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 chlorpyriphos 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/m\(^2\) 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 Leguminocoeae. 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). 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).

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  | **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 B. bassiana @ 5 kg ha-1 (Min. 2 x 10^6 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** |
| M2  | **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 M. anisopliae @ 5 kg ha-1 (Min. 2 x 10^6 CFU/g) + castor cake (250 kg ha-1) before sowing, Application of M. anisopliae @ 5 kg ha-1 in plant row with FYM (250 kg ha-1) after 30 days of germination** |
| FP  | **Farmers practices (Control) [Included application of chlorpyriphos 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 10^6 cfu/g) + castor cake (250 kg ha-1) before sowing and application of B. bassiana @ 5 kg ha-1 (Min. 2 x 10^6 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 results also confirmed to the work of Bhattacharyya and Pujari (2014) on the green gram, Visalakshi et al. (2015) on sugarcane and Chudasama (2019) 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 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 followed by module I in which recorded pod and halum 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 halum 2829 kg ha-1 yield was recorded in farmer’s practices.

Chudasama (2019) from Junagadh (Gujarat) reported the highest pod (1883 kg ha-1) and halum 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/m²** |
|-----|------------|----------------------|------------------|
|     |            | 35 DAG | 50 DAG | 75 DAG | 90 DAG | 35 DAG | 50 DAG | 75 DAG | 90 DAG |
| 1   | M1         | 21.32  | 19.86  | 18.27  | 12.97  | 2.00   | 1.89   | 1.32   | 0.91   |
|     |            | (13.22)| (11.54)| (9.83) | (5.04) | (4.01) | (3.58) | (1.75) | (0.63) |
| 2   | M2         | 19.15  | 17.87  | 15.16  | 10.03  | 1.78   | 1.69   | 1.10   | 0.75   |
|     |            | (10.76)| (9.42) | (6.84) | (3.03) | (3.15) | (2.86) | (1.22) | (0.66) |
| 3   | FP         | 27.34  | 26.03  | 24.73  | 23.46  | 2.30   | 2.27   | 1.71   | 1.36   |
|     |            | (21.09)| (19.26)| (17.51)| (15.85)| (15.31)| (15.17)| (12.92)| (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  |
| 4   | Y          | 0.58   | 0.56   | 0.53   | 0.43   | 0.05   | 0.06   | 0.05   | 0.04   |
|     | 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     | NS     | NS     | NS     | NS     | NS     | NS     |
|     | YXT        | 0.58   | 0.56   | 0.53   | 0.43   | 0.05   | 0.06   | 0.05   | 0.04   |
|     | 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     | 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 chlorpyriphos 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 Yield (kg ha⁻¹) | Increase in yield over control (%) | Avoidable yield loss | Halum Yield (kg ha⁻¹) | Increase in yield over control (%) | Avoidable yield loss | Gross realization (Rs /ha) | Net realization (Rs /ha) | ICBR | NICBR |
|-----|------------|---------------------|-----------------------------------|---------------------|---------------------|-----------------------------------|---------------------|-----------------------------|---------------------------|------|-------|
| 1   | T1         | 1986                | 19.33                             | 16.20               | 3495                | 23.57                             | 19.07               | 120249                      | 20082                     | 1.39 | 1.29  |
| 2   | T2         | 2180                | 31.00                             | 23.67               | 3942                | 39.37                             | 28.25               | 132641                      | 32474                     | 1.63 | 1.53  |
| 3   | T3         | 1664                | 0.00                              | 0.00                | 2829                | 0.00                              | 0.00                | 100167                      | 0                         | 0.00 | --    |

- **S.Em.±**: 43.58
- **C.D. at 5 %**: 123.62
- **C.V. %**: 10.03

**Y**
- **S.Em.±**: 35.58
- **C.D. at 5 %**: 100.94
- **C.V. %**: 10.03

**Y X T**
- **S.Em.±**: 61.66
- **C.D. at 5 %**: 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)
- sprayer 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 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 morality 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.

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REFERENCES

1. Bhattacharyya B, Dutta SK. White grubs as emerging pests in the North Eastern Region of India and their management. Proceeding of National Symposium on Entomology as a Science and IPM as a Technology-the Way Forward. Pasighat, (Arunachal Pradesh), 14-15th November 14-15, 2014, pp. 88-119.
2. Badal B, Pujari D. Field evaluation of *Beauveria brongniartii* and *Metarhizium anisopliae* against white grubs damaging green gram in Assam. International Journal of Plant Protection. 2014;7(1):67-70.
3. Chelvi CT, Thalagarar WR, Nalini R. Field efficacy of formulations of microbial insecticide *Metarhizium anisopliae* (Hyphocreales: Clavicipitaceae) for the control of sugarcane white grub *Holotrichia serrata* F (Coleoptera: Scarabidae). Journal of Biopesticides. 2011;4(2):186.
4. Chudasama K. Biodiversity, biology and management of *Holotrichia consanguinea* (Blanchard) infesting Kharif Groundnut. Ph.D. Thesis submitted to Junagadh Agricultural University, Junagadh, 2019.
5. Kapadia MN, Butani PG, Beria NN. White grub species attacking groundnut in the Saurashtra Region in Gujarat, India. International Arachis Newsletter. 2006(26):28-9.
6. Kulye MS, Pokharkar DS. Evaluation of two species of entomopathogenic fungi against white grub, *Holotrichia consanguinea* (Blanchard) infesting potato in Maharashtra, India. Journal of Biological Control. 2009;23(1):1-4.
7. Rakesha HS, Prabhu ST, Balikai RA. Laboratory evaluation of fungal pathogens and plant extracts against arecanut root grub, Leucopholis lepidophora blanchard. Journal of Experimental Zoology, India. 2012;15(2):463-5.
8. Visalakshi M, Bhavani B, Rao SG. Field evaluation of entomopathogenic fungi against white grub, Holotrichia consanguinea Blanch in sugarcane. J Biol Control. 2015;29(2):103-6.

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