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Management of White Grub, *H. consanguinea* in Groundnut using Entomopathogens

Tara Yadav, A.S. Baloda, K.K. Saini, B.L. Jakhar

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ABSTRACT

The white grubs infests diverse crops of food and horticultural importance such as groundnut, sugarcane, *kharif* pulses, vegetables areca nut, ginger, potato, *etc*. and it inflict losses as high as 100 per cent, depending upon the severity of infestation have been uncommon. In present study, attemts have been made to explore the potentiality of entomopathogens for the management of the white grub *Holotrichia consanguinea* a serious pest in groundnut crop in Rajasthan during *kharif* seasons, 2018 and 2019. Results revealed that furrow application of *Beauveria bassiana*, *Metarhizium anisopliae* powder formulation @ 5 kg (1×10^{12} CFU/gm) and *H. indica* galleria @ 5000 galleria per hectare at the time of sowing were significantly superior in reducing the per cent plant mortality (28.00%, 29.33%, 31.77%, respectively) and increase yield over untreated control (12.82, 11.53, 10.78 q/ ha respectively).

Key words: *Beauveria bassiana,* Groundnut*, Metarhizium anisopliae*, White grub.

Division of Entomology, Rajasthan Agriculture Research Institute, SKN Agriculture University Jobner, Durgapura, Jaipur-302 018, Rajasthan, India.

Corresponding Author: Tara Yadav, Division of Entomology, Rajasthan Agriculture Research Institute, SKN Agriculture University Jobner, Durgapura, Jaipur-302 018, Rajasthan, India. Email: yadavtara8233@gmail.com

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Groundnut (*Arachis hypogaea* L.) belongs to family Fabaceae and having rank 2nd in oilseed crop in India. It is the most important food and cash crop of our country having high quality edible oil (45-50%), easily digestible protein (26-28%), 13 essential vitamins and 7 crucial minerals necessary for normal human growth and maintenance, it produces high quality fodder for animals. Groundnut is cultivated on about 4.81 mha in India, with an average annual production of 6.69 million tonnes (Anonymous, 2019). The average yield in India is over 1393 kg/ha. In Rajasthan, total area under groundnut is 0.67 million hectare with total production of 1.38 million tonnes (Anonymous, 2019). White grub *Holotrichia consanguinea* existing as soil-inhabiting polyphagous pest, grub feeding on roots and is pre dominant species in Rajasthan, Gujarat, Haryana, Punjab, Bihar and Uttar Pradesh followed by *M. insanabilis.* The scarabaeids have become difficult insect to control as both the adult and immature have different habitats. The grubs sometimes go deep into the soil and become more difficult to control (Khagta, 2006). To combat this pest, usually insecticides are recommended but management of the grubs is often ineffectual because of the difficulty of insecticides to reach the insect and insecticides have deleterious effects on the environment. Therefore, there is urgent need to search and explore, alternate ecofriendly and economically realistic strategy for the control of white grub. Several isolates of fungi*, Beauveria bassiana, Beauveria brongniartii*, *Metarhizium anisopliae, Paecilomyces fumusoroseus* and *Verticillium lecanii* have been applied in a number of countries (Rath *et al.,* 1995). The entomopathogens against white grub, *Holotrichia serrata* (Supekar and Mohite, 2015), *Leucopholis lepidophora* (Bharathi and Mohite, 2015) and *Phyllognathus dionysius* (Rathour *et al*., 2015) reported high infection rates in the grub population. The use of nematodes as biological pest control agents has increased exponentially over the past few decades. Nematodes that parasitize insects have been described from 27 nematode families but most significant families, *Heterorhabditidae* and *Steinernematidae* also called as entomopathogenic nematodes have received the most attention because of their potential as inundatively applied biological control agents (Kaya and Gaugler, 1993; Grewal *et al.,* 2005; Koppenhofer, 2007).

The experiment was conducted for two consecutive seasons during *kharif* 2018 and 2019 at Research Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur. The RG-510 variety was sown in field at 30 cm distance from row to row and 10 cm plant to plant apart in plot size of 5 × 4 m and treatments were replicated thrice with randomized block design (RBD). Groundnut crop was raised following standard recommended package of practices for the zone IA except for soil insect management. Bioagents treatments were applied in furrow at sowing time.
Details of treatments are as follows: 7 treatments

T1: *Metarhizium anisopliae* @ 5 kg per hectare at sowing (1×10^{12} CFU/ gm)

T2: *Beauveria bassiana* @ 5 kg per hectare at sowing (1×10^{12} CFU/ gm).

