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Bioefficacy of Some New Molecule of Insecticides against Sucking Pests of Chilli *(Capsicum annum* L.) in Gangetic Basin of West Bengal

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ABSTRACT

A field study was conducted at C Unit Farm, Kalyani, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal to determine the bio-efficacy of insecticides against sucking insect pests viz., thrips (*Scirtothrips dorsalis* Hood), mite (*Polyphagotarsonemus latus* Banks) and aphid (*Aphis gossypii* Glover) in chilli variety bullet during *kharif* season of 2019. Total seven treatments viz., Flonicamid 50% WG @ 60 g a.i. ha^{-1}, Dimethoate 30% EC@ 300 g a.i. ha^{-1}, Fipronil 5% SC @ 50 g a.i. ha^{-1}, Diafenthiuron 50% WP @ 300 g a.i. ha^{-1}, Propargite 57% EC @ 850 g a.i. ha^{-1}, Spiromesifen 22.9% SC @ 96 g a.i. ha^{-1} including control were considered. Among the different insecticides, Propargite 57% EC @ 850 g a.i. ha^{-1} against mite (75.24%), Fipronil 5% SC @ 50 g a.i. ha^{-1} against thrips (59.43%) and Flonicamid 50% WG @ 60 g a.i. ha^{-1} against aphid (55.45%) population were recorded as the most effective treatments. Highest green chilli fruit yield (30.20 quintal per hectare) was harvested from crop treated with Diafenthiuron 50% WP @ 300 g a.i. ha^{-1}.

Keywords Bioefficacy, Chilli, Insecticides, Sucking pests.

INTRODUCTION

Chilli (*Capsicum annum* L.) is one of the important vegetable and condiment crop grown throughout the year. It is the most widely used universal spice, named as wonder spice. It is widely cultivated and used as spice in temperate and tropical countries. Chilli is mainly used as green or dried to impart pungency to food. It is rich in vitamin 'A' and 'C' and the seeds contain traces of starch, which has medicinal significance in dyspepsia and prevent blood cancer. Capsaicin an active component of chilli is responsible for burning sensation and is used for medicinal purposes having analgesic properties. In India, Chilli was grown in an area of 309 thousand hectares with a production of 3592 thousand tones and the productivity was 11.62 tones per hectare in 2017-18 (NHB 2018).

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India contributes 37% of total world's production and remained in first position in terms of international trade by exporting nearly 30% from its total production (NHB 2018). Nearly 35 species of insect pests occur on chilli which includes thrips, aphid, whitefly, fruit borer, cutworm, plant bug, mite, and other minor pests (Sorensen 2005). Among all the sucking pests attacking chilli thrips (*Scirtothrips dorsalis* Hood), mite (*Polyphagotarsonemus latus* Banks) and aphid (*Aphis gossypii* Glover) are dominant pests (Berke and Shieh 2000). The estimated loss due to sucking pests was up to 30 to 50% (Varadharajan 1994). Insecticide application is one of the management options that can substantially reduce yield losses caused by sucking insects. Bio-efficacy of newer pesticides needs to be studied for formulating effective and economical management strategies of insect pests. Therefore, the present investigation was conducted to evaluate the bio-efficacy of certain newer insecticides against sucking insect pests infesting chilli.

MATERIALS AND METHODS

This investigation was carried out at C Unit Farm, Kalyani, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal located at 22.98° N latitude and 88.42° E longitude. The experiment was laid out in a Randomized Block Design with three replications having the plot size of 3×3 sq m. Chilli variety bullet was raised at 60 cm × 45 cm spacing. All the recommended agronomical practices except plant protection were followed for raising the crop. Total seven treatments viz., Flonicamid 50% WG @ 60 g a.i ha^{-1} (T_1), Dimethoate 30% EC@ 300 g a.i. ha^{-1} (T_2), Fipronil 5% SC @ 50 g a.i. ha^{-1} (T_3), Diafenthiuron 50% WP @ 300 g a.i. ha^{-1} (T_4), Propargite 57% EC @ 850 g a.i. ha^{-1} (T_5), Spiromesifen 22.9% SC @ 96 g a.i. ha^{-1} (T_6) and untreated control (T_7) were taken into consideration for the study. First spray application of respective insecticides was given when the pest population crossed the ETL level and subsequently one more spray was given using manually operated knapsack sprayer at 15 days after first spray. The observation on the population of mite, thrips and aphids were recorded by selecting five plants randomly from net plot area of each plot and tagged accordingly. From three tender leaves of tagged plants, the number of nymphs as well as adults were counted. The sucking insect pest's population was recorded before a day as well as 1, 3, 5, 7 and 10 days after each spray. The total green chilli fruit yield was recorded from each plot. The data thus obtained for sucking insect pests were analyzed by adopting square root transformation before statistical analysis following Gomez and Gomez (1984) to test the significance of treatment effect.

