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Research Article

Field evaluation of entomopathogenic fungi against white grub, *Holotrichia consanguinea* Blanch in sugarcane

M. VISALAKSHI*, B. BHAVANI and S. GOVINDA RAO
Regional Agricultural Research Station, Anakapalle-531 001, Andhra Pradesh, India.
**Corresponding author E-mail*: visalamahanthi@yahoo.co.in

ABSTRACT: Field experiments were conducted on sugarcane for white grub management using two entomopathogenic fungi i.e., *Beauveria bassiana* and *Metarhizium anisopliae* in Andhra Pradesh during 2013-14. Among the treatments imposed at the time of planting, *M. anisopliae* @ $5x10^{13}$ spores ha^{-1} mixed with farm yard manure (FYM) was found effective followed by *B. bassiana* @ $5x10^{13}$ spores ha^{-1} applied in FYM enriched field and registered 93.6 % and 88.09 % decrease in white grub damage and 77.22 % and 74.08 % decrease in white grub population. The highest cane yield was recorded when *M. anisopliae* @ $5x10^{13}$ spores ha^{-1} (81.44 t ha^{-1}) applied with FYM followed by *B. bassiana* @ $5x10^{13}$ spores ha^{-1} (76.6 t ha^{-1}) with FYM . Similar trend was observed by imposing treatments at one month after planting i.e., after the onset of monsoon in the month of july. *M. anisopliae* @ $5x10^{13}$ spores ha^{-1} (79.73 t ha^{-1}) recorded highest cane yield followed by *B. bassiana* @ 5x10 ^{13} spores ha-1 (76.45 t ha^{-1}) when applied with FYM at one month after planting. However, highest percent yield increase was recorded in *M. anisopliae* @ 5x10 ^{13} spores ha^{-1} (71.56 %) applied with FYM at the time of planting.

KEY WORDS: Sugarcane, *Holotrichia consanguinea, Beauveria bassiana, Metarhizium anisopliae,* field evaluation

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INTRODUCTION

The white grub, *Holotrichia consanguinea* Blanch (Melolonthinae: Scarabaeidae: Coleoptera) is an important soil pest of sugarcane in tropical India. White grubs have become increasingly difficult pests in Andhra Pradesh during the last few years. Their infestation has been reported throughout the country and the magnitude of the problem has been wide spread over the past years. Although endemic to sugarcane tract in high altitude or assured rainfall areas earlier, the pest has been extending its spatial range in the recent years apparently due to monoculture of sugarcane and minimal varietal diversity. The adults feed on foliage of host trees like neem, acasia etc., late larval stages feed on roots of sugarcane and subsequently damage the underground portions of stalks by scooping holes. Following injury, spindle wilts and leaves turn yellow; such clumps gradually dry up and can be easily pulled out. Affected canes lose weight, dry up, collapse and become unfit for crushing or planting. Although the damage generally occurs in patches, often leaving gaps in severe cases of attack the entire field may be devastated. In such fields, affected clumps often harbor 7-10 grown up grubs around the root region. Such severe symptoms of damage by older grubs generally manifest only late in the season resulting in complete loss of crop since curative chemical control is ineffective against late stage grubs. The yield loss due to white grubs was reported to be as high as 100 per cent in Tamil Nadu (Thamarai Chelvi *et al*., 2010). Several tactis have been adopted for the management of white grubs including cultural, mechanical, biological, chemical and integrated methods (Sahayaraj and Borgio, 2009; Srikanth and Singaravelu, 2011). In a majority of the farming situations, control of white grub has become difficult because of the lack of control over the damage. Pest management strategy depends primarily on the use of highly poisonous chemical pesticides. Chemical control is practically uneconomical, difficult and associated with high cost, environmental pollution and pesticide residues. Hence, there is a need for development of alternate ecofriendly and economically feasible strategy for the control of white grubs. The use of entomopathogenic fungi particularly, *Beauveria bassiana* and *Metarhizium anisopliae* have great importance in the management of white grubs. Both the fungi are eco-friendly, cost effective, highly persistent and also self-perpetuating in nature and the microclimate of sugarcane eco-system

is ideal for their multiplication. Keeping these aspects in view, experiments were conducted to study the efficacy of entomopathogenic fungi for the management of white grub in sugarcane as studies are meagre.

