 0.2 ml/l | 5.53 (2.45)$^{a}$ | 2.07 (1.59)$^{a}$ | 0.67 (1.06)$^{a}$ | 0.20 (0.84)$^{a}$ | 0.98(1.21)$^{a}$ | 2.83 (1.82)$^{a}$ | 1.00 (1.22)$^{a}$ | 0.77 (1.12)$^{a}$ | 0.50 (0.99)$^{a}$ | 0.77(1.12)$^{a}$ |
| Cyantraniliprole 10.26 OD | 0.3 ml/l | 5.83(2.50)$^{a}$ | 2.47 (1.72)$^{ab}$ | 0.73 (1.11)$^{a}$ | 0.27 (0.87)$^{a}$ | 1.16(1.29)$^{a}$ | 1.97 (1.56)$^{a}$ | 1.17 (1.29)$^{ab}$ | 0.83 (1.15)$^{a}$ | 0.67 (1.07)$^{a}$ | 0.89(1.18)$^{a}$ |
| Spinetoram 11.7 SC | 0.5 ml/l | 6.17 (2.57)$^{a}$ | 3.10 (1.89)$^{abc}$ | 0.80 (1.14)$^{a}$ | 0.33 (0.91)$^{a}$ | 1.41(1.38)$^{ab}$ | 2.63 (1.77)$^{a}$ | 1.07 (1.25)$^{ab}$ | 0.80 (1.14)$^{a}$ | 0.53 (1.01)$^{a}$ | 0.79(1.13)$^{a}$ |
| Tolfenpyrad 15 EC | 2.0 ml/l | 5.20 (2.34)$^{a}$ | 4.40(2.21)$^{c}$ | 2.33 (1.68)$^{c}$ | 1.30 (1.33)$^{c}$ | 2.68(1.78)$^{d}$ | 2.47 (1.72)$^{a}$ | 2.13 (1.62)$^{c}$ | 1.90 (1.54)$^{c}$ | 1.80 (1.51)$^{c}$ | 1.94(1.56)$^{c}$ |
| Fipronil 5 SC | 1.0 ml/l | 5.47 (2.44)$^{a}$ | 3.63 (2.03)$^{bc}$ | 1.20 (1.28)$^{ab}$ | 0.53 (1.01)$^{ab}$ | 1.79(1.51)$^{bc}$ | 2.00 (1.57)$^{a}$ | 1.50 (1.41)$^{abc}$ | 1.07 (1.24)$^{ab}$ | 0.90 (1.17)$^{ab}$ | 1.16(1.28)$^{ab}$ |
| Chlorfenapyr 10 SC | 2.0 ml/l | 5.60(2.46)$^{a}$ | 4.13 (2.15)$^{c}$ | 1.37 (1.36)$^{abc}$ | 0.77 (1.13)$^{bc}$ | 2.09(1.61)$^{cd}$ | 1.97 (1.55)$^{a}$ | 1.67 (1.46)$^{abc}$ | 1.30(1.33)$^{abc}$ | 1.40 (1.36)$^{bc}$ | 1.46(1.38)$^{ab}$ |
| Lambda cyhalothrin 5 EC | 1.0 ml/l | 5.23 (2.36)$^{a}$ | 4.23 (2.15)$^{c}$ | 1.87 (1.54)$^{bc}$ | 0.90 (1.18)$^{bc}$ | 2.33(1.68)$^{cd}$ | 2.07 (1.59)$^{a}$ | 1.87 (1.53)$^{bc}$ | 1.73 (1.49)$^{bc}$ | 1.43 (1.38)$^{bc}$ | 1.68(1.47)$^{bc}$ |
| Untreated control | - | 6.13 (2.58)$^{a}$ | 6.33 (2.60)$^{d}$ | 6.07 (2.56)$^{d}$ | 6.13 (2.57)$^{d}$ | 6.16(2.58)$^{e}$ | 3.05 (1.88)$^{a}$ | 3.32 (1.95)$^{d}$ | 3.42 (1.98)$^{d}$ | 3.52 (2.00)$^{d}$ | 3.50(2.00)$^{d}$ |
| S.Em.± | - | 0.18 | 0.13 | 0.10 | 0.07 | 0.07 | 0.12 | 0.09 | 0.08 | 0.09 | 0.08 |
| C.D. (p=0.05) | - | NS | 0.38 | 0.31 | 0.20 | 0.21 | NS | 0.26 | 0.25 | 0.28 | 0.24 |
| C.V. (%) | - | 12.57 | 10.55 | 12.08 | 9.39 | 9.21 | 12.00 | 10.20 | 10.26 | 12.01 | 10.02 |

DBS-Day Before Spray, DAS-Day After Spray, Figures in the parentheses are √x+0.5 transformed values.
In vertical columns, means followed by same letter do not differ significantly by DMRT (P = 0.05).