RESULTS AND DISCUSSION

Yellow mite, *Polyphagotarsonemus latus* Banks

Before 1st spraying, pre observation of mean population of mites non-significantly varied from 8.13 to 8.80 $plant^{-1}$ (Table 1). All the insecticidal treatments were found effective as compared to untreated control in minimizing the population of the pests. One day after spraying (DAS) the maximum reduction was recorded in T_5 i.e., Propargite 57% EC (5.40 mites $plant^{-1}$) and T_1 i.e., Flonicamid 50% WG recorded the minimum reduction (7.67 mite $plant^{-1}$). Next to Propargite, the best treatment was Spiromesifen (6.13 mites $plant^{-1}$) which is at par with the other treatments viz., Diafenthiuron and Dimethoate. However, the population of *P.latus* in all the treatments was significantly less than untreated control (12.20 mites' $plant^{-1}$). This similar trend of efficacy is also observed on the third, fifth, seventh and tenth DAS. At the end of tenth day the maximum mean reduction of thrips over control is recorded for Propargite 57% EC (68.05%) and the lowest reduction is for Flonicamid 50% WG (42.62%).

The second spray data indicated that minimum (4.82 mites $plant^{-1}$) population of mites were found

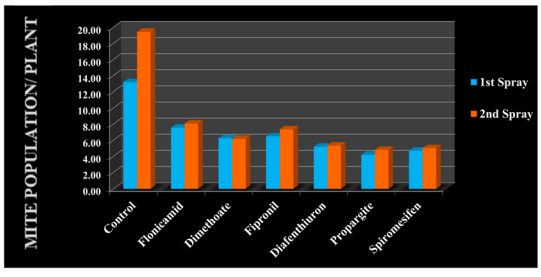

Fig. 1. Efficacy of some newer insecticides against the population of yellow mites, *P.latus* on chilli during *kharif* 2019.

Table 1. Effect of newer molecules of insecticides on population of yellow mite, *P.latus* in chilli during *kharif* 2019.

Sl. No.	Treatments	Dose (g a.i. ha^{-1})	First spraying Mean population of *P. latus* per plant*						PTM
			PTC	1DAS	3DAS	5DAS	7DAS	10DAS	
1	T_1=Flonicamid 50 WG	60	8.77 (3.12)	7.67 (2.94)	5.47 (2.54)	6.67 (2.77)	8.47 (3.07)	9.23 (3.19)	7.58
2	T_2=Dimethoate 30 EC	300	8.13 (3.02)	7.07 (2.84)	3.90 (2.21)	5.77 (2.61)	6.37 (2.72)	6.53 (2.74)	6.27
3	T_3=Fipronil 5 EC	50	8.37 (3.06)	7.20 (2.86)	4.10 (2.25)	5.73 (2.59)	6.80 (2.79)	7.33 (2.88)	6.50
4	T_4=Diafenthiuron 50 WP	300	8.20 (3.03)	6.73 (2.78)	2.40 (1.84)	4.33 (2.28)	5.27 (2.51)	6.00 (2.64)	5.21
5	T_5= Propargite 57 EC	850	8.33 (3.05)	5.40 (2.52)	1.77 (1.66)	2.90 (1.92)	4.00 (2.19)	4.83 (2.41)	4.22
6	T_6= Spiromesifen 22.9 SC	96	8.30 (3.05)	6.13 (2.67)	1.80 (1.67)	3.83 (2.19)	4.43 (2.32)	5.47 (2.54)	4.72
7	T_7=Control	-	8.80 (3.13)	12.20 (3.63	14.07 (3.89)	14.47 (3.93)	14.87 (3.98)	15.27 (4.03)	13.21
	SEm±		0.038	0.052	0.048	0.065	0.078	0.079	
	CD @ 5%		NS	0.164	0.149	0.201	0.223	0.240	

Table 1. Continued.

