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RESEARCH ARTICLE :

Bioefficacy of newer insecticides against onion thrips (*Thrips tabaci* L.) and their effect on ladybird beetle

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SUMMARY : A field experiment was conducted at Research Farm of Department of Agricultural Entomology, VNMKV, Parbhani, during *Kharif* 2016, to study bioefficacy of newer insecticides against onion thrips (*Thrips tabaci* L.), their effect on ladybird beetle and onion bulb yield. Nine insecticides including acetamiprid 20 SP @ 20 g. a.i. /ha, emamectin benzoate 5 SG @ 10 g.a.i./ha, fipronil 5 SC @ 50 g.a.i. /ha, flonicamid 50 SG @ 75g a.i./ha, imidacloprid 17.8 SL @ 25 g.a.i. /ha, lamdacyalothrin 5 EC @ 15 g.a.i./ha, spinosad 45 SC @ 73 g.a.i./ha, thiamethoxam 25 WG @ 25 g.a.i./ha were tested along with water spray treatment in RBD with three replication. For management of thrips Spinosad 45 SC @ 73 g. a.i. ha^{-1} and fipronil 5 SC @ 50 g. a.i. ha^{-1} were the most superior and persistent treatments against thrips as compared to evaluated insecticides followed by lamdacyhalothrin 5 EC @ 15 g. a.i. ha^{-1}. Among insecticidal treatment flonicamid 50 SG @ 75 g a.i ha^{-1} and spinosad 45 SC @ 73 g a.i ha^{-1} were found promising regarding its safety to predators. The highest bulb yield was recorded in spinosad 45 SC @ 73 g a.i ha^{-1} (18.03 t/ha) treated plots followed by fipronil 5 SC @ 50 g. a.i. ha^{-1} (16.78 t/ha), indicating the significance of thrips management in *Kharif* onion.

KEY WORDS :
Bioefficacy, Onion thrips, Spinosad, Flonicamid, Newer insecticides

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BACKGROUND AND OBJECTIVES

Onion (*Allium cepa* L.) belonging to family Liliaceae is one of the most popular bulb vegetables originated from Central Asia (Brewster, 1994). It has special qualities which add taste and flavour to food as well as medicinal value and hence it is mainly used in India for cuisine and culinary preparations. This crop is attacked by several insect pests among those, onion thrips (*Thrips tabaci* L.) is a major pest and reported to cause significant economic losses upto 30-50% (Nault and Shelton, 2012). Immature and adult thrips prefer to feed on young leaves in the inner neck of plants. Soni and Ellis (1990) listed seven species of thrips as onion pests, the best known of which is *Thrips tabaci*, the onion thrip, which attacks all edible onions. Therefore, it is important to protect the onions from thrips damage throughout the entire growing season. These are slender insects only about 2 mm long as adults. They are found wherever onions are grown, but are most severe in the warmer production regions (Brewster, 1994).

Onion thrips are difficult to control because of the mobile stages of this insect are found mainly in the narrow spaces between the inner leaves where spray coverage is difficult to accomplish. In addition, the eggs are laid into the leaf tissues where they may escape control. Re-infestation of fields can occur from surrounding non-crop vegetation and immigration of thrips from nearby fields. The chemical insecticides have been the primary tactics for thrips management, however, repeated applications often led to resistance in thrips, suppression of natural enemies and unsustainable management. Besides the increased cost and environmental pollution, it is difficult to control this pest with insecticides because of its small size and cryptic habits (Lewis, 1997). Insecticides should be persistent enough to control the pest effectively. But longer persistence of insecticides may affect natural enemies and also result in pest resurgence. The increasing concern for environmental safety and global demand for pesticide residue free commodities have evolved a keen interest and necessitated a deep insight into issue of safer products in pest management. Keeping in view the above facts, the studies were planned with objectives:

Objectives :

– Bioefficacy of newer insecticides against onion thrips

– To study effect of newer insecticides on natural enemies of onion thrips and bulb yield in *Kharif* season

RESOURCES AND METHODS

The present investigation was carried out in *Rabi* season of 2016-17 at Research Farm, Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The experiment was laid on uniform, heavy black cotton soil having good fertility and drainage. The sowing was done on 10^{th} June 2015 by using N-53 variety. The plant to plant and row to row distance was 45 x 30 cm.