T3: *Heterorhabditis indica* @ 5000 galleria per hectare (2 lakh IJs/galleria).

T4: *Heterorhabditis indica* powder @ 5 kg/hectare at sowing.

T5: *Steinernema glaseri* @ 5000 galleria per hectare (2 lakh IJs/galleria).

T6: *Steinernema glaseri* powder @ 5 kg/hectare at sowing.

T7: Control.

Observation recorded

Observations on initial plant population just after the germination and plant mortalities due to white grub infestation at 20, 40, 60 and 80 days after sowing were taken. The data on groundnut pod yield were also recorded treatment wise at the time of harvest and collected data were subjected to statistical analysis to draw the conclusion.

Crop yield and economics

Groundnut crop was harvested when the pods mature and their weight from each treatment was expressed as pod yield q ha^{-1}. The yield was subjected to analysis of variance. The increase yield of groundnut over the control was calculated for each treatment separately by the formula given by Pradhan (1964).

Increase yield (%) =

$$\frac{\text{Yield in treatment-Yield in control}}{\text{Yield in control}}\times100$$

The incremental cost benefit ratios of different treatments were also worked out by given following formula.

$$\text{B: C ratio} = \frac{\text{Return in treatment (Rs./ha.)}}{\text{Return in control (Rs. /ha.) + Cost of insecticide (Rs./ha.)}}\times100$$

The data presented in the Table 1 on efficacy of *M. anisopliae, B. bassiana, H. indica* galleria*, H. indica* powder, *Steinernema glaseri* galleria and *Steinernema glaseri* powder indicated that all the bio-agent treatments were significantly superior over untreated control in reducing the per cent plant mortality due to white grub, *H. consanguinea* in groundnut crop. During both the seasons per cent plant mortality was observed at 20, 40, 60 and 80 days after sowing and minimum (28%) per cent plant mortality on 80^{th} day after sowing observed in the plots treated with *B. bassiana* @ 5 kg (1×10^{12} CFU/ gm) per hectare followed by *M. anisopliae* (29.33%) @ 5 kg (1×10^{12} CFU/ gm) per hectare and *H. indica* galleria (31.77%) @ 5000 galleria (2 lakh IJs per galleria) per hectare at the time of sowing in comparison to 87.28 per cent in untreated control. The treatment of *S. glaseri* powder proved to be the least effective (37.11%) followed by *H. indica* powder (35.69%) and *S. glaseri* galleria (33.75%).

The results bare that yield of pod in all the treatments of bio-control agents was significantly superior in comparison to untreated control of 0.5 q/ha. The maximum pod yield of 12.82 q/ha was recorded with treatment of *B. bassiana* @ 5 kg (1×10^{12} CFU/gm) per hectare which was at par with the

Table 1: Efficacy of different bioagents against white grub, *H. consanguinea* in groundnut crop under field conditions in *kharif* 2018 and 2019.

Treatments	Doseha^{-1} (at sowing)	Mean initial plant population	Per cent Plant Mortality Pooled (2018 and 2019) 20 DAS	40 DAS	60 DAS	80 DAS	Protection over control (%)	Pod yield (q/ha) Pooled	ICBR
M. anisopliae powder	5 kg	452.33	0.37	11.20	24.62	29.33	66.39	11.53	1:27.82
	(@ 1×10^{12} CFU/ gm)		(3.48)*	(19.55)	(29.75)	(32.79)			
B. bassiana powder	5 kg	451.00	0.30	9.75	23.77	28.00	67.91	12.82	1:31.05
	(@ 1×10^{12} CFU/ gm)		(3.12)	(18.19)	(29.18)	(31.95)			
H. indica galleria	5000 galleria	452.33	0.44	13.05	26.21	31.77	63.59	10.78	1:4.60
	(@ 2 lakh IJs/galleria)		(3.81)	(21.18)	(30.79)	(34.31)			
H. indica powder	5 kg	452.66	0.66	15.98	28.27	35.69	59.10	9.85	1:9.64
			(4.67)	(23.57)	(32.12)	(36.69)			
S. glaseri galleria	5000 galleria	450.66	0.59	14.24	26.92	33.75	61.33	10.17	1:4.33
	(@ 2 lakh IJs/galleria)		(4.41)	(22.17)	(31.25)	(35.52)			
S. glaseri powder	5 kg	450.33	0.70	16.46	29.31	37.11	57.48	9.25	1:9.00
			(4.81)	(23.94)	(32.78)	(37.53)			
Control	-	453.00	1.14	29.89	59.44	87.28	0.00	0.50	-
			(6.13)	(34.91)	(61.33)	(89.11)			
SEm±	-	0.59	0.21		0.71	0.82	1.21	-	0.88
CD at 5%	-	N/A	0.65	2.19	2.49	3.52	-	2.75	-
CV%	-	0.19	11.70	7.71	6.29	7.85	-	16.52	

DAS = Days after sowing.