Sl. No.	Treatments	Dose (g a.i. ha^{-1})	Second spraying Mean population of *P. latus* per plant*							MRC%
			PTC	1DAS	3DAS	5DAS	7DAS	10DAS	PTM	
1	T_1=Flonicamid 50 WG	60	13.50 (3.81)	7.73 (2.95)	5.80 (2.62)	6.23 (2.81)	6.93 (2.95)	8.33 (3.05)	8.09	50.53
2	T_2=Dimethoate 30 EC	300	12.17 (3.62)	6.87 (2.81)	3.83 (2.12)	4.40 (2.32)	4.87 (2.39)	5.07 (2.46)	6.20	60.35
3	T_3=Fipronil 5 EC	50	13.03 (3.74)	7.07 (2.64)	5.13 (2.56)	6.07 (2.68)	5.93 (2.63)	7.03 (2.83)	7.38	57.13
4	T_4=Diafenthiuron 50 WP	300	12.17 (3.63)	6.10 (2.66)	2.57 (1.88)	3.13 (2.03)	3.60 (2.13)	4.57 (2.14)	5.36	66.51
5	T_5=Propargite 57 EC	850	12.33 (3.65)	5.67 (2.58)	3.73 (1.46)	2.00 (1.71)	2.37 (1.76)	2.83 (1.96)	4.82	71.64
6	T_6=Spiromesifen 22.9 SC	96	12.13 (3.62)	6.13 (2.67)	2.13 (1.46)	2.50 (1.87)	3.00 (1.92)	4.27 (3.01)	5.03	69.21
7	T_7=Control	-	14.67 (3.96)	16.87 (4.23)	18.33 (4.69)	21.07 (3.93)	22.77 (4.87)	23.13 (4.91)	19.47	
	SEm±		0.082	0.036	0.039	0.041	0.051	0.057		
	CD @ 5%		NS	0.113	0.121	0.126	0.159	0.176		

*Mean of three replications.
** Figures in the parenthesis are square root transformed value.
PTC = Pre treatment count, PTM = Post treatment mean,
DAS = Days after spray, MRC = Mean reduction over control (overall mean).

in plots sprayed with Propargite 57% EC followed by Spiromesifen (5.03 mites/ plant) and Diafenthiuron (5.36 mites/ plant). Dimethoate, Fipronil and Flonicamid stood next to above insecticides and exhibited mite population as 6.20, 7.38 and 8.09 mites/ plant, respectively. Among all insecticides, Fipronil and Flonicamid found inferior and proved less effective against mites but proved statistically better than untreated check (19.47 mites/ plant). The data presented in Table 1 indicated that on the basis of mean per cent reduction in mite population after two sprays the order of efficacy of different treatments was as follows: Propargite (75.24%)> Spiromesifen (74.16%) > Diafenthiuron (72.47%) > Dimethoate (68.16%) > Fipronil (63.48%) > Flonicamid (58.45%) > Untreated check (Fig. 1).

Thrips, *Scirtothrips dorsalis* Hood

The data obtained after first spray showed (Table 2) that minimum (3.46 thrips plant^{-1}) population of thrips were found in plots sprayed with Fipronil 5 EC @ 50 g a.i. ha^{-1} (T_3). Diafenthiuron 50 WP @ 300 g a.i. ha^{-1}(3.86 thrips plant^{-1}) and Flonicamid 50 WG @ 60 g a.i. ha^{-1} (4.02 thrips plant^{-1}) are the next best treatments. Though, Propargite 57 EC (4.96 thrips plant^{-1}) recorded the minimum reduction of population, it was superior to the untreated check (6.86 thrips plant^{-1}).

In the second spray, like the first one the least numbers (2.86 thrips plant^{-1}) were found in plots treated with Fipronil 5 EC @ 50 g a.i. ha^{-1} (T_3) followed by Diafenthiuron 50 WP @ 300 g a.i. ha^{-1} (3.34 thrips plant^{-1}). Spiromesifen 22.9 SC (4.14 thrips plant^{-1}) and Propargite 57 EC (4.52 thrips plant^{-1}) proved less effective against thrips but registered significantly less population of the pest as compare to untreated check (7.05 thrips plant^{-1}). The insecticides were ranked as following order based on their overall performance of percent reduction of thrips population after second

Table 2. Effect of newer molecules of insecticides on population of thrips, *S. dorsalis* in chilli during *kharif* (2019).

