Impact of Bifenthrin on Yellow Mite in Pepper Plants under Field Conditions at Wadi Al-Mollak, East Delta, Egypt

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ABSTRACT

Yellow mite, *Polyphagotarsonemus latus* (Banks) is the greatest destructive pest on pepper plants in Egypt. The efficacy of bifenthrin 25% EC against the yellow mite *Polyphagotarsonemus latus* (Banks) and its impact on natural enemies (predatory mites) were assessed through three field experiments conducted at Wadi Al-Mollak, East Delta, Egypt for three seasons. The treatments included bifenthrin applied at the rate of 40, 50, 60, 80, 100, 160 and 320g a.i.ha^{-1}compared with standard check dicofol at 290 g a.i.ha^{-1} and an untreated check. Obtained percentages of reduction in yellow and predatory mites were 1, 3, 5, 7, and 14 days after spraying. The initial population of mites/leaf before first spraying ranged from 3.83 to 4.91 in all the treatments without any significant difference. The dose of 80 g a.i.ha^{-1} of bifenthrin had a significant effect on the entire treatments units. The standard check dicofol at 290 g a.i.ha^{-1} recorded 71.81, 73.63 and 67.76% of reduction in mite population at first, second and third experiment after first spraying, respectively, and 74.76, 85.09 and 76.09% of reduction at first, second and third experiment after second spraying, respectively. The initial population of predatory mites, *Amblyseius ovalis* ranged from 0.70 to1.11 mites/leaf in the entire treatment. Dicofol at 290 g a.i.ha^{-1} caused the highest reduction of 49.77, 56.75 and 54.56 % in the first, second and third experiment, respectively. The lowest dose of bifenthrin at 40 g a.i.ha^{-1} was the least toxic treatment, The toxicity order for different bifenthrin doses against predatory mites and were 320 > 160 > 80 > 100 > 60 > 50 > 40 g a.i.ha-1. Dicofol was highly toxic to *A. ovalis* compared to bifenthrin treatments. Even after 14 days of spraying nearly 50% reduction was noticed in the case of dicofol. It can be conducted that bifenthrin was found to be relatively safer than dicofol because most likely due to its residues being longer than bifenthrin.

Keywords: Yellow Mite, Bifenthrin, Pepper, Egypt.

INTRODUCTION

The Solanaceae family is native to the Americas, including vegetables of peppers, tobaccos, potatoes, tomatoes and others. Sweet pepper (*Capsicum annuum* L.) is a vital agricultural crop with several varieties grown in Egypt (Ochoa-Alejo and Ramirez-Malagon, 2001; Aboshama, 2011; El Nagar, 2012). To date, pepper is used fresh or dried in various foods. Its nutritional properties as antioxidants are important for human nutrition (Mateos *et al.,* 2003; Orlinska and Nowaczyk, 2015). Furthermore, pepper is also a source for natural colours and as medicine (Zhuang, *et al.*, 2012).

Tarsonemidae is a large family of worldwide distribution. Many tarsonemid species are fungivores, algivores and herbivores and others are predators of other mites, parasites of insects and possibly symbionts of insects (Zhang, 2003). Though more than 20 insect and non-insect pests attack pepper plants, such as the yellow mite, which is also known as a broad mite, white mite and muranai mite, *Polyphagotarsonemus latus* (Banks) which is the most destructive among them (Alzoubi and Cobanogu, 2008). The major pests of this crop include several species of lepidopteran insects, whitefly, thrips, aphid and phytophagous mites, causing severe damages and substantial losses in crop yield (Srinivasan, 2009; Reddy and Miller, 2014). Since *P. latus* which is infesting different crops in Egypt has been recently raised to the pest status, the present work is intended to study the density of life cycle stages infesting six cultivars of pepper on a seasonal basis (Montasser *et al.*, 2011). *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae), yellow mite, is a dangerous insect of vegetable crops including pepper. It is known to cause leaf curling and limits the yield leading to huge economic losses (Monika *et al.*, 2017). *P. latus* mostly prefers the apical leaves or growing parts for their feeding and shelter on the internal surface of leaf surfaces. Young pepper plants have a particularly low tolerance for broad mite damage (Jovicich *et al.*, 2009). The nymphs and adults actively feed on the ventral surface of the tender leaves causing elongation and downward bending of the leaf lamina. Newly transplanted seedlings show typical boat-shaped curling of leaves. When flower buds are also damaged it results in heavy yield loss (Patavardhan *et al.*, 2021). If the mite infestation starts at the flowering stage and continues up to the fruiting stage of the crop, the crop may fail or gives only one or two pickings in the place

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of 8 to10 rounds of pickings leading to a 60-75% yield reduction in affected areas (Alpkent *et al.,* 2020). Susurluk and Gürkan (2020) reported that as few as ten mites per plant could cause characteristic injury symptoms. This mite, together with aphids and thrips, transmits serious diseases like leaf arm and mosaic viruses (Alpkent *et al.,* 2020). It is distributed throughout the world on more than 50 host plants including economically important ones like cotton, rubber, tea, citrus, tobacco, potato, beans, pepper, dahlias, zinnia and chrysanthemum (Kakkar *et al.,* 2016). Among the different species of *Amblyseius,* which are predaceous on yellow mite, *Amblyseius ovalis* (Evans) is the commonly occurring one on pepper. Ghazy *et al.* (2016) reported that *A. ovalis* effectively controlled *P. latus* by feeding on the eggs and larvae.

The commonly used conventional acaricides like dicofol, ethion, quinalphos, triazophos *etc.,* are not giving adequate control of this mite. The synthetic pyrethroids which were widely used in the control of lepidopterous pests on cotton and other crops because of their short residual action and lesser environmental pollution have been reported to induce the resurgence of mites (Alpkent *et al.,* 2020). However, bifenthrin has been reported to be effective against phytophagous mites. Henceforth, the present investigation was taken to study the efficacy of bifenthrin against *P. latus* and its impact on the natural enemies of yellow mite.

MATERIALS AND METHODS

Location and Description of field experiments

Three field experiments were conducted at Wadi Al-Mollak area, East Delta, Egypt to study the bioefficacy of bifenthrin 25 EC against the yellow mite *Polyphagotarsonemus latus* (Banks) and impacts on natural enemies. California wonder bell variety of sweet pepper (*Capsicum annuum* L.) was used for the three field experiments (Fig. 1). The California Wonder sweet bell pepper is an heirloom variety introduced in 1928 (Zhuang, *et al.,* 2012). Its fruit can be harvested while green or left to ripen to bright crimson red (Fig. 1). This variety is easy to grow because of its convenient resistance to the tobacco mosaic virus: a plus for beginner gardeners (El Nagar, 2012).

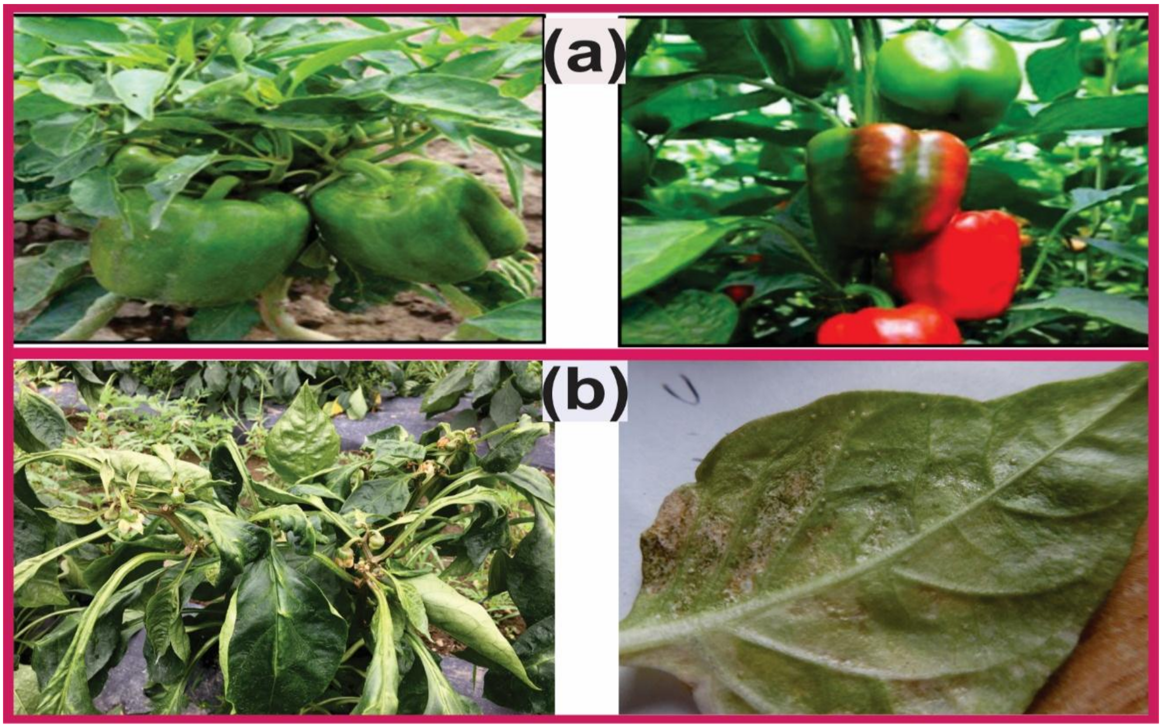

Fig. 1. California wonder variety of pepper utilized in the current field experiments. (a) Healthy and undamaged pepper plants; (b) Infested pepper plants by the yellow mite (*Polyphagotarsonemus latus*)

