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Efficacy of insecticides as standing crop treatment against white grubs in groundnut crop

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Abstract
A field experiment comprised of nine insecticides was conducted at Rajasthan agricultural research farm field during *kharif* season 2017 and 2018. The treatment of imidacloprid 17.8 SL @ 360 ml per ha was significantly superior over all other treatments with lowest plant mortality and highest pod yield during both seasons. This treatment was also have higher highest incremental cost benefit ratio (ICBR=1:117.6).

Keywords: imidacloprid, standing crop treatment, standing crop, plant mortality, pod yield, ICBR

Introduction
White grubs are the soil inhibiting and root feeding immature stages of scarab beetles of which larval stage is destructive in nature (Theurkar *et al*., 2013) [9]. These are generally known as May-June beetles because of their coincidence of their emergence during the month of May/June. This is a polyphagous pest both in the grub and adult stage and inflicts heavy damage on various fruit trees, their nurseries, vegetables, lawns and field crops (Chandel and Kashyap, 1997) [2]. White grubs are broad, fleshy, whitish or grayish white and the body is curved in the form of 'C' shape. Grubs are favored by light soil, fibrous rooted plants and high particulate organic matter content and are not abundant in waterlogged, compacted, stony soils or lands lacking vegetation (Mehta *et al.*, 2008) [6]. In endemic areas, the damage to groundnut ranges from 20-100 per cent. The presence of one grub/m^2 in soil may cause 80-100 per cent plant mortality (Yadava and Sharma, 1995) [11]. In our country, *Holotrichia*, *Brahmina*, *Leucopholis* and *Lepidiota* recorded as major genus of white grubs (Kumar, 2015) [3]. In Rajasthan, mainly three species *viz.*, *Holotrichia consanguinea*, *Holotrichia serrata* and *Maladera insenabilis* are identified to damage groundnut crop in their larval stages (Mathur *et al.*, 2010) [5]. To combat this pest, usually insecticides are recommended but control of the grubs is often ineffective because of the difficulty of insecticides to move into the root zone and development of high level of resistance to the white grub. There is necessity of implementation of alternative options, such as the performance of new group of insecticides which change insect plant environment interaction with specific and novel mode of action, less hazardous eco-friendly and compatible with eco-friendly pest management programmes.

Materials and Methods
The experiment was laid out in a simple randomized block design with ten treatments including control, each replicated thrice. The seeds of groundnut were sown in the field on the last week of June during *kharif*, 2017 and 2018 in the plots measuring 6.0 x 4.0 m^2 keeping 0.45 and 0.10 m row to row and plant to plant distance, respectively. The recommended package of practices was followed to raise the crop.
Soil collected from the field (100 kg/ha) was treated with required amount of insecticides and the insecticides impregnated soil was uniformly applied in standing crop near root zone in furrow at 21 DAS followed by light irrigation so that the insecticides percolate downwards. Observations were taken on initial plant population just after the germination and plant mortality due to whitegrub at harvesting. The data on groundnut pod yield was also recorded treatment wise at harvesting time. The incremental cost benefit ratio of different treatments was also worked out.

Table 1: Details of insecticides

S. No.	Treatments	Dose/ ha
1	Thiamethoxam 30 FS	600 g
2	Thiamethoxam 25 WDG	600 g
3	Imidacloprid 17.8 SL	360 ml
4	Fipronil 5 SC	3.0 lit.
5	Clothianidin 50 WDG	300 g
6	Imidacloprid 600 FS	1042 ml
7	Acephate 50% +Imidacloprid 1.8%	1250 g
8	Chlorantraniliprole 18.5 SC	500 ml
9	Fipronil 40% + Imidacloprid 40%	500 g
10	Untreated check	-

Results And Discussion

The plant mortality due to white grub in different insecticidal treatment was significantly low as compared to untreated plots at harvesting time. Result thus, obtained are presented in table 2.

