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Efficacy of new Seed Treatment and Granular Insecticides against Sucking Pests of Greengram (*Vigna radiata* L.)

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ABSTRACT: Field experiment was conducted during *rabi* 2021-22 to evaluate efficacy of seed treatment, granular insecticides and seed treatment in combination with soil spraying of acephate against sucking pest complex in greengram at Regional Agricultural Research Station, Warangal, PJTSAU. The overall mean data obtained from 7 DAG up to 56 DAG revealed that seed treatment with cyantraniliprole 19.8% + thiamethoxam 19.8% @ 4 ml kg^{-1} seed + soil spraying of acephate @ 3 g l^{-1} was the most effective treatments against thrips with 88.93 % mean reduction of thrips over control, which was followed by seed treatment with acephate @ 5g kg^{-1} seed + soil spraying of acephate @ 3 g l^{-1} (86.73 % mean reduction) and seed treatment with chlorantraniliprole @ 8 ml kg^{-1} seed + soil spraying of acephate @ 3 g l^{-1} (77.03 % mean reduction). Granular application of fipronil @ 10 kg ha^{-1} was found to be most effective treatment against aphids (79.45 % mean reduction) and whitefly population (67.31 % mean reduction) in *rabi* greengram.

Keywords: Seed treatment, granular insecticides, soil spraying, sucking pests, greengram.

INTRODUCTION

Pulses are center of proteins, they are frequently called as poor-man's meat and rich man's vegetable. India accounts for about 33% of world area and with 22% of world's production of pulses (Soundararajan and Chitra 2011). Greengram (*Vigna radiata* L.) is the third most important crop in India after chickpea and pigeon pea. In India, area covered by green gram is 4.74 million hectares with a production of 2.62 metric tonnes and productivity of 0.55 t/ha (AICRP on MULLaRP, Annual Report, 2020-21). Potential yields and good quality seed can be achievable during *Rabi* season, but insect pests pose a major threat especially sucking pests (thrips, whiteflies, aphids and viral diseases). The annual yield loss due to the insect pests has been estimated at about 30 per cent in greengram out of which, whitefly can cause losses around 30-70 % and thrips can cause 40% losses (Soundararajan and Chitra 2011). Sucking pests should be controlled even from early stage itself especially thrips and whiteflies which are considered as major threat to *rabi* greengram. Sucking pests were the significant nuisances in beginning phases of growth since they decreases the energy of plant and also act as vectors for many viral diseases. Several foliar insecticides have been recommended for combating various insect pests attacking greengram. Such sole reliance on foliar insecticides has created many problems such as very frequent application of insecticides led to excessive residues in the produce, which are the concerns of general consumer health and environment, insecticides resistance, poisoning and hazards to non target organisms and increased production costs *etc*. (Rao *et al.,* 2000). Hence, it is necessary to identify new seed treatment molecules, new granular insecticides and combination of seed treatment with effective soil spraying of liquid insecticides against sucking pests in greengram.

MATERIALS AND METHODS

A field experiment was conducted to test the efficacy of seed treatment, granular insecticides and seed treatment in combination of soil spraying of insecticides against sucking pests, thrips, aphids and whiteflies infesting greengram. The experiment was carried out at Regional Agricultural Research Station (RARS), Warangal during the *Rabi* season of year 2021-2022. The experiment was laid out in Randomized block design with ten treatments and 3 replications with plot size was 7.5 Sq.mt with a spacing of 30 cm × 10 cm. The popular variety of greengram WGG-42 was used while conducting the experiment. The details of treatments imposed in experiment are given below.

Table 1: Details of different treatments.

Treatments	Insecticides
T1	Seed treatment with Cyantraniliprole19.8%+Thiamethoxam19.8%
T2	Seed treatment with Chlorantraniliprole62.5%FS
T3	Seed treatment with Acephate75%S.P
T4	Granular application of Benfuracarb 3% Gat TOS and 20 DAG
T5	Granular application of Chlorantraniliprole 0.4%Gat TOS and 20DAG
T6	Granular application of Fipronil 0.6% G at TOS and 20 DAG
T7	T1+Acephate soil spraying at 20 and 40 DAG
T8	T2+Acephate soil spraying at 20 and 40 DAG
T9	T3+Acephate soil spraying at 20 and 40 DAG
T10	Control untreated