**Table 2 :** Efficacy of novel molecules against *Thysanoplusia orichalcea* under field condition during first and second sprays (*kharif* 2018).

| Treatments | Dosage | Number of larvae per plant at | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First spray (45 DAS) | | | | | Second spray (65 DAS) | | | | |
| | | 1 DBS | 1 DAS | 3 DAS | 5 DAS | Mean | 1 DBS | 1 DAS | 3 DAS | 5 DAS | Mean |
| Chlorantraniliprole 18.5 SC | 0.2 ml/l | 1.27 (1.32)$^{a}$ | 0.60 (1.05)$^{a}$ | 0.43 (0.96)$^{a}$ | 0.13 (0.8)$^{ab}$ | 0.39(0.94)$^{ab}$ | 0.57 (1.03)$^{a}$ | 0.37 (0.93)$^{ab}$ | 0.23 (0.86)$^{ab}$ | 0.20 (0.84)$^{ab}$ | 0.27(0.88)$^{ab}$ |
| Cyantraniliprole 10.26 OD | 0.3 ml/l | 1.00 (1.22)$^{a}$ | 0.47 (0.98)$^{a}$ | 0.40 (0.94)$^{a}$ | 0.10 (0.77)$^{a}$ | 0.32(0.91)$^{a}$ | 0.60 (1.05)$^{a}$ | 0.27 (0.88)$^{a}$ | 0.20 (0.84)$^{a}$ | 0.13 (0.8)$^{a}$ | 0.20(0.84)$^{a}$ |
| Spinetoram 11.7 SC | 0.5 ml/l | 1.10 (1.26)$^{a}$ | 0.67 (1.08)$^{ab}$ | 0.50 (1.00)$^{ab}$ | 0.17 (0.81)$^{ab}$ | 0.44(0.97)$^{abc}$ | 0.57 (1.03)$^{a}$ | 0.40 (0.95)$^{ab}$ | 0.30 (0.89)$^{abc}$ | 0.27 (0.87)$^{abc}$ | 0.32(0.91)$^{abc}$ |
| Tolfenpyrad 15 EC | 2.0 ml/l | 1.17 (1.29)$^{a}$ | 1.10 (1.26)$^{c}$ | 0.90 (1.18)$^{b}$ | 0.80 (1.14)$^{d}$ | 0.93(1.91)$^{e}$ | 0.63 (1.06)$^{a}$ | 0.60 (1.05)$^{b}$ | 0.58 (1.04)$^{d}$ | 0.53 (1.01)$^{d}$ | 0.57(1.04)$^{d}$ |
| Fipronil 5 SC | 1.0 ml/l | 1.10 (1.26)$^{a}$ | 0.70 (1.09)$^{ab}$ | 0.53 (1.01)$^{ab}$ | 0.37 (0.93)$^{bc}$ | 0.53(1.02)$^{bc}$ | 0.67 (1.07)$^{a}$ | 0.50 (1.00)$^{ab}$ | 0.47 (0.98)$^{abcd}$ | 0.40 (0.95)$^{bcd}$ | 0.46(0.98)$^{bcd}$ |
| Chlorfenapyr 10 SC | 2.0 ml/l | 1.07 (1.25)$^{a}$ | 0.77 (1.12)$^{abc}$ | 0.63 (1.06)$^{ab}$ | 0.43 (0.96)$^{c}$ | 0.61(1.05)$^{cd}$ | 0.60 (1.05)$^{a}$ | 0.53 (1.01)$^{ab}$ | 0.50(1.00)$^{bcd}$ | 0.43 (0.96)$^{bcd}$ | 0.48(0.99)$^{cd}$ |
| Lambda cyhalothrin 5 EC | 1.0 ml/l | 1.03 (1.24)$^{a}$ | 1.03 (1.24)$^{bc}$ | 0.77 (1.12)$^{ab}$ | 0.63 (1.06)$^{cd}$ | 0.81(1.14)$^{de}$ | 0.90 (1.18)$^{a}$ | 0.57 (1.02)$^{ab}$ | 0.53 (1.01)$^{cd}$ | 0.50 (1.00)$^{cd}$ | 0.53(1.01)$^{cd}$ |
| Untreated control | - | 1.47 (1.4)$^{a}$ | 1.80 (1.52)$^{d}$ | 1.83 (1.53)$^{c}$ | 1.97 (1.57)$^{e}$ | 1.94(1.56)$^{f}$ | 0.90 (1.18)$^{a}$ | 1.00 (1.21)$^{c}$ | 1.13 (1.28)$^{e}$ | 1.17 (1.29)$^{e}$ | 1.10(1.26)$^{e}$ |
| S.Em.± | - | 0.06 | 0.05 | 0.06 | 0.04 | 0.03 | 0.05 | 0.04 | 0.05 | 0.04 | 0.03 |
| C.D. (p=0.05) | - | NS | 0.15 | 0.18 | 0.13 | 0.10 | NS | 0.13 | 0.14 | 0.12 | 0.10 |
| C.V. (%) | - | 8.48 | 7.47 | 9.22 | 7.53 | 7.57 | 8.42 | 7.69 | 8.15 | 7.07 | 8.07 |