Three field experiments were conducted in three types of soils across the landscapes of Wadi Al-Mollak in the 2020 season (Fig. 2). Randomized block design (RBD) was followed in the field experiments with each treatment replicated thrice to test the bioefficacy against the yellow mite. The plot size was 4 x 5 m; each plot consisted of 8 rows with a spacing of 45 cm between rows and 30 cm between plants. Fifty-day-old seedlings were used for planting at the rate of one seedling per hole. The River Nile water was used to irrigated the variety of pepper that requires moderate watering to keep pepper plants healthy. The interval irrigation days were seven to ten days based on the hotness of the weather across the agricultural seasons. The pepper prefers well-drained sandy to loamy soils with a high amount of organic matter. A soil pH of between 6.2 and 7.0 keeps pepper plants healthy and nourished. Pepper grows best in warm weather since it's native to tropical and subtropical climates (Orlinska and Nowaczyk, 2015). Ideal temperatures are at least 21°C in the days and not below 15°C at night (El Nagar, 2012). It prefers partial shade in warm weather (Zhuang *et al.*, 2012).

Wadi Al-Mollak covers an area of 850 km^2 and is located in the east of Nile Delta, Suez Canal west, Egypt (Fig. 2). Wadi Al-Molak is an open drainage system that drains into the Nile Delta. It is located between 30° 14′ 30″ to 30° 34' 30″ North latitudes and 31° 39' 30″ to 32° 1' 45″ East longitudes (Fig. 2) and extends from the southeastern part of the mountains to the east of Nile Delta in the north of study area. It is characterized by an arid to a hyper-arid climate with dry summers and wet winters (Egyptian Meteorological Authority, 2020). The mean annual soil temperature varies from 21 to 37°C. The mean annual rainfall ranges from 21 to 39 mm. Relative humidity ranges from 45 to 57%, while the evaporation rate is very high (8-17 mm/day). Soils across all landscapes showed differences in particle size distribution. Clay loam was the most abundant textural class that occurred in the Nile old deltaic plain soils (Field experiment 1), followed by loam soils in the alluvial plain (Field experiment 2), and sandy loam in piedmont slope (Field experiment 3) as shown in fig. 2. Soil available water ranged from 35.7 to 57.2% in Nile old deltaic plain, 10.5-25.1% in bajada plain, 5.5-29.7% in alluvial plain (Elwan, 2018). Cation exchange capacity (CEC) increased downslope from 3.1 cmol (+)kg^{-1} in sandy loam soils to 60.5 cmol(+)kg^{-1} in the clay loam soils. Gypsum concentration was low (0.0-2.2%) (Elwan, 2018).

The first field experiment was performed on clay loam soils at Nile old deltaic plain of lowland during the spring season, while the second and third field experiments were achieved on loam soil at the alluvial plain of midland and sandy loam soil at a piedmont slope of upland during the summer and fall seasons, respectively as shown in Fig. (2).

Insecticides used

Chemical Name	Trade Name	International Union of Pure and Applied Chemistry, Name
Bifenthrin	Telecam® 25%EC	(2- methyl biphenyl –3-yl methyl (z) –(1RS, 3RS) – 3 – (2- chloro – 3, 3, 3 – trifluoropsrop - 1- enyl- 2, 2 dimethyl cyclo propane carboxylate).
Dicofol	Kelthane® 18.5 EC	2 , 2 , 2 – trichloro – 1, 1- bis (4- chlorophenyl) ethanol

Treatment details

Treatment	Dose of pesticide
T_1	Bifenthrin 25 EC 40 g a.i. per hectare
T_2	Bifenthrin 25 EC 50 g a.i. per hectare
T_3	Bifenthrin 25 EC 60 g a.i. per hectare
T_4	Bifenthrin 25 EC 80 g a.i. per hectare
T_5	Bifenthrin 25 EC 100 g a.i. per hectare
T_6	Bifenthrin 25 EC 160 g a.i. per hectare
T_7	Bifenthrin 25 EC 320 g a.i. per hectare
T_8 (Standard check)	Dicofol 18.5 EC @ 290 g a.i. per hectare
T_9 (Untreated check)	Control

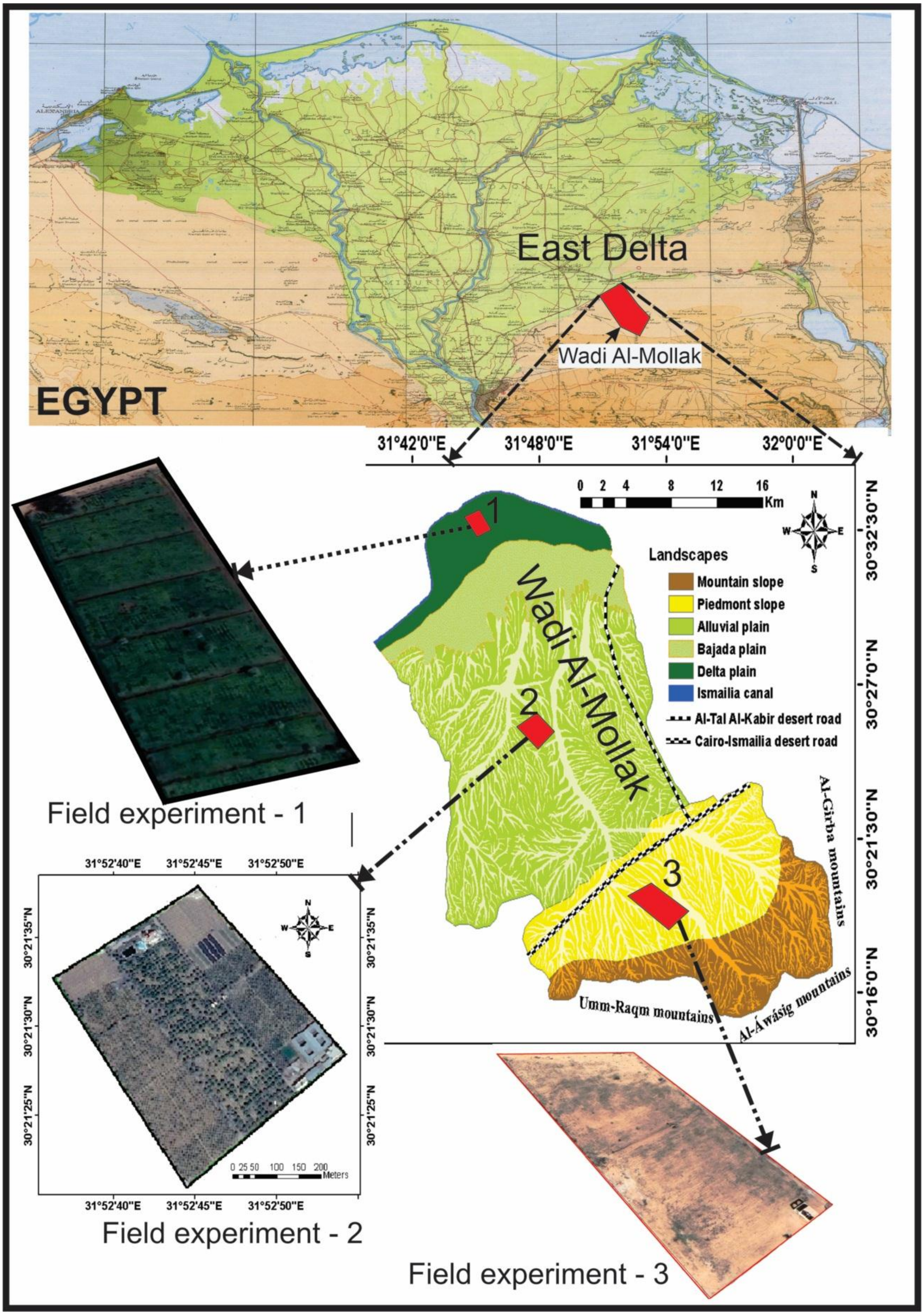

Fig. 2. Location of the three field experiments at Wadi Al-Mollak, East Delta, Egypt

Application of chemicals

The first spraying was given when the incidence of mite was noticed and the subsequent spraying was given after 15 days. The spray fluid was applied at 500 litre per hectare in all the sprayings. The data was taken on percent reduction in yellow mites and predatory mites after the first and second rounds of spraying at 1, 3, 5, 7 and 14 days after spraying (DAS).