The recommended amount of insecticide and arabic gum were added to one kilogram of greengram seeds in polythene cover and the mixture was shaken vigorously to ensure that the insecticides were evenly distributed throughout the seeds. The seeds were then used for sowing after being dried for 24 hours. All granular insecticides were applied in soil twice, at the time of sowing and 20 days after sowing (DAS), whereas soil spraying of acephate was carried out at 20 and 40 days after sowing in conjunction with seed treatments. The sucking pests: thrips, aphids and whiteflies were recorded early morning. The number of sap-sucking pests was counted by tapping the top two, middle two, and bottom two leaves on a white piece of paper at weekly intervals from 7 days after germination (DAG) up to 56 days after germination (DAG) on five randomly selected and tagged plants as suggested by Men and Sarode (1999) for whiteflies and Rathore and Tiwari for thrips (1999) during morning hours. The data was subjected for square root transformation and statistical analysis.

RESULTS AND DISCUSSION

Thrips. The mean population of thrips per six leaves varied between different treatments, including the untreated control, and ranged from 0.61 to 5.51 (Table 2 and Fig. 1). Among all the treatments evaluated seed treatment with cyantraniliprole 19.8% + thiamethoxam 19.8% @ 4 ml kg^{-1} seed + soil spraying of acephate @ 3 g l^{-1}(T7) was found to be the most effective treatment against thrips as only 0.61 thrips per six leaves was recorded with 88.93% reduction of thrips population over untreated control. Seed treatment with acephate @ 5g kg^{-1} seed + soil spraying of acephate @ 3 g l^{-1} (T9) recorded 0.73 thrips per six leaves (86.73% reduction), followed by seed treatment with chlorantraniliprole @ 8 ml kg^{-1} seed + soil spraying of acephate @ 3 g l^{-1} (T8) (77.03% reduction) with 1.26 thrips per six leaves. While seed treatment with chlorantraniliprole @ 8 ml kg^{-1} seed (T2) (26.54% reduction) and application of chlorantraniliprole granules @ 10 kg ha^{-1} (T5) (25.75% reduction) were recorded as least effective treatments with 4.05 and 4.09 thrips per six leaves and were on par with each other. The population of thrips was significantly highest in untreated control (T10) with a mean population of 5.51 thrips per six leaves. The results are in concurrence with Jordan *et al*. (2006) who revealed that acephate @ 1.1 kg ha^{-1} applied in soil furrow was proved to be very effective in controlling tobacco thrips in peanut. Similarly, Mahoney *et al.* (2018) also reported that acephate @ 1.1 kg a.i. ha^{-1}, imidacloprid @ 0.21 kg a.i. ha^{-1} and phorate @ 0.56 kg a.i. ha^{-1} applied in the soil furrows at the time of planting were most effective in reducing thrips population in peanut. Majumdar *et al.* (2020) also reported that, in soil furrow application of admire Pro 4.6 F and orthene 75 S were most effective in controlling thrips population in peanut.

Aphids. The mean population of aphids was ranged in between 1.57 to 7.66 across the different treatments including untreated control and the per cent reduction was ranged in between 79.54 to 34.34% (Table 3 and Fig. 2). Among all the treatments tested, application of fipronil granules (T6) @ 10 kg ha^{-1} (79.54% reduction) was found to be most effective treatment in controlling aphid population as only 1.57 aphids per six leaves was recorded, followed by application benfuracarb granules (T4) @ 25 kg ha^{-1} (75.32% reduction) with 1.89 aphids per six leaves. Where as application of chlorantraniliprole granules (T5) @ 10 kg ha^{-1} (35.48% reduction), seed treatment with chlorantraniliprole @ 8 ml kg^{-1} seed + soil spraying of acephate @ 3 g l^{-1} (T8) (34.34% reduction)and seed treatment with chlorantraniliprole @ 8 ml kg^{-1} seed (T2) (33.90% reduction) were found to be least effective treatments against aphids with 4.95, 5.03 and 5.06 aphids per six leaves respectively. Significantly highest population of aphids was noticed from untreated control (T10) with 7.66 aphids per six leaves. The present results obtained were in accordance with Surulivelu and Kumaraswami (1990) who concluded that carbofuran granules @ 1 kg a.i. ha^{-1} was effective in controlling aphids up to 47 DAS in cotton. Similarly, Zhang *et al.* (2015) also concluded that application of clothianidin granules @ 3.6 kg a.i. ha^{-1} was effective against aphids in cotton up to 115 days after planting. Further, Adama *et al*. (2016) also stated that single application of carbofuran 3G granules was very effective against aphids in cowpea. Shah *et al*. (2021) also concluded that fipronil 0.3G @ 25 kg ha^{-1} performed best and was on par with fipronil 0.3G @ 20 kg ha^{-1}, cartap hydrochloride 4G @ 20 kg ha^{-1} and cartap hydrochloride 4G @ 25 kg ha^{-1}.

