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Efficacy of different seed dressing insecticides against shoot fly, *Atherigona soccata* (Rondani) in sorghum

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Abstract
Attack of shoot fly in sorghum causes considerable yield losses at initial growth stage of plant. Delay in insecticides application for control adds to high yield losses. Seed treatment is the easiest and economical method for timely management of shoot flies. Different seed dressing insecticide treatments thiamethoxam 30 FS @ 3 and 6 ml/kg seed, imidacloprid 70 WS @ 3 and 6 ml/kg seed, fipronil 5 SC @ 5 ml/kg seed, dimethoate 30 EC @ 4 ml/kg seed, acetamiprid 20 SP @ 3 gm/kg seed with one untreated control was evaluated against shoot fly. Overall pooled data of two seasons during *Kharif,* 2020 and *Kharif,* 2021 revealed that the there was significantly difference in shoot fly incidence among all the insecticidal treatments and all treatments shows their superiority against untreated control plot. Seed treatment with thiamethoxam 30 FS @ 6 ml/kg seed proved its efficacy during both seasons at different periods and found effective among all the insecticidal treatments and recorded overall significantly lower shoot fly incidence in terms of dead hearts as 8.26 per cent. Seed treatment with imidacloprid 70 WS @ 6 ml/kg seed (9.39%) also found effective during both the seasons of investigation and observed statistically at par effective treatment. As far as grain yield concerned, the grain yield was significantly superior in all insecticidal treatments over control. The seed treatment thiamethoxam 30 FS @ 6 ml/kg seed recorded highest grain yield (1470 kg/ha) which was statistically at par with seed treatment with imidacloprid 70 WS @ 6 ml/kg seed (1407 kg/ha). The best treatment also obtained highest ICBR ratio (1:39.48).

Keywords: Sorghum, shoot fly, *Atherigona soccata*, insecticides, seed treatment

Introduction

Sorghum (*Sorghum bicolor*) is one of the most important cereal crops grown in Africa, Asia, United States of America, Australia and Latin America. It is widely grown for food, feed, fodder, forage and fuel in the semi-arid tropics (SAT) of Asia, Africa, the Americas and Australia. It's importance after wheat, maize, rice and barley is because of its good adaptation to a wide range of ecological conditions, low input cultivation and diverse uses (Aruna *et al*., 2011) [1]. In India, sorghum is grown on an area of 6.18 million ha with annual production of 5.28 million tonnes with productivity 845.4 kg/ha in *kharif* and 674.7 kg/ha in *rabi* season (FAO, 2014) [6]. Gujarat, Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh and Rajasthan are the major states of the country gaining the sorghum. Insect pests are the major biotic constraints for production and productivity of sorghum causing economic losses over US$1 billion annually in the SAT. Nearly 150 insect species have been reported as pest on sorghum out of which twenty two are of potential economic importance. Among these, shoot fly (*Atherigona soccata*) is a major grain yield restrictive factor that causes damage under delayed sowings in rainy season. Shoot fly infestation decreases plant stand, and also causes severe losses in grain and fodder yield. Increase in shoot fly dead hearts by 1% results in a loss of 143 kg grain yield/ha, and an overall loss of 90–100% was reported under delayed sowings (Dhaliwal *et al.*, 2004) [5]. The worldwide yield loss due to shoot fly has been estimated to be over 274 million US$ (Sharma 2006) [11]. The early-sown sorghum crop escapes from shoot fly damage but in most cases the late-sown crop is affected. Shoot fly infestation is high when sorghum sowings are spread over a period of time due to unreliable rainfall distribution which is common in the state. Early sowing is not for all time practicable as the sowing window is short in rainfed situations and there exists a competition with other crops for sowing. For shoot fly management, strategies such as agronomic practices, natural enemies, synthetic insecticides and host plant resistance have been employed for minimizing the pest losses. Chemical control alone proves expensive as it requires repeated applications against target pest which is not affordable for marginal farmers as well as safety concern to dairy animals.

Therefore, the seed treatment seems to be a viable option for pest management system in terms of cost effectiveness and compatibility with other components of IPM and also protection of early stage growth of the plants which is most susceptible to shoot fly devastation. Seed treatments, especially those with systemic activity show great promise, infested with a variety of soil inhabiting and early-season foliar-feeding insect pests. Because of the convenience of seed treatments, it may help in areas where one or more early season pests are chronic problems. The effectiveness of different chemicals to this pest has also been promising for the control of dipteran shoot flies.

