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Effect of different insecticides along with silica and non-silica based surfactant for management of thrips in onion

Sujay Pandey, MK Pathak, MK Pandey, Satyendra Singh and PK Gupta

Abstract
Onion thrips causes 30–50% reduction in bulb yield during severe infestation. If onion thrips are not controlled, damage can routinely reduce bulb yield by 23-85%. In spite of all recommended insecticides onion thrips survives between the leaves in deep, due to this some of these were not affected during spray and remains live results in large scale multiplication. Surfactant reduces the surface tension of spray solution and gives an ideal coverage and penetration between the leaves. In addition to this, surfactants solubilize, suspend and disperse the active ingredient of pesticide. Therefore, the present study was carried out to find out the role of silica based surfactant in the efficacy of insecticides against onion thrips during two consecutive years i.e. rabi, 2017-18 and 2018-19 seasons on onion variety NHRDF Red at Regional Research Station, NHRDF, Karnal (Haryana). The combined data revealed that the lowest thrips population (7.94 nymphs/plant) was recorded in treatment Fipronil 5% SC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L water) and the highest population (16.97 nymphs /plant) was noted in control. The highest gross and marketable yields (278.52 q/ha and 258.0 q/ha) were recorded in treatment Fipronil 5% SC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L water and were found at par with treatment Fipronil 5% SC @ 1.0 ml/L + Sever Surfactant (non-silica based) @ 0.5 ml/L. The lowest gross and marketable yields (231.80 q/ha and 212.27 q/ha) were recorded in treatment control. The highest B:C ratio (6.73:1) was recorded in treatment Fipronil 5% SC @ 1.0 ml/L + Sever Surfactant (non-silica based) @ 0.5 ml/L.

Keywords: *Allium cepa*, thrips, *thrips tabaci*, efficacy, silica, surfactant, insecticides

Introduction
Onion (*Allium cepa* L.) is an important export oriented vegetable crop among the cultivated *Alliums* in India. It is grown in rabi, *kharif* and late *kharif* season in India with the maximum area under cultivation covered in Rabi season. India is the second largest onion producing country in the world after China and producing 31.70 lakh MT from an area of 1.94 lakh ha during 2021-22.

Onion thrips (*Thrips tabaci* L.) is a serious pest of onion crop and losses are reported to be as high as 90% (Mote, 1977, Gupta *et al*., 1984 and Srivastava *et al*., 1997) [4, 2, 10]. Thrips attacks onion at all the stages of crop growth, but their count increases from bulb initiation and remain high up to bulb development and maturity. Both nymphs and adults cause damage directly through feeding and indirectly through the transmission of lethal plant viruses. It is difficult to control this pest with insecticides because of its small size and cryptic habits. Failure to control this pest by timely and effective means causes considerable damage and results in immense economic losses by remarkably reducing yield. Surfactants are widely used in the formulation and enhancement of pesticides. Surfactant also reduces the surface tension of spray solution and gives an ideal coverage and penetration between the leaves. In addition to this, surfactants solubilize, suspend and disperse the active ingredient of pesticide (Katagi 2008) [3]. Waxy leaf surfaces are readily wetted by aqueous sprays containing a suitable surface acting agent (Stevens *et al*. 1993) [11]. To find out the effect of different insecticides along with silica and non-silica based surfactant for management of thrips in onion, a field experiment was conducted during two consecutive years i.e. rabi, 2017-18 and 2018-19 seasons on onion variety NHRDF Red at Regional Research Station, NHRDF, Karnal (Haryana).

Materials and Methods
The field experiment was conducted at Regional Research Station, NHRDF, Karnal during rabi, 2017-18 and 2018-19 seasons. The 60 days old seedlings of onion variety NHRDF Red