Whiteflies. The mean population of whiteflies was ranged from 1.68 (application of fipronil granules @ 10 kg ha^{-1}) to 5.14 (Untreated control) (Table 4 and Fig. 3). Among all the treatments tested, application of fipronil granules @ 10 kg ha^{-1} (T6) (67.31% reduction) was found to be most effective treatment in controlling whitefly population as only 1.68 whiteflies per six leaves was recorded. This treatment was followed by seed treatment with cyantraniliprole 19.8% + thiamethoxam 19.8% @ 4 ml kg^{-1} seed + soil spraying

of acephate @ 3 g l^{-1} (T7) (57.97% reduction) and seed treatment with cyantraniliprole 19.8% + thiamethoxam 19.8% @ 4 ml kg^{-1} seed (T1) (57.39% reduction) with 2.16 and 2.19 whiteflies per six leaves respectively and were significantly at par with each other. However, application of chlorantraniliprole granules @ 10 kg ha^{-1} (T5) (31.12% reduction), seed treatment with chlorantraniliprole @ 8 ml kg^{-1} seed + soil spraying of acephate @ 3 g l^{-1} (T8) (30.73% reduction) and seed treatment with chlorantraniliprole @ 8 ml kg^{-1} seed (T5) (30.35% reduction) were found to be least effective treatments in controlling whitefly population with 3.54, 3.56 and 3.58 whiteflies per six leaves respectively. Significantly the highest population of whiteflies was recorded in untreated control (T10) with 5.14 whiteflies per six leaves. The results obtained were in accordance with Singh *et al.* (2017) as they concluded that application of carbofuran granules 3 G @ 1.5 kg a.i. ha^{-1} at the time of sowing and hoeing was effective in controlling whiteflies population in blackgram. Similarly, Zhang *et al.* (2017) also stated that spot application of clothianidin granules @ 4 g a.i. ha^{-1} was most effective in reducing whitefly population in cotton. Shah *et al.* (2021) also concluded lowest incidence of whiteflies was recorded with fipronil 0.3G @ 25 kg ha^{-1} which was on par with fipronil 0.3G @ 20 kg ha^{-1} in potato.

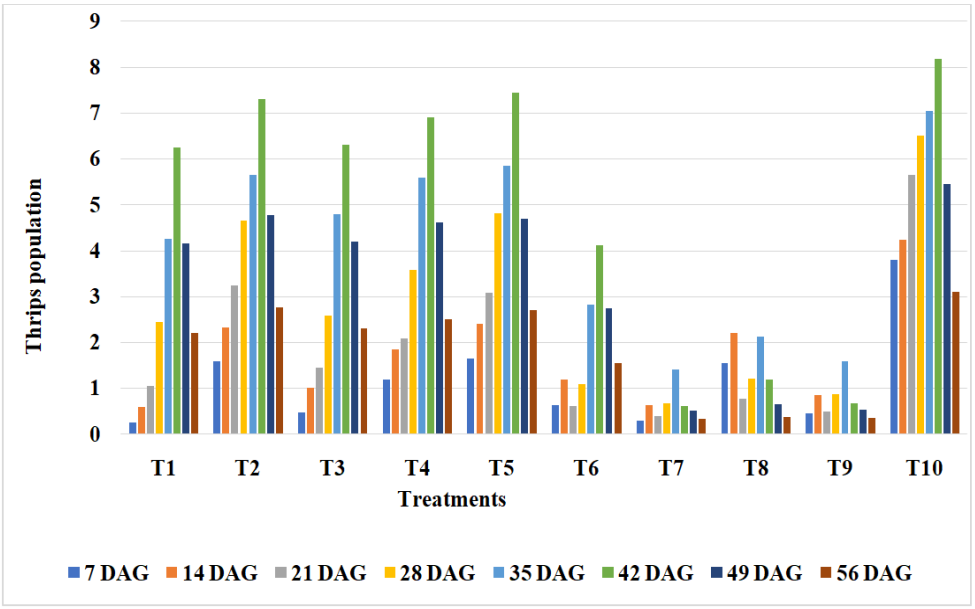

Fig. 1. Efficacy of seed treatment and granular insecticides against thrips in *rabi* greengram, 2021-22.