Materials and Methods

The trial was sown in randomized block design having eight treatment including untreated control were evaluated for shoot fly resistance at Main Sorghum Research Station, Navsari Agricultural University, Athwa Farm Surat. Plant population in each entry was counted at 7 days after emergence of crop. Shoot fly incidence was recorded in term of dead heart formation. Dead heart percentage was recorded at 7, 14, 21 and 28 days after emergence of crop. The number of dead heart caused by shoot fly and total numbers of plants were counted from each treatment at 7, 14, 21 and 28 days after emergence of crop and percentage of dead heart were calculated by using following formula.

$$\text{Dead hearts (\%)} = \frac{\text{No. of dead heart plants}}{\text{Total numbers of plants}} \times 100$$

Result and Discussion

Dead heart percentage was recorded at 7, 14, 21 and 28 days after emergence of crop. The number of dead heart caused by shoot fly and total numbers of plants were counted from each genotype at 7, 14, 21 and 28 days after emergence of crop and percentage of dead heart were calculated.

Dead hearts (*Kharif* 2020)

Pooled mean over four periods at 7, 14, 21 and 28 days after emergence of crop during *Kharif* 2020 the significantly minimum shoot fly incidence was recorded in seed treatment with thiamethoxam 30 FS @ 6 ml/kg seed (7.93%) and this treatment was statistically at par with other treatments like seed treatment with imidacloprid 70 WS @ 6 ml/kg seed and seed treatment with thiamethoxam 30 FS @ 3 ml/kg seed in which shoot fly dead hearts were recorded as 8.82 and 9.49 per cent, respectively during *Kharif* 2020. Higher dead heart percentage were recorded in control plot (21.25%) followed by seed treatment with fipronil 5 SC @ 5 ml/kg seed (17.46%), seed treatment with dimethoate 30 EC @ 4 ml/kg seed (16.09%), seed treatment with acetamiprid 20 SP @ 3 gm/kg seed (13.12%) and seed treatment with imidacloprid 70 WS @ 3 ml/kg seed (11.08%) during *Kharif* 2020 (Table 1 and Fig. 1). During *Kharif* 2020 it was observed that the grin yield of sorghum varied from 781 to 1464 kg/ha. The grain yield was significantly superior in all insecticidal treatments over control. The seed treatment thiamethoxam 30 FS @ 6 ml/kg seed recorded significantly highest grain yield (1464 kg/ha) which was statistically at par with seed treatment with imidacloprid 70 WS @ 6 ml/kg seed (1396 kg/ha). Other treatments *viz.*, seed treatment with thiamethoxam 30 FS 3 ml/kg seed, imidacloprid 70 WS @ 3 ml/kg seed, acetamiprid 20 SP @ 3 gm/kg seed, dimethoate 30 EC @ 4 ml/kg and fipronil 5 SC @ 5 ml/kg seed recorded grain yield as 1299 kg/ha, 1190 kg/ha, 1047 kg/ha, 946 kg/ha and 890 kg/ha, respectively. Significantly minimum grain yield (781 kg/ha) was recorded in control plot. The economics of different insecticidal treatments was worked out. The highest ICBR ratio was recorded in the seed treatment with treatment of thiamethoxam 30 FS @ 6 ml/kg seed (1:39.65) followed by seed treatment with thiamethoxam 30 FS 3 ml/kg seed (1:34.97), seed treatment with acetamiprid 20 SP @ 3 gm/kg seed (1:17.79), seed treatment with imidacloprid 70 WS @ 3 ml/kg seed (1:15.23), seed treatment with imidacloprid 70 WS @ 6 ml/kg seed (1:15.02), seed treatment with dimethoate 30 EC @ 4 ml/kg seed (1:11.50) and seed treatment with fipronil 5 SC @ 5 ml/kg seed (1:6.40) (Table 2).

Table 1: Impact of seed treatment of insecticides on incidence of shoot fly (*Kharif*, 2020)