*Figures in parentheses are angular transformed values.

Appendix I: Efficacy of different bioagents against white grub, *H. consanguinea* in groundnut under field conditions.

Treatments	2018					2019					Yield	
	20 DAS*	40 DAS	60 DAS	80 DAS	Mean	20 DAS	40 DAS	60 DAS	80 DAS	Mean	2018	2019
M. anisopliae	0.36	11.61	25.66	30.66	17.07	0.37	10.78	23.59	28.00	15.68	11.30	11.76
B. bassiana	0.29	10.26	24.88	29.51	16.24	0.30	9.24	22.66	26.50	14.67	12.60	13.04
H. indica galleria	0.44	13.50	26.62	32.45	18.25	0.45	12.61	25.79	31.09	17.48	10.50	11..06
H. indica powder	0.66	16.48	29.21	35.71	20.51	0.67	15.49	27.33	35.68	19.79	9.61	10.09
S. glaseri galleria	0.58	14.96	27.67	33.90	19.28	0.60	13.51	26.17	33.60	18.47	10.11	10.23
S. glaseri powder	0.73	17.18	29.77	36.52	21.05	0.68	15.74	28.84	37.70	20.74	9.12	9.38
Control	1.16	28.70	58.50	86.30	33.61	1.12	31.08	60.38	88.26	32.26	0.45	0.55

*DAS- Days after Sowing.

treatment of *M. anisopliae* @ 5 kg (1 × 10^{12} CFU/gm) per hectare (11.53 q/ha), *H. indica* galleria @ 5000 galleria/ha (10.78 q/ha) and *S. glaseri* galleria @ 5000 galleria/ha (10.17 q/ha). The maximum incremental cost benefit ratio of 1:31.05 was obtained in the treatment of *B. bassiana* @ 5 kg per hectare at the time of sowing followed by the treatment *M. anisopliae* @ 5 kg (1 × 10^{12} CFU/gm) per hectare (1:27.82), *H. indica* powder (1:9.64), *S. glaseri* powder (1:9.00), *H. indica* galleria (1:4.60) and *S. glaseri* galleria (1:4.33). The present studies indicated that the furrow application of *B. bassiana* @ 5 kg per hectare or *M. anisopliae* @ 5 kg per hectare at the sowing time is the most active than others used in reducing the percent plant mortality due to white grub, *H. consanguinea* and increasing the pod yield in groundnut crop.

The results are in agreement with work of Bhagat *et al.* (2003), Chirame *et al*. (2003), Hajeri (2003), Channakeshava (2006), Manisegaran *et al*. (2011), Prabhu *et al*. (2011) Visalakshi *et al*. (2015), Vinayaka and Patil (2018) and Kumbhar *et al*. (2019) who evaluated *Beau-veria bassiana* and *Metarhizium anisopliae* and found that *M. anisopliae* was most effective in reduction of plant mortality and increase of yield in sugarcane followed by applied in FYM enriched field. Patil *et al*. (2016) evaluated efficacy of *Steinernema abbasi* and *Heterorhabditis indica* against white grub, *H. consanguinea* and found that *H. indica* at a dose of 2.5×10^9 IJs ha^{-1} significantly reduce the grub population of *H. consanguinea* then followed by *S. abbasi*. Mohan *et al.* (2017) reported an average reduction of 69.1 per cent in the white grub population by use of *H. indica* infected galleria and an average increase of 60.49 q /acre in sugarcane yield over untreated control. Sharmila *et al*. (2019) recorded the highest grub mortality (58.32%) with *S. glaseri* @ 5×10^9 IJs/ ha and increase in yield by 15.78 t/ha.

CONCLUSION

Among the tested entomopathogens the furrow application of *B. bassiana*, *M. anisopliae* powder formulation @ 5 kg (1×10^{12} CFU/gm) and *H. indica* galleria @ 5000 galleria per hectare at the time of sowing is better in reducing the per cent plant mortality and increase yield of groundnut crop.

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