MATERIALS AND METHODS

Field experiments were conducted in white grub endemic areas in Pakki village, Bobbilli mandal of NCS sugars, Vizianagaram district, Andhra Pradesh. The sugarcane variety 87 A 298 was planted in June with spacing of 0.8 m between rows with a plot size of 10 m X0.8m X12 rows and all the recommended package of practices were adopted in two fields for conducting experiments on the efficacy of treatments imposed at the time of planting in the month of june and at one month after planting i.e., after the onset of monsoon in the month of july.

Talc based formulations of *Metarhizium anisopliae* and *Beauveria bassiana* commercially available in the market were applied at the rate of @ $5x10^{13}$ spores ha^{-1} with FYM or without FYM and application was done in rows by 5 cm deep furrow extending front to back. The raised soil beside the furrow was pushed back to cover the formulation. Phorate and neem cake were applied to soil near root zone. The field was irrigated immediately after application. There were seven treatments replicated thrice in a randomized block design.

Observations were recorded on plant damage due to white grubs, the number of white grubs per 10 meter row in the root zone recorded at 60 days after treatment (DAT). The percent decrease in white grub damage and white grub population was calculated and compared. Data on millable cane, cane yield and sucrose (%) was recorded at harvest. Data were subjected to analysis of variance.

RESULTS AND DISCUSSION

From Table 1 it is evident that soil application of entomopathogenic fungi mixed with farm yard manure (FYM) was effective in reducing plant damage and also white grub population in both the experiments by imposing treatments at the time of planting or at one month after planting. *Metarhizium anisopliae* @ $5x10^{13}$ spores ha^{-1} mixed with FYM recorded less plant damage (1.72%) and less number of grubs (1.67 per 10 m row) ; the treatment *Beauveria bassiana* @ $5x10^{13}$ spores ha^{-1} mixed with FYM resulted in less plant damage (3.2%) and less number of grubs (1.9 per 10 m row) followed by *M. anisopliae* without FYM recorded 3.62 per cent plant damage and 2.33 grubs per 10 m row at 60 DAT. Application of *Metarhizium nisopliae* @ $5x10^{13}$ spores ha^{-1} mixed with FYM proved significantly superior to neem cake @ 500 kg/ha, phorate 10 G @ 15 kg/ha and untreated check. It has reduced the grub population to the extent of 1.67 grubs/10 m row and was on par with *Beauveria bassiana* @ $5x10^{13}$ spores ha^{-1}. The highest per cent decrease in plant damage over control was noticed in the treatment with *M. anisopliae* mixed with FYM (93.6), whereas *B. bassiana* mixed with FYM, *M. anisopliae* without FYM, *B. bassiana* without FYM, phorate and neem cake recorded 88.09, 86.34, 83.13, 68.69 and 65.45 per cent decrease over untreated control respectively. Similarly, highest per cent decrease in white grub population (77.22) over untreated check was observed in the treatment with *M. anisopliae* mixed with FYM , *B. bassiana* without FYM, phorate and neem cake recorded 74.08, 68.21, 68.21, 45.43 and 40.93 per cent decrease over untreated control respectively. In the present study, application of *Metarhizium anisopliae* @ $5x10^{13}$ spores ha^{-1} mixed with FYM was found effective followed by *Beauveria bassiana* @ $5x10^{13}$ spores ha^{-1} with FYM and registered 87.89% and 86.2 % decrease in white grub damage and 76.93 % and 69.2 % decrease in white grub population compared to untreated check. The present findings are in line with observations on large scale field application of *M. anisopliae* @ $3.3x10^{13}$ conidia ha^{-1} against gray back cane grub in Australia. They have recorded 50-60 and 70-90 per cent reduction in grub population in plant crop and next ratoon crop (Samson *et al*., 1999). Manisegaram *et al*. (2011) also reported that *Metarhizium anisopliae* @ $4x10^{9}$ conidia ha^{-1} at 60 days after treatment recorded 92% mortality in grubs resulted in higher cane yield .