Sr. No.	Treatments	Dose (g or ml/kg seed)	Mean dead heart (%)				
			7 DAE	14 DAE	21 DAE	28 DAE	Pooled
1	Thiamethoxam 30 FS	3 ml	14.54 (6.30)	16.15 (7.74)	19.79 (11.46)	21.30 (13.20)	17.94^{ab} (9.49)
2	Thiamethoxam 30 FS	6 ml	13.17 (5.19)	14.93 (6.64)	17.71 (9.25)	19.61 (11.26)	16.36^{a} (7.93)
3	Imidacloprid 70 WS	3 ml	15.54 (7.18)	17.65 (9.19)	21.10 (12.96)	23.47 (15.86)	19.44^{bc} (11.08)
4	Imidacloprid 70 WS	6 ml	13.61 (5.54)	15.64 (7.27)	19.17 (10.78)	20.71 (12.51)	17.28^{ab} (8.82)
5	Fipronil 5 SC	5 ml	19.61 (11.26)	22.38 (14.50)	27.09 (20.74)	29.74 (24.61)	24.70^{d} (17.46)
6	Dimethoate 30 EC	4 ml	18.76 (10.34)	21.37 (13.28)	26.21 (19.51)	28.27 (22.43)	23.65^{d} (16.09)
7	Acetamiprid 20 SP	3 gm	17.04 (8.59)	19.23 (10.85)	23.32 (15.67)	25.20 (18.13)	21.24^{c} (13.12)
8	Control	--	22.16 (14.23)	25.17 (18.09)	28.98 (23.47)	33.51 (30.48)	27.45^{e} (21.25)
S. Em. (±)			1.11	1.25	1.53	1.69	0.65
C.D. at 5%			3.26	3.66	4.51	4.96	1.84
S. Em.(±) (Y X T)			--	--	--	--	1.41
C.D. at 5% (Y X T)			--	--	--	--	NS
C.V. (%)			13.22	13.07	13.38	13.35	13.45

Note:- 1) DAE-Days After Emergence.
2) Figures in parentheses are retransformed value, while those outside are arcsine transformed value.
3) Treatment means with the common super scripts letters are non-significant by DNMRT at 5% level of significance.

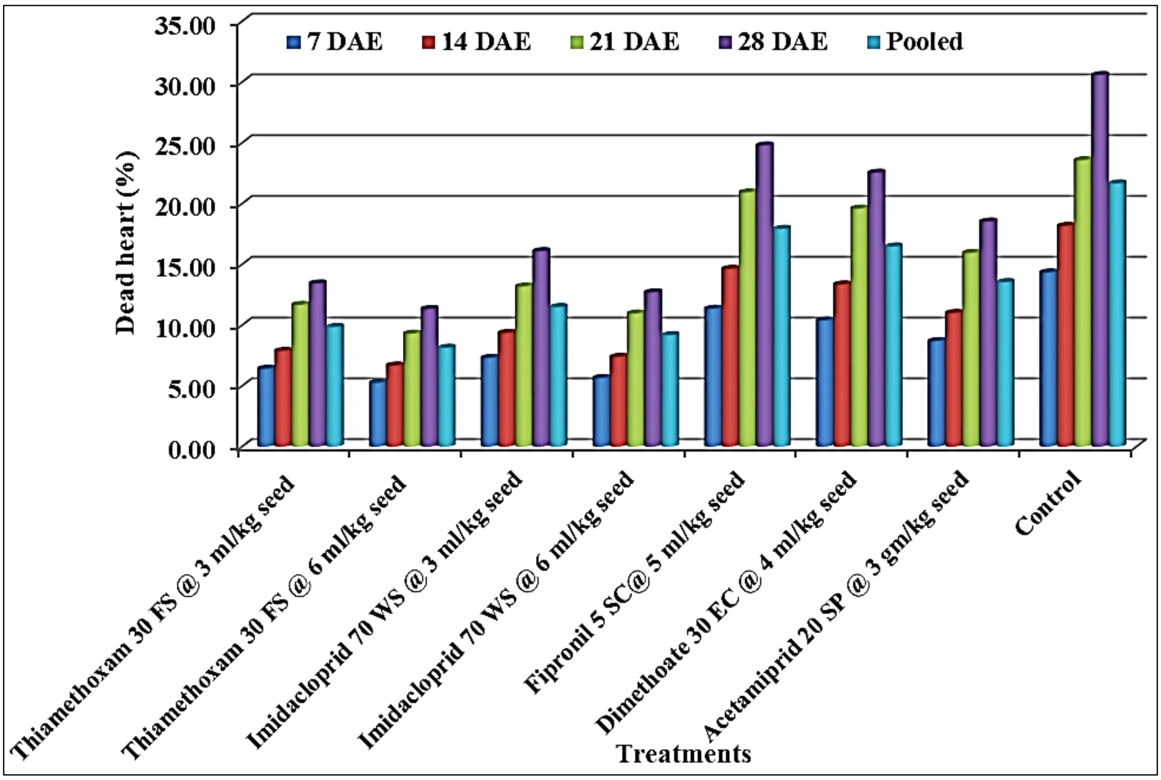

Fig 1: Efficacy of different seed dressing insecticides on incidence of shoot fly (*Kharif*, 2020)