Kharif 2017: During *Kharif* season 2017 the treatment of imidacloprid 17.8 SL (11.04%) was found significantly superior over all other treatments and statically at par with imidacloprid 600FS (12.92%) and chlorantraniliprole (13.82%). The mortality of the plants varies from 11.04 to 20.83 per cent as compared to 100 per cent in untreated control. The treatments of clothianidin, thiamethoxam 30 FS, fipronil, thiamethoxam 25 WDG and fipronil 40% + imidacloprid 40% ranked in the moderate group of efficacy with 16.99, 17.40, 17.59, 18.80, and 19.44 per cent plant mortality, respectively. All these treatments were statically at par with each other. The treatment of acephate 50% +imidacloprid 1.8% proved least effectiveness with 20.85 per cent plant mortality but superior than untreated control. Highest pod yield occurred in imidacloprid 17.8 SL (25.93 q/ha) treated plots followed by imidacloprid 600 FS (25.31 q/ha) and chlorantraniliprole (24.36 q/ha) which were statically at par with each other. Second best group in pod yield of ground nut were clothianidin, thiamethoxam 30 FS, fipronil, thiamethoxam 25 WDG with 17.90, 16.68, 16.43, and 16.32 q/ ha, respectively. All these treatments were statically at par to each other. The minimum pod yield of ground nut was obtained from acephate 50% + imidacloprid 1.8% treated plots followed by fipronil 40% + imidacloprid 40%, 13.33, 14.15 q/ha, respectively.

***Kharif*, 2018:** In *Kharif*, season 2017-2018 minimum plant mortality was recorded in plots treated with imidacloprid 17.8 SL (13.00%) followed by imidacloprid 600 FS (14.67%), clothianidin 50 WDG (16.33%), chlorantraniliprole 18.5 SC (17.00%), fipronil (18.00%) and thiamethoxam 30 FS (18.67%) which were found significantly superior over rest of the treatments. These treatments were comparable to each other and existed as best effective group**.** Highest plant mortality occurs in plots treated with acephate 50% + imidacloprid 1.8% followed by fipronil 40% + imidacloprid 40% with 28.33, 29.00 per cent plant mortality, respectfully. These treatments were observed as least effective group but significantly superior than untreated control. The treatment thiamethoxam 25 WDG proved middle orders of efficacy with 19.00 per cent plant mortality. Highest pod yield found in imidacloprid 17.8 SL (27.13 q/ha) treated plots followed by imidacloprid 600 FS (26.67 q/ha) and clothianidin 50 WDG (22.33 q/ha), which were at par to each other. The next best treatments were chlorantraniliprole, fipronil, thiamethoxam FS and thiamethoxam 25 WDG which gave a pod yield of 21.10, 19.23, 18.93 and 18.30 q/ha, respectively. The minimum pod yield 12.93 q/ha was obtained from fipronil 40% + imidacloprid 40% treated plots followed by, 14.20 q/ha was obtained from the plots treated with acephate 50% + imidacloprid 1.8% but superior than untreated plots.

The pooled data procured during both the seasons, *Kharif*, 2017 and 2018. The highest protection to groundnut crop was recorded in the imidacloprid 17.8 SL with lowest 12.02 per cent plant mortality followed by imidacloprid 600 FS (13.80%), chlorantraniliprole (15.41%), clothianidin (16.67%), fipronil, (17.70%), thiamethoxam FS (18.03%) and thiamethoxam 25 WDG (18.90%). However, these treatments were found statistically at par with each other. The treatments fipronil 40% + imidacloprid 40% and acephate 50% + imidacloprid 1.8% were less effective but significantly superior over control with 24.22%, 24.59% plant mortality, respectively. Present findings are in conformity with that of Mohapatra *et al.* (2013) [7] and Bhatnagar *et al.* (2012) [1] they reported that soil drenching of imidacloprid was found to be most effective followed by clothianidin. Mane and Mohite (2014) [4] also confirms that soil drenching of imidacloprid 40 per cent + fipronil 40 per cent and clothianidin was found to be effective treatment for control of white grub. Pandey (2016) [8] result slight contrary to these and he found that clothianidin 50 WDG proved to be most effective by followed by imidacloprid.