were transplanted in a bed having size of 3.0m x 1.2m at 15cm X 10cm spacing. A total of 7 treatments with 3 replications in Randomized Block Design were arranged. The application of treatments was started at 30 days after transplanting and total 5 sprays were given at 15 days interval. The treatments evaluated were T_1- Deltamethrin 2.8% EC @ 1.0 ml/L + Sever Surfactant @ 0.5 ml/L (Non-silica based), T_2- Deltamethrin 2.8% EC @ 1.0 ml/L +Surfactant (silica based) @ 0.5 ml/L, T_3- Lamdacyhalothrin 5% EC @ 1.0 ml/L + Sever Surfactant @ 0.5 ml/L (Non-silica based), T_4 – Lamdacyhalothrin 5% EC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L, T_5- Fipronil 5% SC @ 1.0 ml/L + Sever Surfactant @ 0.5 ml/L (Non-silica based), T_6 - Fipronil 5% SC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L and T_7- Control (no spray). The data on thrips (nymph/plant) number were counted at the inner most leaves in 10 plants marked randomly in each treatment before and 5 days after each spray. All other agronomical practices were performed as per need in all the treatments. The crop was harvested after attaining the maturity. The cost: benefit ratio was worked out and data of two consecutive years i.e. rabi 2017-18 and 2018-19 were pooled, analysed statistically and presented in Table-1, 2 and 3.

Results

Rabi, 2017-18

Data presented in Table-1 and Fig.-1 revealed that before 1st spray (30 DAT), five days after 1st spray, before IVth spray (75 DAT), five days after IVth spray, before Vth spray (90 DAT) and five days after Vth spray data did not differ significantly due to regular rainfall (15.8 mm before 1st spray, 18.4 mm before 2nd spray, 35 mm before 4th spray and 7.1 mm before 5th spray) throughout observational period. Significantly lowest overall average thrips population (9.57 nymphs/plant) was recorded in T_6 (Fipronil 5% SC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L). The data further revealed that significantly highest gross yield (265.37 q/ha) was recorded in T_5 (Fipronil 5% SC @ 1.0 ml/L + Sever Surfactant @ 0.5 ml/L (Non-silica based)) and it was found at par with all the treatments except T_1 (248.61 q/ha) and T_7 (238.33 q/ha).

Table 1: Effect of silica based surfactant on the efficacy of different insecticides against onion thrips at RRS, NHRDF, Karnal during rabi, 2017-18

Treatment	Thrips population (Nymphs/plant) at											
	Before Ist spray at 30 DAT	5 days after Ist spray	Before IInd spray at 45 DAT	5 days after IInd spray	Before IIIrd spray at 60 DAT	5 days after IIIrd spray	Before IVth spray at 75 DAT	5 days after IVth spray	Before Vth spray at 90 DAT	5 days after Vth spray	Overall average thrips population	Gross yield (q/ha)
T_1	0.27 (0.87)	1.37 (1.37)	0.83(1.15)	6.67 (2.67)	8.97 (3.08)	13.63 (3.75)	15.77 (4.03)	15.30 (3.97)	19.87 (4.51)	15.63 (4.01)	10.29 (3.29)	248.61
T_2	0.17 (0.81)	1.27 (1.32)	0.93(1.19)	6.53 (2.65)	8.23 (2.95)	12.80 (3.64)	15.43 (3.99)	16.57 (4.12)	19.40 (4.42)	15.70 (4.02)	10.11 (3.26)	259.90
T_3	0.33 (0.91)	1.40 (1.38)	0.70(1.09)	5.60 (2.46)	8.37 (2.97)	13.43 (3.73)	15.73 (4.03)	17.50 (4.24)	17.13 (4.20)	14.73 (3.90)	9.95 (3.23)	250.46
T_4	0.27 (0.87)	1.53 (1.42)	0.87 (1.17)	5.33 (2.41)	8.17 (2.94)	13.10 (3.68)	15.23 (3.97)	16.87 (4.16)	19.17 (4.43)	12.83 (3.65)	9.75 (3.20)	257.68
T_5	0.20 (0.84)	1.33 (1.35)	0.93(1.19)	4.90 (2.32)	8.40 (2.98)	12.47 (3.59)	16.83 (4.16)	17.63 (4.26)	15.33 (3.97)	15.20 (3.94)	9.87 (3.22)	265.37
T_6	0.17 (0.81)	1.27 (1.33)	1.13(1.27)	4.13 (2.15)	8.27 (2.96)	12.93 (3.66)	14.87 (3.91)	18.33 (4.34)	16.10 (4.06)	13.67 (3.76)	9.57 (3.17)	264.16
T_7	0.30 (0.89)	1.80 (1.51)	2.40 (1.70)	9.00 (3.08)	12.90 (3.66)	19.37 (4.46)	19.13 (4.43)	20.07 (4.53)	23.10 (4.86)	17.03 (4.18)	12.91 (3.66)	238.33
S.Em ±	- 0.06	- 0.09	- 0.10	- 0.11	- 0.07	- 0.18	- 0.15	- 0.14	- 0.31	- 0.24	- 0.05	6.86
CD at 5%	- NS	- NS	- 0.22	- 0.24	- 0.15	- 0.39	- NS	- NS	- NS	- NS	- 0.11	14.95
CV%	- 8.52	- 8.18	- 9.39	- 5.20	- 2.82	- 5.93	- 4.55	- 4.19	- 8.84	- 7.49	- 1.69	3.30

