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Evaluation of new formulation of seed dressing chemicals for the management of sucking insect pests of chilli

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Abstract
Studies were conducted to evaluate new formulation of seed dressing chemical like imidacloprid 60 FS (10 & 20 ml/kg seed) and thiamethoxam 35 FS (15 & 30 ml/kg seed) at MARS, Raichur and ARS, Bidar during 2015-16 to 2017-18. These two chemicals earlier available as 70 WS but now their formulation has changed to FS (Formulation of seed) hence in order to work out the effective dosage of new formulations of above chemicals were tested at different dosages among them imidacloprid 60 FS @ 20 ml/kg seed registered minimum thrips population of 4.42 and 2.87 per leaf from MARS, Raichur and ARS, Bidar respectively hence it could harvest highest fruit yield of 24.6 and 23.95 q/ha with a B:C ratio of 2.20 and 2.14 from former and later treatments respectively. However, this treatment showed non-significant difference with thiamethoxam at higher dosage of 30 ml/kg seed which registered 3.96 and 1.44 thrips per leaf from MARS, Raichur and ARS, Bidar respectively. The fruit yield obtained from these two treatments were 26.35 and 25.60 q/ha with a B: C ratio of 2.36 and 2.29.

Keywords: Thrips, chilli, seed dressing

1. Introduction
Chilli (*Capsicum annum*) popularly known as 'mirch' in Hindi belongs to family solanaceae is one of the important vegetable and commercial spice crop [3]. India is the largest consumer and exporter of chilli in the world with a production of 1492 mt from an area of 775 thousand ha and productivity 1.9 mt per ha during 2014 [5]. The major chilli growing states are Andra Pradesh, Maharastra, Karnataka, Tamilnadu and Rajasthan [10]. Major bottleneck in the production of chilli is biotic stress in which the insect pests play major role followed by diseases. The chilli crop is infested with several insect *viz.*, thrips, aphids, whiteflies, mite and fruit borer complex (*Spodoptera litura* and *Helicoverpa armigera*). The damage due to mite and thrips together had been estimated to the tune of 50 per cent [2].
Management of these sucking pest by conventional insecticide application is a routine and never ending process because if some pest are controlled by the use of selective new molecules but excessive dependence on insecticides, their over use and abuse has accelerated insect control problem through development of insecticide resistance [7]. The indiscriminate use of insecticide not only cause resistance development in insect but also resulted in accumulation of insecticide residue in the fruit and soil. Hence, to avoid these upshots an eco-friendly, cost effective and easy to adopt method evolved was seed treatment with systemic insecticide which is an integral part of integrated pest management reported to maintain natural equilibrium [11]. Seed treatment with imidacloprid 70 WS and thiamethoxam 70 WS were recommended and used earlier to manage the sucking insect population but these chemicals formulations was changed to FS (Formulation of seed). Hence, studies were conducted to evaluate new formulations of these two chemicals for their effective dosage against sucking insect pest management in chilli.

2. Materials and Methods
The field experiment was conducted to evaluate new formulation of seed treatment chemicals against sucking insect pests of chilli across different location of north eastern dry zone of Karnataka *i.e.,* Main Agricultural Research Station, Raichur (Zone II) and Agricultural Research station, Bidar (Zone I) during 2015-16, 2016-17 and 2017-18. Two seed dressing chemicals *viz.,* imidacloprid 60 FS (Gaucho) at 10 and 20 ml per kg and thiamethoxam 35 FS

were tested at 15 and 30 ml per kg seed in comparison with imidacloprid 17.8 SL @ 0.30 ml per lit spray against sucking insect pests. A popular crop variety Byadagi dabbi was seed dressed with respective chemicals separately at specified dosages and transplanted during 3rd week of August during 2015, 2016 and 2017 with a spacing of 75× 45 cm and in a plot size of 4.5 × 3.0 m at both the Agricultural Research Stations.