Assessment of phytophagous mite population

The population of mites, both nymphs and adults were recorded in the morning by using a 10x hand lens. For this, five plants were selected at random in each plot and from each plant three-terminal leaves were observed for the mite population.

Assessment of predatory mite population

The population of predatory mites, both nymphs and adults were recorded as indicated above.

Statistical analysis

Data were analyzed using SPSS software for each treatment and replicates. Replication units for each treatment was measured as random effects in the model. The entire data of the treatment units were examined at the 5% level by DMRT. The corrected % reduction of phytophagous and predatory mite populations was carried out by using the Henderson and Tilton formula (Alzoubi and Cobanogu, 2008) as follows:

$$\text{Corrected reduction (\%)} = 1 - \frac{(Ta \times Cb)}{(Tb \times Ca)} \times 100$$

Where,

T_a is the mites number in the treated units after spraying, T_b is the mites number in the treated units before spraying, C_b is the mites number in the untreated unit (control) before spraying, C_a is the mites number in the untreated unit after spraying the different treatments. All the data expressed in per cent were transformed to arcsine values, while the data on pretreatment population were subjected to square root transformation and used for statistical analysis.

RESULTS AND DISCUSSION

The results of the present investigation on bioefficacy and impact on natural enemies of bifenthrin 25 EC used against yellow mite on pepper are presented hereafter.

Evaluation of bifenthrin 25 EC against the yellow mite *P.latus*

The initial population of mites/leaves before the first spraying ranged from 4.33 to 4.91 in all the treatments including untreated control without any significant differences. After first spraying, bifenthrin at 80 g a.i.ha^{-1} had a significant effect on the whole of treated units and affected 84.06, 80.65, 75.35, 72.02 and 65.01% reduction in mite population at 1, 3, 5, 7 and 14 days after spraying, respectively (Table 1).

One day after spraying, % reduction ranged from 63.75 (bifenthrin 40 g a.i.ha^{-1}) to 78.66 (dicofol 290 g a.i.ha^{-1}), while at seven and fourteen days after spraying, % of the reduction in mite population ranged from 51.66 to 69.35 and 40.34 to 65.32, respectively. The treatments, bifenthrin at 80 and 100 g a.i.ha^{-1}and dicofol at 290 g a.i.ha^{-1} registered 72.02, 68.34 and 69.35 % reduction at 7 DAS and 65.02 ,64.01 and 65.02 % reduction at 14 DAS, respectively. A similar trend was observed after the second round of spraying. Bifenthrin at 80 g a.i.ha^{-1} was the most effective treatment bringing about 76.37 to 88.36 % reduction in mites after the second round of spraying. The other treatments *viz.,* 40, 50, 60,100,160 and 320 g a.i.ha^{-1} of bifenthrin registered a mean in % of reduction of 60.32, 62.30, 65.44, 72.36, 70.94 and 70.02, respectively 14 days after the second spraying (Table 1). In the second field experiment, the pretreatment population of mites before first spraying ranged between 4.12 and 4.45 mites/leaf among the various treatments (Table 2). The results of this experiment revealed that bifenthrin at 80 g a.i.ha^{-1} was the most effective dose recording a 50.05 to 89.02 % of reduction in mite population after the first round of spray and 86.69 to 92.36 % of reduction after the second round of spray at 14 DAS (Table 2). The other doses *viz.,* bifenthrin at 100 and 160 g a.i.ha^{-1} were the next effective treatments and the % of reduction after the first spray ranged from 48.68 to 88.07 and 24.69 to 86.36 and 77.07 to 88.69 and 81.35 to 85.35 % after the second round, respectively. In other bifenthrin doses, the mean % of reduction in mites ranged from 60.41 to 66.56 and 70.34 to 79.76 after the first and second rounds of sprayings, respectively (Table 2). The standard check dicofol at 290 g a.i.ha^{-1} registered a reduction of 73.63 and 85.09 % after the first and second rounds of spraying, respectively, and was inline with bifenthrin 80 g a.i.ha^{-1} on 14 DAS and had a significant effect on completely other doses. In general, bifenthrin treatments recorded a 70.34 to 88.75 mean % of reduction in the mite population after the second round of spraying (Table 2).

In the third field experiment, the initial population of yellow mites varied between 3.83 and 4.32/leaf in the various treatments (Table 3). After the first round of spraying, there were significant differences among various treatments in their efficacy against yellow mite one day after spraying. On the third day after spraying, the reduction in mite population ranged from 52.62 to 78.85 % in various treatments. On the fourteenth day after treatment, the mite population reduction was very low at bifenthrin 40 g a.i.ha^{-1} (28.95 %) and 50 g a.i.ha^{-1} (31.44%). Dicofol, the standard check at 290 g a.i.ha^{-1} affected the population reduction by 59.55%. The other doses of bifenthrin tested *viz.*, 60, 80,100,160, and 320 g a.i.ha^{-1} registered a mean population reduction of more than 50%. A similar trend was observed after the second round of spraying (Table 3).

The results of the field experiments revealed that the synthetic pyrethroid, bifenthrin when applied at 80 g a.i.ha^{-1} was found to be superior to the other treatments in reducing the mite population and the reduction ranged from 71.72 - 88.75% (Fig. 3). Dicofol at 290 g a.i.ha^{-1} was the next best treatment in its effectiveness to reduce the phytophagous mite population in pepper. This finding is parallel with the early reports made by Somchoudhury *et al*. (2000) and Ramaraju (2002). Similar results were presented by Sridhar and Rani (2011) who accounted that the efficacy of clofentezine 50 SC (300 g a.i ha^{-1}) was superior over dicofol (231.25 g a.i. ha^{-1}) against *Tetranychus urticae* on rose. Dittmar *et al.* (2015) observed that fenazaquin at 150 g a.i.ha^{-1} was more effective in controlling the sucking pests of chillies than fenazaquin at 300 a.i.ha^{-1}. In the present study also, bifenthrin at 80 g a.i.ha^{-1} was found to be more effective in reducing the mites population than the higher doses of bifenthrin 160 and 320 g a.i.ha^{-1}. Jia *et al.* (2019) reported that bifenthrin (0.015%) recorded more than 60 % of reduction of red spider mite, *T. cinnabarinus* and 80 % of reduction in aphid, *Aphis gossypii* Glov. The population on bhendi, seven days after treatment.

The efficacy of pyrethroids in checking mites had been reported earlier by many workers. Razzak *et al.* (2019) also reported the effectiveness of lambda-cyhalothrin at 15 and 30 g a.i.ha^{-1} in reducing the thrips and mite population on chillies at three days after the first round of application. The 40 g a.i.ha^{-1} (lowest dose of bifenthrin) used in this study was the least effective treatment with 46.27 to 70.34 mean % of reduction of phytophagous mites (Fig. 3). This might be because this dose was only half of the most effective dose. This result is in agreement with the findings of Dittmar *et al.* (2015), who also reported that there was a lesser reduction in mite population 72 hours after spraying clocythrin in sublethal dose.

Kim *et al.* (2019) reported an immediate reduction in the population of aphids 24 hours after treatment due to liphophilicity effect of synthetic pyrethroids. In the present study also, an immediate reduction of mite population was observed one day after spraying. But, the effectiveness of bifenthrin 2.50 EC at 0.25 ml.l^{-1} even 30 days after treatment against cotton leafhopper, *Amrasca devastans* (Distant) was reported by Adachi-Hagimori *et al.* (2020). While in the case of lambda-cyhalothrin, Razzak *et al.* (2019) observed that there was a slow build-up of mite population at 5, 7, and 10 days after treatment suggesting the induction of mite resurgence.

The mite population, in general, was found to be less (3.83 to 4.32 mites/leaf) in various treatments in the field trial conducted during the third field experiment than in trials conducted during the first field experiment (4.33 to 4.91 and 4.12 to 4.45 mites/leaf). This conformed to the findings of Susurluk and Gürkan (2020) who reported that mite population on plants were the lowest during winter, possibly due to a combination of low temperature and heavy rainfall. The effectiveness of bifenthrin in case of checking, the sucking insects and mite population was reported by several workers as in the case of *A. gossypii* on watermelon by Kanika *et al*. (2013); *F. intousa* on pea plant, *T. vaporarium* and *B. tabaci* on cucumbers by Shaalan (2016). Generally, the density of *P. latus* adults infesting pepper cultivars was almost higher in autumn (September and October) and spring (March) months of the studied period (Montasser *et al.*, 2011).