Sl. No.	Treatments	Dose (g a.i. ha^{-1})	First spraying Mean population of *S.dorsalis* per plant*						PTM
			PTC	1DAS	3DAS	5DAS	7DAS	10DAS	
1	T_1=Flonicamid 50 WG	60	5.67 (2.58)**	5.57 (2.52)	2.17 (1.77)	2.70 (1.92)	3.40 (2.09)	4.60 (2.26)	4.02
2	T_2=Dimethoate 30 EC	300	5.73 (2.58)	5.70 (2.54)	2.50 (1.86)	3.27 (2.06)	4.00 (2.23)	4.80 (2.41)	4.33
3	T_3=Fipronil 5 EC	50	5.80 (2.59)	4.67 (2.38)	1.77 (1.45)	2.30 (1.77)	2.73 (1.81)	3.47 (1.92)	3.46
4	T_4=Diafenthiuron 50 WP	300	5.87 (2.61)	5.33 (2.52)	2.03 (1.74)	2.47 (1.94)	3.00 (2.01)	4.43 (2.33)	3.86
5	T_5=Propargite 57 EC	850	6.13 (2.62)	5.87 (2.62)	3.47 (2.11)	4.30 (2.31)	4.77 (2.41)	5.20 (2.48)	4.96
6	T_6=Spiromesifen 22.9 SC	96	6.07 (2.66)	5.80 (2.61)	2.73 (1.92)	3.77 (2.18)	4.53 (2.35)	5.00 (2.45)	4.65
7	T_7=Control	-	5.80 (2.65)	6.53 (2.74)	6.67 (2.76)	6.97 (2.82)	7.27 (2.87)	7.90 (2.98)	6.86
	SEm±		0.057	0.063	0.044	0.061	0.068	0.069	
	CD @ 5%		NS	0.196	0.138	0.185	0.211	0.216	

Table 2. Continued.

Sl. No.	Treatments	Dose (g a.i. ha^{-1})	Second spraying Mean population of *S.dorsalis* per plant*						PTM	MRC%
			PTC	1DAS	3DAS	5DAS	7DAS	10DAS		
1	T_1=Flonicamid 50 WG	60	6.23 (2.69)	4.37 (2.31)	2.03 (1.74)	2.37 (1.83)	2.83 (1.96)	3.13 (2.03)	3.49	45.94
2	T_2=Dimethoate 30 EC	300	6.20 (2.68)	4.77 (2.40)	2.13 (1.75)	2.53 (1.76)	3.20 (1.88)	3.23 (2.05)	3.68	42.34
3	T_3=Fipronil 5 EC	50	6.03 (2.65)	3.80 (2.18)	1.27 (1.19)	1.67 (1.51)	1.87 (1.63)	2.53 (1.69)	2.86	54.50
4	T_4=Diafenthiuron 50 WP	300	6.23 (2.68)	4.13 (2.26)	1.93 (1.71)	2.30 (1.91)	2.53 (1.94)	2.90 (1.96)	3.34	48.17
5	T_5=Propargite 57 EC	850	6.27 (2.70)	5.80 (2.61)	3.13 (2.03)	3.43 (2.21)	4.13 (2.26)	4.37 (2.31)	4.52	31.79
6	T_6=Spiromesifen 22.9 SC	96	6.20 (2.68)	5.27 (2.51)	3.03 (2.03)	3.00 (2.01)	4.13 (2.26)	4.37 (2.31)	4.14	36.74
7	T_7=Control	-	7.30 (2.88)	7.33 (2.83)	7.03 (2.83)	7.17 (2.85)	7.33 (2.89)	6.13 (2.67)	7.05	
	SEm±		0.052	0.059	0.042	0.048	0.052	0.058		
	CD @ 5%		NS	0.183	0.131	0.151	0.168	0.180		

* Mean of three replications.
** Figures in the parenthesis are square root transformed value.
PTC = Pre treatment count, PTM = Post treatment mean,
DAS = Days after spray, MRC = Mean reduction over control (overall mean).

Table 3. Effect of newer molecules of insecticides on population of aphid *A.gossypii* in chilli during *kharif* 2019.