Each treatment was replicated thrice and crop was raised with recommended package of practice prescribed by the University [1] excluding plant protection measures. Observation on sucking insect pests *viz.*, thrips, aphids and whiteflies were started documenting from 10 days after sowing and continued at 20, 30 and 40 days. But in imidacloprid 17.8 SL spray treatment chemical was imposed when the crop was 15-20 and 25-30 days after sowing anticipating that population of sucking pests would cross threshold levels. Five plants were selected randomly in each plot per replication were tagged to document the sucking insect *viz.*, thrips, aphids and whiteflies per leaf. The data on insect counts were subjected to square root $(\sqrt{x+1})$ transformation prior to statistical analysis. While, the fruit yield per plot harvested from each picking was summed up and converted to per hectare. Later, cost-economics was worked out separately for each centre.

3. Results and Discussion

3.1 Effect of seed treatments on thrips population at MARS, Raichur

The insecticidal activity of imidacloprid 60 FS (10 and 20 ml/kg) and thiamethoxam 35 FS (15 and 30 ml/kg) applied as a seed dressing against thrips on a chilli were evaluated under field conditions. Data presented in Table 1 summarize the effect of these chemical against thrips during three consecutive seasons (2015 to 18). It is evident that imidacloprid 60 FS and thiamethoxam 35 FS induced a fast initial effect in reducing sucking insect population. There was heavy incidence of thrips during all the three seasons. The thiamethoxam 35 FS @ 30 ml per kg seed treatment showed significantly lower population of thrips (3.13/leaf) while, lower dosage (15 ml/ kg) of the thiamethoxam 35 FS and imidacloprid 60 FS @ 20 ml per kg seed recorded lowest thrips population of 3.15 and 3.68 per leaf respectively, indicating these two treatments were found to be on par with the thiamethoxam 35 FS @ 30 ml per kg seed at 10 days after sowing. The observation recorded against the thrips population during 20, 30 and 40 days after sowing followed the similar trend as above. All the seed treatment chemicals differed significantly over standard check like imidacloprid 17.8 SL @ 0.30 ml per lit spray (5.28/ leaf) as well as with untreated control (5.87 thrips/leaf). As the observation days progressed there was a gradual increase in the thrips population because of dilution of the insecticides in the plant system however, did not cross the economic threshold level uptill 40 days after sowing.

3.2 Effect of seed treatments on thrips population at ARS, Bidar

The pooled mean of incidence of thrips over three years of observation indicated that variation in thrips population due to treatments were significant (Table 2). Among the two different seed dressing chemical tested at different dosages wherein, thiamethoxam 35 FS @ 30 ml per kg of seed was significantly superior to all other treatments, which apparent from the the minimum thrips population of 0.70, 1.30, 1.84 and 2.58 per leaf at 10, 20, 30 and 40 days after sowing, respectively. This was followed by thiamethoxam 35 FS @ 15 ml (1.48, 2.31, 2.94 and 3.50 thrips per leaf at 10, 20, 30 and 40 days after sowing respectively) and imidacloprid 60 FS @ 20 ml per kg seed (1.64, 2.51, 3.21 and 3.87 thrips per leaf at 10, 20, 30 and 40 days after sowing respectively) as against imidacloprid 17.8 SL @ 0.30 ml per lit spray (7.26, 3.0, 2.17 and 4.45 per leaf at 10, 20, 30 and 40 days after sowing respectively). As the observation days progressed there was gradual increase in the thrips population but crossed the economic threshold levels.

3.3 Yield

Fruit yield obtained from the MARS, Raichur depicted that among the two seed dressing chemicals tested highest chilli yield of 26.35 q/h was obtained from thiamethoxam 35 FS @ 30 ml per kg seed treatment which found to be on par with its lower dosage *i.e.*, 15 ml per kg seed treatment (23.06 q/ha) and also imidacloprid 60 FS at both the dosages. All the above treatments were superior over untreated check which recorded only 11.03 q/ha as well as with standard check (imidacloprid 17.8 SL @ 0.30 ml/lit) which recorded 18.88 q/ ha chilli yield (Table 1).