Similar trend was observed in the experiment conducted by imposing treatments at one month after planting. Highest per cent decrease in white grub damage (87.89) over control was observed in treatment with *M. anisopliae* mixed with FYM (87.89), whereas *B. bassiana* mixed with FYM, *M. anisopliae* without FYM, *B. bassiana* without FYM, phorate and neem cake recorded 86.2, 79.42, 76.55, 48.22 and 21.72 per cent decrease over untreated check respectively. The highest per cent decrease in white grub population over control was noticed in treatment with *M. anisopliae* with or without FYM (79.93) followed by treatment with *B. bassiana* with or without FYM at one month after planting (69.2), phorate (34.6) and neem cake (26.99). Keller (1998) suggested that repeated application of the entomopathogenic fungi formulations enhance the pest control process. White grubs could be controlled in field situations in various crops like *H. consanguinea* infesting potatoes were controlled by *M. anisopliae* (Kulye and Pokharkhar, 2009).

The highest cane yield was recorded in the application of *M. anisopliae* (81.44 t ha^{-1}) mixed with FYM at planting followed by *B. bassiana* (76.6 t ha^{-1}) (Table 2). The yields of cane were less in phorate (65.14 t ha^{-1}), neem cake (56.95 t ha^{-1}) and lowest in untreated check (47.47 t ha^{-1}). Similarly, the treatment *M. anisopliae* (79.73 t ha^{-1}) mixed with FYM at one month after planting also recorded highest cane yield followed by *B. bassiana* (76.45 t ha^{-1}) mixed with FYM whereas cane yields were less in neem cake (59.38 t ha^{-1}), phorate (66.77 t ha^{-1}) and lowest in untreated check (63.48 t ha^{-1}).

It is evident that the millable cane and cane yield varied significantly among *M. anisopliae*, *B. bassiana* and phorate and were significantly superior to untreated check. The application of *M. anisopliae* @ $5x10^{13}$ spores ha^{-1} mixed with FYM resulted in higher cane yield in both the experiments i.e., imposing treatments at the time of planting and at one month after planting. Samuels *et al.* (1990) reported higher cane yield by the application of *M. anisopliae* @ $1x10^{13}$ spores ha^{-1} . Thamarai Chelvi *et al.* (2010) also reported that the biopesticide, *M. anisopliae* at the concentration of $8x10^{9}$ conidia per ml found to be effective in controlling the population of white grub and also reported that yield and quality parameters recorded were higher in treated plots compared to control plots.

Entomopathogenic fungi, *Metarhizium anisopliae*- and *Beauveria bassiana* have great promise as biocontrol agents against different pests. However, the stage of the target pest, dose and time of exposure of the insect to insect pathogenic fungus and time taken to kill are the important parameters for evaluating the suitability of entomopathogenic fungi. As entomopathogenic fungi persist in the soil for a longer period than chemicals, *Metarhizium anisopliae* and *Beauveria bassiana* are better alternatives for the management of white grubs in endemic areas. The results of the present field experiments demonstrated the efficacy of entomopathogenic fungi to control sugarcane white grub without any hazardous chemical pesticides.

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Table 1. Efficacy of entomopathogenic fungi against sugarcane white grub

Treatment	Applied at the time of Planting				Applied at One Month After Planting			
	White grub damage		White grub population		White grub damage		White grub population	
	Damage (%)	Per cent decrease over untreated check	No. of grubs per 10 m row	Per cent decrease over untreated check	Damage (%)	Per cent decrease over untreated check	No. of grubs per 10 m row	Per cent decrease over untreated check
Beauveria bassiana @ $5x10^{13}$ spores/ha	04.53	83.13	02.33	68.21	05.15	76.55	02.67	69.20
Beauveria bassiana @ $5x10^{13}$ spores/ha mixed with FYM	03.02	88.09	01.09	74.08	03.03	86.20	02.67	69.20
Metarhizium anisopliae @ $5x10^{13}$ spores/ha	03.67	86.34	02.33	68.21	04.52	79.42	02.00	79.93
Metarhizium anisopliae @ $5x10^{13}$ spores/ha mixed with FYM	01.72	93.06	01.67	77.22	02.66	87.89	02.00	79.93
Neem cake @ 500 kg/ha	09.28	65.45	04.33	40.93	17.19	21.72	06.33	26.99
Phorate 10G @ 15kg/ha	08.41	68.69	04.00	45.43	11.37	48.22	05.67	34.60
Untreated check	26.86		07.33		21.96		08.67	
CD(*P*=0.05)	04.36		02.09		05.61		02.01	
CV %	09.34		13.90		13.49		16.38	