First insecticidal application was given as soon as incidence of thrips was observed and the subsequent sprays were given at an interval of 15 days. Spraying was done early in the morning hours to avoid the mid day heat. Total three sprays were given. For recording observations five plants were randomly selected in each experimental plot. The pre count was recorded one day before application of treatments. Post application observations were recorded at 1, 3, 7, 10 and 14 days after each spray.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Bioefficacy of newer insecticides against onion thrips (*T. tabaci*) based on pooled data :

The data regarding thrips count before spray revealed that population of thrips was uniform throughout the experimental treatments, since the average pre-treatment population of thrips was statistically non- significant. The average pre-tratment population was 13.20 to 14.12 thrips/plant justifying that there was need to protect the crop from thrips infestation.

The overall efficacy data indicated that the plants treated with spinosad 45 SC @ 73 g a.i. ha^{-1} (4.95 thrips/ plant) and fipronil 5 SC @ 50 g a.i. ha^{-1} (5.36 thrips/ plant) recorded minimum incidence of onion thrips indicating their significance over rest of the treatments. The remaining insecticides also effectively controlled the thrips but their persistence lasted upto ten days showing more number of thrips/plant at 14 DAS.Performance of spray treatments with eight insecticides was studied on the basis of infestation of thrips (No. /plant) recorded at 1, 3, 7, 10 and 14 DAS. Pooled data of three sprays was used for comparison of efficacy. All the insecticides under test significantly reduced the thrips incidence. The reviews of the earlier workers in respect of these insecticides and this pest are discussed here, Kadam *et al.* (2012) revealed that spinosad @ 56.25 g a.i. ha^{-1} was the most effective treatment against pomegranate thrips, *S. dorsalis* at 14 DAS and was at par with fipronil @ 50 g a.i. ha^{-1} followed by lamdacyhalothrin and imidacloprid. Mallinath and Biradar *et al.* (2015) suggested that new generation insecticides *viz.*, thiamethoxam 25 WG @ 0.2 g/l, imidacloprid 200 SL @ 0.33 ml/l and acetamiprid 20 SP @ 0.5 g/l were most effective in controlling thrips. According to Kadri and Goud (2006) acetamiprid 20 SP @ 0.5 g/l, imidacloprid 200 SL @ 0.2 ml/l and emamectin benzoate 5 SG @ 0.3 g/l proved significantaly superior in controlling onion

Table 1 : Bioefficacy of newer insecticides against thrips infesting onion after 1st spray

