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Efficacy of insecticides as seed treatment for the management of white grubs

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Abstract

The efficacy of six insecticides namely chlorpyriphos 20 EC (5.0 ml/kg seed), imidacloprid 17.8 SL (5.0 ml/kg seed), clothianidin 50 WDG (3.5 g/kg seed), thiamethoxam 25 WG (3.5 g/kg seed), bifenthrin 10 EC (2.5 ml/kg seed) and chlorantraniliprole 18.5 SC (2.5 ml/kg seed) as seed treatment was tested against grubs of *Melolontha indica* Hope under laboratory conditions. Rajmash, *Phaseolus vulgaris* L. was used as test crop. The experiment was conducted in plastic trays filled with soil and farm yard manure (FYM) in 3:1 ratio. In each tray, ten third instar grubs of *M. indica* were released and 20 treated rajmash seeds were sown at a depth of about 5 centimeter. The results revealed that plants from chlorantraniliprole 18.5 SC (2.5 ml/kg seed) treated seeds registered least mortality (20.0 %), followed by chlorpyriphos 20 EC (5 ml/kg seed) (21.67 %) at 10 days after sowing (DAS). The grub mortality recorded in seeds treated with chlorantraniliprole 18.5 SC (2.5 ml/kg seed) and chlorpyriphos 20 EC (5 ml/kg seed) was 56.67 and 46.67 per cent, respectively at 20 DAS. Therefore, seed treatment with chlorantraniliprole 18.5 SC (2.5 ml/kg seed) could be another alternative in addition to chlorpyriphos 20 EC (5 ml/kg seed) for effective management of *M. indica* grubs infesting rajmash under field conditions in high hills of north western Himalaya.

Key words: Insecticides, Rajmash, seed treatment, white grubs.

In Himachal Pradesh, white grubs are the most destructive and troublesome soil pests affecting production of many crops especially in high hills. Rajmash, *Phaseolus vulgaris* L. in particular is attacked by a large number of insect-pests including white grubs at different crop growth stages from germination to harvest (Sood *et al*. 2003). The economic importance of white grubs is primarily due to root damage caused by feeding activity of third instar grubs resulting in plant mortality and subsequent yield losses (Chandel *et al*. 2015). The grubs of *Melolontha* sp. have been observed to damage roots of rajmash causing sudden wilting and death of plants in different regions of the state. The plants at 5-6 leaves stage are more prone to the attack of white grubs causing considerable plant mortality at this stage (Mehta *et al*. 2010). In Sangla valley of Kinnaur, Himachal Pradesh, white grubs potentially caused 8-10 per cent plant mortality in rajmash (Sood *et al*. 2007). Rajmash, is an important pulse crop grown in different states of India including Himachal Pradesh for grains as well as for vegetable purposes (Singh and Singh 2015). Nationally, it is cultivated on an area of approximately 228 thousand hectares with a production of nearly 2277 thousand tones. In Himachal Pradesh, it is cultivated in high hills of Chamba, Kinnaur, Kullu, Lahaul & Spiti, Mandi, Shimla and Sirmaur districts on about 3.80 thousand hectares with an annual production of 50.87 thousand tones (Anonymous 2018). Therefore, it is necessary to manage the menace of white grubs in this important pulse crop. White grubs are generally managed by soil application of synthetic insecticides either through drenching or by broadcasting after mixing with sand or fine soil. However, soil application of insecticides is usually ineffective because insecticides are not readily trans-located through soil to the root zone in lethal concentrations. Moreover, *Melolontha* grubs are generally present in the soil at a depth of about 5-10 centimeters, and it is very difficult to manage them with soil treatment. Therefore, the present study was undertaken to evaluate the efficacy of some new insecticides as seed treatment against grubs of *Melolontha indica* Hope.