Table 2: Yield and economics of different treatments for the control of sorghum shoot fly (*Kharif*, 2020)

Treatment	Insecticide doze	Yield (kg/ha)	% Increase over control	Quantity of insecticide required per ha.	Price of insecticide (Rs/ lit or kg.)	Cost of insecticide (Rs./ha)	Labour charge (Rs./day)	Cost of plant protection (Rs./ha)	Grain price (Rs./kg)	Gross income per ha	Gross realization (Rs./ha)	Net realization (Rs./ha)	ICBR
Thiamethoxam 30 FS	3 ml	1299	66.33	30 ml	2000	60	300	360	25	32475	32115	12590	1:34.97
Thiamethoxam 30 FS	6 ml	1464	87.45	60 ml	2000	120	300	420	25	36600	36180	16655	1:39.65
Imidacloprid 70 WS	3 ml	1190	52.37	30 ml	11000	330	300	630	25	29750	29120	9595	1:15.23
Imidacloprid 70 WS	6 ml	1396	78.75	60 ml	11000	660	300	960	25	34900	33940	14415	1:15.02
Fipronil 5 SC	5 ml	890	13.96	50 ml	1350	68	300	368	25	22250	21882	2357	1:6.40
Dimethoate 30 EC	4 ml	946	21.13	40 ml	760	30	300	330	25	23650	23320	3795	1:11.50
Acetamiprid 20 SP	3 gm	1047	34.06	30 gm	1800	54	300	354	25	26175	25821	6296	1:17.79
Control	--	781	0.00	--	--	--	--	--	25	19525	--	--	--
S. Em. (±)		37.58	--	--	--	--	--	--	--	--	--	--	--
C.D. at 5%		110.56	--	--	--	--	--	--	--	--	--	--	--
C.V. (%)		6.67	--	--	--	--	--	--	--	--	--	--	--

Dead hearts (*Kharif* 2021)

Pooled mean over four periods at 7, 14, 21 and 28 days after emergence of crop during *Kharif* 2021 clearly indicated that all the insecticides recorded significantly lower incidence of shoot fly over untreated control. However, there was variation in the effectiveness due to insecticidal treatments. Seed treatment with thiamethoxam 30 FS @ 6 ml/kg seed recorded significantly minimum shoot fly incidence (8.59% dead heart) and this treatment was statistically at par with seed treatment with imidacloprid 70 WS @ 6 ml/kg seed (9.96%). Higher dead heart percentage was recorded in control plot (23.50%). Other treatments in merit were seed treatment with thiamethoxam 30 FS @ 3 ml/kg seed (10.83% dead heart), seed treatment with imidacloprid 70 WS @ 3 ml/kg seed (12.83% dead heart), seed treatment with acetamiprid 20 SP @ 3 gm/kg seed (14.31% dead heart), seed treatment with dimethoate 30 EC @ 4 ml/kg seed (16.39% dead heart) and seed treatment with fipronil 5 SC @ 5 ml/kg seed (17.94% dead heart) during *Kharif* 2021(Table 3 and Fig. 2). During *Kharif* 2021 it was observed that the grin yield of sorghum varied from 800 to 1475 kg/ha. The grain yield was significantly superior in all insecticidal treatments over control. The seed treatment thiamethoxam 30 FS @ 6 ml/kg seed recorded highest grain yield (1475 kg/ha) which was statistically at par with seed treatment with imidacloprid 70 WS @ 6 ml/kg seed (1411 kg/ha). It was followed by seed treatment with thiamethoxam 30 FS 3 ml/kg seed, imidacloprid 70 WS @ 3 ml/kg seed, acetamiprid 20 SP @ 3 gm/kg seed, dimethoate 30 EC @ 4 ml/kg and fipronil 5 SC @ 5 ml/kg seed in which grain yield recorded as 1314 kg/ha, 1205 kg/ha, 1047 kg/ha, 995 kg/ha and 916 kg/ha, respectively. Minimum grain yield (800 kg/ha) was recorded in control plot. The economics of different insecticidal treatments was worked out. The highest ICBR ratio was recorded in the treatment of thiamethoxam 30 FS @ 6 ml/kg seed (1:39.18) followed by thiamethoxam 30 FS 3 ml/kg seed (1:34.69), acetamiprid 20 SP @ 3 gm/kg seed (1:16.44), imidacloprid 70 WS @ 3 ml/kg seed (1:15.07), imidacloprid 70 WS @ 6 ml/kg seed (1:14.91), dimethoate 30 EC @ 4 ml/kg seed (1:13.77) and fipronil 5 SC @ 5 ml/kg seed (1:6.88) (Table 4).