Treatments	Dose g.a.i./ha	Pre count	Average no. of thrips/plant I														
			1 DAS	3 DAS	7 DAS	10 DAS	14 DAS	1 DAS	3 DAS	7 DAS	10 DAS	14 DAS	1 DAS	3 DAS	7 DAS	10 DAS	14 DAS
Acetamiprid 20 SP	20	13.20	3.57	5.69	6.44	8.11	9.01	3.02	4.29	5.23	7.01	7.93	2.94	4.13	5.17	6.88	7.68
		(3.70)	(2.13)	(2.58)	(2.72)	(3.00)	(3.15)	(2.00)	(2.29)	(2.49)	(2.82)	(2.90)	(1.98)	(2.26)	(2.48)	(2.80)	(2.94)
Emamectin benzoate 5 SG	10	14.12	4.12	5.21	5.91	6.88	9.34	3.88	5.11	6.39	7.96	8.56	3.72	5.01	6.22	7.85	8.32
		(3.82)	(2.26)	(2.49)	(2.62)	(2.79)	(3.20)	(2.20)	(2.47)	(2.71)	(2.98)	(3.0)	(2.17)	(2.44)	(2.68)	(2.97)	(3.04)
Fipronil 5 SC	50	13.52	2.6	4.21	5.16	6.01	6.45	1.93	2.42	3.86	4.96	5.92	1.35	1.47	2.58	3.49	3.72
		(3.74)	(1.89)	(2.28)	(2.47)	(2.64)	(2.72)	(1.71)	(1.84)	(2.20)	(2.43)	(2.53)	(1.53)	(1.57)	(1.89)	(2.11)	(2.17)
Flonicamid 50 SG	75	13.67	4.58	6.02	7.92	8.22	10.29	4.56	6.42	6.93	8.71	9.34	4.42	5.62	6.75	8.53	9.27
		(3.76)	(2.36)	(2.64)	(2.98)	(3.02)	(3.34)	(2.35)	(2.72)	(2.81)	(3.11)	(3.13)	(2.32)	(2.57)	(2.78)	(3.08)	(3.19)
Imidacloprid 17.8 SL	25	13.32	2.92	3.58	4.98	6.92	8.92	2.59	4.01	4.92	6.27	7.21	2.38	3.52	4.87	6.31	7.22
		(3.71)	(91.98)	(2.13)	(2.44)	(2.80)	(3.13)	(1.89)	(2.23)	(2.43)	(2.69)	(2.77)	(1.83)	(2.12)	(2.42)	(2.69)	(2.86)
Lamdacyalothrin 5 EC	15	13.50	3.31	4.6	5.11	6.98	8.5	2.16	3.13	4.43	5.11	6.47	1.69	2.06	2.93	4.35	5.31
		(3.74)	(2.07)	(2.36)	(2.46)	(2.81)	(3.07)	(1.77)	(2.03)	(2.32)	(2.46)	(2.64)	(1.63)	(1.74)	(1.98)	(2.31)	(2.50)
Spinosad 45 SC	73	13.77	2.18	3.36	4.41	5.02	5.61	1.82	2.37	3.21	4.92	5.74	1.23	1.34	2.42	3.25	3.5
		(3.77)	(1.78)	(2.08)	(2.32)	(2.44)	(2.56)	(1.67)	(1.83)	(2.05)	(2.42)	(2.49)	(1.49)	(1.52)	(1.84)	(2.05)	(2.11)
Thiamethoxam 25 WG	25	13.99	3.02	5.28	4.92	7.23	7.71	2.27	3.42	4.47	5.37	6.68	2.17	3.21	4.05	5.5	6.11
		(3.80)	(2.00)	(2.50)	(2.43)	(2.86)	(2.94)	(1.80)	(2.10)	(2.33)	(2.52)	(2.67)	(1.77)	(2.05)	(2.24)	(2.54)	(2.66)
Untreated control	-	13.37	12.46	10.72	13.23	14.91	15.3	15.35	12.11	13.41	15.19	17.32	18.01	18.72	20.15	20.42	20.88
		(3.72)	(3.66)	(3.42)	(3.76)	(3.97)	(4.02)	(4.03)	(3.61)	(3.79)	(4.01)	(4.22)	(4.35)	(4.43)	(4.59)	(4.61)	(4.66)
S.E.±	-	0.41	0.02	0.01	0.19	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.04	0.04	0.03	0.04	0.03
C.D. (P=0.05)	-	NS	0.06	0.04	0.05	0.06	0.06	0.09	0.06	0.06	0.08	0.08	0.11	0.12	0.11	0.11	0.11

Fig in parenthesis are √x + 0.5 transformed values

Table 2 : Overall efficacy of newer insecticides against thrips on onion based on pooled data