Table 1. Effect of bifenthrin 25 EC on yellow mite *Polyphagotarsonemus latus* (Field experiment-1)

Treatment	Dose (g a.i.ha^{-1})	Pretrt. popn (No/leaf)	Percent reduction in mite population *											
			Days after first spraying						Days after second spraying					
			1	3	5	7	14	Mean	1	3	5	7	14	Mean
T$_1$ - Bifenthrin 25 EC	40	4.91 (2.32)^{a}	63.75 (52.99)^{g}	57.65 (49.41)^{f}	54.65 (47.68)	51.66 (45.96)^{f}	40.33 (39.41)^{e}	53.61	68.02 (55.55)	63.63 (52.94)^{e}	61.61 (51.75)^{f}	58.65 (49.99)^{f}	49.67 (44.81)^{e}	60.32
T$_2$ - Bifenthrin 25 EC	50	4.81 (2.30)^{a}	66.58 (54.69)^{f}	61.65 (51.75)^{e}	58.33 (49.80)	56.34 (48.66)^{e}	44.01 (41.54)^{d}	57.38	69.32 (56.38)	67.12 (54.94)^{d}	64.69 (53.53)^{e}	61.72 (51.75)^{ef}	48.67 (44.22)^{e}	62.30
T$_3$ - Bifenthrin 25 EC	60	4.63 (2.26)^{a}	71.93 (58.00)^{e}	68.66 (56.00)^{d}	64.02 (53.15)	60.66 (51.17)^{d}	49.35 (44.62)^{c}	62.92	73.34 (58.91)	69.09 (56.17)^{c}	67.37 (55.15)^{d}	64.09 (53.13)^{d}	53.33 (46.91)^{e}	65.44
T$_4$ - Bifenthrin 25 EC	80	4.39 (2.21)^{a}	84.06 (66.45)^{a}	80.65 (63.92)^{a}	75.35 (60.23)	72.02 (58.07)^{a}	65.02 (53.74)^{a}	75.42	88.36 (70.10)	84.66 (66.96)^{a}	84.38 (66.73)^{a}	81.04 (64.16)^{a}	76.37 (60.92)^{a}	82.96
T$_5$ - Bifenthrin 25 EC	100	4.44 (2.22)^{a}	75.02 (60.00)^{d}	71.34 (57.63)^{c}	70.35 (57.01)	68.34 (55.77)^{a}	64.01 (53.14)^{a}	69.81	84.02 (66.51)	73.12 (58.71)^{b}	70.66 (57.21)^{c}	68.35 (55.77)^{b}	65.67 (54.13)^{bc}	72.36
T$_6$ - Bifenthrin 25 EC	160	4.33 (2.20)^{a}	77.02 (61.35)^{c}	72.34 (58.27)^{b}	68.03 (55.56)	65.02 (53.74)^{c}	62.01 (51.96)^{b}	68.88	81.02 (64.18)	72.35 (58.33)^{b}	73.68 (59.16)^{b}	66.02 (54.35)^{c}	61.65 (51.75)^{cd}	70.94
T$_7$ -Bifenthrin 25 EC	320	4.44 (2.22)^{a}	74.66 (59.78)^{d}	72.03 (58.06)^{b}	68.65 (55.98)	66.32 (54.55)^{b}	61.32 (51.57)^{b}	68.60	78.69 (62.50)	73.36 (58.92)^{d}	72.37 (58.27)^{b}	66.02 (54.33)^{c}	59.66 (50.57)^{d}	70.02
T$_8$ – Dicofol 18.5 EC	290	4.61 (2.26)^{a}	78.66 (62.49)^{b}	74.68 (59.78)^{b}	71.33 (57.64)	69.35 (56.39)^{a}	65.02 (53.74)^{a}	71.81	85.03 (67.24)	75.05 (60.02)^{b}	74.07 (59.35)^{b}	70.32 (57.00)^{b}	69.32 (56.38)^{b}	74.76
T$_9$ – Untreated check	-	4.70 (2.28)^{e} NS	-	-	-	-	-	-	-	-	-	-	-	-

* Mean of three replications.

Parentheses are arcsine transformed values in the post-treatment observations and square root transformed values in the pre-treatment observations.

Means followed by common letters are not significantly different at the 5% level by DMRT, NS- Non-significant; Pretrt .popn- Pretreatment population.

Table 2. Effect of bifenthrin 25 EC on yellow mite *Polyphagotarsonemus latus* (Field experiment-2)

Treatment	Dose (g a.i.ha^{-1})	Pretrt. popn (No/leaf)	Percent reduction in mite population *											
			Days after first spraying						Days after second spraying					
			1	**3**	**5**	**7**	**14**	**Mean**	**1**	**3**	**5**	**7**	**14**	**Mean**
T_1 - Bifenthrin 25EC	40	4.12 (2.15)^{a}	76.66 (61.13)^{g}	71.02 (57.43)^{d}	67.66 (55.35)^{d}	62.33 (52.15)^{e}	21.36 (27.46)^{d}	60.41	78.03 (62.03)^{c}	75.35 (60.27)^{c}	74.33 (59.56)^{d}	70.35 (57.00)^{d}	53.66 (47.10)^{d}	70.34
T_2 - Bifenthrin 25 EC	50	4.16 (2.16) ^{a}	79.65 (63.22)^{f}	74.35 (59.58)^{cd}	67.35 (55.15)^{d}	63.35 (52.75)^{e}	21.02 (27.01)^{d}	61.21	82.36 (65.22)^{bc}	78.35 (62.43)^{bc}	76.04 (60.71)^{cd}	72.66 (58.50)^{cd}	56.06 (48.47)^{d}	73.09
T_3 - Bifenthrin 25EC	60	4.25 (2.18) ^{a}	83.02 (65.67)^{e}	77.02 (61.35)^{bc}	70.69 (57.23)^{c}	66.69 (54.75)^{d}	23.69 (27.71)^{d}	64.22	85.67 (67.89)^{b}	79.67 (63.22)^{bc}	78.08 (62.03)^{cd}	74.67 (59.81)^{c}	63.67 (52.94)^{cd}	76.35
T_4 - Bifenthrin 25 EC	80	4.12 (2.15) ^{a}	89.02 (70.68) ^{a}	84.35 (66.70)^{a}	77.35 (61.58)^{a}	77.35 (61.61) ^{a}	50.05 (44.83) ^{a}	75.62	92.36 (74.01) ^{a}	90.34 (71.95) ^{a}	87.66 (69.82) ^{a}	86.69 (68.60) ^{a}	86.69 (70.65) ^{a}	88.75
T_5 - Bifenthrin 25EC	100	4.21 (2.17) ^{a}	88.07 (69.74)^{b}	78.03 (62.04)^{bc}	74.67 (59.81)^{b}	72.69 (58.48)^{b}	48.68 (44.25)^{ab}	72.43	88.69 (70.50)^{ab}	86.05 (68.10)^{ab}	84.33 (66.71)^{ab}	82.33 (65.16)^{b}	77.07 (61.40)^{abc}	83.69
T_6 - Bifenthrin 25EC	160	4.45 (2.21) ^{a}	86.36 (68.31)^{c}	83.35 (65.97)^{a}	71.03 (57.42)^{c}	69.36 (56.38)^{cd}	24.69 (29.39)^{bcd}	66.96	85.35 (67.51)^{b}	81.06 (64.22)^{bc}	80.36 (63.74)^{bcd}	76.37 (60.90)^{c}	81.35 (67.02)^{ab}	80.89
T_7 -Bifenthrin 25 EC	320	4.36 (2.20) ^{a}	85.03 (67.24)^{d}	79.35 (62.98)^{b}	73.69 (59.13)^{b}	69.69 (56.60)^{c}	25.02 (28.68)^{cd}	66.56	86.69 (68.73)^{ab}	82.69 (65.42)^{bc}	81.69 (64.66)^{bc}	76.36 (60.89)^{c}	71.35 (57.63)^{bcd}	79.76
T_8 – Dicofol 18.5 EC	290	4.28 (2.19) ^{a}	87.66 (69.46)^{b}	84.03 66.45)^{a}	74.04 (59.53)^{b}	75.36 (60.23)^{a}	47.05 (43.27)^{abc}	73.63	87.04 (69.02)^{ab}	83.06 (65.80)^{bc}	86.36 (68.34)^{ab}	81.33 (64.42)^{b}	84.68 (66.96)^{ab}	85.09
T_9 – Untreated check	-	4.27 (2.18)^{a} NS	-	-	-	-	-	--	-	-	-	-	-	-

* Mean of three replications.