Note: Data in the parenthesis shows Square root transformed values

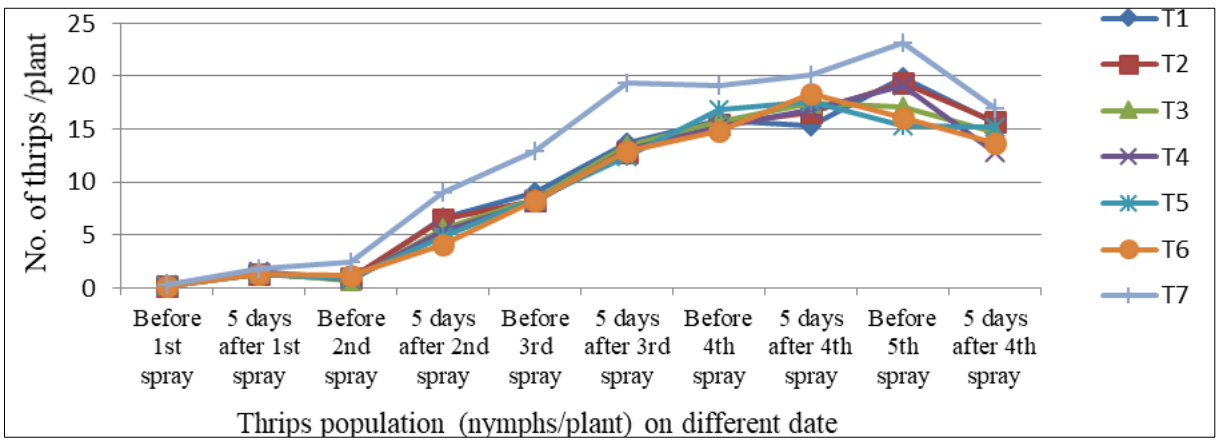

Fig 1: Effect of silica based surfactant on the efficacy of different insecticides against onion thrips at RRS, NHRDF, Karnal during rabi, 2017-2018

Rabi (2018-19)

Based on the data presented in Table-2 and Fig.-2 revealed that significantly lowest mean thrips population at 5 days after 1st spray (0.13 nymphs/plant), before 2nd spray (6.13 nymphs/plant), 5 days after 2nd spray (4.43 nymphs/plant), before 3rd spray (1.27 nymphs/plant), 5 days after 3rd spray (3.93 nymphs/plant), before 4th spray (4.67 nymphs/plant), 5 days after 4th spray (5.97 nymphs/plant), before 5th spray (6.27 nymphs/plant), 5 days after 5th spray (15.37 nymphs/plant) were recorded in T_6 (Fipronil 5% SC @ 1.0 ml/lit. + Surfactant (silica based) @ 0.5 ml/L). The data further revealed that significantly highest gross yield (302.40 q/ha) was recorded in T_6 (Fipronil 5% SC @ 1.0 ml/L + Sever Surfactant @ 0.5 ml/L (silica based)) and it was found at par with treatment T_5 (291.66q/ha).

Table 2: Effect of silica based surfactant on the efficacy of different insecticides against onion thrips at RRS, NHRDF, Karnal during rabi, 2018-19

