

The Journal of Phytopharmacology

(Pharmacognosy and phytomedicine Research)

Research Article

ISSN 2320-480X

JPHYTO 2021; 10(3):215-219

May- June

Received: 09-05-2021

Accepted: 26-05-2021

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doi:10.31254/phyto.2021.10313

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Area wide management of white grub *Holotrichia consanguinea* Blachard through IPM modules in groundnut

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ABSTRACT

Field experiments were conducted on groundnut for white grub *Holotrichia consanguinea* Blachard management using different IPM components in Gujarat during kharif 2018 and 2019. Two different eco-friendly modules were evaluated and compare with farmers practices. In Module I included on set of monsoon, spraying of chlorpyrifos 20 EC @ 0.04% on surrounding trees, seed treatment of chlorpyrifos 20 EC @ 20 ml/kg, Placement of aggregation pheromone on host tree (5 block/tree), Soil application of *Beauveria bassiana* @ 5 kg ha⁻¹ (Min. 2 x 10⁶ CFU/g) + castor cake (250 kg ha⁻¹) before sowing, Application of *B. bassiana* @ 5 kg ha⁻¹ in plant row with FYM (250 kg ha⁻¹) after 30 days of germination. While Module II used *Metarhizium anisopliae* instead of *B. bassiana*. While in farmers practices included application of chlorpyrifos 10 G @ 10 kg ha⁻¹ with urea at initiation of pest attack. Among the evaluated two ecofriendly module and farmers practices the lowest per cent plant mortality (3.03 %) and 0.56 grub/m² was recorded in Module II. The highest pod and halum yield 2180 and 3942 kg ha⁻¹, yield increase over control 31.00 and 39.37 %, avoidable loss 23.67 and 28.25% was recorded in module II. The maximum (32474 Rs/ha) net realization was found in the treatment of Module II. Looking to the NICBR, the highest (1:5.35) return was obtained with the treatment of Module II followed by Module I (1:2.93).

Keywords: Groundnut, *Holotrichia consanguinea*, Evaluation, IPM modules, *B. bassiana*, *M. anisopliae*, Aggregation pheromone.

INTRODUCTION

Groundnut (*Arachis hypogaea* Linnaeus) is an annual legume crop and belongs to family Leguminosae. 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⁻¹. 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)^[1]. 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)^[5].

It is rather difficult to eradicate this polyphagous and noxious pest because of its peculiar behaviour and nature of damage to the various crops. The pests are univoltine and from eggs to adult stage wide behaviour variations are observed with different nature of damage. The one management practices chemical, physical and mechanical are not sufficient to suppressed pest population. The pest can be managed effectively only by integration of several methods. Keeping to the mind present investigation was carried out with novel integrated management approach in large area for management of white grub in groundnut.

MATERIALS AND METHODS

Field experiment was conducted at farmer's field; where the severe problems of white grub infestation in groundnut. So, the experiment was carried out at village Chandigadh (Ta: Keshod, Dis.: Junagadh) of Gujarat state during two consecutive *kharif* seasons of 2018 and 2019. The experiment was carried out in large plot technique with ten repetitions. Each module covers minimum 0.5 ha area.

For checking the effectiveness two IPM modules and farmers practices were evaluated. An integrated management strategy of particular module was practiced as per treatment schedule mention in Table 1. For recording per cent plant damage, randomly select 20 spot from each field. From each spot, randomly select 15 plants and count number of healthy and damaged plant and number of larval population after 35, 50, 75 and 90 days of sowing. 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 and economics of each IPM modules were calculated.