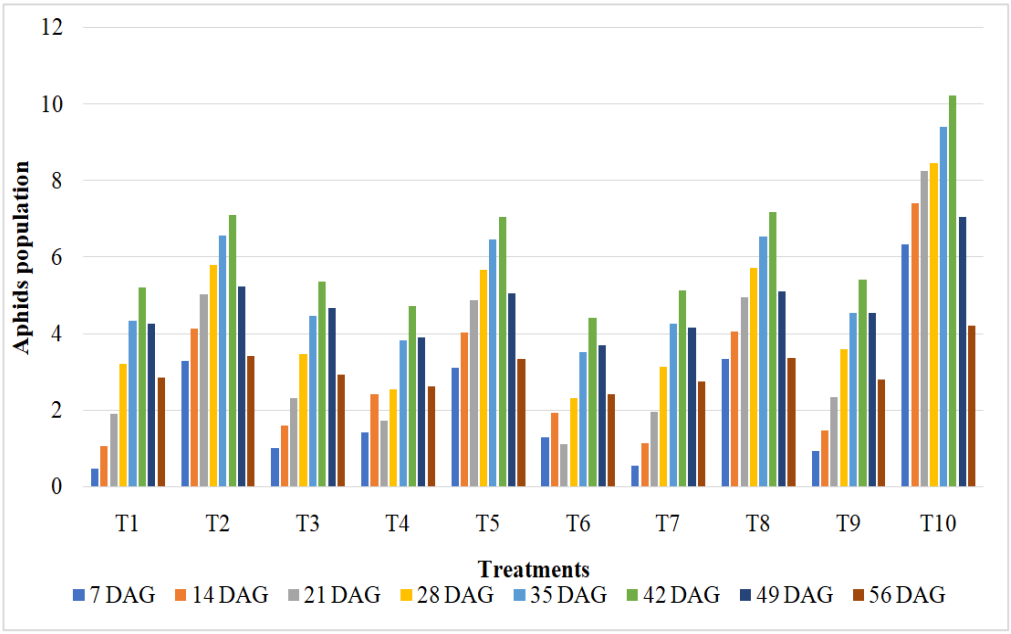

Fig. 2. Efficacy of seed treatment and granular insecticides against aphids in *rabi* greengram, 2021-22.

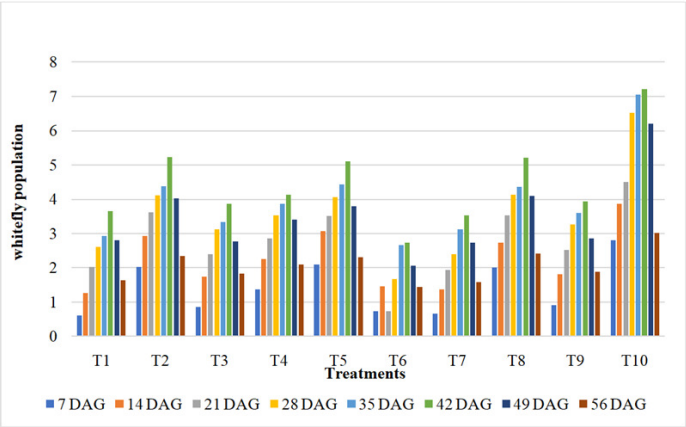

Fig. 3. Efficacy of seed treatment and granular insecticides against whiteflies in *rabi* green gram, 2021-22.

Table 2: Efficacy of treatments against thrips in *rabi* greengram, 2021-22.