Table 3: Impact of seed treatment of insecticides on incidence of shoot fly (*Kharif*, 2021)

Sr. No.	Treatments	Dose (g or ml/kg seed)	Mean dead heart (%)				
			7 DAE	14 DAE	21 DAE	28 DAE	Pooled
1.	Thiamethoxam 30 FS	3 ml	15.81 (7.42)	17.95 (9.50)	20.18 (11.90)	22.92 (15.17)	19.21[b] (10.83)
2.	Thiamethoxam 30 FS	6 ml	13.91 (5.78)	16.33 (7.91)	17.26 (8.80)	20.66 (12.45)	17.04[a] (8.59)
3.	Imidacloprid 70 WS	3 ml	17.27 (8.81)	19.79 (11.46)	21.60 (13.55)	25.28 (18.24)	20.99[c] (12.83)
4.	Imidacloprid 70 WS	6 ml	14.81 (6.53)	17.57 (9.11)	18.38 (9.94)	22.87 (15.10)	18.40[ab] (9.96)
5.	Fipronil 5 SC	5 ml	20.42 (12.17)	24.06 (16.62)	25.85 (19.01)	29.90 (24.85)	25.06[d] (17.94)
6.	Dimethoate 30 EC	4 ml	19.48 (11.12)	22.65 (14.83)	24.66 (17.41)	28.74 (23.12)	23.88[d] (16.39)
7.	Acetamiprid 20 SP	3 gm	18.18 (9.73)	20.94 (12.77)	22.97 (15.23)	26.85 (20.40)	22.23[c] (14.31)
8.	Control	--	23.52 (15.93)	27.42 (21.21)	29.76 (24.64)	35.31 (33.41)	29.00[e] (23.50)
S. Em. (±)			0.80	0.93	1.03	1.24	0.48
C.D. at 5%			2.36	2.73	3.03	3.65	1.35
S. Em. (±) (Y X T)			--	--	--	--	--
C.D. at 5% (Y X T)			--	--	--	--	--
C.V. (%)			8.94	8.90	9.13	9.34	9.22

Note:- 1) DAE- Days After Emergence
2) Figures in parentheses are retransformed value, while those outside are arcsine transformed value.
3) Treatment means with the common super scripts letters are non-significant by DNMRT at 5% level of significance.