Table 2. Efficacy of entomopathogenic fungi on yield parameters of sugarcane

Treatment	Applied at the time of Planting				Applied at one month after planting			
	Millable canes at harvest (000'ha)	Yield t ha^{-1}	Per cent yield increase over untreated check	Sucrose %	Millable canes at harvest (000'ha)	Yield t ha^{-1}	Per cent yield increase over untreated check	Sucrose %
Beauveria bassiana @ $5x10^{13}$ spores/ha	83.33	73.77	55.40	19.95	90.33	73.35	15.53	22.50
Beauveria bassiana @ $5x10^{13}$ spores/ha mixed with FYM	87.30	76.60	61.37	21.44	81.67	76.45	20.43	19.76
Metarhizium anisopliae @ $5x10^{13}$ spores/ha	94.00	76.55	61.26	18.86	90.33	74.16	16.82	21.15
Metarhizium anisopliae @ $5x10^{13}$ spores/ha mixed with FYM	92.33	81.44	71.56	19.16	94.67	79.73	25.60	21.89
Neem cake @ 500 kg/ha	94.67	56.95	19.97	16.63	85.33	59.38	-06.46	18.10
Phorate 10G @ 15kg/ ha	82.67	65.14	37.22	18.79	80.67	66.77	05.18	17.95
Untreated check	83.67	47.47		16.59	83.00	63.48		17.07
CD(P=0.05)	04.92	05.21		01.24	06.88	14.68		01.73
CV %	03.12	04.48		03.72	04.47	11.25		04.91

REFERENCES

Keller S. 1998. Use of fungi for pest control in sustainable agriculture. *Phytoprotection.* **79**(suppl): 56–60.

Kulye MS, Pokharkar DS. 2009. Evaluation of two species of entomopathogenic fungi against white grub, *Holotrichia consanguinea* (Blanchard) infesting potato in Maharastra , India. *J Biol Control* **23**(1): 1–4.

Manisegaran S, Lakshmi SM, Srimohanapriya V. 2011. Field evaluation of *Metarhizium anisopliae* (Metschnikoff) Sorokin against *Holotrichia serrata* (Blanch) in sugarcane. *J Biopesticides* **4**(2): 190–193.

Sahayaray K, Borgio JF. 2009. Distribution of *Metarhiziuanisopliae* (Metsch.) Sorokin (Deuteromycotina : Hyphomycetes) in Tamil Nadu, India, Its biocontrol potential on *Dysdercus cingulatus* (Fab.) (Hemiptera : Pyrrhocoridae). *Arch Phytopathol Pl Prot*. **42**(5): 424–435.

Samson PR, Milner RJ, Ballard GK, Hogorth DM. 1999. Development of *Metarhizium* as Biopesticides for sugarcane pest management. Current progress and future prospects. *Proc Australian Soc Sugarcane Technol*. **21**: 156–163.

Samules KDZ, Dinnock DE, Bull RM. 1990. Scarabaeid larvae control in sugarcane using *Metarhizium anisopliae* (Metsch.) Sorokin. *J Inv Pathol.* **55**: 135–137.

Srikanth J, Singaravelu B. 2011. *White grub* (*Holotrichia serrata*) *as pest of sugarcane and its management.* Technical Bulletin No 197 pp.1-8. Sugarcane Breeding Institute, Coimbatore.

Thamarai Chelvi C, Rhichard TW, Kandasamy R. 2010. Laboratory culture & virulence of *Beauveria brangniarti* isolates on sugarcane white grub, *Holotrichia serrata* F. *J Biopesticides* **3**(1): 177–179.