Sr. No.	Treatments	Dosage	Number of thrips / six leaves									Per cent reduction over control
			7 DAG	14 DAG	21 DAG	28 DAG	35 DAG	42 DAG	49 DAG	56 DAG	Pooled Mean	
T_1	Seed treatment with Cyantraniliprole 19.8% + thiamethoxam19.8% FS	4 ml kg^{-1}	0.26 (0.50)	0.60 (0.76)	1.06 (1.02)	2.46 (1.57)	4.27 (2.06)	6.27 (2.51)	4.17 (2.27)	2.22 (1.78)	2.66 (1.91)	51.68
T_2	Seed treatment with Chlorantraniliprole 62.5% FS	8 ml kg^{-1}	1.59 (1.20)	2.33 (1.52)	3.26 (1.80)	4.83 (2.18)	5.85 (2.42)	7.33 (2.70)	4.78 (2.44)	2.77 (1.97)	4.05 (2.24)	26.54
T_3	Seed treatment with Acephate 75% S.P	5 g kg^{-1}	0.48 (0.68)	1.01 (0.96)	1.45 (1.12)	2.60 (1.60)	4.81 (2.19)	6.33 (2.53)	4.22 (2.28)	2.31 (1.81)	2.90 (1.97)	47.38
T_4	Granular application of Benfuracarb 3% G at TOS and 20 DAS	25 kg ha^{-1}	1.20 (1.06)	1.86 (1.35)	2.10 (1.61)	3.60 (2.02)	5.10 (2.23)	6.93 (2.63)	4.62 (2.37)	2.51 (1.87)	3.55 (2.13)	35.57
T_5	Granular application of Chlorantraniliprole 0.4%G at TOS and 20 DAS	10 kg ha^{-1}	1.66 (1.23)	2.41 (1.56)	3.13 (1.76)	4.67 (2.16)	5.67 (2.37)	7.47 (2.73)	4.70 (2.42)	2.71 (1.92)	4.09 (2.25)	25.75
T_6	Granular application of Fipronil 0.6% G at TOS and 20 DAS	10 kg ha^{-1}	0.63 (0.76)	1.20 (1.07)	0.61 (0.72)	1.09 (0.97)	1.83 (1.28)	4.13 (2.03)	2.75 (1.67)	1.55 (1.59)	1.84 (1.68)	66.47
T_7	T_1 + Acephate soil spraying at 20 and 40 DAS	3 g l^{-1}	0.30 (0.54)	0.63 (0.77)	0.40 (0.61)	0.67 (0.81)	1.41 (1.16)	0.62 (0.76)	0.51 (1.22)	0.23 (1.15)	0.61 (1.26)	88.93
T_8	T_2 + Acephate soil spraying at 20 and 40 DAS	3 g l^{-1}	1.56 (1.19)	2.21 (1.41)	0.77 (0.93)	1.22 (1.31)	2.13 (1.46)	1.20 (1.09)	0.66 (1.29)	0.42 (1.20)	1.26 (1.50)	77.03
T_9	T_3 + Acephate soil spraying at 20 and 40 DAS	3 g l^{-1}	0.45 (0.64)	0.86 (0.92)	0.60 (0.62)	0.97 (0.90)	1.60 (1.26)	0.70 (0.81)	0.54 (1.23)	0.36 (1.16)	0.73 (1.31)	86.73
T_{10}	T_{10}. Untreated Control		3.82 (1.94)	4.26 (2.04)	5.66 (2.34)	6.53 (2.55)	7.07 (2.67)	8.20 (2.86)	5.46 (2.24)	3.11 (2.02)	5.51 (2.55)	--------
	CD at 5%		0.10	0.22	0.17	0.27	0.19	0.11	0.08	0.07	0.05	
	CV		3.96	8.05	7.92	10.26	5.82	3.16	2.12	2.46	1.49	
	SE(m)		0.034	0.076	0.040	0.071	0.053	0.030	0.021	0.023	0.016	

DAG – Days after germination; TOS – Time of sowing; Figures in the parentheses ( ) are square root transformation values

Table 3: Efficacy of treatments against aphids in *rabi* greengram, 2021-22.