Pooled yield data of ARS, Bidar over three years (2015, 2016 and 2017) revealed that there was a significant impact of seed dressing chemical on chilli fruit yield. Highest mean fruit yield was observed in thiamethoxam 35 FS @ 30 ml per kg seed (25.60 q/ha) followed by imidacloprid 60 FS @ 20 ml per kg seed (23.95 q/ha). The mean fruit yield of 22.98 and 22.90 q/ha recorded by thiamethoxam 35 FS @ 15 ml per kg seed and imidacloprid @ 10 ml per kg seed respectively. Whereas the lowest fruit yield of 16.36 was recorded by imidacloprid 17.8 SL @ 0.30 ml per lit spray (Table 2).

3.4 Benefit: Cost ratio

Cost economics made from the MARS, Raichur revealed that seed treated with different seed dressing chemical *viz.*, thiamethoxam 35 FS @ 30 ml per kg seed and imidacloprid 60 FS @ 20 ml per kg seed recorded highest B: C ratio of 2.36 and 2.20 respectively, accordingly the net returns obtained from these seed dressers was Rs. 118575 and Rs.110700 respectively as against their lower dosage *i.e.*, 15 ml per kg (Rs.103770/-) and 10 per kg seed (Rs.103860/-) respectively which was much less than former treatments (Table 3).

The cost economics of Bidar stations worked out during the all the three seasons revealed that net returns was higher in thiamethoxam 35 FS @ 30 ml per kg seed treatment (Rs.115200/ha) followed by imidacloprid 60 FS @ 20 ml per kg seed (Rs.107775/ha) treatments. Likewise, the cost effectiveness of thiamethoxam was high with benefit –cost ratio of 2.29, followed by imidacloprid (2.14) as against standard check (Table 4).

Present investigation on the effects of seed treatment chemicals on the sucking insect pest management revealed that imidacloprid 60 FS @ 20 ml per kg seed and thiamethoxam 35 FS @ 30 ml per kg seed were found optimum to reduce the menace of thrips on chilli and also getting fruit yield.

The reviews pertaining to efficacy of new formulation, imidacloprid 60 FS and thiamethoxam 35 FS in chilli are lacking as it is new molecule. However, their superiority in

managing the sucking pests in other crops has been documented. Thiamethoxam and imidacloprid 70 WS seed dressing chemical protect the crop up to 55 days after sowing in okra [9]. Further, imidacloprid 60 FS @ 10 ml/kg seed was most effective in controlling sucking pest up to 40-45 days after sowing with highest grain yield and cost effective in green gram crop [8]. Further, lowest thrips population was recorded in the plots where green gram seeds were treated with thiamethoxam 70 WS and imidacloprid 70 WS [12]. The efficacy of imidacloprid against thrips was also reported chilli [4], while, thiamethoxam @ 4.3 and 2.8 g/kg, imidacloprid @ 7.5 g/kg kept the population of thrips below ETL in cotton [13].

Table 1: Effect of new formulation of seed dressing chemicals against sucking insect pest of chilli at MARS, Raichur

Treatment details	Population of thrips/ leaf					Fruit Yield (q/ha)
	10 DAS	20 DAS	30 DAS	40 DAS	Mean	
T1: Imidacloprid 60 FS (Gaucho 48 FS) @ 10 ml/kg seed	4.28 (2.18)^{b}	5.48 (2.42)^{c}	6.63 (2.67)^{bc}	7.10 (2.75)^{b}	5.87	23.08
T2: Imidacloprid 60 FS (Gaucho 48 FS) @ 20 ml/kg seed	3.68 (2.04)^{ab}	4.33 (2.19)^{ab}	4.75 (2.29)^{a}	4.94 (2.33)^{a}	4.42	24.6
T3: Thiamethoxam 35 FS (Cruiser 35 FS)@ 15 ml/kg seed	3.13 (1.90)^{a}	4.16 (2.15)^{a}	4.59 (2.25)^{a}	4.73 (2.28)^{a}	4.15	23.06
T4: Thiamethoxam 35 FS (Cruiser 35 FS)@ 30 ml/kg seed	3.15 (1.91)^{a}	3.84 (2.09)^{a}	4.18 (2.16)^{a}	4.69 (2.27)^{a}	3.96	26.35
T5: Imidacloprid 17.8 SL spray @ 0.30 ml/lit	5.28 (2.40)^{c}	4.89 (2.33)^{bc}	5.95 (2.53)^{b}	7.10 (2.75)^{b}	5.80	18.88
T6: Untreated Control	5.87 (2.52)^{c}	7.11 (2.75)^{d}	7.73 (2.86)^{c}	8.72 (3.03)^{c}	7.35	11.03
S. Em ±	0.04	0.05	0.06	0.04	0.04	0.61
CD @ 5 %	0.14	0.17	0.20	0.14	0.16	1.88
CV (%)	5.37	4.65	4.45	3.90	4.59	6.38