Treatments	Dose g.a.i./ha	Pre count	Average no. of thrips/plant				
			1 DAS	3 DAS	7 DAS	10 DAS	14 DAS
Acetamiprid 20 SP	20	10.05 (3.31)	3.18 (2.04)	4.7 (2.38)	5.61 (2.56)	7.33 (2.88)	8.21 (3.03)
Emamectin benzoate 5 SG	10	10.67 (3.41)	3.91 (2.21)	5.11 (2.46)	6.17 (2.67)	7.56 (2.92)	8.74 (3.11)
Fipronil 5 SC	50	8.63 (3.09)	1.96 (1.72)	2.7 (1.92)	3.87 (2.20)	4.82 (2.41)	5.36 (2.52)
Flonicamid 50 SG	75	11.1 (3.47)	4.52 (2.34)	6.02 (2.64)	7.2 (2.85)	8.49 (3.08)	9.63 (3.25)
Imidacloprid 17.8 SL	25	9.82 (3.28)	2.63 (1.90)	3.7 (2.16)	4.92 (2.43)	6.5 (2.73)	7.78 (2.95)
Lamdacyalothrin 5 EC	15	9.49 (3.23)	2.39 (1.84)	3.26 (2.06)	4.16 (2.27)	5.48 (2.54)	6.76 (2.78)
Spinosad 45 SC	73	8.37 (3.05)	1.74 (1.65)	2.36 (1.83)	3.35 (2.08)	4.4 (2.32)	4.95 (2.43)
Thiamethoxam 25 WG	25	9.46 (3.23)	2.49 (1.86)	3.97 (2.22)	4.48 (2.33)	6.03 (2.65)	6.83 (2.79)
Control	-	15.33 (4.03)	15.27 (4.02)	13.85 (3.85)	15.6 (4.07)	16.84 (4.22)	17.83 (4.33)
S.E.±	-	0.11	0.06	0.10	0.09	0.08	0.08
C.D. (P=0.05)	-	0.38	0.18	0.30	0.27	0.24	0.27

Fig in parenthesis are √x + 0.5 transformed values

thrips. Sule *et al.* (2008) observed that lamdacyhalothrin was the most effective treatment against *T. tabaci* on onion crop. Pandey *et al*. (2013) observed the lowest mean thrips population in fipronil, spinosad and imidacloprid treated plots.

Overall effect of insecticides on ladybird beetles on onion based on pooled data :

Pooled average in respect of efficacy of insecticides against coccinelids are presented in (Table 3 and Fig. 3). The overall efficacy data indicated that the plants treated with lambda cyhalothrin 5 EC @ 50 g a.i/ha (1.47 beetles / plant), fipronil 5 SC @ 50 g a.i./ha (1.58 beetles /plant) and imidacloprid 17.8 SL @ 50 g a.i./ha (1.68 beetles / plant) recorded minimum predator population as compared to other treatments at 14 days after spray.

The overall results on population of ladybird beetle, an active predator normally found in onion, revealed that flonicamid 50 SG @ 75 g a.i/ha and spinosad 45 SC @ 73 g a.i/ha were safe to beetles. This is indicated by the higher numbers in both the treatments comparable to the density observed in untreated control; other insecticides recorded significantly lower activity of predatory beetles revealing their toxicity. The results of present investigations are in conformity with the following findings of previous workers. Ghosh *et al.* (2010) studied the efficacy of spinosad 45% SC against tomato fruit borer (*H. armigera* Hub.) and natural enemies and stated that spinosad at 73 to 84 g a.i./ha were very safe to three important predators *viz.*, *Menochilus sexmaculaus*., *Syrphus corollae* and *Chrysoperl acarnea*. Sechser *et al*. (2003) reported emamectin benzoate was relatively safe for the eggs of two ladybird beetles, *Scymnus* spp. and *Coccinella undecimpunctata* L. The observations made by Jalali *et al.* (2009) are parallel to the present findings who reported that spinosad had no effect on adults of two-spoted ladybird, *Adaliabi punctata*. The results of Jyoti and Basavana (2008) and Williams *et al.* (2003) are likewise in accordance with the results of present findings who reported spinosad 45 SC safe for coccinelids. Whereas, Sharma and Kaushik (2010) reported toxicity of emamectin benzoate to ladybird beetles. Ahmad *et al.* (2011) stated that in residual film method, acetamiprid was the least toxic but most toxic in glass vial method against *Coccinella undecimpunctata.*

Effect of newer insecticides on yield of onion :

The data on yield of onion is presented in (Table 4 and Fig. 2) It was seen from the data that all the insecticides treated plots recorded significantly higher onion yield than the untreated control (10.0 t/ha). The average marketable bulb yield among different treatments ranged from (10.37 to 18.03 t/ha). The highest yield was

Table 3 : Overall effect of newer insecticides on ladybird beetles on onion based on pooled data

