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Evaluation of insecticidal seed treatments against white grub *Holotrichia consanguinea* Blachard infesting groundnut

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ABSTRACT

Field experiment on evaluation of insecticidal seed treatments against white grub *Holotrichia consanguinea* Blachard infesting groundnut was conducted during *kharif* 2018 and 2019 at farmers field. The nine insecticides evaluated as seed treatment against white grub infesting groundnut, the lowest per cent plant morality and number of grub/m^2 was observed in treatment of clothianidin 50 WDG @ 2 g a.i. /kg and imidacloprid 40 + fipronil 40 WG @ 3 g a.i. /kg. These treatments were produced 2329 and 2296 yield of pod, 3970 & 3780 kg/ha yield of halum, respectively. Increased in yield over control in these treatments was recorded 57.79 and 55.56 per cent in pod, 76.29 and 64.65 per cent in halum. Whereas avoidable yield loss recorded of these treatments was recorded 36.63 and 35.71 per cent in pod, 43.27 and 39.27 per cent in halum. However, the highest 1:28.32 NICRB was recorded in treatment of chlorpyriphos 20 EC @ 30 ml a.i. /kg. The NICRB of clothianidin 50 WDG @ 2 g a.i. /kg and imidacloprid 40 + fipronil 40 WG @ 3 g a.i. /kg were recorded 1:14.95 and 1:9.20, respectively. The evaluated insecticides had no adverse effect on seed germination.

Keywords: Seed treatment, White grub, Insecticides, Groundnut and *H. consanguinea*.

INTRODUCTION

Groundnut (*Arachis hypogaea* Linnaeus) is an annual legume crop and belongs to family Leguminoceae. In India, it is mainly grown in southern and north-western states. Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Madhya Pradesh together occupied about 90% of the groundnut area in the country. Among the major groundnut growing states, Gujarat occupied an area of about 16.77 lakh hectare with production of 30.48 lakh tons and productivity of 1871 kg/ha. (Anon., 2019) [2]. The low productivity in groundnut is attributed to several constraints. Besides abiotic stresses, groundnut production is limited by insect pests, diseases and weeds. Insect pests represent a major yield constraint in groundnut by direct damage or as vectors of virus diseases. The crop is mainly attacked by 500 species of arthropod.

Among different insect pest white grub cause severe damage to the groundnut crop. The white grubs have thus attained the status of serious pest of almost all *kharif* crops due to several factors like cropping pattern, agricultural practices, weather conditions, climate change, lack of suitable plant protection measures *etc.* (Bhattacharyya and Dutta, 2014) [4]. In India, out of 171 species of white grub, 12 are of major importance, while 14 are of minor importance for Gujarat state (Kapadia *et al*., 2006) [6]. Yadava and Sharma (1995) [15] reported that the presence of one grub/m^2 may caused 80-100 per cent plant mortality.

It is known fact that this pest showed certain levels of behavioral resistance to different class of insecticides; hence successful control of this pest is very difficult. So, it was necessary to evaluate some newer insecticides as seed treatment to minimized initial pest population. Among all management components seed treatment is one of the highly progressive and demandable technologies in integrated pest management (IPM) for controlling various crop pests (Taylor *et al.*, 2001; Magalhaes *et al*., 2009) [13, 7]. Seed treatment with systemic insecticide is an integral part of pest management tactics, which is comparatively less pollutant to the environment, cost effective, selective and reported to maintain natural equilibrium (Nault *et al*., 2004) [8].

MATERIALS AND METHODS

Field experiment was conducted at farmers field; where the severe problems of white grub in groundnut. So, the experiment was carried out at village Zonpur (Ta:Keshod, Dis.:Junagadh) of Gujarat state during two consecutive *kharif* seasons of 2018 and 2019. For checking the effectiveness; different eight

insecticides were evaluated along with control in a Randomized Block Design replicated three times.