DAS-Days after sowing, Figures in the parentheses are square root $\sqrt{x+1}$ transformed values.

Table 2: Effect of new formulation of seed dressing chemicals against sucking insect pest of chilli at ARS, Bidar

Treatment details	Population of thrips/ leaf					Fruit Yield (q/ha)
	10 DAS	20 DAS	30 DAS	40 DAS	Mean	
T1: Imidacloprid 60 FS (Gaucho 48 FS) @ 10 ml/kg seed	2.16 (1.63)^{c}	3.61 (2.02)^{c}	4.93 (2.33)^{c}	5.75 (2.50)^{c}	4.11	22.90
T2: Imidacloprid 60 FS (Gaucho 48 FS) @ 20 ml/kg seed	1.64 (1.46)^{bc}	2.51 (1.73)^{b}	3.21 (1.92)^{b}	3.87 (2.09)^{b}	2.87	23.95
T3: Thiamethoxam 35 FS (Cruiser 35 FS)@ 15 ml/kg seed	1.48 (1.40)^{b}	2.31 (1.67)^{b}	2.94 (1.85)^{b}	3.50 (2.00)^{ab}	2.55	22.98
T4: Thiamethoxam 35 FS (Cruiser 35 FS)@ 30 ml/kg seed	0.70 (1.09)^{a}	1.30 (1.34)^{a}	1.84 (1.52)^{a}	2.58 (1.75)^{a}	1.44	25.60
T5: Imidacloprid 17.8 SL spray @ 0.30 ml/lit	7.26 (2.78)^{d}	3.00 (1.87)^{bc}	2.17 (1.63)^{ab}	4.45 (2.22)^{bc}	4.22	16.36
T6: Untreated Control	7.37 (2.80)^{de}	10.49 (3.31)^{d}	11.60 (3.47)^{d}	13.20 (3.70)^{d}	10.66	10.98
S. Em ±	0.04	0.09	0.10	0.09	0.08	0.58
CD @ 5 %	0.20	0.26	0.29	0.29	0.26	1.74
CV (%)	6.83	7.85	8.80	7.94	7.85	5.98

DAS-Days after sowing, Figures in the parentheses are square root $\sqrt{x+1}$ transformed values.

Table 3: Cost economics of chilli at MARS, Raichur

Sl. No	Treatment details	Okra fruit yield (q/ha)	Common cost of cultivation (Rs/ha)	Treatment cost (Rs/ha)	Total cost (Rs/ha)	Gross return (Rs/ha)	Net returns (Rs/ha)	B:C Ratio
1	T1: Imidacloprid 60 FS (Gaucho 48 FS) @ 10 ml/kg seed	23.08	50000	147	50147	103860	53713	2.07
2	T2: Imidacloprid 60 FS (Gaucho 48 FS) @ 20 ml/kg seed	24.60	50000	293	50293	110700	60407	2.20
3	T3: Thiamethoxam 35 FS (Cruiser 35 FS)@ 15 ml/kg seed	23.06	50000	145	50145	103770	53625	2.07
4	T4: Thiamethoxam 35 FS (Cruiser 35 FS)@ 30 ml/kg seed	26.35	50000	190	50190	118575	68385	2.36
5	T5: Imidacloprid 17.8 SL spray @ 0.30 ml/lit	18.88	50000	1650	51650	84960	33310	1.65
6	T6: Untreated Control	11.03	50000	-	50000	49635	(365)	

Imidacloprid 60 FS @ Rs. 372/100ml Seed rate: 1250 gm/hectare
Imidacloprid 17.8 SL @ Rs. 1200/lit Volume of water required for spray: 625 lit
Thiamethoxam 35 FS @ 600/250ml Chilli rate: Rs. 4500/qt.