The parentheses are arcsine transformed values in the post-treatment observations and square root transformed values in the pre-treatment observations.

Means followed by common letters are not significantly different at the 5% level by DMRT.

NS- Non significant ; Pretrt.popn- Pretreatment population.

Table 3. Effect of bifenthrin 25 EC on yellow mite Polyphagotarsonemus latus (Field experiment-3)

Treatment	Dose (g a.i.ha^{-1})	Pretrt. popn (No/leaf)	Percent reduction in mite population *											
			Days after first spraying						Days after second spraying					
			1	3	5	7	14	Mean	1	3	5	7	14	Mean
T$_1$ - Bifenthrin 25 EC	40	4.11 (2.14)^{a}	61.35 (51.54)^{h}	54.82 (47.75)^{cd}	48.75 (44.27)^{d}	37.52 (37.70)^{d}	28.95 (32.44)^{d}	46.27	68.02 (55.58)^{f}	66.69 (54.74)^{d}	64.35 (53.34)^{e}	59.02 (50.19)^{c}	48.69 (44.23)^{d}	61.35
T$_2$ - Bifenthrin 25 EC	50	4.21 (2.17)^{a}	63.69 (52.93)^{g}	52.62 (49.37)^{d}	50.29 (45.16)^{d}	44.29 (41.68)^{cd}	31.44 (33.99)^{d}	48.47	69.35 (56.39)^{ef}	69.69 (56.60)^{cd}	64.35 (53.34)^{e}	60.35 (50.97)^{c}	51.69 (45.96)^{cd}	63.09
T$_3$ - Bifenthrin 25 EC	60	4.23 (2.17)^{a}	68.35 (55.76)^{f}	61.55 (51.69)^{cd}	56.35 (48.66)^{c}	49.32 (44.60)^{c}	39.42 (38.86)^{c}	54.99	72.69 (58.49)^{de}	70.69 (57.21)^{bcd}	65.69 (54.14)^{de}	61.35 (51.55)^{c}	56.69 (48.84)^{bcd}	65.42
T$_4$ - Bifenthrin 25 EC	80	4.20 (2.16)^{a}	83.69 (66.16)^{a}	78.87 (62.60)^{a}	73.49 (59.01)^{a}	59.19 (56.28)^{a}	63.35 (52.73)^{a}	71.72	88.35 (70.07)^{a}	82.69 (65.48)^{a}	81.69 (64.68)^{a}	81.02 (64.26)^{a}	79.35 (62.97)^{a}	82.62
T$_5$ - Bifenthrin 25EC	100	4.11 (2.14)^{a}	71.35 (57.63)^{d}	68.65 (55.94)^{bc}	65.35 (53.75)^{b}	57.22 (49.14)^{b}	52.72 (46.56)^{b}	63.16	82.35 (65.15)^{bc}	79.35 (63.07)^{a}	74.02 (59.35)^{bc}	72.02 (58.06)^{b}	65.69 (54.15)^{bc}	74.69
T$_6$ - Bifenthrin 25EC	160	4.15 (2.15)^{a}	72.69 (58.48)^{c}	69.09 (56.22)^{bc}	61.92 (51.90)^{b}	57.62 (49.39)^{b}	53.59 (47.05)^{b}	62.98	80.02 (63.43)^{c}	80.02 (63.45)^{a}	75.69 (60.46)^{bc}	70.69 (57.32)^{b}	54.02 (47.31)^{bcd}	72.09
T$_7$ -Bifenthrin 25 EC	320	4.07 (2.13)^{a}	70.02 (56.79)^{e}	62.69 (52.40)^{cd}	64.89 (53.70)^{b}	60.69 (51.21)^{b}	55.72 (47.95)^{b}	62.80	74.02 (59.36)^{d}	77.02 (61.74)^{abc}	70.35 (57.08)^{cd}	64.69 (53.55)^{bc}	63.69 (53.10)^{bcd}	69.95
T$_8$ – Dicofol 18.5 EC	290	3.83 (2.08)^{a}	75.02 (60.00)^{b}	75.95 (60.96)^{ab}	65.52 (54.051)^{b}	62.75 (52.39)^{ab}	59.55 (50.51)^{ab}	67.76	84.35 (66.73)^{b}	78.69 (62.56)^{ab}	76.02 (60.69)^{b}	70.02 (56.88)^{b}	68.35 (55.90)^{ab}	76.09
T$_9$ – Untreated check	-	4.32 (2.19)^{a} NS	-	-	-	-	-	-	-	-	-	-	-	-

* Mean of three replications.

The parentheses are arcsine transformed values in the post-treatment observations and square root transformed values in the pre-treatment observations.

Means followed by common letters are not significantly different at the 5% level by DMRT.

NS- Non significant ; Pretrt.popn- Pretreatment population.

Table 4. Effect of bifenthrin 25 EC on predatory mite *Amblyseius ovalis* (Field experiment-1)

Treatment	Dose (g a.i.ha^{-1})	Pretrt.popn (No/leaf)	Percent reduction in mite population *											
			Days after the first spraying						Days after the second spraying					
			1	3	5	7	14	Mean	1	3	5	7	14	Mean
T_1 - Bifenthrin 25 EC	40	1.11 (1.26)^{a}	25.02 (29.98)^{a}	20.06 (26.53)^{a}	16.69 (24.07)^{a}	16.02 (23.52)^{a}	15.35 (22.63)^{a}	18.63	23.03 (28.63)^{a}	22.02 (27.94)^{a}	20.02 (26.53)^{a}	16.03 (23.52)^{a}	15.35 (22.94)^{ab}	19.29
T_2 - Bifenthrin 25 EC	50	0.99 (1.21)^{a}	27.02 (31.30)^{a}	24.69 (29.77)^{abc}	20.02 (26.53)^{ab}	20.02 (26.53)^{a}	19.96 (26.26)^{ab}	22.34	24.69 (29.72)^{a}	22.35 (28.17)^{a}	20.69 (26.99)^{a}	19.71 (26.26)^{ab}	16.69 (24.06)^{ab}	20.82
T_3 - Bifenthrin 25EC	60	0.94 (1.19)^{a}	25.68 (30.42)^{a}	23.02 (28.63)^{ab}	22.35 (28.18)^{bc}	21.69 (27.71)^{ab}	21.35 (27.50)^{ab}	22.82	29.69 (32.97)^{ab}	22.69 (28.39)^{a}	20.02 (26.52)^{a}	20.03 (26.53)^{ab}	12.36 (20.46)^{a}	20.96
T_4 - Bifenthrin 25 EC	80	1.06 (1.24)^{a}	34.03 (35.66)^{b}	28.65 (32.34)^{bcd}	27.69 (31.69)^{cd}	27.69 (31.68)^{b}	23.33 (28.8)^{b}	28.28	34.35 (35.86)^{b}	29.35 (32.77)^{b}	22.35 (28.18)^{a}	20.02 (26.55)^{ab}	18.02 (25.08)^{b}	24.82
T_5 - Bifenthrin 25 EC	100	1.08 (1.25)^{a}	34.04 (35.87)^{b}	26.05 (30.62)^{abc}	25.69 (30.39)^{bcd}	21.69 (27.67)^{ab}	21.33 (27.40)^{ab}	25.76	30.06 (33.13)^{ab}	25.02 (29.99)^{ab}	22.02 (27.96)^{a}	15.69 (23.24)^{a}	15.69 (23.26)^{ab}	21.70
T_6 - Bifenthrin 25 EC	160	1.08 (1.25)^{a}	33.72 (35.50)^{b}	30.71 (33.53)^{cd}	28.35 (32.12)^{cd}	28.03 (31.90)^{b}	22.32 (28.2)^{b}	28.63	30.04 (33.16)^{ab}	27.04 (31.27)^{ab}	26.02 (30.63)^{a}	25.35 (30.15)^{bc}	17.69 (24.84)^{ab}	25.23
T_7 -Bifenthrin 25 EC	320	0.96 (1.20)^{a}	35.73 (36.70)^{b}	33.69 (35.43)^{d}	30.35 (33.41)^{d}	28.69 (32.34)^{b}	24.71 (30.0)^{b}	30.63	32.69 (34.82)^{b}	28.36 (32.14)^{b}	26.02 (30.59)^{a}	28.02 (31.90)^{c}	17.02 (24.31)^{ab}	26.49
T_8 – Dicofol 18.5 EC	290	0.90 (1.19)^{a}	50.74 (45.40)^{c}	51.68 (45.96)^{e}	52.34 (46.34)^{e}	54.05 (47.30)^{c}	40.03 (39.21)^{c}	49.77	60.69 (51.19)^{c}	61.63 (51.76)^{c}	62.35 (52.15)^{b}	63.35 (52.74)^{d}	56.35 (48.64)^{c}	60.87
T_9 – Untreated check	-	1.01 (1.20)^{a} NS	-	-	-	-	-	-	-	-	-	-	-	-

* Mean of three replications.