The groundnut seeds were treated with respective insecticides at mentioned rates by using require amount of water before 2 hours of sowing. From each treatment, 5 spots was randomly selected and total number of seed germinated in 1 m length area of each spot after 15 days of sowing, For recording per cent plant damage, 10 plants randomly selected from each treatment and count the number of healthy and damaged plant and number of larval population after 30, 50, 70 and 90 days after treatment. The periodical data on number of larval population and per cent damage (%) were subjected to analysis of variance (ANOVA) after transforming them to square root/ angular transformation. The data were analyzed periodically as well as pooled over periods.

At the time of harvesting, pod as well as dry haulm yield was recorded from the net plot area. The avoidable losses due to white grub was calculated with the help of formula described by Poul (1976) [10]. The economics of each synthetic insecticides was calculated.

RESULTS AND DISCUSSION

Per cent plant mortality

Per cent plant mortality at 30, 50, 70 and 90 days after treatment

The pooled data of two year at 30 days after seed treatment was revealed that the lowest 1.00 per cent plant mortality was recorded in the treatment of clothianidin 50 WDG @ 2 g a.i. /kg which was statistically at par with imidacloprid 40 + fipronil 40 WG @ 3 g a.i. /kg treatment (Table 1). Next effective treatments were imidacloprid 600 FS @ 9 ml a.i./kg, chlorpyriphos 20 EC @ 20 ml a.i./kg and thiamethoxam 35 FS @ 9 ml a.i./kg which showed 2.21, 2.22 and 3.02 per cent plant mortality, respectively. On the other hand, the highest 5.15 per cent plant mortality was recorded in the treatment of bifenthrin 10 EC @ 5 ml a.i./kg which was statistically at par with the treatment of fipronil 5 SC @ 5 ml a.i. /kg (4.65%) and quinalphos 25 EC @ 15 ml a.i. /kg (3.97%). The more or less similar trends was observed at 50, 70 and 90 days after treatment. However, as time left the effectiveness of each seed treatments were decreased.

The results of the present study are in close agreement with the results of Patel *et al.*(2018) [9] who reported that the lowest per cent plant mortality was observed in seed treatment of clothianidin 50 WDG at 30, 45, 60, 75 and 90 days after germination followed by treatment of chlorpyriphos 20% EC. Similar observations were also reported by Singh *et al.* (2012) [12] who showed that the seed treatment of clothianidin 50 WDG @ 2.0 g/kg provided maximum (82.64%) protection with minimum (5.47%) plant damage followed by its higher dose of 3.0 g/kg seed (82.39% protection and 5.55%plant damage) and imidacloprid 17.8 SL @ 3 ml/kg seed (80.36% plant damage and 6.19% plant damage). These observations also support the work of Yadav (2017) [14] who concluded that the seed treatment of clothianidin 50 WDG @ 1.5 g a.i./kg gave the highest (80.29 %) per cent plant protection followed by imidacloprid 600 FS @ 4.8 ml a.i./kg with 79.58% protection over the untreated check.

The present finding also more or less similar to the finding of Anitha *et al* (2005) [1] they found the seed treatment of chlorpyrifos and imidacloprid were effective against *H. serrata* at rates as low as 0.6 and 3.5 g a.i./kg, respectively. Shrilakshmi and Patil (2017) [11] reported that seed treatment of chlorpyriphos 20 EC @ 25 ml/kg was found to be effective in managing this most devastating pest under rainfed conditions. Jakhar *et al.* (2020) [5] from Rajasthan evaluated nine different insecticides as seed treatment against white grub in groundnut and found that imidacloprid 600 FS @ 6.5 ml per kg was significantly superior over all other treatments with the lowest (17.43%) plant mortality followed by clothianidin 50 WDG @ 2.0 g per kg seed.