DBS-Day Before Spray, DAS-Day After Spray, Figures in the parentheses are √x+0.5 transformed values.
In vertical columns, means followed by the same letter do not differ significantly by DMRT (P=0.05).

cyantraniliprole 10.26 OD @ 0.3 ml/l treaded plot recorded the lowest larval population which was significantly superior and on par with chlorantraniliprole 18.5 SC @ 0.2 ml/l and spinetoram 11.7 SC @ 0.5 ml/l, followed by fipronil 5 SC @ 1.0 ml/l and chlorfenapyr 10 SC @ 2.0 ml/l. The highest population was recorded in tolfenpyrad 15 EC @ 2 ml/l at 5 DAS in both the first and second sprays, respectively (Tables 2 & 3). Natikar and Balikai (2015) documented that the Emamectin benzoate 5 SG was found to be the most toxic to *S. litura* with $LC_{50}$ value of 0.50 ppm followed by cyantraniliprole 10 OD (0.63 ppm), indoxacarb 15.8 EC (1.44 ppm), chlorantraniliprole 18.5 SC (2.26 ppm) and spinosad 45 SC (8.41 ppm).

## Effect of different treatments on seed yield (q/ha)

The seed yield of different treatments was statistically significant and varied from 18 to 22.96 quintal per hectare during *kharif* 2018. However, the maximum seed yield was recorded in chlorantraniliprole 18.5 SC @ 0.2 ml/l followed by cyantraniliprole 10.26 OD, spinetoram 11.7 SC @ 0.5 and the minimum seed yield was recorded in the untreated control. There was a variation in the seed yield level between treatments, which may be due to the effect of the newer molecule on defoliators.

## Cost economics of newer insecticides

The highest net profit and benefit-cost ratio were recorded highest in chlorantraniliprole 18 SC @ 0.2ml/l (2.69) and followed by and cyantraniliprole 10.26 OD (2.49) and spinetoram 11.7 SC @ 0.5 (2.32) recorded the maximum benefit: cost ratio and higher seed yield. The lowest cost-benefit ratio was found in tolfenpyrad 15 EC @ 2 ml/l treatment plot (1.73) (Table 4). Muzammil *et al* (2017) reported that among insecticides tested against defoliating insect pests on sunflower, the

**Table 3 :** Efficacy of novel molecules against *Spodoptera litura* under field condition during second spray (*kharif,* 2018).

| Treatments | Dosage | Number of larvae per plant at Second spray (65 DAS) | | | | Mean |
|---|---|---|---|---|---|---|
| | | 1 DBS | 1 DAS | 3 DAS | 5 DAS | |
| Chlorantraniliprole 18.5 SC | 0.2 ml/l | 0.24 (0.86)$^{a}$ | 0.13 (0.79)$^{ab}$ | 0.09 (0.77)$^{ab}$ | 0.04 (0.74)$^{ab}$ | 0.09(0.77) $^{ab}$ |
| Cyantranaliprole 10.26 OD | 0.3 ml/l | 0.27 (0.87)$^{a}$ | 0.09 (0.77)$^{a}$ | 0.04 (0.73)$^{a}$ | 0.01 (0.71)$^{a}$ | 0.04(0.74) $^{a}$ |
| Spinetoram 11.7 SC | 0.5 ml/l | 0.23 (0.85)$^{a}$ | 0.16 (0.81)$^{abc}$ | 0.12 (0.79)$^{abc}$ | 0.08 (0.76)$^{ab}$ | 0.12(0.79) $^{bc}$ |
| Tolfenpyrad 15 EC | 2.0 ml/l | 0.33 (0.91)$^{a}$ | 0.29 (0.89)$^{c}$ | 0.24 (0.86)$^{c}$ | 0.21 (0.84)$^{b}$ | 0.25(0.86) $^{e}$ |
| Fipronil 5 SC | 1.0 ml/l | 0.28 (0.88)$^{a}$ | 0.20(0.83)$^{abc}$ | 0.15 (0.81)$^{abc}$ | 0.10 (0.78)$^{ab}$ | 0.15(0.81) $^{bcd}$ |
| Chlorfenapyr 10 SC | 2.0 ml/l | 0.26 (0.87)$^{a}$ | 0.22(0.85)$^{abc}$ | 0.20 (0.83)$^{bc}$ | 0.14 (0.8)$^{ab}$ | 0.19(0.83) $^{cde}$ |
| Lambda cyhalothrin 5 EC | 1.0 ml/l | 0.30 (0.89)$^{a}$ | 0.24 (0.86)$^{bc}$ | 0.21 (0.84)$^{bc}$ | 0.16 (0.81)$^{ab}$ | 0.21(0.84) $^{de}$ |
| Untreated control | - | 0.40 (0.95)a | 0.47 (0.98)$^{d}$ | 0.48 (0.99)$^{d}$ | 0.55 (1.02)$^{c}$ | 0.53(1.01) $^{f}$ |
| S.Em.± | - | 0.04 | 0.03 | 0.03 | 0.04 | 0.01 |
| C.D. (p=0.05) | - | NS | 0.08 | 0.09 | 0.11 | 0.04 |
| C.V. (%) | - | 7.45 | 5.44 | 6.01 | 7.71 | 7.20 |