The maximum production was recorded in imidacloprid 17.8 SL with 26.53 q/ha followed by imidacloprid 600 FS (25.99 q/ha), chlorantraniliprole (22.73 q/ha) and clothianidin (20.11 q/ha). Fipronil, thiamethoxam 30 FS and thiamethoxam 25 WDG were found next best treatments with 17.83, 17.80, 17.31 q/ha pod yield, respectively. All these treatments were significantly superior over control. The least effective treatments were acephate 50% + imidacloprid 1.8% and fipronil 40% + imidacloprid 40% with 16.66, 16.40 q/ha pod yield, respectively but statistically superior as compared to untreated check. Untreated control provided 1.08 q/ha pod yield. The present finding are support by Bhatnagar *et al.* (2012) [1] were recorded maximum pod yield in imidacloprid treated plots followed by clothianidin with (21.13 q/ha and 18.61 q/ha, respectively).

Net incremental cost benefit ratio: Further, it could be seen from the results that the highest ICBR was recorded in the imidacloprid 17.8 SL @ 360 ml/ ha (1:117.6) and imidacloprid 600 FS @ 1042 ml/ ha (1:45.8). The lowest NICBR (1:7.2) was obtained in the treatment of fipronil 40% + imidacloprid 40%@ 3 ml per kg seed. The present finding also confirms with the finding of Yadav (2017) [10] he reported that highest incremental cost benefit ratio was obtained with the imidacloprid 17.8 SL.

Conclusion

From the experimental results it was concluded that use of imidacloprid 17.8 SL as standing groundnut crop treatment at 360 ml/ha. 21 days after sowing is very effective for the management of whitegrub, *Holotrichia consanguinea*.

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Table 2: Evaluation of some insecticides used as standing crop treatment against white grub in groundnut crop

S. No.	Treatments	Dose/ kg seed	Plant mortality (%)			Pod yield (q/ha)			NICBR
			2017	2018	Mean	2017	2018	Mean	
1	Thiamethoxam 30 FS	600 g	17.40 (24.63)	18.67 (25.40)	18.03 (25.11)	16.68	18.93	17.805	1:38.8
2	Thiamethoxam 25 WDG	600 g	18.80 (25.65)	19.00 (25.70)	18.90 (25.75)	16.32	18.30	17.310	1:23.9
3	Imidacloprid 17.8 SL	360 ml	11.04 (19.39)	13.00 (20.99)	12.02 (20.26)	25.93	27.13	26.530	1:117.6
4	Fipronil 5 SC	3.0 lit.	17.59 (24.79)	18.00 (24.74)	17.70 (24.94)	16.43	19.23	17.830	1:14.8
5	Clothianidin 50 WDG	300 g	16.99 (24.31)	16.33 (23.52)	16.67 (24.07)	17.90	22.33	20.115	1:15.6
6	Imidacloprid 600 FS	1042 ml	12.92 (21.04)	14.67 (22.34)	13.80 (21.78)	25.31	26.67	25.990	1:45.8
7	Acephate 50% +Imidacloprid 1.8%	1250 g	20.85 (27.14)	28.33 (32.12)	24.59 (29.65)	13.33	14.20	13.765	1:30.9
8	Chlorantraniliprole 18.5 SC	500 ml	13.82 (21.69)	17.00 (24.30)	15.41 (23.07)	24.36	21.10	22.730	1:10.2
9	Fipronil 40% + Imidacloprid 40%	500 g	19.44 (26.12)	29.00 (32.48)	24.22 (29.36)	14.15	12.93	13.540	1:7.2
10	Untreated check	–	100.00 (90.00)	94.00 (76.28)	97.00 (82.89)	00.00	2.17	1.085	-
	SE(m)	-	(0.96)	1.894	2.785	0.64	1.624	1.074	
	C.D. at 5%	-	(2.92)	5.67	9.03	1.90	4.86	3.483	
	C.V. %	-	5.54	10.65	12.83	6.46	12.21	8.592	

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