Treatment	Thrips population (Nymphs/plant) at											
	Before I st spray at 30 DAT	5 days after I st spray	Before II nd spray at 45 DAT	5 days after II nd spray	Before III rd spray at 60 DAT	5 days after III rd spray	Before IV th spray at 75 DAT	5 days after IV th spray	Before V th spray at 90 DAT	5 days after V th spray	Overall average thrips population	Gross yield (q/ha)
T_1	2.53 1.74)	0.40 (0.94)	5.57 (2.46)	6.10 (2.56)	3.70(2.04)	10.60 (3.33)	14.03 (3.81)	26.17 (5.16)	17.23 (4.20)	23.30 (4.86)	12.87 (3.66)	269.35
T_2	2.83(1.83)	0.23 (0.86)	5.43 (2.44)	5.23(2.39)	2.17(1.62)	7.90(2.90)	8.77 (3.03)	22.90 (4.83)	14.90 (3.91)	17.93 (4.28)	10.81 (3.36)	268.52
T_3	2.53 1.74)	0.70 (1.09)	6.20 (2.58)	6.83 (2.71)	2.53(1.73)	9.77 (3.20)	9.73 (3.19)	22.03 (4.74)	18.27 (4.33)	23.03 (4.85)	12.27 (3.57)	276.29
T_4	3.07 (1.89)	0.57 (1.03)	6.20(2.59)	6.7 (2.66)	2.27 (1.66)	7.50 (2.83)	8.47 (2.98)	19.30 (4.44)	15.97 (4.05)	20.93 (4.63)	10.83 (3.37)	271.75
T_5	2.57(1.75)	0.17(0.81)	6.23 (2.59)	6.3 (2.62)	2.20(1.64)	4.67 (2.27)	6.53 (2.65)	10.87 (3.35)	9.03 (3.08)	15.57 (4.00)	8.20 (2.95)	291.66
T_6	2.30 (1.66)	0.13(0.79)	6.13(2.57)	4.43 (2.21)	1.27(1.33)	3.93 (2.10)	4.67 (2.26)	5.97 (2.52)	6.27 (2.60)	15.37 (3.98)	6.31 (2.61)	302.40
T_7	2.93(1.85)	4.57 (2.25)	9.33 (3.13)	10.4 (3.28)	8.73(3.03)	21.70 (4.71)	23.73 (4.91)	35.10 (5.97)	31.87 (5.69)	41.00 (6.44)	21.04 (4.64)	225.27
S.Em ±	- 0.11	- 0.09	- 0.11	- 0.22	- 0.14	- 0.11	- 0.22	- 0.25	- 0.15	- 0.21	- 0.07	5.39
CD at 5%	- NS	- 0.20	- 0.24	- 0.48	- 0.31	- 0.24	- 0.48	- 0.54	- 0.33	- 0.46	- 0.15	11.74
CV%	- 7.42	- 9.77	- 5.23	- 10.04	- 9.48	- 4.23	- 8.43	- 6.89	- 4.52	- 5.49	- 2.49	2.43

Note: Data in the parenthesis shows Square root transformed values

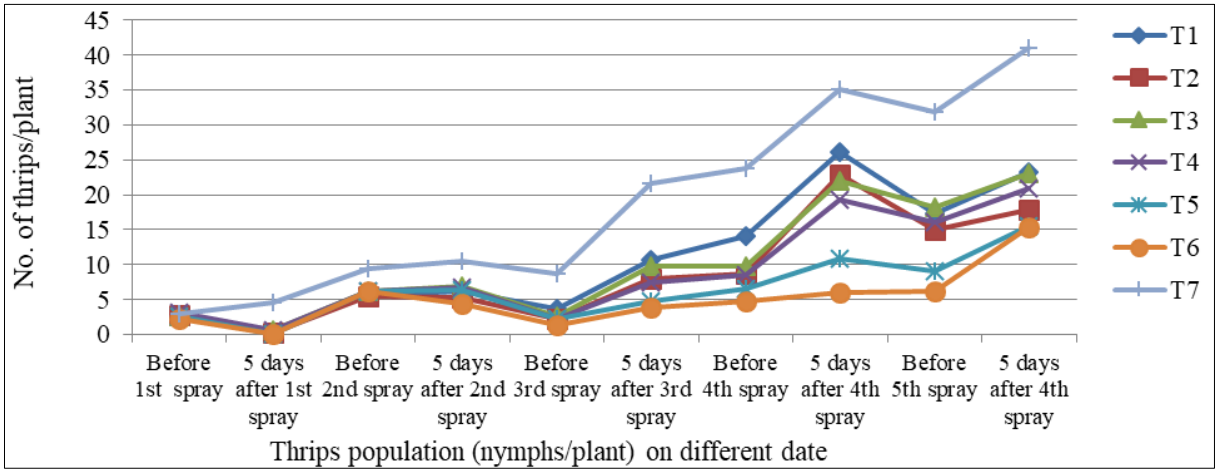

Fig 2: Effect of silica based surfactant on the efficacy of different insecticides against onion thrips at RRS, NHRDF, Karnal during *rabi*, 2018-19.