Treatments	Dose g.a.i./ ha	Pre count	Average no. of beetles/plant				
			1 DAS	3 DAS	7 DAS	10 DAS	14 DAS
Acetamiprid 20 SP	20	2.69 (1.9)	0.41 (1.18)	1.04 (1.42)	1.53 (1.42)	2.18 (1.63)	2.38 (1.69)
Emamectin benzoate 5 SG	10	2.53 (1.859)	0.27 (1.12)	0.84 (1.35)	1.24 (1.31)	1.88 (1.54)	2.10 (1.61)
Fipronil 5 SC	50	2.19 (1.76)	0.13 (1.06)	0.55 (1.24)	0.66 (1.07)	1.15 (1.28)	1.58 (1.44)
Flonicamid 50 SG	75	3.32 (2.05)	1.18 (1.47)	1.41 (1.55)	2.05 (1.59)	2.71 (1.79)	3.17 (1.91)
Imidacloprid 17.8 SL	25	2.3 (1.79)	0.21 (1.1)	0.76 (1.32)	0.87 (1.17)	1.66 (1.46)	1.68 (1.47)
Lamdacyalothrin 5 EC	15	2.11 (1.74)	0.09 (1.04)	0.43 (1.19)	0.53 (1.01)	1.02 (1.23)	1.47 (1.40)
Spinosad 45 SC	73	3.12 (2.00)	0.96 (1.39)	1.24 (1.49)	1.95 (1.56)	2.54 (1.74)	2.98 (1.86)
Thiamethoxam 25 WG	25	3.06 (1.99)	0.7 (1.30)	1.14 (1.46)	1.61 (1.45)	2.46 (1.72)	2.78 (1.81)
Control	-	3.27 (2.04)	3.25 (2.05)	2.91 (1.97)	3.15 (1.91)	3.24 (1.93)	3.30 (1.94)
S.E.±	-	0.02	0.04	0.01	0.04	0.16	0.02
C.D. (P=0.05)	-	0.07	0.12	0.05	0.12	0.50	0.08

Figs in parenthesis are $\sqrt{x + 0.5}$ transformed values

Table 4 : Effect of newer insecticides on bulb yield in onion

Treatments	Dose (g.a.i./ha)	Yield (t/ha)
Acetamiprid 20 SP	20	12.96
Emamectin benzoate 5 SG	10	11.20
Fipronil 5 SC	50	16.78
Flonicamid 50 SG	75	10.37
Imidacloprid 17.8 SL	25	14.25
Lamdacyalothrin 5 EC	15	15.85
Spinosad 45 SC	73	18.03
Thiamethoxam 25 WG	25	15.82
Untreated control	-	10.00
S.E.±		0.59
C.D. (P=0.05)		1.78