Table 4: Effect of different seed dressing chemicals against cost economics of chilli at ARS, Bidar

Sl. No	Treatment details	Okra fruit yield (q/ha)	Common cost of cultivation (Rs/ha)	Treatment cost (Rs/ha)	Total cost (Rs/ha)	Gross return (Rs/ha)	Net returns (Rs/ha)	B:C Ratio
1	T1: Imidacloprid 60 FS (Gaucho 48 FS) @ 10 ml/kg seed	22.90	50000	147	50147	103050	52903	2.05
2	T2: Imidacloprid 60 FS (Gaucho 48 FS) @ 20 ml/kg seed	23.95	50000	293	50293	107775	57482	2.14
3	T3: Thiamethoxam 35 FS (Cruiser 35 FS)@ 15 ml/kg seed	22.98	50000	145	50145	103410	53265	2.06
4	T4: Thiamethoxam 35 FS (Cruiser 35 FS)@ 30 ml/kg seed	25.60	50000	190	50190	115200	65010	2.29
5	T5: Imidacloprid 17.8 SL spray @ 0.30 ml/lit	16.36	50000	1650	51650	73620	21970	1.42
6	T6: Untreated Control	10.98	50000	-	50000	49410	-590	-

Imidacloprid 60 FS @ Rs. 372/100ml Seed rate: 1250 gm/hectare
Imidacloprid 17.8 SL @ Rs. 1200/lit Volume of water required for spray: 625 lit
Thiamethoxam 35 FS @ 600/250ml Chilli rate: Rs. 4500/qt.