Materials and Methods

The study was carried out in the White Grub Laboratory of the Department of Entomology, CSK

Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh during May, 2019. The third instar grubs of *M. indica* were collected from apple orchards in Pangna area of Mandi district of the state. These grubs were brought to the laboratory and were maintained for one week before application of treatments. Six insecticides *viz*. chlorpyriphos 20 EC (5.0 ml/kg seed), imidacloprid 17.8 SL (5.0 ml/kg seed), clothianidin 50 WDG (3.5 g/kg seed), thiamethoxam 25 WG (3.5 g/kg seed), bifenthrin 10 EC (2.5 ml/kg seed) and chlorantraniliprole 18.5 SC (2.5 ml/kg seed) were evaluated as seed treatment. Simultaneously, untreated control was also maintained. Each treatment including control was replicated thrice. The seeds of rajmash were used for carrying out experimentation. For seed dressing, sixty rajmash seeds per treatment were counted and weighed separately. Subsequently, the required quantity of each insecticide as per measured seed weight per treatment was taken by using calibrated test tube/ electronic weighing balance. Thereafter, treatment wise measured quantity of insecticide and sixty rajmash seeds were placed inside transparent polythene bag. Separate polythene bags were used for seed treatment with each insecticide. To ensure uniform coating, the seeds were made wet by sprinkling water immediately before mixing. The polythene bags were then gently swirled/ shaken so that a uniform layer of insecticide got coated over seeds. The treated seeds were shade dried for about two hours in Petri plates before sowing. The sowing was done in plastic trays (45 x 35 x 7cm^3) filled with the mixture of soil and FYM in the ratio of 3:1. Initially, ten third instar grubs of *M. indica* were released in each tray. Thereafter, twenty treated rajmash seeds were sown at a depth of about 5 centimeter. Seed to seed and row to row distance was approximately 8 cm and 7 cm, respectively. The trays were watered daily to maintain proper soil moisture. The data on plant mortality were recorded 10 and 20 days after sowing (DAS). The plants showing wilting symptoms were also counted as dead. On the other hand, grub mortality was observed at 20 DAS. For this purpose, the trays were emptied individually and the numbers of healthy and dead grubs were counted. Subsequently, the per cent plant and grub mortalities were worked out as under:

$$\text{Plant mortality (\%)} = \frac{\text{Number of wilted or dead plants}}{\text{Total number of plants}} \times 100$$

$$\text{Grub mortality (\%)} = \frac{\text{Number of dead grubs}}{\text{Total number of grubs released}} \times 100$$

The data on per cent plant and grub mortalities were subjected to arcsine transformations before analysis.

Results and Discussion

The plant emergence in experimental trays started three days after sowing and all plants emerged out of soils within five days of sowing. The germination was 100 per cent in control as well as in treatment trays. The results pertaining to plant and grub mortalities have been presented in Tables 1 and 2, respectively. Under field conditions, the *Melolontha* grubs have been reported to attack rajmash at 5-6 leaves stage. As a result of grub attack, the roots get totally pruned. The attacked plants wilt and ultimately die leading to reduced plant stand (Chandel *et al.* 2015). Similar observations were recorded under laboratory conditions. The plants started wilting after about one week of sowing.

After 10 days of treatment, very high plant mortality to the extent of 41.67 per cent was recorded in control. Seed treatment with chlorantraniliprole was found to be highly effective showing least plant mortality (20.0 %), followed by chlorpyriphos (21.67 %) and bifenthrin (26.17 %). All these treatments were found statistically superior to control. Jakhar *et al.* (2020) found seed treatment with imidacloprid 600 FS (6.5 ml/ kg seed) superior to chlorantraniliprole 18.5 SC (2.0 ml/ kg seed) in reducing damage by *Holotrichia consanguinea* Blanchard grubs in groundnut. The plant mortality (20.0-36.67%) with chlorantraniliprole, chlorpyriphos, clothianidin, thiamethoxam, and bifenthrin was statistically at par with each other. Seed treatment with imidacloprid 17.8 SL (3.0 ml/ kg seed) and clothianidin 50WDG (2.0 g/ kg seed) performed better than chlorantraniliprole 18.5 SC (2.0 ml/ kg seed) against grubs of *H. consanguinea* in groundnut (Jakhar *et al*. 2020). This difference in mortality can be due to differences in pest species, crop, location and the dose of the pesticide used. Seed treatment with imidacloprid showed 36.67 per cent plant mortality after 10 days of sowing and was at par with control. Thiamethoxam and clothianidin were also found to be at par with control. The plant mortality in imidacloprid, clothianidin, thiamethoxam and bifenthrin varied from 26.67-36.67 per cent, and the plant mortality data exhibited non significant differences, but clothianidin, thiamethoxam and bifenthrin were also statistically at par with chlorantraniliprole and chlorpyriphos.