The parentheses are arcsine transformed values in the post-treatment observations and square root transformed values in the pretreatment observations.

Means followed by common letters are not significantly different at the 5% level by DMRT, NS- Non-significant; Pretrt.popn- Pretreatment population.

Table 5. Effect of bifenthrin 25 EC on predatory mite *Amblyseius ovalis* (Field experiment-2)

Treatment	Dose (g a.i.ha^{-1})	Pretrt. popn (No/leaf)	Percent reduction in mite population *											
			Days after the first spraying						Days after the second spraying					
			1	**3**	**5**	**7**	**14**	**Mean**	**1**	**3**	**5**	**7**	**14**	**Mean**
T$_1$ - Bifenthrin 25 EC	40	0.84 (1.15)^{a}	23.02 (28.61)^{a}	22.69 (28.40)^{a}	22.02 (27.94)^{a}	14.35 (22.12)^{a}	13.69 (21.38)^{a}	19.15	29.36 (32.77)^{a}	28.02 (31.90)^{a}	26.35 (30.86)^{ab}	25.02 (29.98)^{b}	15.35 (22.97)^{a}	24.82
T$_2$ - Bifenthrin 25 EC	50	0.86 (1.16)^{a}	32.35 (34.65)^{b}	28.02 (31.90)^{b}	26.02 (30.65)^{abc}	19.02 (25.77)^{abc}	16.69 (23.76)^{ab}	24.42	32.35 (34.65)^{ab}	31.02 (33.78)^{a}	29.02 (32.57)^{ab}	19.02 (25.74)^{a}	18.69 (25.55)^{ab}	26.02
T$_3$ - Bifenthrin 25 EC	60	0.91 (1.18)^{a}	33.69 (35.45)^{b}	28.69 (32.34)^{b}	23.35 (28.86)^{ab}	17.69 (24.82)^{ab}	17.02 (24.28)^{ab}	24.09	32.69 (34.85)^{ab}	28.69 (32.33)^{a}	25.35 (30.20)^{a}	23.69 (29.04)^{ab}	23.02 (28.61)^{bc}	26.69
T$_4$ - Bifenthrin 25 EC	80	0.70 (1.10)^{a}	34.02 (35.66)^{b}	32.35 (34.62)^{c}	29.67 (32.98)^{bc}	28.02 (31.90)	21.02 (27.15)^{bc}	29.02	33.69 (35.45)^{b}	31.02 (33.80)^{a}	30.02 (33.19)^{ab}	27.69 (31.70)^{b}	23.69 (29.04)^{c}	29.22
T$_5$ - Bifenthrin 25 EC	100	0.79 (1.13)^{a}	34.02 (35.66)^{b}	32.69 (34.83)^{c}	27.67 (31.70)^{abc}	21.35 (27.50)^{bc}	13.69 (21.59)^{a}	25.88	40.35 (39.42)^{c}	35.69 (36.67)^{a}	30.69 (33.59)	24.02 (29.30)^{ab}	22.35 (28.17)^{bc}	30.62
T$_6$ - Bifenthrin 25 EC	160	0.71 (1.09)^{a}	36.02 (36.87)^{bc}	34.02 (35.66)^{c}	33.00 (35.01)^{c}	20.02 (26.53)^{bc}	17.02 (24.31)^{ab}	28.02	34.69 (36.06)^{b}	33.35 (35.25)^{a}	28.69 (32.34)^{ab}	25.69 (30.40)^{b}	22.69 (28.4)^{bc}	29.09
T$_7$ -Bifenthrin 25 EC	320	0.79 (1.13)^{a}	40.02 (39.21)^{c}	36.02 (36.87)^{c}	29.00 (32.56)^{abc}	24.69 (29.72)^{cd}	24.69 (29.72)^{c}	30.88	32.02 (34.42)^{ab}	30.02 (33.19)^{a}	28.35 (32.14)^{ab}	25.69 (30.40)^{b}	24.35 (29.53)^{c}	28.09
T$_8$ – Dicofol 18.5 EC	290	0.88 (1.17)^{a}	55.35 (48.07)^{d}	55.69 (48.26)^{d}	63.33 (52.76)^{d}	64.02 (53.13)^{e}	45.35 (42.33)^{d}	56.75	59.35 (50.39)^{d}	62.02 (51.95)^{c}	63.35 (52.74)^{c}	64.02 (53.13)^{d}	60.02 (50.78)^{b}	61.75
T$_9$ – Untreated check	-	0.99 (1.20)^{a} NS	-	-	-	-	-	-	-	-	-	-	-	-

* Mean of three replications.

Figures in the parentheses are arcsine transformed values in the post-treatment observations and square root transformed values in the pre-treatment observations.

Means followed by common letters are not significantly different at the 5% level by DMRT.

NS- Non significant ; Pretrt.popn- Pretreatment population.

Table 6. Effect of bifenthrin 25 EC on predatory mite Amblyseius ovalis (Field experiment-3)

Treatment	Dose (g a.i.ha^{-1})	Pretrt. popn (No/leaf)	Percent reduction in mite population *											
			Days after first spraying						Days after second spraying					
			1	3	5	7	14	Mean	1	3	5	7	14	Mean
T_1 - Bifenthrin 25EC	40	0.92 (1.18)^{a}	30.69 (33.57)^{a}	26.69 (31.06)^{ab}	21.35 (27.51)^{a}	21.02 (27.25)^{a}	19.02 (25.76)^{ab}	23.75	24.69 (29.73)^{a}	16.69 (24.00)^{a}	16.69 (23.73)^{a}	12.35 (20.38)^{a}	10.35 (18.69)^{a}	16.15
T_2 - Bifenthrin 25 EC	50	0.96 (1.20)^{a}	34.02 (35.65)^{a}	25.35 (30.18)^{a}	24.35 (29.49)^{a}	24.35 (29.49)^{ab}	21.35 (27.46)^{bc}	25.88	23.69 (29.02)^{a}	20.02 (26.48)^{ab}	18.02 (25.04)^{ab}	16.35 (23.99)^{ab}	14.02 (21.94)^{ab}	18.42
T_3 - Bifenthrin 25EC	60	0.84 (1.10)^{a}	29.35 (32.76)^{a}	29.35 (32.76)^{ab}	26.02 (30.58)^{ab}	19.69 (26.20)^{a}	17.35 (24.58)^{a}	24.35	26.02 (30.61)^{ab}	24.02 (29.32)^{bc}	20.69 (27.03)^{abc}	18.35 (25.02)^{b}	15.35 (22.94)^{abc}	20.89
T_4 - Bifenthrin 25EC	80	0.95 (1.20)^{a}	34.35 (35.86)^{a}	33.02 (35.01)^{b}	32.69 (34.82)^{b}	29.69 (32.97)^{b}	28.35 (32.13)^{e}	31.62	27.02 (31.29)^{ab}	27.02 (31.24)^{c}	25.02 (29.98)^{c}	24.35 (29.50)^{c}	21.35 (27.44)^{c}	24.95
T_5 - Bifenthrin 25EC	100	0.84 (1.20)^{a}	32.02 (34.41)^{a}	28.35 (32.12)^{ab}	26.35 (30.85)^{ab}	24.02 (29.30)^{ab}	24.02 (29.31)^{cd}	26.95	27.69 (31.73)^{ab}	25.69 (30.42)^{bc}	24.35 (29.42)^{bc}	24.35 (29.50)^{c}	20.02 (26.53)^{bc}	24.42
T_6 - Bifenthrin 25 EC	160	0.89 (1.17)^{a}	34.69 (36.06)^{a}	33.35 (35.25)^{b}	33.04 (35.01)^{b}	31.03 (33.78)^{b}	27.05 (31.21)^{de}	31.83	23.69 (29.02)^{a}	22.69 (28.43)^{bc}	16.69 (24.07)^{a}	15.35 (23.00)^{ab}	15.35 (22.88)^{abc}	18.75
T_7 -Bifenthrin 25 EC	320	0.95 (1.20)^{a}	33.69 (35.03)^{a}	33.02 (35.01)^{b}	33.69 (35.45)^{b}	32.02 (34.41)^{b}	30.02 (33.20)^{e}	32.49	30.35 (33.39)^{b}	23.69 (29.09)^{bc}	19.69 (26.29)^{abc}	15.69 (23.26)^{ab}	10.69 (19.03)^{a}	20.02
T_8 – Dicofol 18.5 EC	290	0.98. (1.20)^{a}	52.69 (46.53)^{b}	53.69 (47.11)^{c}	56.02 (48.45)^{c}	59.35 (50.39)^{c}	51.02 (45.57)^{f}	54.56	57.69 (49.42)^{c}	62.35 (52.15)^{d}	63.02 (52.55)^{d}	65.05 (53.76)^{d}	56.02 (48.45)^{d}	60.83
T_9 – Untreated check	-	0.91 (1.18)^{a} NS	-	-	-	-	-	-	-	-	-	-	-	-

* Mean of three replications. The parentheses are arcsine transformed values in the post-treatment observations and square root transformed values in the pretreatment observations. Means followed by common letters are not significantly different at the 5% level by DMRT. NS- Non significant ; Pretrt.popn- Pretreatment population.