Table 1: Details of IPM components/Modules

No.	Details
M1	<ul style="list-style-type: none"> On set of monsoon, spraying of chlorpyrifos 20 EC @ 0.04% on surrounding trees, Seed treatment of chlorpyrifos 20 EC @ 20 ml/kg, Place of aggregation pheromone on host tree (5 block/tree), Soil application of <i>B. bassiana</i> @ 5 kg ha-1 (Min. 2 x 10⁶ CFU/g) + castor cake (250 kg ha-1) before sowing, Application of <i>B. bassiana</i> @ 5 kg ha-1 in plant row with FYM (250 kg ha-1) after 30 days of germination
M2	<ul style="list-style-type: none"> On set of monsoon, spraying of chlorpyrifos 20 EC 0.04% on surrounding trees, Seed treatment of chlorpyrifos 20 EC@ 20 ml/kg, Place of aggregation pheromone on host tree (5 block/tree), Soil application of <i>M. anisopliae</i>@ 5 kg ha-1 (Min. 2 x 10⁶ CFU/g) + castor cake (250 kg ha-1) before sowing, Application of <i>M. anisopliae</i> @ 5 kg ha-1 in plant row with FYM (250 kg ha⁻¹) after 30 days of germination
FP	<ul style="list-style-type: none"> Farmers practices (Control) [Included application of chlorpyrifos 10 G @ 10 kg ha-1 with urea after the initiation of pest was done]

M1 = Module 1, M2 = Module 2, FP = Farmers Practices

RESULTS AND DISCUSSION

Per cent plant mortality at 35, 50, 75 and 90 days after treatment

The per cent plant mortality at 35 DAG was varied from 10.76 to 21.09 per cent (Table 2) in different treatments. Significantly lowest (10.76 %) plant mortality was recorded in module- II which included on set of monsoon, spraying of chlorpyrifos 20 EC 0.04% on surrounding trees, seed treatment of chlorpyrifos 20 EC @ 20 ml/kg seed, place of aggregation pheromone on host tree, soil application of *M. anisopliae* @ 5 kg ha-1 + castor cake (250 kg ha-1) before sowing and application of *M. anisopliae* @ 5 kg ha-1 in plant row with FYM (250 kg ha-1) after 30 days of germination followed by module I which included on set of monsoon, spraying of chlorpyrifos 20 EC 0.04% on surrounding trees seed treatment of chlorpyrifos 20 EC@ 20 ml/kg seed and place of aggregation pheromone on host tree, soil application of *B. bassiana* @ 5 kg ha-1 + castor cake (250 kg ha-1) before sowing and application of *B. bassiana* @ 5 kg ha-1 in plant row with FYM (250 kg ha-1) after 30 days of germination. The highest 21.09 per cent plant mortality recorded in farmer's practices. The similar trends were observed at 50, 75 and 90 days after treatment.

Number of grub/m² at 35, 50, 75 and 90 days after treatment

The pooled data in Table 2 revealed that module- II was effective to reduced pest population which showed 3.15 grub/m² over both years. The module I, which included on set of monsoon, spraying of chlorpyrifos 20 EC 0.04% on surrounding trees seed treatment of chlorpyrifos 20 EC @ 20 ml/kg seed and place of aggregation pheromone on host tree, soil application of *B. bassiana* @ 5 kg ha-1 (Min. 2 x 10⁶ cfu/g) + castor cake (250 kg ha-1) before sowing and application of *B. bassiana* @ 5 kg ha-1 (Min. 2 x 10⁶ cfu/g) in plant row with FYM after 30 days of germination showed 4.01 grub/m². The highest 5.31 grub/m² was recorded in the farmer's practices. The similar trends was observed at 50, 75 and 90 days after treatment.

The similar results were observed by Kulye and Pokharkhar (2009)^[6] who reported *M. anisopliae* more effective against *H. consanguinea* infesting potatoes. Chelvi *et al.* (2011)^[3] reported that the combination of the three entomopathogenic talc based fungal formulation of *B. bassiana*, *B. brongniarti* and *M. anisopliae* showed relatively higher virulence and proved to be suitable candidates for controlling larvae of sugarcane white grub *H. serrata*. Rakesha *et al.* (2012)^[7] evaluated two fungal pathogens against arecanut white grub, *L. lepidophora*. The treatment of *M. anisopliae* @ 4 x 10⁸ conidia/g recorded 33.33% grub mortality and was superior over the lower dosage of 2 x 10⁸ conidia/g that recorded 14.81% mortality. *B. brongniarti* recorded 22.22 and 14.81% grub mortality at two dosages tried @ 4 x 10⁸ and 2 x 10⁸ conidia/g, respectively.

