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Management of termites using biocontrol agents in sugarcane in coastal Andhra Pradesh

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Abstract
The present study was taken up to assess the efficacy of biocontrol agents for the management of termites in sugarcane ecosystem during 2015-16 and 2016-17. Two entomopathogenic fungi (*Beauveria bassiana* NBAIR Bb-5a and *Metarhizium anisopliae* NBAIR Ma4), two entomopathogenic nematodes (*Heterorhabditis indica* (NBAII-H38). and *Steinernema carpocapsae* (NBAII Sc 05), were applied through soil in the furrows at the time of planting three budded sets of sugarcane. During 2015-16, among the treatments tested, soil applications of *H. indica* (NBAII-H38) @ 12 kg mixed in 150 kg moist soil per hectare proved effective showing
28.02% reduction in termite bud damage, 40.26% reduction in seedling mortality and 37.17% increased yield over untreated control. Similarly, soil application of 2.5 kg of *M. anisopliae*, (ICAR-NBAIR Ma-4) enriched with 250 kg Farmyard manure per hectare showed 30.55% reduction in bud damage, 56.47% reduction in seedling mortality and 37.05% increased yield over untreated control. During 2016-17, *H. indica* application resulted in 16.78% reduction in bud damage, 68.02% reduction in seedling mortality and 78.08% increased yield over untreated control. Whereas, *M. anisopliae* showed 18.63% reduction in bud damage, 31.96% reduction in seedling mortality and 51.3% increased yield over untreated control. *B. Bassiana* and *S. carpocapsae* were better than the chlorpyriphos insecticidal/neem cake application in the management of termites in sugarcane crop. Entomopathogenic nematode, *Heterorhabditis indica* (NBAII-H38) and Entomopathogenic fungi, *Metarhizium anisopliae* (NBAIR Ma-4) two times application was effective in reducing bud damage and seedling mortality due to termites resulted in higher germination inturn increased cane yields.

Keywords: *Beauveria bassiana*, *Metarhizium anisopliae*, *Heterorhabditis indica*, *Steinernema carpocapsae*, termites, Sugarcane

Introduction
Sugarcane is one of the important commercial crop grown in India. In Andhra Pradesh, sugarcane is largely grown in Visakhapatnam, West Godavari, East Godavari, Chittoor, Krishna, Vizayanagaram, Srikakulam and Nellore Districts to an extent of 2.40 lakh hectares with 136 lakh tons of sugarcane production (Kumar and Suneetha 2016). Termites are highly polyphagous and most destructive soil pests damaging a wide variety of crops.
Termites cause economic losses by directly injuring and destroying both living and dead vegetation. Sugarcane crop in its early vegetative stage is affected due to infestation of termite (Mirandfa *et al*., 2004) [9]. Subterranean termites affect the sugarcane crop from germination till harvest (Sattar and Salihah, 2001) [11]. Termite damage on sugarcane setts leading to death of buds and young seedlings (Koto *et al*., 2000) [5] Management of termites using chemical pesticides is costly and have adverse effects on environment. Biocontrol agents having high potency in the management of termites have much importance with regards of environment.
Microbial biological control aims at suppression and management of insect pests with the use of microbial organisms. Entomopathogenic fungi (EPF) have been used in the management of insect pests as effective biological control agent due to their environmental persistence. Various strains of EPF are effective against different insect life stages, and may act as ecto-parasites by infecting through cuticle contact or as endoparasites which enter into the body, and producing toxins. Entomopathogens like *Beauveria bassiana*, *Metarhizium anisopliae*, *Heterorhabditis indica*. and *Steinernema carpocapsae* were effective, cost effective, eco-friendly, persistent and also self-perpetuating in nature and sugarcane eco-system microclimate is ideal for their multiplication. Entomopathogenic nematodes and entomopathogenic fungi are effective against various termite species and offer an environmentally safe alternative to chemical insecticides.

Hence, the present study was conducted to findout effective biocontrol agent for the management of termites in sugarcane.

Materials and Methods

Field experiments were conducted to evaluate the efficacy of entomopathogenic nematode and entomopathogenic fungus against termites in sugarcane using NBAIR formulations during 2015-16 & 2016-17 in a field at regional agricultural research station, Anakapalle, Visakhapatnam district, Andhra Pradesh. The field trials were laid out with seven treatments as given below in Randomized Block Design (RDB). Each treatment had three replications distributed randomly.