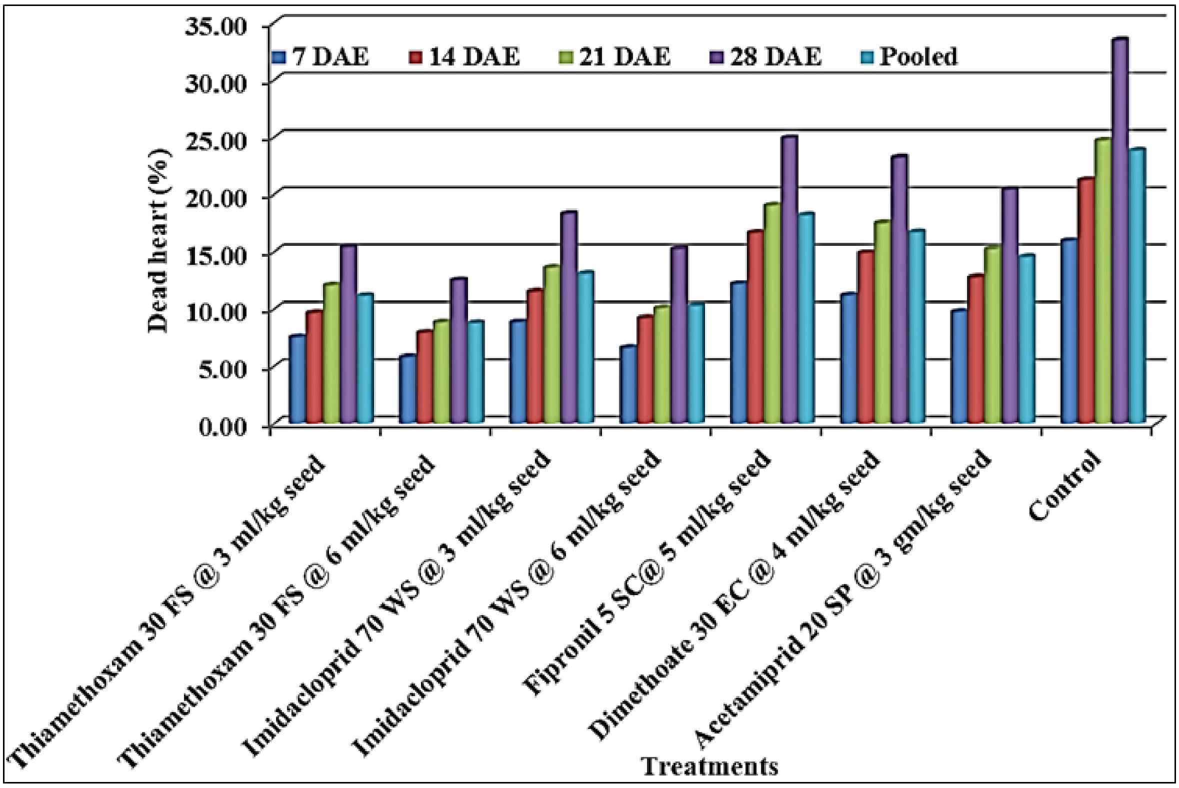

Fig 2: Efficacy of different seed dressing insecticides on incidence of shoot fly (*Kharif*, 2021)

Table 4: Yield and economics of different treatments for the control of sorghum shoot fly (*Kharif*, 2021)

Treatment	Insecticide doze	Yield (kg/ha)	% Increase over control	Quantity of insecticide required per ha.	Price of insecticide (Rs/lit or kg.)	Cost of insecticide (Rs./ha)	Labour charge (Rs./day)	Cost of plant protection (Rs./ha)	Grain price (Rs./kg)	Gross income per ha	Gross realization (Rs./ha)	Net realization (Rs./ha)	ICBR
Thiamethoxam 30 FS	3 ml	1314	64.25	30 ml	2000	60	300	360	25	32850	32490	12490	1:34.69
Thiamethoxam 30 FS	6 ml	1475	84.38	60 ml	2000	120	300	420	25	36875	36455	16455	1:39.18
Imidacloprid 70 WS	3 ml	1205	50.63	30 ml	11000	330	300	630	25	30125	29495	9495	1:15.07
Imidacloprid 70 WS	6 ml	1411	76.38	60 ml	11000	660	300	960	25	35275	34315	14315	1:14.91
Fipronil 5 SC	5 ml	916	14.50	50 ml	1350	68	300	368	25	22900	22532	2532	1:6.88
Dimethoate 30 EC	4 ml	995	24.38	40 ml	760	30	300	330	25	24875	24545	4545	1:13.77
Acetamiprid 20 SP	3 gm	1047	30.88	30 gm	1800	54	300	354	25	26175	25821	5821	1:16.44
Control	--	800	0.00	--	--	--	--	--	25	20000	--	--	--
S. Em. (±)		28.06	--	--	--	--	--	--	--	--	--	--	--
C.D. at 5%		82.55	--	--	--	--	--	--	--	--	--	--	--
C.V. (%)		4.90	--	--	--	--	--	--	--	--	--	--	--

Overall Pooled

Overall pooled data of two seasons during *Kharif* 2020 and *Kharif* 2021 revealed that the there was significantly difference in shoot fly incidence among all the insecticidal treatments and all treatments shows their superiority against untreated control plot. Seed treatment with thiamethoxam 30 FS @ 6 ml/kg seed proved its efficacy during both seasons at different periods and found effective among all the insecticidal treatments and recorded overall significantly lower shoot fly incidence in terms of dead hearts as 8.26 per cent. Seed treatment with imidacloprid 70 WS @ 6 ml/kg seed (9.39%) also found effective during both the seasons of investigation and observed statistically at par effective treatment. During *Kharif* 2020 and *Kharif* 2021 significantly higher dead heart percentage were recorded in control plot (22.36%) followed by seed treatment with fipronil 5 SC @ 5 ml/kg seed (17.70%), seed treatment with dimethoate 30 EC @ 4 ml/kg seed (16.25%), seed treatment with acetamiprid 20 SP @ 3 gm/kg seed (13.72%), seed treatment with imidacloprid 70 WS @ 3 ml/kg seed (11.93%) and seed treatment with thiamethoxam 30 FS @ 3 ml/kg seed (10.15%) during both seasons (Table-5 and Fig. 3).