Evaluation of bifenthrin 25 EC against the predatory mite *A. ovalis*

The percentages of reduction in predatory mites after the first and second rounds of spraying at 1, 3, 5, 7 and 14 DAS in the first field experiment are presented in Table 4. The initial population ranged from 0.90 to 1.11 mites/leaf in various treatments including the untreated check. After the first round of spraying, dicofol at 290 g a.i.ha-1 caused the highest reduction (49.77%) among the treatments and this was followed by bifenthrin at 320 g a.i./ha with a 30.63 % of reduction. The other doses of bifenthrin tested viz., 40, 50, 60, 80,100 and 160 g a.i./ha affected 18.63 to 28.63 % of reduction in mite population. After the second round of spraying also, a similar trend was observed. The standard check dicofol 290 g a.i.ha^{-1} inflicted a reduction of 60.87 % followed by bifenthrin 320 g a.i.ha^{-1} with 26.49 %. The order of toxicity against predatory mites exhibited by different doses of bifenthrin was 320 > 160 > 80 > 100 > 60 > 50 > 40 g a.i.ha^{-1}.

The pretreatment population of predatory mites in the second field experiment ranged from 0.70 to 0.99/leaf in various treatments. Among the treatments tested, the standard check dicofol at 290 g a.i.ha^{-1} was found the most toxic and recorded a reduction of 56.75 and 61.75 % after the first and second rounds of sprayings, respectively. This was followed by bifenthrin at 320 g a.i.ha^{-1} (30.88 %) and 80 g a.i.ha^{-1} (29.02 %) after the first round and bifenthrin at 100 g a.i.ha^{-1} (30.62 %) and 80 g a.i.ha^{-1} (29.22 %) after the second round of spraying. Bifenthrin at the lowest dose of 40 g a.i.ha^{-1} was the least toxic treatment, which registered a mean population reduction of 19.15 and 24.82 %, respectively, after the first and second rounds of spraying (Table 5).

In the third field experiment, the pretreatment population of predatory mites ranged between 0.84 and 0.98 mites/leaf in the various treatments. The results of this experiment revealed that dicofol at 290 g a.i.ha^{-1} was the most toxic treatment among the treatments studied by recording 51.02 to 59.35 % of reduction in mite population after the first round of spray and 56.02 to 65.05 % of reduction after the second round at 14 DAS (Table 6).

Among the different doses of bifenthrin, bifenthrin at 320 g a.i.ha^{-1} registered the highest reduction of 32.49 % after the first round of spray followed by bifenthrin 80 g a.i.ha^{-1} with a 24.95 per cent reduction in population after the second round of spraying. Bifenthrin at the lowest dose of 40 g a.i.ha^{-1} affected reductions of 23.75 and 16.15 % after the first and second rounds of sprayings, respectively. Bifenthrin at 80 g a.i.ha^{-1} inflicted 31.62 and 24.95 % of reduction of predatory mites after the first and second round of sprayings respectively, which was comparatively safer to predatory mites than the standard check (Table 6).

Among the two chemicals tested, dicofol was highly toxic to *A. ovalis* when compared to bifenthrin treatments. Even after 14 days of spraying nearly 50% reduction was noticed in the case of dicofol. Bifenthrin was found to be relatively safer than dicofol (Fig. 4). Similar results were reported by Dey *et al.* (2001) with fenpropathrin and dicofol. There was not much variation in the reduction of the population of predatory mites in different doses of the bifenthrin. Razzak and Seal (2017) reported similar trends with different doses of fenazaquin. As in the case of yellow mites, the population reduction in predatory mites was higher one day after the first and second rounds of sprayings in all the treatments.

The present findings agree with the observations of Somchoudhury *et al.* (2000) who reported that fenazaquin, dicofol and ethion tested against yellow mite had a similar effect on predatory mites. Bifenthrin 40 g a.i.ha^{-1} caused the least reduction in the population of the predatory mite (18.63 to 24.82 %) among different doses of bifenthrin in all the trials. This may be due to that bifenthrin also had a lesser effect on phytophagous mites and thereby favouring an increase in the predatory mite population. Bifenthrin 80 g a.i.ha^{-1}, the most effective dose against yellow mites was also comparatively safer to predatory mites as indicated by the fact that the population reduction was only half of that caused by dicofol (Fig. 4). This agrees with the findings of Somchoudhury *et al.* (2000) who stated that fenazaquin at 150 g a.i.ha^{-1} was comparatively safer to predatory mites of *P. latus.*