The results also conformed to the work of Bhattacharyya and Pujari (2014)^[2] on the green gram, Visalakshi *et al.* (2015)^[8] on sugarcane Chudasama (2019)^[4] on Groundnut who found the *B. bassiana* and *M. anisopliae* effective bioagent against white grub in the respective crop.

Yield, avoidable yield loss and Economics

The highest pod and haulm yield 2180 and 3942 kg ha-1, yield increase over control 31.00 and 39.37 %, avoidable loss 23.67 and 28.25% was recorded in module II followed by module I in which recorded pod and haulm yield, yield increase over control and avoidable loss 1986 and 3495 kg ha-1, 19.33 and 2357%, 16.20 and 19.07%, respectively. The lowest pod 1664 kg ha-1 and haulm 2829 kg ha-1 yield was recorded in farmer's practices.

Chudasama (2019)^[4] from Junagadh (Gujarat) reported the highest pod (1883 kg ha-1) and haulm yield (6255 kg ha-1) were recorded in *B. bassiana* 1.15% WP @ 5.0 kg per ha as soil application + *M. anisopliae* 1.15% WP @ 5.0 kg per ha as soil drenching at 30 days after germination.

Looking to the economics of various module used against white grub infesting groundnut in Table 3 revealed that the maximum (32474 Rs/ha) net realization was found in the treatment of Module II followed by Module I (20082 Rs/ha). Looking to the NICBR, the highest (1:5.35) return was obtained with the treatment of Module II. The NICBR of Module I was 1:2.93.

Table 2: Effectiveness of different IPM component against white grub *H. consanguinea* in groundnut

No.	Treatments	Plant mortality (%)*				No. of grub/m ²			
		35 DAG	50 DAG	75 DAG	90 DAG	35 DAG	50 DAG	75 DAG	90 DAG
1	M1	21.32 (13.22)	19.86 (11.54)	18.27 (9.83)	12.97 (5.04)	2.00 (4.01)	1.89 (3.58)	1.32 (1.75)	0.91 (0.83)
2	M2	19.15 (10.76)	17.87 (9.42)	15.16 (6.84)	10.03 (3.03)	1.78 (3.15)	1.69 (2.86)	1.10 (1.22)	0.75 (0.56)
3	FP	27.34 (21.09)	26.03 (19.26)	24.73 (17.51)	23.46 (15.85)	2.30 (5.31)	2.27 (5.17)	1.71 (2.92)	1.36 (1.85)
	S.Em.±	0.41	0.39	0.38	0.30	0.04	0.04	0.03	0.03
	C.D. at 5 %	1.16	1.12	1.06	0.86	0.11	0.11	0.10	0.08
	C.V. %	8.09	8.31	8.66	8.73	8.33	9.19	11.20	12.84
	Y								
	S.Em.±	0.33	0.32	0.31	0.25	0.03	0.03	0.03	0.02
	C.D. at 5 %	0.95	NS	0.87	NS	NS	NS	NS	NS
	YXT								
	S.Em.±	0.58	0.56	0.53	0.43	0.05	0.06	0.05	0.04
	C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS

*.= Pooled data of two year, M1 = Module I, M2 = Module II, FP = Farmers practices, DAG = Day after germination, Figures in parenthesis are original values, while outside values are square root/arc sign transformed.

M1 (module- I) = on set of monsoon, spraying of chlorpyrifos 20 EC 0.04% on surrounding trees + seed treatment of chlorpyrifos 20 EC@ 20 ml/kg seed and place of aggregation pheromone on host tree, soil application of *B. bassiana* @ 5 kg ha-1 (Min. 2 x 10⁶ cfu/g) + castor cake (250 kg ha-1) before sowing and application of *B. bassiana* @ 5 kg ha-1 (Min. 2 x 10⁶ cfu/g) in plant row with FYM (250 kg ha-1) after 30 days of germination.