Table 5: Impact of seed treatment on incidence of shoot fly (Pooled over years)

Sr. No.	Treatments	Dose (g or ml/kg seed)	Mean dead heart (%)				
			7 DAE	14 DAE	21 DAE	28 DAE	Pooled
1.	Thiamethoxam 30 FS	3 ml	15.17 (6.85)	17.05 (8.60)	19.98 (11.68)	22.11 (14.17)	18.58b (10.15)
2.	Thiamethoxam 30 FS	6 ml	13.54 (5.48)	15.63 (7.26)	17.48 (9.02)	20.14 (11.86)	16.70a (8.26)
3.	Imidacloprid 70 WS	3 ml	16.41 (7.98)	18.72 (10.30)	21.35 (13.25)	24.38 (17.04)	20.21c (11.93)
4.	Imidacloprid 70 WS	6 ml	14.21 (6.03)	16.60 (8.16)	18.77 (10.35)	21.79 (13.78)	17.84ab (9.39)
5.	Fipronil 5 SC	5 ml	20.01 (11.71)	23.22 (15.54)	26.47 (19.87)	29.82 (24.73)	24.88e (17.70)
6.	Dimethoate 30 EC	4 ml	19.12 (10.73)	22.01 (14.05)	25.44 (18.45)	28.51 (22.78)	23.77e (16.25)
7.	Acetamiprid 20 SP	3 gm	17.61 (9.15)	20.08 (11.79)	23.18 (15.49)	26.08 (19.33)	21.74d (13.72)
8.	Control	--	22.84 (15.07)	26.30 (19.63)	29.37 (24.05)	34.41 (31.94)	28.22f (22.36)
S. Em. (±)			0.64	0.72	0.87	0.98	0.40
C.D. at 5%			1.81	2.05	2.48	2.78	1.14
S. Em. (±) (Y X T)			0.97	1.10	1.31	1.48	1.23
C.D. at 5% (Y X T)			NS	NS	NS	NS	NS
C.V. (%)			11.15	11.01	11.49	11.43	11.44

Note:- 1) DAE- Days After Emergence.
2) Figures in parentheses are retransformed value, while those outside are arcsine transformed value.
3) Treatment means with the common super scripts letters are non-significant by DNMRT at 5% level of significance.

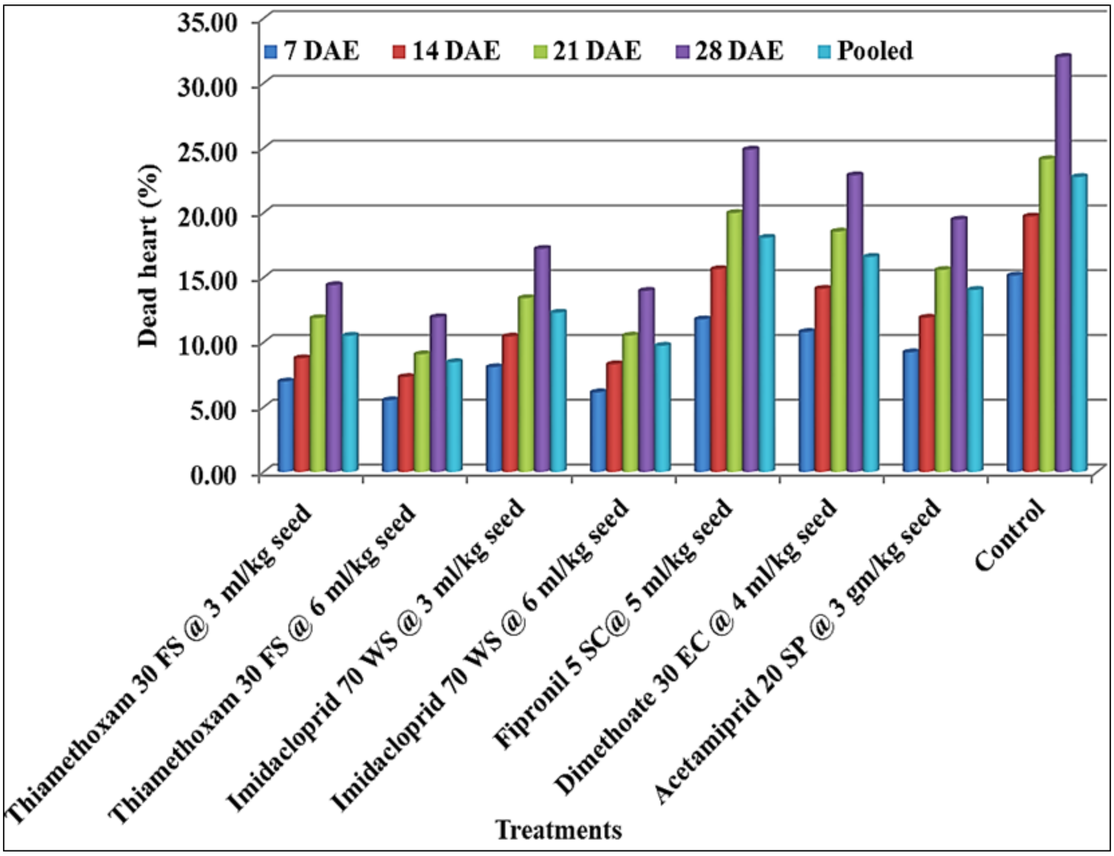

Fig 3: Efficacy of different seed dressing insecticides on incidence of shoot fly (Pooled over years)