Combined data of Rabi (2017-18 and 2018-19)

The combined result of two consecutive years revealed that during subsequent sprays and observations recorded upto 5 days after last spray, significantly lowest mean thrips population (7.94 nymphs/plant) was recorded in treatment T_6 (Fipronil 5% SC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L. Significantly highest gross yield (283.28q/ha) was also recorded in the same treatment. Significantly higher mean thrips population (16.97 nymphs/plant) and lowest yield (231.80q/ha) were recorded in control treatment. The highest cost: benefit ratio (1:6.36) was also recorded in treatment T_6 (Fipronil 5% SC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L).

Table 3: Effect of silica based surfactant on the efficacy of different insecticides against onion thrips at RRS, NHRDF, Karnal (Combined data Rabi, 2017-18 & 2018-19)

Treatment	Thrips population (Nymphs/plant) at												
	Before Ist spray at 30 DAT	5 days after Ist spray	Before IInd spray at 45 DAT	5 days after IInd spray	Before IIIrd spray at 60 DAT	5 days after IIIrd spray	Before IVth spray at 75 DAT	5 days after IVth spray	Before Vth spray at 90 DAT	5 days after Vth spray	Overall average thrips population	Gross yield (q/ha)	B: C ratio
T_1	1.40 (1.30)	0.88(1.16)	3.20(1.81)	6.38 (2.62)	6.33(2.56)	12.12(3.54)	14.90 (3.92)	20.73 (4.57)	18.55(4.36)	19.47 (4.44)	11.59	258.98	4.41:1
T_2	1.50 (1.32)	0.75 (1.09)	3.18 (1.81)	5.88 (2.52)	5.20 (2.29)	10.35 (3.27)	12.10 (3.51)	19.73(4.48)	17.15(4.17)	16.82 (4.15)	10.46	264.21	4.43:1
T_3	1.43 (1.32)	1.05(1.23)	3.45(1.84)	6.22 (2.59)	5.45 (2.35)	11.60 (3.47)	12.73 (3.61)	19.77(4.49)	17.70 (4.27)	18.88 (4.38)	11.11	263.38	5.40:1
T_4	1.67 (1.38)	1.05 (1.23)	3.53(1.88)	6.03 (2.54)	5.22(2.30)	10.30 3.26)	11.85 (3.47)	18.08 (4.30)	17.57 (4.24)	16.88 (4.14)	10.29	264.72	4.70:1
T_5	1.38 (1.29)	0.75 (1.08)	3.58 (1.90)	5.63 (2.47)	5.30(2.31)	8.57 (2.93)	11.68(3.41)	14.25 (3.81)	12.18 (3.53)	15.38 (3.97)	9.03	278.52	6.73:1
T_6	1.23 (1.24)	0.70 (1.06)	3.63 (1.92)	4.28 (2.18)	4.77 (2.14)	8.43 (2.88)	9.77 (3.08)	12.15 (3.43)	11.18 (3.33)	14.52 (3.87)	7.94	283.28	6.36:1
T_7	1.62 (1.37)	3.18 (1.88)	5.87 (2.42)	9.73 (3.18)	10.82 (3.35)	20.53 (4.58)	21.43 (4.67)	27.58 (5.25)	27.48 (5.27)	29.02 (5.31)	16.97	231.80	-
S.Em ±	- 0.04	- 0.04	- 0.05	- 0.09	- 0.06	- 0.08	- 0.10	- 0.10	- 0.12	- 0.11	0.20	3.09	-
CD at 5%	- 0.09	- 0.09	- 0.11	- 0.18	- 0.12	- 0.16	- 0.20	- 0.21	- 0.25	- 0.23	0.40	6.37	-

Note: Data in the parenthesis shows Square root transformed values

Details of Treatments

T_1: Spray of Deltamethrin 2.8% EC @ 1.0 ml/L + Sever Surfactant @ 0.5 ml/L (non-silica based)

T_2: Spray of Deltamethrin 2.8% EC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L water

T_3: Spray of Lamdacyhalothrin 5% EC @ 1.0 ml/L + Sever Surfactant @ 0.5 ml/L (non-silica based)

T_4: Spray of Lamdacyhalothrin 5% EC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L water

T_5: Spray of Fipronil 5% SC @ 1.0 ml/L + Surfactant (non-silica based) @ 0.5 ml/L water