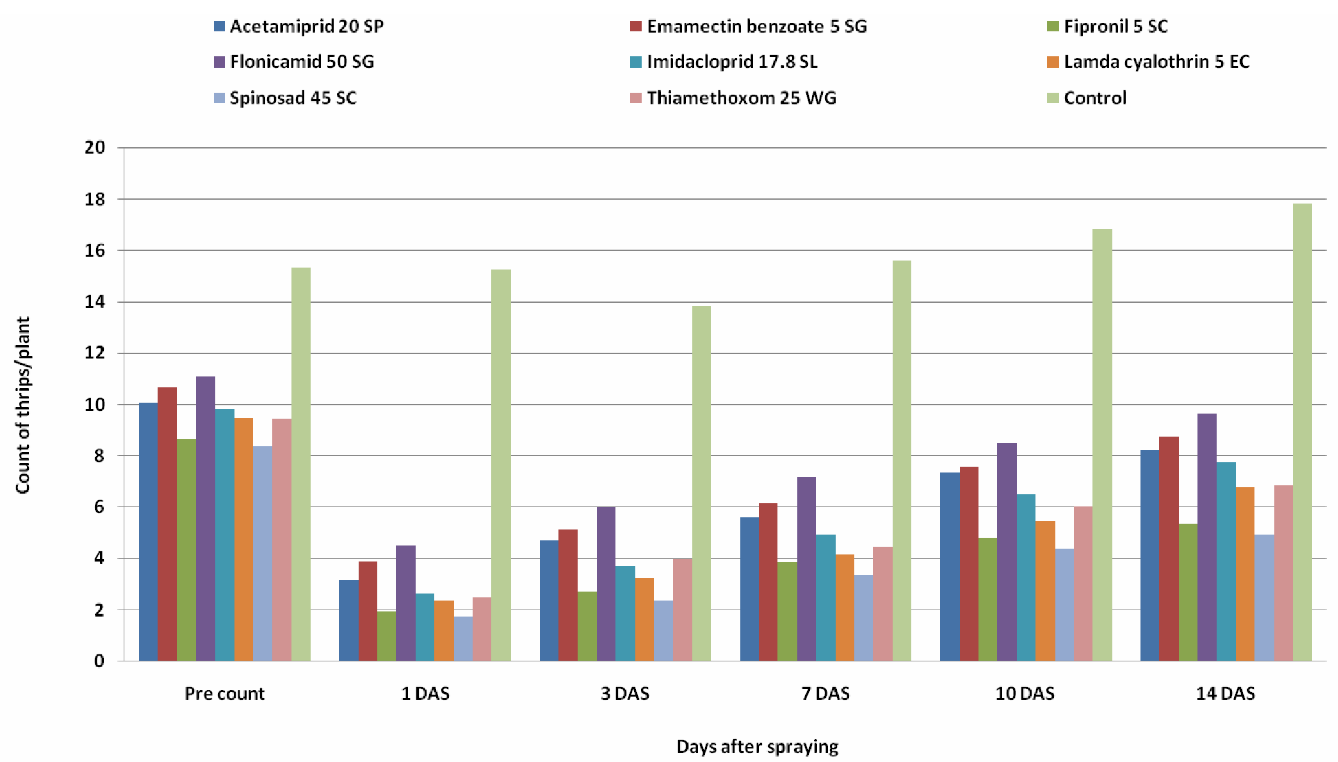

Fig. 1 : Bio efficacy of insecticides against thrips on onion based on pooled data