Overall pooled data of both years revealed that the grain yield was significantly superior in all insecticidal treatments over control. The seed treatment thiamethoxam 30 FS @ 6 ml/kg seed recorded highest grain yield (1470 kg/ha) which was statistically at par with seed treatment with imidacloprid 70 WS @ 6 ml/kg seed (1407 kg/ha). It was followed by seed treatment with thiamethoxam 30 FS 3 ml/kg seed, imidacloprid 70 WS @ 3 ml/kg seed, acetamiprid 20 SP @ 3 gm/kg seed, dimethoate 30 EC @ 4 ml/kg and fipronil 5 SC @ 5 ml/kg seed in which grain yield recorded as 1306 kg/ha, 1197 kg/ha, 1047 kg/ha, 970 kg/ha and 903 kg/ha, respectively. Minimum grain yield (790 kg/ha) was recorded in control plot. The economics of different insecticidal treatments was worked out. The highest ICBR ratio was recorded in the treatment of thiamethoxam 30 FS @ 6 ml/kg seed (1:39.48) followed by thiamethoxam 30 FS 3 ml/kg seed (1:34.83), acetamiprid 20 SP @ 3 gm/kg seed (1:17.15), imidacloprid 70 WS @ 3 ml/kg seed (1:15.15), imidacloprid 70 WS @ 6 ml/kg seed (1:14.99), dimethoate 30 EC @ 4 ml/kg seed (1:12.64) and fipronil 5 SC @ 5 ml/kg seed (1:6.68) (Table 6). Similar outcomes were also reported by Karibasavaraja *et al.* (2005) [9], Balikai (2006) [2], Daware *et al.* (2012) [4], Khandare *et al.* (2016) [10], Biradar and Sajjan (2018) [3], Jindal *et al.* (2021) [8] and Jambagi *et al.* (2022) [7] at different locations among country.

Table 6: Yield and economics of different treatments for the control of sorghum shoot fly (Pooled over years)

Treatment	Insecticide doze	Yield (kg/ha)	% Increase over control	Quantity of insecticide required per ha.	Price of insecticide (Rs./lit or kg.)	Cost of insecticide (Rs./ha)	Labour charge (Rs./day)	Cost of plant protection (Rs./ha)	Grain price (Rs./kg)	Gross income per ha	Gross realization (Rs./ha)	Net realization (Rs./ha)	ICBR
Thiamethoxam 30 FS	3 ml	1306	65.32	30 ml	2000	60	300	360	25	32650	32290	12540	1:34.83
Thiamethoxam 30 FS	6 ml	1470	86.08	60 ml	2000	120	300	420	25	36750	36330	16580	1:39.48
Imidacloprid 70 WS	3 ml	1197	51.52	30 ml	11000	330	300	630	25	29925	29295	9545	1:15.15
Imidacloprid 70 WS	6 ml	1407	78.10	60 ml	11000	660	300	960	25	35100	34140	14390	1:14.99
Fipronil 5 SC	5 ml	903	14.30	50 ml	1350	68	300	368	25	22575	22207	2457	1:6.68
Dimethoate 30 EC	4 ml	970	22.78	40 ml	760	30	300	330	25	24250	23920	4170	1:12.64
Acetamiprid 20 SP	3 gm	1047	32.53	30 gm	1800	54	300	354	25	26175	25821	6071	1:17.15
Control	--	790	0.00	--	--	--	--	--	25	19750	--	--	--
S. Em. (±)		21.88	--	--	--	--	--	--	--	--	--	--	--
C.D. at 5%		62.22	--	--	--	--	--	--	--	--	--	--	--
P X T			--	--	--	--	--	--	--	--	--	--	--
S. Em. (±)		33.17	--	--	--	--	--	--	--	--	--	--	--
C.D. at 5%		NS	--	--	--	--	--	--	--	--	--	--	--
C.V. (%)		5.83	--	--	--	--	--	--	--	--	--	--	--

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