Sl. No.	Treatments	Dose (g a.i. ha^{-1})	First spraying Mean population of A.gossypii per plant*						PTM
			PTC	1DAS	3DAS	5DAS	7DAS	10DAS	
1	T_1=Flonicamid 50 WG	60	20.47 (4.63)**	15.53 (4.06)	5.27 (2.51)	9.27 (3.21)	10.80 (3.43)	16.27 (4.15)	12.93
2	T_2=Dimethoate 30 EC	300	20.13 (4.58)	16.47 (4.17)	6.27 (2.69)	10.27 (3.35)	12.73 (3.71)	17.93 (4.34)	13.97
3	T_3=Fipronil 5 EC	50	20.73 (4.66)	18.03 (4.36)	7.13 (2.84)	11.40 (3.52)	13.73 (3.83)	18.73 (4.43)	14.96
4	T_4=Diafenthiuron 50 WP	300	20.33 (4.61)	21.67 (4.76.)	10.93 (3.45)	14.93 (3.98)	16.13 (4.13)	20.40 (4.62)	17.40
5	T_5=Propargite 57 EC	850	20.53 (4.64)	23.07 (4.91)	11.53 (3.53)	17.20 (4.26)	18.00 (4.35)	20.93 (4.68)	18.54
6	T_6=Spiromesifen 22.9 SC	96	22.27 (4.82)	20.73 (4.66)	10.33 (3.56)	13.47 (3.81)	15.40 (4.04)	19.40 (4.52)	16.93
7	T_7=Control	-	20.07 (4.59)	28.27 (5.41)	33.27 (5.85)	37.33 (6.19)	44.27 (6.72)	44.73 (6.75)	34.66
	SEm±		0.051	0.062	0.061	0.062	0.069	0.088	
	CD @ 5%		NS	0.188	0.194	0.211	0.215	0.274	

Table 3. Continued.

Sl. No.	Treatments	Dose (g a.i. ha^{-1})	Second spraying Mean population of *A.gossypii* per plant*					PTM	MRC%
			PTC	1DAS	3DAS	5DAS	7DAS	10DAS		
1	T_1=Flonicamid 50 WG	60	20.70 (4.65)	11.53 (3.53)	3.63 (2.19)	5.80 (2.93)	6.10 (3.28)	8.37 (3.66)	9.19	59.07
2	T_2=Dimethoate 30 EC	300	21.40 (4.73)	13.13 (3.75)	4.40 (1.61)	6.07 (2.33)	6.47 (3.07)	8.93 (3.45)	10.07	55.44
3	T_3=Fipronil 5 EC	50	21.93 (4.78)	14.33 (3.91)	5.80 (1.75)	6.20 (2.44)	7.00 (3.13)	9.47 (3.63)	10.79	52.27
4	T_4=Diafenthiuron 50 WP	300	22.37 (4.84)	15.07 (4.01)	6.33 (1.86)	7.47 (2.62)	7.87 (3.23)	10.67 (3.78)	11.63	46.70
5	T_5=Propargite 57 EC	850	22.33 (4.83)	15.67 (4.08)	6.73 (2.15)	7.70 (2.69)	8.27 (3.27)	11.07 (3.83)	11.96	44.26
6	T_6=Spiromesifen 22.9 SC	96	22.17 (4.81)	14.60 (3.94)	6.13 (2.25)	6.40 (2.59)	7.60 (3.18)	10.60 (3.71)	11.25	48.31
7	T_7=Control	-	22.93 (4.89)	23.73 (4.97)	25.53 (5.15)	23.13 (4.91)	16.07 (4.13)	12.40 (2.05)	20.63	
	SEm±		0.045	0.051	0.041	0.065	0.087	0.073		
	CD @ 5%		NS	0.159	0.128	0.203	0.272	0.227		

*Mean of three replications.
** Figures in the parenthesis are square root transformed value.
PTC = Pre treatment count, PTM = Post treatment mean,
DAS = Days after spray, MRC = Mean reduction over control (overall mean).

spraying: Fipronil 5 EC (59.43%) > Diafenthiuron 50 WP (5.62%) > Flonicamid 50 WG (50.49%) > Dimethoate 30 EC (47.80%) > Spiromesifen 22.9 SC (41.28%) >Propargite 57 EC (35.89%) > Untreated check (Fig. 2).

Aphid, *Aphis gossypii* Glover

Data obtained after the application of first and second spray has been depicted in Table 3. There was no significant difference in the population of aphid among the different treatments on a day before first spray. Based on mean population of aphid all the treatments were found to be significantly superior over the untreated control (34.66 aphid plant^{-1}) in reducing the aphid population, however, considerable difference

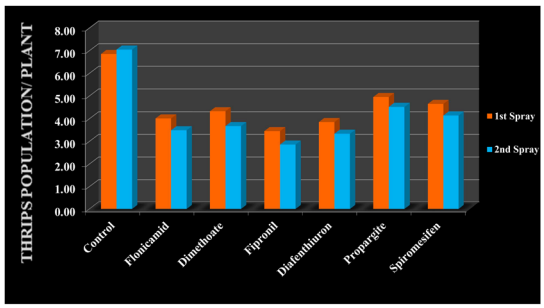

Fig. 2. Efficacy of some newer insecticides against the population of thrips, *S.dorsalis* on chilli during *kharif* 2019.