After 20 days of treatment, 76.67 per cent plants succumbed to grub attack in control. The trend of

Table 1. Mortality of rajmash plants due to *Melolontha indica* grubs under laboratory conditions

Treatments	Dose (ml or g/ kg seed)	Mean mortality of plants* (%)		Reduction in plant mortality over control (%)	
		10 DAS#	20 DAS#	10 DAS#	20 DAS#
Chlorpyriphos 20 EC	5	21.67 (27.45)	33.33 (35.12)	48.00	56.52
Imidacloprid 17.8 SL	5	36.67 (37.07)	55.00 (48.07)	12.01	28.26
Clothianidin 50 WDG	3.5	31.67 (34.00)	51.67 (46.12)	24.01	32.61
Thiamethoxam 25 WDG	3.5	33.33 (33.52)	55.00 (47.92)	20.01	28.26
Bifenthrin 10 EC	2.5	26.67 (29.34)	46.67 (43.20)	36.01	39.13
Chlorantraniliprole 18.5 SC	2.5	20.00 (26.33)	30.00 (33.03)	52.00	60.87
Control	-	41.67 (40.13)	76.67 (61.44)	-	-
CD (P=0.05)	-	(8.29)	(7.27)		

*Figures in parentheses are arc sine transformed values
Days after sowing

Table 2. Mortality of *Melolontha indica* grubs due to seed treatment with different insecticides

Treatments	Total grubs released (No.)	Dead grubs observed at 20 DAS (No.)	Grub mortality at 20 DAS (%)*#
Chlorpyriphos 20 EC	30	14	46.67 (43.04)
Imidacloprid 17.8 SL	30	9	30.00 (31.72)
Clothianidin 50 WDG	30	10	33.33 (32.09)
Thiamethoxam 25 WDG	30	8	26.67 (26.62)
Bifenthrin 10 EC	30	12	40.00 (39.14)
Chlorantraniliprole 18.5 SC	30	17	56.67 (50.46)
Control	30	4	13.33 (14.09)
CD (P=0.05)	-	-	(13.68)

*Figures in parentheses are arc sine transformed values
#Days after sowing

efficacy was almost similar with chlorantraniliprole showing least plant mortality (30.0 %), followed by chlorpyriphos (33.33 %). Both these treatments were statistically superior to all other treatments. There was 46.67-55.0 per cent plant mortality when seeds were treated with imidacloprid, clothianidin, thiamethoxam and bifenthrin, and all these treatments were statistically at par with each other. Sood *et al*. (2010) reported 55.96 per cent reduction in mortality of rajmash plants due to white grubs when seeds were treated with chlorpyriphos 20 EC (4.0 ml/ kg seed) in Sangla valley of Himachal Pradesh. However, seed treatment with imidacloprid and thiamethoxam was found to be comparatively less effective in present study. Mishra and Singh (1994) had also recommended seed treatment with chlorpyriphos (25 ml/ kg seed) for protection against *Anomala dimidiata* Hope in soybean.

Similarly, after 20 days of sowing, maximum grub mortality was recorded in chlorantraniliprole treatment (56.67 %), followed by chlorpyriphos (46.67 %) and bifenthrin (40.0 %). The mortality data registered in chlorantraniliprole treatment was at par to chlorpyriphos and bifenthrin, but mortality response in bifenthrin treatment was also statistically at par with imidacloprid and clothianidin. The grub mortality with thiamethoxam was recorded to be 26.67 per cent and it was statistically at par with control (Table 2).

The grubs of *Melolontha* sp. cause damage immediately after seed germination leading to plant mortality. The grubs of *Melolontha* sp. remain deep in the soil and hence are unaffected by soil treatment (Chandel *et al*. 2019). Therefore seed treatment with chlorpyriphos and chlorantraniliprole may be done for effective management of white grubs infesting rajmash grown under field conditions in high hills of north western Himalaya.

Conflict of interest: The authors declare that they have no conflict of interest in this research paper.

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