Number of grub per meter row

Number of grub/m^2 at 30, 50, 70 and 90 days after treatment

The data in Table 1 revealed that the lowest number of 0.15 grub/m^2 was recorded in the treatment of clothianidin 50 WDG @ 2 g a.i. /kg which was statistically at par with imidacloprid 40 + fipronil 40 WG @ 3 g a.i. /kg treatment. Next effective treatments were imidacloprid 600 FS @ 9 ml a.i./kg, chlorpyriphos 20 EC @ 20 ml a.i./kg and thiamethoxam 35 FS @ 9 ml a.i./kg which showed 0.45, 0.54 and 0.60 grub/m^2, respectively. On the other hand, the highest 1.27 grub/$m^2$was recorded in the treatment of bifenthrin 10 EC @ 5 ml a.i. /kg which was statistically at par with the treatment of fipronil 5 SC @ 5 ml a.i. /kg (1.24 grub/m^2) and quinalphos 25 EC @ 20 ml a.i. /kg (1.20 grub/m^2). The more or less similar trends was observed at 50, 70 and 90 days after treatment. However, as time left the effectiveness of each treatments were decreased.

The present findings were in complete conformity with the results found by Patel *et al.* (2018) [9] who reported the lowest grub population was observed in the seed treatment of clothianidin 50 WDG at 30, 45, 60, 75 and 90 days after germination followed by treatment of chlorpyriphos 20% EC. Yadav (2017) [14] reported that the seed treatment of clothianidin 50 WDG and fipronil + imidacloprid 80 WG were found more effective by observing the lowest plant mortality and grub population in groundnut.

Effect of seed treatment on germination

The data on seed germination in Table 3 indicate that there was no any adverse effect of insecticides on seed germination in field condition at ten days after sowing. However, the maximum 88.09% germination of groundnut seeds was observed in seed treatment of clothianidin 50 WDG @ 2 g/kg and seed treatment with imidacloprid 40 + fipronil 40 WG @ 3 g/kg.

Yield, avoidable yield loss and Economics

It was evident from the Table 3 that all the treatments gave significantly higher yield over control plots in both the years. The highest pod and halum yield (2329 and 3970 kg/ha) was obtained from the treatment of clothianidin 50 WDG @ 2 g a.i. /kg. It was statistically at par with the seed treatment of imidacloprid 40 + fipronil 40 WG @ 3 g a.i. /kg (2296 and 3708 kg/ha). While, lowest yield was recorded from the treatment of bifenthrin 10 EC @ 5 ml a.i./kg (1501 and 2551 kg/ha), fipronil 5 SC @ 5 ml a.i. /kg (1561 and 2418 kg/ha).

The increase in yield over control (%) and avoidable yield loss of pod as well as halum was observed maximum in seed treatment of clothianidin 50 WDG @ 2 g a.i. /kg and imidacloprid 40 + fipronil 40 WG. The increase in yield over control and avoidable yield loss of these treatment was observed 57.79 and 36.63, 55.56 and 35.71 in pod, 76.29 and 43.27, 64.65 and 39.27 in halum, respectively.

The present result close agreement with the finding of Singh *et al.* (2012) [12] who recorded a maximum (23.30 kg/ha) pod yield of in 3.0 g/kg seed dose of clothianidin 50 WDG followed by in its lower dose 2.0 g/kg seed (22.24 q/ha) and imidacloprid 17.8 SL (20.93 q/ha). Bhatnagar *et al.* (2012) [3] reported that the maximum protection over control was recorded in imidacloprid (81.51%), followed by clothianidin (78.60%) with maximum pod yield (21.13 q/ha and 18.61 q/ha, respectively).

These observations also support the work of and Yadav (2017) [14] reported maximum (22.03 q/ha) pod yield in the seed treatment of clothianidin 50 WDG@1.5 g a.i./kg followed by imidacloprid 600 FS at 4.8ml a.i./kg (20.77 q/ha) whereas, lower doses of imidacloprid 17.8 SL @0.53 ml a.i./kg and 3.12 ml a.i./kg were found next better treatments with 18.43 and 17.77 q/ha pod yield, respectively. This result was strongly supported by Patel *et al.* (2018) [9] reported the seed treatment with clothianidin 50% WDG (ST) @ 250 gm per ha proved most effective by achieving the maximum pod yield (1944 kg/ha), although it was at par with chlorpyriphos 20% EC (ST) @ 4000 ml per ha (1806 kg/ha), clothianidin 50% WDG (D) @ 250 gm per ha (1701 kg/ha) and chlorpyriphos 20% EC (D) @ 4000 ml per ha (1632 kg/ha).