Entomopathogenic fungi, *Beauveria bassiana* NBAIR Bb-5a and *Metarhizium anisopliae* NBAIR-Ma4 were grown separately in Sabouraud's Dextrose Yeast extract Broth (SDYB) (Dextrose 20 g, Mycological peptone 10 g, yeast extract 5 g in 1L of distilled water) was mixed in talcum powder at 2% (20grams of pellet in 1 kg talc). The talc formulations of *M. anisopliae*; *B. bassiana* @ 2.5kg ha-1 (1x108spores/gm) containing 1.0 x108 was mixed with FYM in 250 kg FYM. After 15 days incubation, the fungus enriched farmyard manure was used for the studies. Entomopathogenic nematode, *Heterorhabditisindic* NBAII H38 and *Steinernema carpocapse* NBAII Sc 05 wettable powder formulation obtained from NBAIR, Bangalore was used for the experiment.

Soil application of *M. anisopliae*; *B. bassiana* NBAIR Bb-5a @ 2.5 kg ha-1 mixed with 250 kg Farmyard manure was done in sugarcane furrows at the time of planting and the second application was done after one month of first application in every year. The first application was done at the time of planting and the second application was done after one month of first application in every year. Entomopathogenic nematode, *H. indica* was applied @ 12 kg ha-1; *S. carpocapse* WP @ 20 kg/ha in 150 kg moist sand ha-1 two times at one month interval. Soil application of chemical insecticide, Chlorpyriphos 50 TC@ 5 ml L-1; Neem cake @ 500 kg ha-1 was conducted and Untreated control plot was maintained for the comparision.

Observations on number of plants damage by termites at monthly interval till harvest. Damaged buds and total buds were observed randomly by removing the soil over the setts in each treatment and bud damage was recorded upto germination. The number of buds before planting the crop and number of germinated buds at 45 days after planting was counted to determine the percentage germination of sugarcane setts in each treatment. Termite population was estimated by digging the soil (15x15x15 cm) between furrows and counting termites by spreading the soil on black cloth. Data on yield parameters like shoot population and cane yield was recorded at harvest. The comparision of treatments was done statistically for drawing inferences.

Results and Discussion

Field efficacy of entomopathogenic nematode and entomofungus against termites are presented in Table-1 (2015-16) and Table-2 (2016-17).

During the first year field trial (2015-16), Sugarcane germination was high in *Metarhizium anisopliae* (59.62%); *Beauveria bassiana* (58.15%) and *Heterorhabditis indica* (58.07%) and low in control (44.1%). Bud damage recorded low in *Metarhizium anisopliae* (40.38%); *Beauveria bassiana* (41.85%) and *Heterorhabditis indica* (41.93%) and high in control (55.9%). Seedling mortality was low in *Beauveria bassiana* (8.54%); *Steinernema carpocapsae* (6.02%); *Heterorhabditis indica* (6.24%); *Metarhizium anisopliae* (12.04%) and high in control (19.62%) (Table 1). Termite population recorded low in *Metarhizium anisopliae* (10.1); *Beauveria bassiana* (11.13) and *Heterorhabditis indica* (14.2) whereas high termite count was noticed in Chlorpyriphos 50 TC (42.63) and neem cake (45.67). Direct application of fungi to nests of timber crop has resulted in complete colony mortality (Andrew 2000) [1]. Seed cane yield was recorded significantly high in *Heterorhabditis indica* (71.85 t/ha) followed by *Metarrhizium anisopliae* (71.71 t/ha), *Beauveria bassiana* (64.31 t/ha) and *Steinernema carpocapsae* (63.21 t/ha) and compared to low cane yield in control (45.14 t/ha) and chemical insecticide, chlorpyriphos 50 TC (51.9 t/ha). The repellent action of *Metarhizium* protected maize crop from termites resulted in higher grain yield in Kenya (Maniania *et al*., 2002) [6]. During the second year field trial (2016-17), Sugarcane germination was recorded high in *Metarhizium anisopliae* (58.99%); *Heterorhabditis indica* (58.07%) and low in control (49.62%). Bud damage recorded low in *Metarhizium anisopliae* (40.97%) ; *Heterorhabditis indica* (41.9%) and *Beauveria bassiana* (42.71%) and high in control (50.35%). Seedling mortality was low in *Heterorhabditis indica* (13.2%); *Steinernema carpocapsae* (23.81%) and *Metarhizium anisopliae* (28.08%) compared high plant mortality in control (41.27%) (Table 2). Termite population recorded low in *Metarhizium anisopliae* (11.33); *Beauveria bassiana* (12.9) and *Heterorhabditis indica* (15.2) whereas high termite count was noticed in Chlorpyriphos 50 TC (39.33) and neem cake (43.66). The application of entomopathogenic fungi proved to be promising alternative to insecticides against termites in sugarcane by producing high germination with low bud damage (Hussain *et al.*, 2001) [4].