DBS-Day Before Spray, DAS-Day After Spray, Figures in the parentheses are $\sqrt{x+0.5}$ transformed values.
In vertical columns, means followed by the same letter do not differ significantly by DMRT (P=0.05).

**Table 4 :** Effect of insecticides on the seed yield and cost economics of sunflower.

| Treatments | Dosage | Yield (q/ha) | Total cost of cultivation* (Rs/ha) | Gross return ('Rs/ha) | Net returns (Rs/ha) | BC ratio |
|---|---|---|---|---|---|---|
| Chlorantraniliprole 18.5 SC | 0.2 ml/l | 22.96 | 21800 | 80370 | 58570 | 2.69 |
| Cyantraniliprole 10.26 OD | 0.3 ml/l | 21.44 | 21458 | 75056 | 53597 | 2.49 |
| Spinetoram 11.7 SC | 0.5 ml/l | 21.11 | 22625 | 73889 | 52430 | 2.32 |
| Tolfenpyrad 15 EC | 2.0 ml/l | 18.00 | 23000 | 63000 | 40000 | 1.73 |
| Fipronil 5 SC | 1.0 ml/l | 19.67 | 20875 | 68833 | 42125 | 2.02 |
| Chlorfenapyr 10 SC | 2.0 ml/l | 19.44 | 21840 | 68056 | 46215 | 2.12 |
| Lambda cyhalothrin 5 EC | 1.0 ml/l | 19.11 | 20390 | 66889 | 46499 | 2.28 |
| Untreated control | | 15.22 | 20000 | 53278 | 33278 | 1.66 |

Market price of sunflower= Rs 3500/q, Other expenditure = 20,000, * Cost of insecticide including application cost for two application also included

**Price of insecticides**

Chlorantraniliprole 18.5 SC- Rs 180/10 ml, Tolfenpyrad 15 EC – Rs 150/50 ml, Cyantraniliprole 10.26 OD- Rs 388.88/20 ml, Lambda cyhalothrin 5 EC –Rs 650/lit, Fipronil 5 SC - Rs 175/100 ml, Chlorfenapyr 10 SC- Rs 184/50 ml, Spinetoram 11.7 SC - Rs 1050/100 ml,

chlorantraniliprole 18 SC @ 0.2 ml/l (17.26 q/ha) and emamectin benzoate 5 SG @ 0.2 g/l (16.67 q/ha) flubendiamide 480 SC @ 0.075 ml/l (16.07 q/ha) and spinosad 45 SC @ 0.15 ml/l (11.71 q/ha) recorded the maximum seed yield and benefit : cost ratio.

## CONCLUSION

For the management of defoliator insect pests of sunflower, chlorantraniliprole 18.5 SC @ 0.2 ml/l, was on par with cyantraniliprole 10.26 OD @ 0.3 ml/l and spinetoram 11.7 SC @ 0.3 ml/l, which were found to be significantly superior over the other treatments in the management of *S. obliqua*, *T. orichalcea* and *S. litura*, which was followed by fipronil 5 SC @ 1 ml/l and the highest larval population was noticed in tolfenpyrad15 SC @ 2 ml/l treated plot.

The highest net profit and benefit: cost ratio was recorded in the case of chlorantraniliprole 18 SC @ 0.2 ml/l (2.69) and followed by and cyantraniliprole 10.26 OD (2.49) and spinetoram 11.7 SC @ 0.5 (2.32). Since, the usage of older insecticide molecules on defoliators is a nagging issue in the present situation, emphasis should be given on the newer molecules that could be successfully employed in the management of defoliators in sunflower.

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