Sr. No.	Treatments	Dosage	No. of aphids / six leaves									Per cent reduction over control
			7 DAG	14 DAG	21 DAG	28 DAG	35 DAG	42 DAG	49 DAG	56 DAG	Pooled mean	
T_1	Seed treatment with Cyantraniliprole 19.8% + Thiamethoxam19.8% FS	4 ml kg^{-1}	0.47 (0.98)	1.06 (1.25)	1.91 (1.52)	3.2 (1.92)	4.33 (2.19)	5.20 (2.38)	4.26 (2.18)	2.84 (1.95)	2.90 (1.95)	62.05
T_2	Seed treatment with Chlorantraniliprole 62.5% FS	8 ml kg^{-1}	3.27 (1.93)	4.13 (2.15)	5.03 (2.35)	5.80 (2.53)	6.56 (2.65)	7.10 (2.76)	5.22 (2.40)	3.42 (2.12)	5.06 (2.45)	33.90
T_3	Seed treatment with Acephate 75% SP	5 g kg^{-1}	1.01 (1.22)	1.60 (1.44)	2.30 (1.67)	3.46 (1.99)	4.46 (2.21)	5.36 (2.40)	4.66 (2.26)	2.93 (1.99)	3.22 (2.03)	57.60
T_4	Granular application of Benfuracarb 3% G at TOS and 20 DAS	25 kg ha^{-1}	1.40 (1.37)	2.40 (1.70)	1.73 (1.50)	2.50 (1.85)	3.81 (2.15)	4.73 (2.28)	3.90 (2.08)	2.61 (1.92)	1.89 (1.65)	75.32
T_5	Granular application of Chlorantraniliprole 0.4% G at TOS and 20 DAS	10 kg ha^{-1}	3.10 (1.89)	4.03 (2.12)	4.86 (2.31)	5.66 (2.48)	6.46 (2.63)	7.06 (2.75)	5.06 (2.35)	3.33 (2.08)	4.95 (2.42)	35.48
T_6	Granular application of Fipronil 0.6% G at TOS and 20 DAS	10 kg ha^{-1}	1.27 (1.33)	1.93 (1.55)	1.40 (1.37)	2.30 (1.62)	3.50 (2.02)	4.40 (2.21)	3.70 (2.08)	2.40 (1.84)	1.57 (1.55)	79.54
T_7	T_1 + Acephate soil spraying at 20 and 40 D.A.S	3 g l^{-1}	0.53 (1.01)	1.13 (1.27)	1.96 (1.43)	3.13 (1.90)	4.26 (2.18)	5.13 (2.36)	4.15 (2.15)	2.75 (1.93)	2.88 (1.94)	62.42
T_8	T_2 + Acephate soil spraying at 20 and 40 D.A.S	3 g l^{-1}	3.34 (1.94)	4.06 (2.13)	4.95 (2.32)	5.73 (2.49)	6.53 (2.68)	7.17 (2.77)	5.10 (2.35)	3.37 (2.09)	5.03 (2.44)	34.34
T_9	T_3 + Acephate soil spraying at 20 and 40 D.A.S	3g l^{-1}	0.93 (1.20)	1.46 (1.40)	2.33 (1.68)	3.60 (2.02)	4.53 (2.24)	5.41 (2.51)	4.55 (2.24)	2.80 (1.94)	3.20 (2.02)	58.23
T_{10}	Untreated Control		6.33 (2.61)	7.40 (2.81)	8.26 (2.96)	8.46 (2.99)	9.40 (3.14)	10.20 (3.28)	7.06 (2.75)	4.21 (2.39)	7.66 (2.93)	-------
	CD at 5%		0.28	0.21	0.17	0.15	0.10	0.13	0.17	0.13	0.12	
	CV		9.76	6.43	4.80	3.86	2.49	2.86	4.15	3.80	3.42	
	SE(m)		0.09	0.07	0.05	0.05	0.03	0.04	0.05	0.04	0.04	

DAG – Days after germination; TOS – Time of sowing; Figures in the parentheses ( ) are square root transformation values

Table 4: Efficacy of treatments against whiteflies in *rabi* greengram, 2021-22.