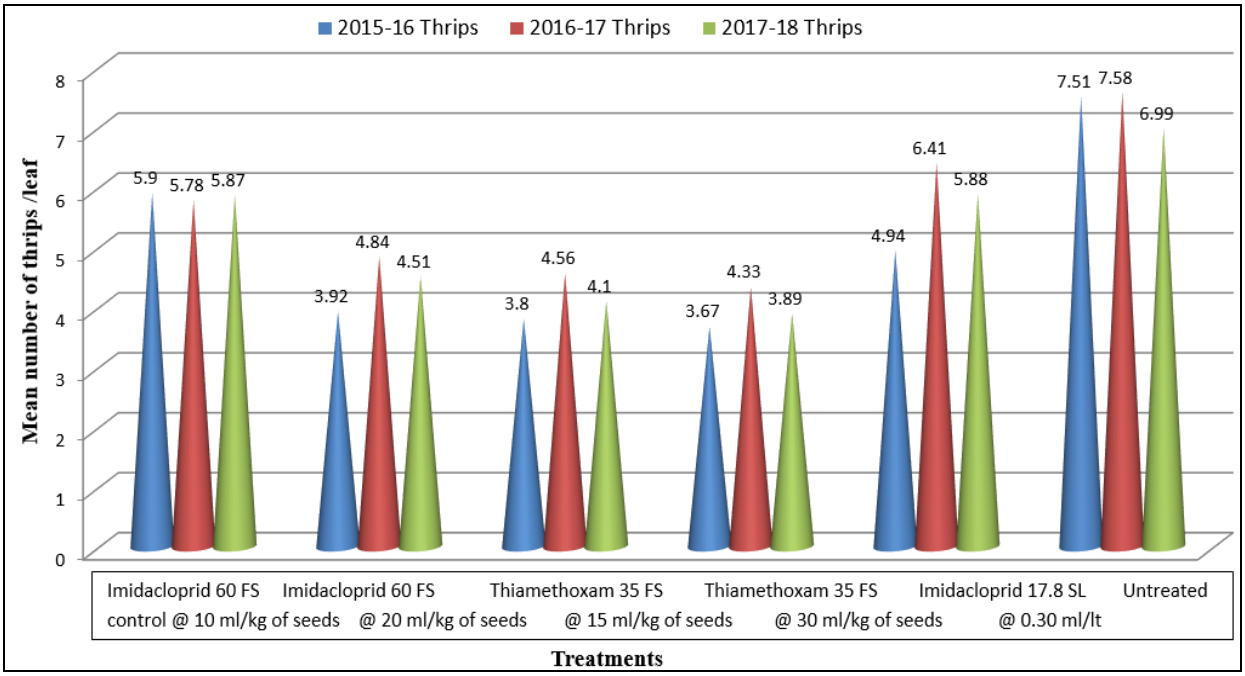

Fig 1: Effect of new formulation of seed dressing chemicals against sucking insect pest of chilli (Pooled data of three years) at MARS, Raichur

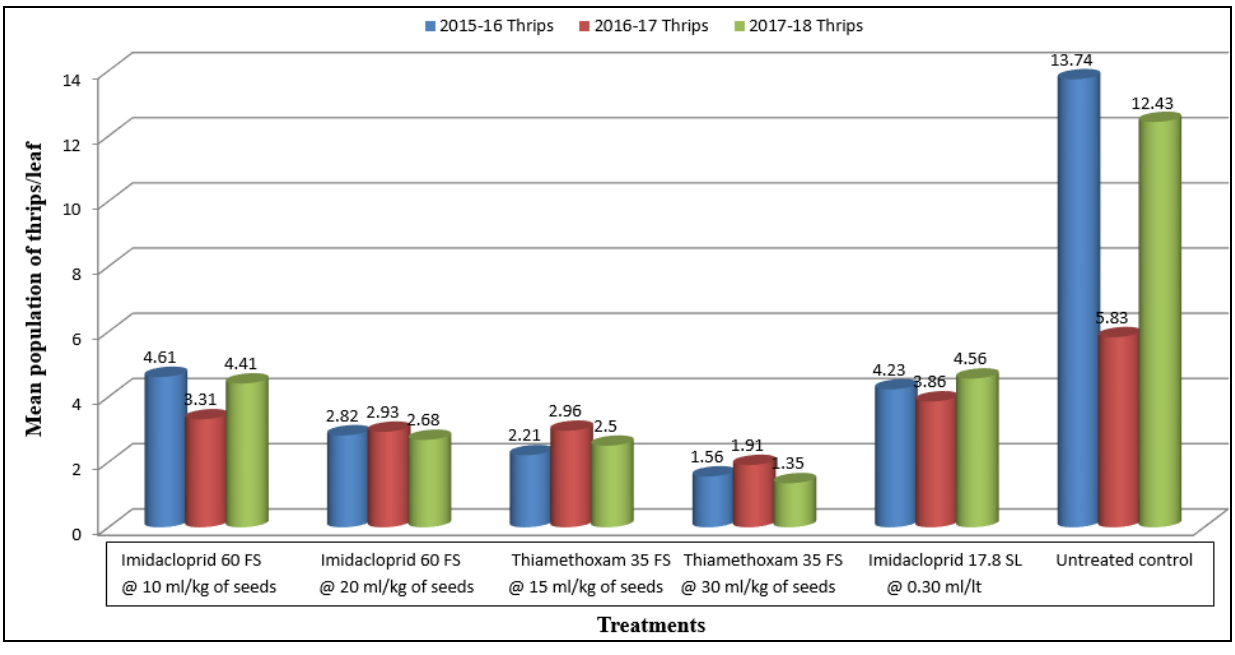

Fig 2: Effect of new formulation of seed dressing chemicals against sucking insect pest of chilli (Pooled data of three years) at ARS, Bidar

4. Conclusion

Imidacloprid 60 FS @ 20 ml per kg seed and thiamethoxam 35 FS @ 30 ml per kg seed were found effective in reducing the thrips population on chilli and also getting higher fruit yield.

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