The present finding corroborates with Jakhar *et al.* (2020) [5] who reported that the maximum yield of the pod was recorded in imidacloprid 600 FS with 24.63 q/ha followed by clothianidin and imidacloprid 17.8 SL whereas, chlorantraniliprole, fipronil, thiamethoxam 30 FS and thiamethoxam 25 WDG were found next best treatments with 21.10, 19.30, 17.60, 17.16 q/ha pod yield, respectively.

Looking to the economics the highest net realization of was found in the treatment of clothianidin 50 WDG @ 2 g a.i. /kg (34128 Rs/ha) and imidacloprid 40 + fipronil 40 WG (Rs. 30984 Rs./ha.) followed by chlorpyriphos 20 EC @ 20 ml a.i./kg (25284 Rs/ha), imidacloprid 600 FS @ 9 ml a.i./kg (22788 Rs/ha). The present result was in close agreement with the finding of Kapadia *et al.*(2006) [6], they reported a maximum (1:11.00) cost-benefit ratio from the seed treatment of chlorpyriphos 20 EC 25 ml/kg. The present result was similar to the finding of Patel *et al.* (2018) [9] they recorded the highest (1:2.42) ICBR from the seed treatment of clothianidin 50 WDG @ 2 g a.i. /kg. The present result was more or less similar to the finding of Yadav (2017) [14] who reported the highest incremental cost-benefit ratio was found with imidacloprid 17.8 SL.

Table 1: Effectiveness of different seed treatment on the per cent plant mortality and population of white grub in groundnut

No.	Seed treatments	Plant mortality (%)*				No. of grub/m^{2*}			
		30 DAG	50 DAG	70 DAG	90 DAG	30 DAG	50 DAG	70 DAG	90 DAG
1	Chlorpyriphos 20 EC @ 20 ml/kg	8.57	12.46	16.47	18.10	0.74	0.87	1.35	1.52
		(2.22)	(4.66)	(8.04)	(9.65)	(0.54)	(0.76)	(1.82)	(2.31)
2	Imidacloprid 600 FS @ 9 ml/kg	8.54	12.27	15.58	17.36	0.67	0.82	1.29	1.48
		(2.21)	(4.52)	(7.21)	(8.91)	(0.45)	(0.67)	(1.66)	(2.19)
3	Clothianidin 50 WDG @ 2 g/kg	5.74	9.67	11.33	12.57	0.39	0.50	0.99	1.12
		(1.00)	(2.82)	(3.86)	(4.74)	(0.15)	(0.25)	(0.99)	(1.26)
4	Imidacloprid 40 + fipronil 40 WG @ 3 g/kg	6.64	10.58	12.49	13.39	0.50	0.58	1.04	1.20
		(1.34)	(3.37)	(4.68)	(5.36)	(0.25)	(0.34)	(1.08)	(1.44)
5	Thiamethoxam 35 FS @ 9 ml/kg	10.01	13.14	17.35	19.40	0.78	0.89	1.42	1.59
		(3.02)	(5.17)	(8.89)	(11.03)	(0.6)	(0.79)	(2.02)	(2.52)
6	Quinalphos 25 EC @ 20 ml/kg	11.49	15.89	18.71	20.24	1.09	1.27	1.67	1.86
		(3.97)	(7.50)	(10.29)	(11.97)	(1.2)	(1.62)	(2.78)	(3.46)
7	Fipronil 5 SC @ 5 ml/kg	12.45	16.28	19.38	22.53	1.12	1.30	1.7	1.87
		(4.65)	(7.86)	(11.01)	(14.68)	(1.24)	(1.69)	(2.89)	(3.5)
8	Bifenthrin 10 EC @ 5 ml/kg	13.12	16.55	19.78	22.77	1.13	1.32	1.71	1.90
		(5.15)	(8.11)	(11.45)	(14.99)	(1.27)	(1.75)	(2.94)	(3.63)
9	Untreated control	16.39	20.78	22.55	26.22	1.31	1.53	1.91	2.02
		(7.96)	(12.59)	(14.70)	(19.52)	(1.71)	(2.34)	(3.65)	(4.08)
	S.Em.±	0.49	0.59	0.68	0.90	0.04	0.04	0.05	0.06
	C.D. at 5 %	1.42	1.71	1.97	2.59	0.11	0.12	0.15	0.18
	C.V. %	11.69	10.25	9.79	11.47	10.47	10.49	8.69	9.50
	Y								
	S.Em.±	0.23	0.28	0.12	0.23	0.00	0.01	0.00	0.01
	C.D. at 5 %	NS	NS	0.35	0.66	0.01	0.03	0.01	0.03
	YXT								
	S.Em.±	0.70	0.84	0.97	1.27	0.05	0.06	0.07	0.09
	C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS

DAG = Days after germination, * Data was pooled of two year

Figures in parenthesis are original values, while outside values are angular/square root transformed.

Table 2: Yield, avoidable yield loss and economics of each seed treatment

No.	Treatments	Pod			Halum			Gross realization (Rs /ha)	Net realization (Rs /ha)	ICBR	NICBR
		Yield (kg/ha)	Increase in yield over control (%)	Avoidable yield loss	Yield (kg/ha)	Increase in yield over control (%)	Avoidable yield loss				
1	T1	1923	30.28	23.24	3025	34.33	25.55	118458	22788	1:29.32	1:28.32
2	T2	1976	33.88	25.30	3233	43.56	30.34	123808	25284	1:8.71	1:7.71
3	T3	2329	57.79	36.63	3970	76.29	43.27	159108	34128	1:15.95	1:14.95
4	T4	2296	55.56	35.71	3708	64.65	39.27	155842	30984	1:10.20	1:9.20
5	T5	1869	26.63	21.03	2900	28.77	22.34	113092	21288	1:8.12	1:7.12
6	T6	1701	15.24	13.23	2643	17.36	14.79	96325	18204	1:6.97	1:5.97
7	T7	1561	5.76	5.45	2551	13.28	11.72	82342	17100	1:5.84	1:4.84
8	T8	1501	1.69	1.67	2418	7.37	6.87	76275	15504	1:2.04	1:1.04
9	T9 (Control)	1476	0.00	0.00	2252	0.00	0.00	73792	13512	--	--
	S.Em.±	73.66			119.78						
	C.D. at 5 %	212.30			345.22						
	C.V. %	9.76			9.89						
	Y										
	S.Em.±	24.18			16.74						
	C.D. at 5 %	69.69			48.26						
	Y X T										
	S.Em.±	104.17			169.39						
	C.D. at 5 %	NS			NS						

Labour charges for seed treatment @ Rs200/ha Price of groundnut pod:Rs 50/ Kg, Price of groundnut dry Halum:Rs 6/Kg

Table 3: Effect of different seed treatment on the germination per cent after 10 days of sowing

Sr. No.	Seed tretment	Germination Per cent (DAG*)		
		2018	2019	Pooled
1	Chlorpyriphos 20 EC @ 20 ml/kg	90.00	84.76	87.38
2	Imidacloprid 600 FS @ 9 ml/kg	86.17	83.46	84.82
3	Clothianidin 50 WDG @ 2 g/kg	90.00	86.17	88.09
4	Imidacloprid 40 + fipronil 40 WG @ 3 g/kg	90.00	86.17	88.09
5	Thiamethoxam 35 FS @ 9 ml/kg	82.40	78.04	80.22
6	Quinalphos 25 EC @ 20 ml/kg	88.09	83.46	85.78
7	Fipronil 5 SC @ 5 ml/kg	81.39	76.29	78.84
8	Bifenthrin 10 EC @ 5 ml/kg	73.77	72.79	73.28
9	Untreated control	85.69	84.52	85.11
S.Em.±		5.00	5.01	3.53
C.D. at 5 %		NS	NS	NS
C.V. %		10.09	10.63	10.36
Y		-	-	-
S.Em.±		-	-	0.37
C.D. at 5 %		-	-	1.08
YXT		-	-	-
S.Em.±		-	-	4.99
C.D. at 5 %		-	-	NS

*DAG- Day after germination

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