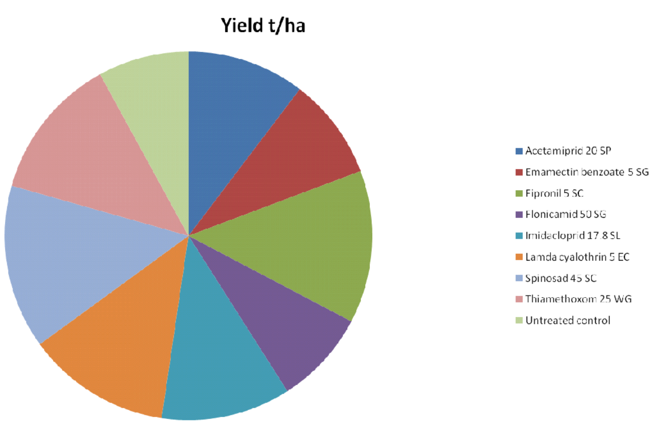

Fig. 2 : Effect of newer insecticides on onion bulb yield

recorded in plots treated with spinosad 45 SC @ 73 g a.i/ha (18.03 t/ha). The second best treatment in respect of bulb yield was fipronil 5 SC @ 50 g a.i/ha (16.78 t/ha). The remaining treatments in respect of yield of onion produced were lambda cyhalothrin 5 EC @ 50 g a.i/ha (15.85 t/ha) > thiamethoxam 25 WG @ 25 g. a.i. ha^{-1} (15.82 t/ha) > imidacloprid 17.8 SL @ 25 g. a.i. ha^{-1} (14.25 t/ha) > acetamiprid 20 SP @ 20 g. a.i. ha^{-1} (12.96 t/ha) > emamectin benzoate 5 SG @ 10 g. a.i. ha^{-1} (11.20 t/ha) > flonicamid 50 SG @ 75 g. a.i. ha^{-1} (10.37 t/ha). Treatment with spinosad 45 SC @ 73 g a.i/ha recorded 80.3 per cent increase in yield over untreated control followed by fipronil 5 SC @ 50 g a.i/ha (67.8 %). These results are in agreement with the results documented by Patra *et al.* (2009) who reported that highest marketable yield of 143.50 q/ha was recorded in spinosad treatment followed by indoxacarb with 126.90 q/ha. Jat and Ameta (2013) reported that the highest marketable yield of tomato was recorded in case of spinosad 45 SC @ 200 ml/ha (251.29 q/ha) and beta-cyfluthrin 2.5 SC @ 750 ml/ha (238.38 q/ha). Hosamani *et al.* (2010) revealed that fipronil 80 WG @ 60 ha^{-1} was effective in reducing the thrips populations with increased onion yield. Mehra and Singh (2013) reported that the highest bulb yield was recorded with imidacloprid (8.25 t/ha) which was at par with thiamethoxam (8.10 t/ha). The lowest mean thrips population (8.0 nymphs/ plant) and the highest marketable yield (362 q/ha) were achieved by applying fipronil @ 1.5 ml/lt, as suggested by Pandey *et al.* (2013). Whereas, Wagh *et al.* (2016) recorded the maximum bulb yield in fipronil treated plots followed by spinosad.

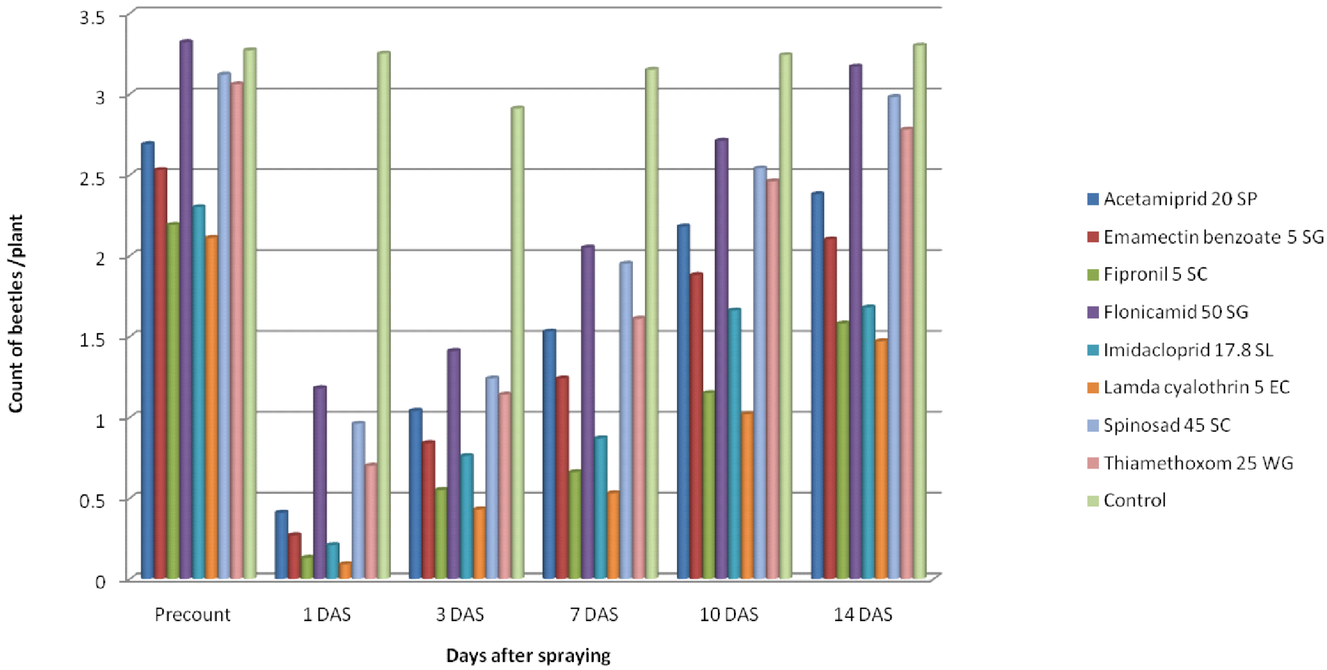

Fig. 3 : Effect of insecticides on ladybird beetles based on pooled data

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