Sr. No.	Treatments	Dosage	No. of whiteflies / six leaves									Per cent reduction over control
			7 DAG	14 DAG	21 DAG	28 DAG	35 DAG	42 DAG	49 DAG	56 DAG	Pooled Mean	
T_1	Seed treatment with Cyantraniliprole 19.8% + Thiamethoxam19.8% FS	4 ml kg^{-1}	0.60 (1.26)	1.35 (1.33)	2.02 (1.59)	2.60 (1.76)	2.93 (1.85)	3.66 (2.04)	2.80 (1.81)	1.57 (1.43)	2.19 (1.78)	57.39
T_2	Seed treatment with Chlorantraniliprole 62.5% FS	8 ml kg^{-1}	2.03 (1.74)	2.81 (1.73)	3.62 (2.02)	4.11 (2.14)	4.38 (2.20)	5.24 (2.39)	4.03 (2.12)	2.34 (1.68)	3.58 (2.13)	30.35
T_3	Seed treatment with Acephate 75% SP	5 g kg^{-1}	0.86 (1.36)	1.73 (1.50)	2.40 (1.70)	3.13 (1.90)	3.33 (1.95)	3.86 (2.08)	2.88 (1.83)	1.83 (1.54)	2.48 (1.86)	51.75
T_4	Granular application of Benfuracarb 3% G at TOS and 20 DAS	25 kg ha^{-1}	1.36 (1.53)	2.26 (1.65)	2.86 (1.83)	3.53 (2.01)	3.86 (2.08)	4.13 (2.15)	3.40 (1.97)	2.10 (1.64)	2.93 (2.12)	43.00
T_5	Granular application of Chlorantraniliprole 0.4%G at TOS and 20 DAS	10 kg ha^{-1}	2.10 (1.78)	2.88 (1.86)	3.51 (2.00)	4.06 (2.13)	4.43 (2.24)	5.10 (2.36)	4.01 (2.10)	2.30 (1.69)	3.54 (2.12)	31.12
T_6	Granular application of Fipronil 0.6% G at TOS and 20 DAS	10 kg ha^{-1}	0.79 (1.31)	1.46 (1.40)	0.73 (1.11)	1.66 (1.47)	2.53 (1.77)	2.73 (1.79)	2.06 (1.60)	1.43 (1.39)	1.68 (1.63)	67.31
T_7	T_1 + Acephate soil spraying at 20 and 40 DAS	3 g l^{-1}	0.66 (1.29)	1.26 (1.32)	1.93 (1.55)	2.40 (1.70)	3.10 (1.90)	3.53 (2.00)	2.74 (1.80)	1.64 (1.44)	2.16 (1.77)	57.97
T_8	T_2 + Acephate soil spraying at 20 and 40 DAS	3 g l^{-1}	2.00 (1.73)	2.73 (1.79)	3.53 (2.01)	4.13 (2.16)	4.36 (2.19)	5.22 (2.38)	4.10 (2.14)	2.41 (1.72)	3.56 (2.13)	30.73
T_9	T_3 + Acephate soil spraying at 20 and 40 DAS	3g l^{-1}	0.90 (1.37)	1.81 (1.51)	2.52 (1.73)	3.26 (1.94)	3.50 (2.04)	3.93 (2.10)	2.90 (1.85)	1.88 (1.54)	2.53 (1.89)	50.77
T_{10}	Untreated Control		2.80 (1.90)	3.87 (2.09)	4.50 (2.23)	6.53 (2.65)	7.06 (2.75)	7.20 (2.77)	6.20 (2.58)	3.03 (1.87)	5.14 (2.47)	-----
	CD at 5%		0.15	0.18	0.12	0.20	0.18	0.20	0.13	0.12	0.05	
	CV		5.05	8.93	3.54	2.92	3.06	3.12	3.44	4.26	1.01	
	SE(m)		0.04	0.03	0.04	0.035	0.039	0.041	0.04	0.04	0.01	

DAG – Days after germination; TOS – Time of sowing; Figures in the parentheses ( ) are square root transformation value

CONCLUSION

In the present field study, certain new seed treatment insecticides, granular insecticides and acephate as soil spraying in combination with seed treatment were tested for their efficacy against sucking pests such as thrips, aphids and whiteflies during *rabi*, 2021-22. Based on the data recorded with regard to thrips, it can be concluded that, among all the treatments, seed treatment with Cyantraniliprole 19.8% + thiamethoxam 19.8% + soil spraying of acephate at 20 and 40 DAG was superior in efficacy followed by seed treatment with acephate 75 % SP + soil spraying of acephate at 20 and 40 DAG. With regard to aphids, application of fipronil granules was found to be the most effective treatment followed by benfuracarb 3% G. The treatment Fipronil 0.6% G was found to be the most superior in efficacy against whiteflies followed by seed treatment with Cyantraniliprole 19.8% + thiamethoxam 19.8% + soil spraying of acephate at 20 and 40 DAG.

FUTURE SCOPE

Seed treatment and granular insecticides are found to be environmentally safe. So there was a need to identify new seed treatment and granular insecticides against sucking pest complex of greengram as the recommended neo nicotinoid seed treatments are found to be harmful to natural enemies like honey bees. There is huge requirement to identify newer seed treatment and granular insecticides.

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