Seed cane yield was recorded significantly high in *Heterorhabditis indica* (67.21 t/ha) followed by *Steinernema carpocapsae* (65.3 t/ha) and *Metarhizium anisopliae* (57.1 t/ha) compared to low cane yield in control (37.74 t/ha) and chemical insecticide, chlorpyriphos 50 TC (49.72 t/ha). Entomogenous nematodes prevented the activity of termites in laboratory and field (Mauldin and Beal, 1989) [7]. Rathour *et al.*(2014) [10] reported that termites were susceptible to entomopathogenic nematodes in the field of wheat and pearl millet crops, due to which crop production was increased.

Maximum germination, less bud damage and low seedling mortality due to low termite population was noticed in *M. anisopliae* and *H. indica* resulted in higher cane yield during the study period. The results indicated that the soil application of entomopathogenic fungi, *M. anisopliae*, NBAIR Ma4 @ 2.5 kg/ha mixed with 250 kg FYM and Entomopathogenic nematode, *H. indica* NBAII-H38@ 20 kg/ha in 150 kg moist sand ha-1 application two times at one month interval were proved effective against termites with high germination, percentage, less termite damage and increased sugarcane yield.

Table 1: Bioefficacy of entomopathogenic fungi in the management of termites in sugarcane during kharif, 2015-16

Treatment	Germination	Bud damage %	Reducti on in bud damage (%) over untreated control	Seedling mortality (%)	Reduction in Seedling mortality (%) over untreated control	Termite population / pit (15x15x 15 cm)	Seed cane yield t/ha	Yield increase (%) over untreated control	Shoot population' 000ha
T1: *Beauveria bassiana* @ 5kg ha- 1 (1x108 spores/ gm) in 250 kg FYM	58.15	41.85	28.02	8.54	56.47	11.13	64.31	42.47	71.02
T2: *Metarhizium anisopliae* @ 5kg ha (1x108 spores/ gm) in 250 kg FYM	59.62	40.38	30.55	12.04	38.63	10.10	71.71	37.05	70.74
T3: *Heterorhabditis indica* WP @ 20 kg/ha in 150 kg moist sand ha-1	54.75	45.63	12.51	11.72	40.26	14.2	71.85	37.17	66.11
T4: *Steinernema carpocapse* WP @ 20 kg/ha in 150 kg moist sand ha-1	56.84	43.16	14.98	13.71	30.12	18.33	63.21	28.59	69.35
T5: Neem cake @ 500 kg/ha	52.13	47.87	17.66	14.6	25.59	45.67	55.02	17.96	66.76
T6: Chlorpyriphos 50 TC @ 5 ml/lt.	44.1	55.90	3.85	14.38	26.71	42.63	51.9	13.03	65.46
T7: Untreated control	41.86	58.14		19.62		54.67	45.14		61.29
CD(P=0.05)	4.62	4.66		5.77		9.3	8.21		8.62
CV%	10.73	12.26		15.39		16.17	14.2		12.14

Table 2: Bioefficacy of Entomopathogenic fungi and Entomopathogenic nematodes in the management of termites in sugarcane during kharif., 2016-17