M2 (module- II) = on set of monsoon, spraying of chlorpyrifos 20 EC 0.04% on surrounding trees + seed treatment of chlorpyrifos 20 EC @ 20 ml/kg seed + place of aggregation pheromone on host tree, soil application of *M. anisopliae* @ 5 kg ha-1 (Min. 2 x 10⁶ cfu/g) + castor cake (250 kg ha-1) before sowing and application of *M. anisopliae* @ 5 kg ha-1 (Minimum 2 x 10⁶ CFU/g) in plant row with FYM (250 kg ha-1) after 30 days of germination.

FP (Farmers practices) = Application of chlorpyrifos 10 G @ 10 kg ha-1 with urea after heavy attack of pest at later stage.

Table 3: Yield, avoidable yield loss and economics of each modules

No.	Treatments	Pod			Halum			Gross realization (Rs /ha)	Net realization (Rs /ha)	ICBR	NICBR
		Yield (kg ha-1)	Increase in yield over control (%)	Avoidable yield loss	Yield (kg ha-1)	Increase in yield over control (%)	Avoidable yield loss				
1	T1	1986	19.33	16.20	3495	23.57	19.07	120249	20082	1:3.93	1:2.93
2	T2	2180	31.00	23.67	3942	39.37	28.25	132641	32474	1:6.35	1:5.35
3	T3	1664	0.00	0.00	2829	0.00	0.00	100167	0	0.00	--
	S.Em.±	43.58			102.49						
	C.D. at 5 %	123.62			290.76						
	C.V. %	10.03			13.39						
	Y										
	S.Em.±	35.58			83.68						
	C.D. at 5 %	100.94			237.40						
	Y X T										
	S.Em.±	61.66			144.94						
	C.D. at 5 %	NS			NS						

Price of groundnut pod : Rs 50/ Kg,

Price of groundnut dry Halum : Rs 6/Kg

Cost of Treatments

T1 & T2 • Cost of chlorpyrifos 20 EC (3 lit X 300 =900) for spraying on surrounding trees and seed treatment. The cost of aggregation pheromone including block materials **Rs.140/15** block (Price of aggregation pheromone Rs.750/0.5 liters). *B. bassiana* or *M. anisopliae* @ 2.5 kg ha-1 (Rs.150 X 2.5 = 375) FYM (250 kg ha-1) before sowing **FYM: 750/250 kg** Rs.3/kg FYM. *B. bassiana* or *M. anisopliae* @ 5 kg ha-1 (Rs.150 X 5 = 750) with castor cake **Total 1500/250 kg** of castor cake (Rs.300/50KG)

our charges: Rs.200 spraying on surrounding trees+ placing of aggregation pheromone, **Rs.250** application of *Beauveria bassiana* at sowing time **Rs.250** application of *Beauveria bassiana* at second time 900+140+375+750+750+1500+700 (labour charges) **Total cost: 5115/ha**

T3 Farmers practices (Control)

While, in farmers practices included application of chlorpyrifos 10 G @ 10 kg ha-1 with urea after heavy attack of pest at later stage

Rs. 300/kg 10 x 300 = 3000

Price of one bag urea = 300/50 kg

Application charge = 250/ha

Total cost:3550

CONCLUSION

It can be concluded from the study that the lowest per cent plant mortality and population of white grub *H. consanguinea* were observed in Module II with highest (2180 kg/ha) pod and halum yield (3942 kg/ha). The maximum increase in yield over control and avoidable yield loss were also recorded in Module II. Whereas the net realization and NICBR were recorded 32474 Rs/ha and 1:5.35, respectively.

Conflict of Interest

None declared.

Funding

None.

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HOW TO CITE THIS ARTICLE

Bhut JB, Jethva DM, Naggana R. Area wide management of white grub *Holotrichia consanguinea* Blanchard through IPM modules in groundnut. J Phytopharmacol 2021; 10(3):215-219.