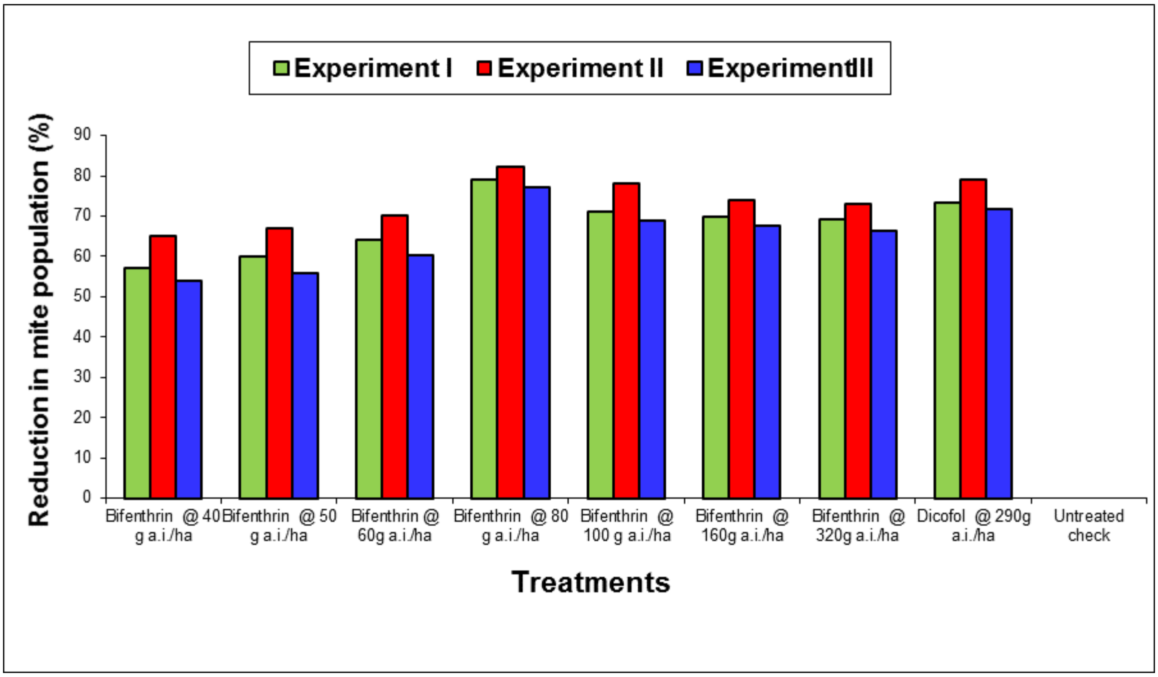

Fig. 3. Effect of bifenthrin 25 EC on yellow mite *Polyphagotarsonemus latus*

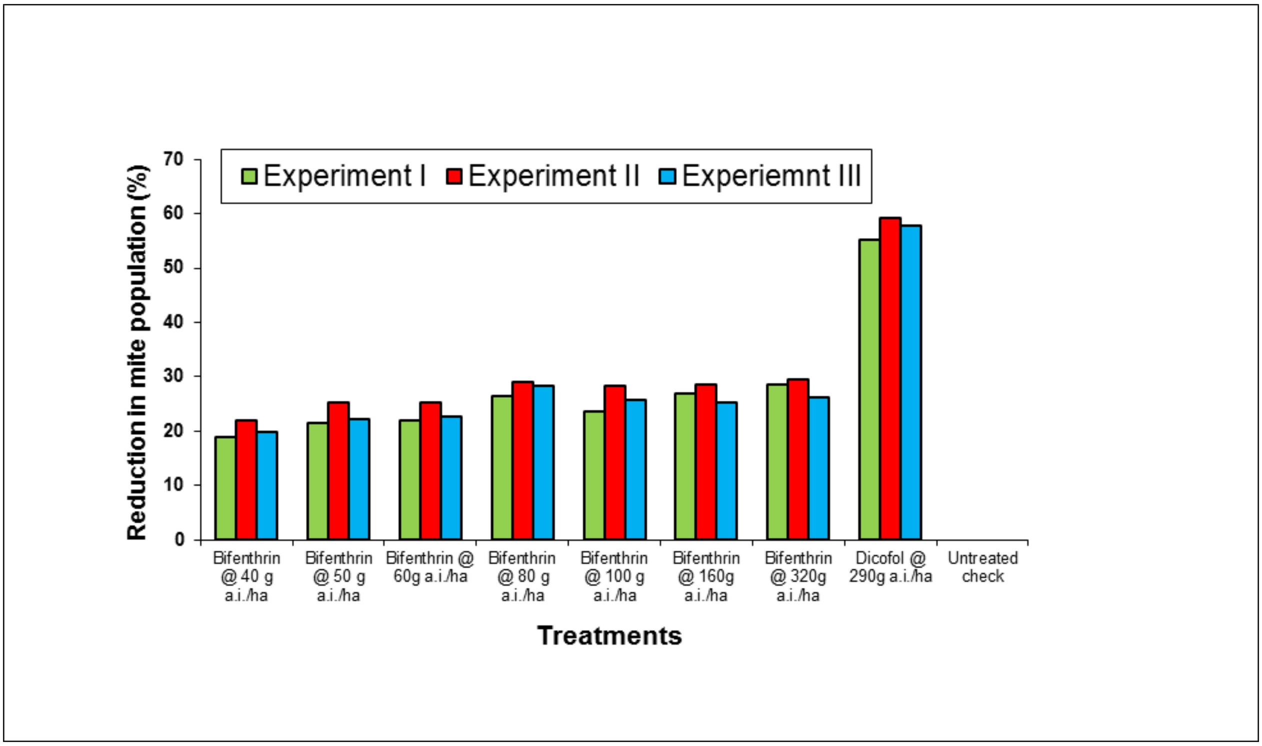

Fig. 4. Effect of bifenthrin 25 EC on predatory mite, *Amblyseius ovalis*

CONCLUSION

Three field experiments were conducted in the Wadi Al-Mollak area, East Delta, Egypt. The results obtained in the studies conducted on the efficacy and impact on natural enemies of bifenthrin 25 EC used against *Polyphagotarsonemus latus* are summarized here. Bifenthrin 80 g a.i.ha^{-1} showed good control of phytophagous mites and population reduction. Dicofol 290 g a.i.ha^{-1} was found to be the next best treatment against phytophagous mites. All the treatments showed an initial quick knockdown effect and the percentage of reduction in mites showed a decrease 72 hours after spraying. In the case of the predatory mite, different doses of bifenthrin caused population reduction ranging from 18.63 to 30.88 % as against 49.77 to 61.75 % in dicofol. This indicates that bifenthrin is comparatively safer to predatory mites.

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الملخص العربي

تأثير البايفينثرين على حلم العنكبوت الأصفر في نباتات الفلفل تحت الظروف الحقلية، وادي الملاك، شرق الدلتا، بمصر

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يعنبر الفلفل *Capsicum annuum* L من أهم الخضروات المزروعة في مصر. كما يعتبر حلم العنكبوت الأصفر *Polyphagotarsonemus latus* (Banks) من أكثر الآفات تدميراً لنباتات الفلفل، حيث يمكن أن يتسبب في حدوث أضرار جسيمة وخسائر كبيرة لمحصول الفلفل. تم إجراء هذه الدراسة بهدف تقييم فعالية البايفنثرين 25EC ضد حلم العنكبوت الأصفر و كذلك دراسة تأثيره على العدو الطبيعي *Amblyseius ovalis* من خلال ثلاث تجارب حقلية في مناطق مختلفة عبر وادي المُلاك ، شرق الدلتا ، مصر لمدة ثلاثة مواسم خلال عام ٢٠٢٠. تم إجراء التجربة بمبيد البايفنثرين بالمعدلات التالية: ٤٠ ، ٥٠ ، ٦٠ ، ٨٠ ، ١٠٠ ، ١٦٠ و ٣٢٠ جم مادة فعالة /هكتار مع المقارنة القياسية Standard check بمبيد الدايكوفول بمعدل٢٩٠جم مادة فعالة/هكتار، بالإضافة الى تجربة الكنترول غير المعاملة. تم تسجيل البيانات على أساس نسبة انخفاض في تعداد حلم العنكبوت الأصفر وعدوه الحيوي بعد ١ و ٣ و ٥ و ٧ و ١٤ يومًا من كلاً من الرشة الاولي والثانية. تراوح العدد الأولي لحلم العنكبوت / الورقة قبل إجراء الرشة الأولى من ٣,٨٣ إلى ٤,٩١ في جميع المعاملات بما في ذلك تجربة الكنترول دون أي فرق معنوي. كما كان Bifenthrin عند ٨٠ جم مادة فعالة/هكتارمتفوقًا بشكل كبير على جميع المعاملات الأخرى حيث سجل نسبة انخفاض في تعداد حلم العنكبوت الاصفر ٧٥,٤٢ ، ٧٥,٦٢ و ٧١,٧٢ % في كلاً من التجربة الأولى والثانية والثالثة بعد الرش الأول ، على التوالي ، و ٨٢,٩٦ ، ٨٨,٧٥ و ٨٢,٦٢ % في التجربة الأولى والثانية والثالثة بعد الرش الثاني ، على التوالي ، يليها الدايكوفول عند ٢٩٠ جم

مادة فعالة/هكتار والذي سجل ٧١,٨١ ، ٧٣,٦٣ و ٦٧,٧٦ % كمتوسط النسبة المئوية للانخفاض في الحلم في التجربة الأولى والثانية والثالثة بعد الرش الأول على التوالي و ٧٤,٧٦ ، ٨٥,٠٩ و ٧٦,٠٩ % في التجربة الأولى والثانية والثالثة بعد الرش الثاني على التوالي. وفيما يتعلق بانخفاض النسبة المئوية في الحلم المفترس *Amblyseius ovalis* ، تراوح عدد المفترس الأولي من ٠,٧٠ إلى ١,١١ حلم / ورقة في المعاملات المختلفة بالتجارب الحقلية الثلاثة بما في ذلك معاملة الكنترول. بعد المعاملة الأولى من الرش ، أعطى الدايكوفول عند ٢٩٠ جرام مادة فعالة/هكتار في أعلى انخفاض للمفترس ٤٩,٧٧ ، ٥٦,٧٥ و ٥٤,٥٦ % في التجربة الأولى والثانية والثالثة على التوالي، وتبع ذلك البايفنثرين عند ٣٢٠ جرام مادة فعالة/هكتار مع انخفاض بنسبة ٣٠,٦٣ و ٣٠,٨٨ و٣٢,٤٩ % في المائة في التجربة الأولى والثانية والثالثة، على التوالي ، بعد المعاملة الأولى من الرش. وكانت النتائج بعد الرشة الثانية مماثلة لنتائج ما بعد الرشة الأولى أيضاً. كما سجلت أقل جرعة من البايفنثرين عند ٤٠ جم مادة فعالة/هكتار انخفاضًا متوسطًا في تعداد المفترس حيث بلغ (١٨,٦٣ ، ١٩,١٥ و ٣,٧٥ %) و (١٩,٢٩ ، ٢٤,٨٢ و ١٦,١٥ %) في التجربة الأولى والثانية والثالثة بعد الجولة الأولى والثانية من الرش على التوالي. كان ترتيب السُمية ضد الحلم المفترس طبقاً للجرعات المستخدمة من البايفنثرين هو كالتالي: ٣٢٠> ١٦٠> ٨٠> ١٠٠> ٦٠> ٥٠> ٤٠ جم من المادة الفعالة/هكتار.

من خلال هذه الدراسة يتضح أن الدايكوفول شديد السمية لـ *Amblyseius ovalis* عند مقارنته بمعاملات البايفنثرين المختلفة حتى بعد ١٤ يومًا من الرش ، لوحظ انخفاض بنسبة ٥٠ % تقريبًا في حالة الدايكوفول، ربما يرجع التأثير الفعال للديكوفول خلال هذه الفترة إلي البقاء العالي لمتبقيات المبيد مقارنة بمركب البايفنثرين.

الكلمات المفتاحية: العنكبوت الأصفر، الفلفل ،البايفنثرين، الدايكوفول