T_6: Spray of Fipronil 5% SC @ 1.0 ml/L + Surfactant (silica based) @ 0.5 ml/L water

T_7: Control

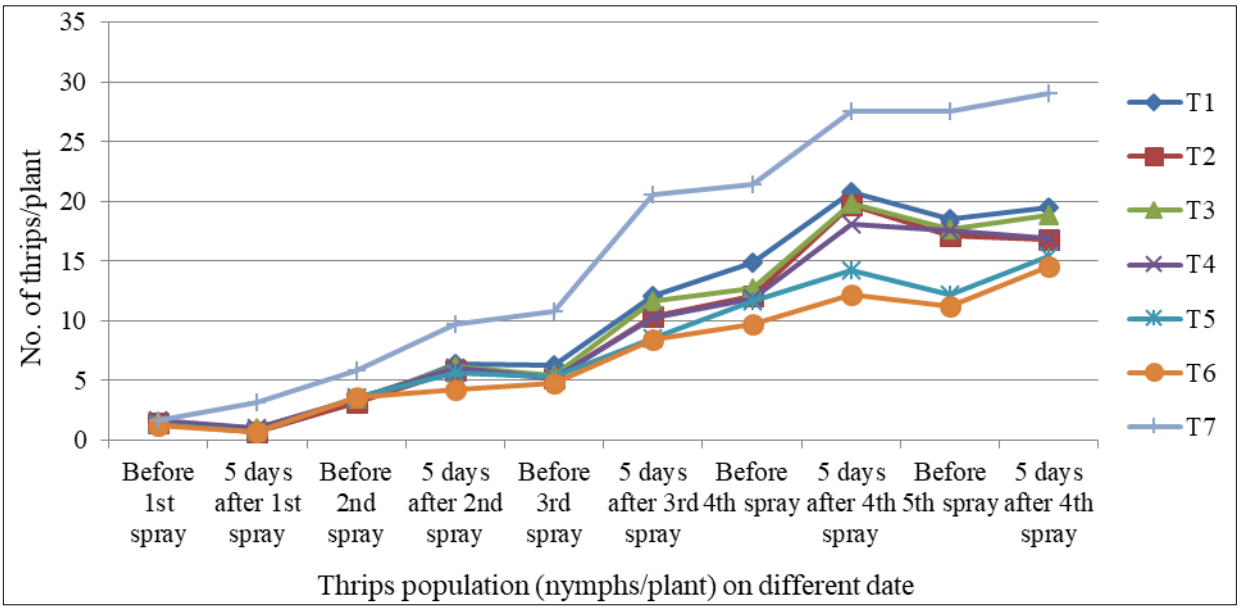

Fig 3: Effect of silica based surfactant on the efficacy of different insecticides against onion thrips at RRS, Karnal (Combined Rabi, 2017-18 & 2018-19

Discussion

The results obtained in this study are quite in conformity with the findings of previous workers who used synthetic insecticides for the management of onion thrips in different parts of the world and got a considerable knockdown effect. The finding shows similarity with the finding of Pandey *et al.* (2013) [6] who have reported that lowest thrips population and highest bulb yield with highest cost benefit ratio were achieved by applying fipronil. The other workers also reported that fipronil and imidacloprid reduced the thrips damage severity and increased the onion bulb yield (Ullah *et al.* 2010, Gachu *et al.* 2012) [12, 1]. The impact of surfactants in improving the efficacy of insecticides has been reported by earlier workers (Ryckaert *et al.* 2007, Katagi *et al.* 2008, Yu *et al.* 2009, Nault *et al.* 2013) [9, 3, 13]. Reddy *et al.* (2005) [8] found that Fipronil 5 SC (0.01%) followed by thiamethoxam

25 WG (0.005%) were the most effective treatments against chilli thrips. Rajkumar *et al*., (2005) [7] found that fipronil (0.01%) was the most effective chemical and protected the crop against thrips.

Conclusions

Use of silica based surfactant with fipronil 5% SC @ 1.0 ml/L was the best way to manage the thrips in onion. This study showed that the efficacy of different insecticides was significantly increased by addition of surfactant from 7.96% to 13.70% in minimizing the number of thrips per plant. Whereas, insecticides along with surfactant increased the bulb yield (0.50–2.01%) in different treatments when compared with the insecticides without surfactant. Therefore, the use of surfactants is a promising tactics and implicated practically along with insecticides.

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