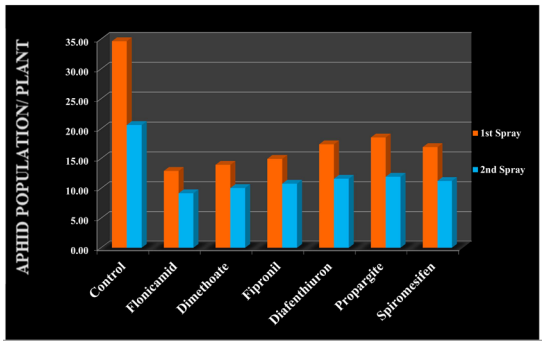

Fig. 3. Efficacy of some newer insecticides against the population of aphids, *A.gossypii* on chilli during *kharif* 2019.

Table 4. Impact of newer insecticidal treatments on chilli yield during *kharif* 2019.

Treatments	Dose (g a.i./ha)	Yield (q/ha)	% Increase in yield over control
T_1=Flonicamid 50 WG	60	24.80	46.48
T_2=Dimethoate 30 EC	300	26.40	55.94
T_3=Fipronil 5 EC	50	28.20	66.57
T_4=Diafenthiuron 50 WP	300	30.20	78.38
T_5=Propargite 57 EC	850	25.27	49.26
T_6=Spiromesifen 22.9 SC	96	26.93	59.07
T_7=Control	-	16.93	-
SEm ±		0.032	-
CD at 5%		1.093	-

was noticed between the different treatments after the first application. Result of 1st spray (Table 3) revealed that maximum reduction in aphid population was observed Flonicamid 50 WG (T_1) @ 60 g a.i. ha^{-1} (12.93 aphids plant^{-1}) and Dimethoate 30 EC @ 300 g a.i. ha^{-1} (13.97 aphids plant^{-1}). The other insecticides ranked as follows: Fipronil (14.96 aphids plant^{-1})> Spiromesifen (16.93 aphids plant^{-1})> Diafenthiuron (17.40 aphids plant^{-1})> Propargite (18.54 aphids plant^{-1}).

The exact trend was found in the second spraying where all the treatments showed superior reduction in aphid population over the untreated control (20.63 aphid plant^{-1}) and Flonicamid (9.19 aphids plant^{-1}) gave the best result. Thus, on the basis of overall mean population reduction of aphids over control (MRC), after two sprays (1st and 2nd spray), the order of efficacy of different treatments in the present study was as follows: Flonicamid 50 WG (59.07%) > Dimethoate 30 EC (55.44%) > Fipronil 5 EC (52.27%)> Spiromesifen 22.9 SC (48.31%)> Diafenthiuron 50 WP (46.70%)> Propargite 57 EC (44.26%)> Untreated check (Fig. 3).

Effect of newer insecticides on yield of chilli

The data presented in Table 4 revealed that in all the plots treated with insecticides significantly higher fruit yield of chilli was obtained over untreated control (16.93 q ha^{-1}). The maximum yield of chilli (30.20 q ha^{-1}) was obtained in the plots treated with Diafenthiuron 50 WP, followed by Fipronil 5 EC (28.20 q ha^{-1}), Spiromesifen 22.9 SC (26.93 q ha^{-1}), Dimethoate 30 EC (26.40 q ha^{-1}). Comparatively lesser yield (24.80 q ha^{-1}) was obtained in the plots treated with Flonicamid 50 WP followed by Propargite 57 EC (25.27 q ha^{-1}).

CONCLUSION

Evaluation of bio-efficacy against the sucking pest (mites, thrips and aphids) of chilli was our major goal in this experiment and for that six newer molecule of insecticides were taken. The chemicals like Propargite 57% EC @ 850 g a.i. ha^{-1}, Fipronil 5% SC @ 50 g a.i. ha^{-1} and Flonicamid 50% WG @ 60 g a.i. ha^{-1} were seen to perform very well in controlling yellow mite, thrips and aphids respectively, whereas the rest of the treatments are performed at moderate level. Highest green chilli fruit yield was harvested from crop treated with Diafenthiuron 50% WP @ 300 g a.i. ha^{-1}.

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