Treatment	Germinat ion (%)	Bud damage %	Reduction in bud damage (%) over untreated control	Seedling mortality (%)	Reduction in Seedling mortality (%) over untreated control	Termite populati on / pit (15x15x 15 cm)	Seed cane yield (t /ha)	Yield increase (%) over untreate d control	Shoot population '000ha
T1: *Beauveria bassiana* @ 5kg ha-1 (1x108 spores/ gm) in 250 kg FYM	57.25	42.71	15.17	32.37	21.57	12.93	44.01	16.61	72.98
T2: *Metarhizium anisopliae* @ 5kg ha-1 (1x108 spores/gm) in 250 kg FYM	58.99	40.97	18.63	28.08	31.96	11.33	57.1	51.3	77.91
T3: *Heterorhabditis indica* WP @ 20 kg/ha in 150 kg moist sand ha-1	58.07	41.9	16.78	13.2	68.02	15.2	67.21	78.08	100.32
T4: *Steinernema carpocapse* WP @ 20 kg/ha in 150 kg moist sand ha-1	54.83	48.14	4.39	23.81	42.31	17.1	65.3	73.03	95.84
T5: Neem cake @ 500 kg/ha	52.86	47.11	6.43	38.0	7.92	46.67	52.49	39.08	84.72
T6: Chlorpyriphos 50 TC @ 5 ml/lt.	54.36	45.60	9.43	34.49	16.43	39.33	49.72	31.74	92.37
T7: Untreated control	49.62	50.35		41.27		56.2	37.74		65.47
CD(P=0.05)	5.01	4.82		8.63		8.9	8.71		9.2
CV%	9.08	10.29		31.92		25.3	27.58		18.07

Conclusion

Soil application of *M. anisopliae* NBAIR Ma4 @ 2.5 kg ha-1 mixed with 250 kg Farmyard manure; Entomopathogenic nematode, *H. indica* NBAII-H38 @ 20 kg/ha in 150 kg moist sand ha-1 application two times at one month interval in sugarcane furrows yielded encouraging results compared to other treatments. The application of *M. anisopliae* NBAIR Ma4 and *H. indica* NBAII- H38 proved as promising alternatives to insecticides against sugarcane termites by producing high germination and low plant mortality.

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References

1. Andrew C Rath. The Use of Entomopathogenic Fungi for Control of Termites.Journal of Biocontrol Science and Technology 2000;10(5).
2. Culliney TW, Grace JK. Prospects for biological control of subterranean termite (Isoptera: Rhinotermitidae), with special reference to *Coptotermes formosanus*. Bull Entomol Res 2000;90:9-21.
3. Grace JK. Biological control strategies for suppression of termites. J Agric Entomol 1997;14:281-289.
4. Hussain A, Ahmed S, Shahid M. Laboratory and field evaluation of *Metarhizium anisopliae var. anisopliae* for controlling subterranean termites. Neotropical entomology 2001;40(2):244-250.
5. Koto IN, Nwasu KI, Busari LD. Control of termites in sugarcane using insecticides. Sugar tech 2000;2(4):17-20.
6. Maniania Nk, Ekesi S, Songa JM, Managing termites in maize cropping systems with the entomopathogenic fungus, *Metarhizium anisopliae*. Insect Sci Appl 2002;21:41-46.
7. Mauldin JK, Beal RH. Entomogenous nematodes for control of subterranean termites, *Reticulitermes spp*.

(Isoptera, Rhinotermitidae). J Econ Entomol 1989;82:1638-1642.
8. Md Aslam Khan, Wasim Ahmad, Bishwajeet Paul, Sangeeta Paul, Zehra Khan, Chetana Aggarwal, *et al*. Entomopathogenic Nematodes for the Management of Subterranean Termites. Springer International Publishing Switzerland, Chapter in Plant, Soil and Microbes 2016, 327.
9. Mirandfa CS, Vasconcellos A, Bandeira AG. Termites in sugarcane in northeast Brazil; ecological aspects and pest status. Neotrap.Entomology 2004;33:237-41.
10. Rathour KS, Sudershan G, Das T, Pargat S, Anjani K, Somvanshi VS. Biological management of subterranean termites (*Odontotermes obesus*) infesting wheat and pearl millet crops by entomopathogenic nematodes. Indian Journal of Nematolog 2014;44:97-100.
11. Sattar A, Salihah Z. Detection and control of subterranean termites. In: technologies for sustainable agriculture (Ed.). Proceed. Natl. Workshop, NIAB, Faisabad, Pakistan 2001, 195-198.
12. Verma M, Sharma S. Prasad R. Biological alternatives for termite control: a review. Int Biodeterior Biodegradation 2009;63:959-972.