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Research Note

Infectivity of entomopathogenic fungal bio-agents on yellow mite, *Polyphagotarsonemus latus* Banks of jute

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ABSTRACT: Yellow mite is a serious pest of many field and horticultural crops including jute. As repeated use of acaricides possess problem of resistance, alternatively, the infectivity of talc based formulation of three entomopathogens, *i.e*., *Lecanicillium lecanii* (Ll), *Isaria fumosorosea* (=*Paecilomyces fumosoroseus)* (Pf) and *Beauveria bassiana* (Bb) at $4x10^8$ cfu/ml, and $6x10^8$ cfu/ml concentrations were evaluated against yellow mite under laboratory condition. In both the concentrations, Pf and Bb recorded significantly higher mortality of yellow mite than Ll. At 3-DPT (days post treatment) significantly highest mortality was observed in Pf (30.35%) followed by Bb (21.59%) and Ll (4.87%). Later on at 4 and 5-DPT period the level of mortality in Pf and Bb treated population was at par but significantly higher than Ll. At 5-DPT, Pf recorded maximum cumulative mortality (40.92%) at par with Bb (35.99%) and significantly higher than Ll (12.92%). Significantly higher cumulative mortality at $6x10^8$ CFU/l concentration during 5 days after treatment was 34.35%. The infectivity of talc based formulation of Ll at both the concentrations was significantly less than Pf and Bb. Higher infectivity of *I. fumosorosea* indicates it to be ideal for yellow mite control in jute.

KEY WORDS: Fungal entomopathogen, jute, yellow mite

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Jute (*Corchorus* spp.: Malvaceae) is one of the important bast fibre crops mostly grown in India and other South Asian countries. In recent years, this crop has witnessed dynamic changes in the pattern of infestation of early season sucking pests which is mostly associated with erratic climatic pattern. The changing cropping sequence, presence of favourable alternate hosts and persistence of slightly elevated temperature are the reasons for such erratic and increasing pest status of yellow mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) in jute. In recent years, the infestation of yellow mite, has been very regular and severe, even raised to the status of outbreaks in few jute growing pockets particularly during the active growth phase of the crop. The infestations of damage symptom caused by mite are more prolonged due to longer activity period of the mite and the stresses encountered by the crops. The crop growth is severely impaired due to the adverse effect on plant physiology and morphology caused by mite damage (Grinberg *et al*., 2005).

Its attack is confined mostly to new growths resulting in curling of leaf margins, firmness of infested leaves, necrosis of growing points, and growth inhibition. As a result, both the quality and yield of the fibre are adversely affected that may cause 38% loss in fibre production (Keka *et al.,* 2008). Chemical acaricides are commonly used to control mite which has negative effects, like resurgence and residues. According to Arthropod Pesticide Resistance Database (APRD) more than 700 cases of acaricide resistance in phytophagous mites have been reported (Whalon *et al*., 2008). Present trend in insecticide-centric management of mites in jute besides enhancing the cost of cultivation may cause the resurgence and secondary pest outbreak. Integration of improved cultural management practices, bio-pesticide based interventions and need-based use of insecticide/acaricides can manage the insect pests/ mites of jute in a sustainable manner (Banerjee *et al*., 2000). Chemical acaricides commonly used to control yellow mite; besides causing residue problem, often result in mite populations resistant to the active ingredients and eliminate non-target organisms, thus affecting natural enemies (Gallo *et al*., 2002). Unlike the chemical acaricides, with the application of Entomopathogenic Fungi (EPF) the activity of predatory mites is maintained and preserved in the agro-ecosystem. Besides, EPF has proven pathogenicity against mite and other sucking pests to variable extent. In this backdrop preliminary laboratory experiments were conducted to evaluate the infectivity of these EPF against yellow mite of jute.

The infectivity of three talc based commerical formulations namely *Lecanicillium lecanii* (Ll) (Mealikil VL, Agri Life, Medak, Telangana) *Isaria fumosorosea* (=*Paecilomyces fumosoroseus*) (Pf) (Pacelomite, Agri Life, Medak, Telangana) and *Beauveria bassiana* (Bb) (Racer BB, Agri Life, Medak, Telangana) at $4x10^8$ CFU/l and $6x10^8$ CFU/l concentrations were evaluated against yellow mite under laboratory condition. Thirty five-day old potted (10 cm dia & 10 cm ht) jute (Cv. JRO 8432) seedlings maintained under glass house condition were used for mite culture. The topical leaves having broad mite eggs were detached from the seedlings with its petiole intact. The petiole tips of such leaves were wrapped in wet cotton swab and placed underside up in Petri plates (9 cm dia) on water soaked 2-layer filter paper. Another leaf of same size and age, free from mite was placed with its underside on top of the leaf with mite eggs. The upper leaf with its dorsal side in contact with the mite eggs were watched for 24 hrs during which the emerged larvae move to the fresh leaf. Such leaves with 10 mite/leaf were used for infectivity test. Each treatment constitutes 30 mites replicated 5 times in CRD. The solutions ($4X10^8$ CFU/l and $6x10^8$ CFU/l concentrations) of respective entomopathogenic fungal formulations prepared in distilled water were applied evenly with hand atomizer on the lower surface of jute leaves containing 10 mites/leaf. Such leaves were kept inside Petri plates lined with moist blotting paper up to 5 days to observe the mycosis and mortality of mites. The Petri plates were incubated at 27°C and mortality was judged on the basis of mycosis of mite at 3, 4 and 5 days after treatment. The cumulative mycosis (%) was observed till five days after treatment. The mortality of the fungus was evaluated as percentages of cumulative daily mortality, corrected for mortality in the control according to Abbott's (1925) formula. These data were analysed by ANOVA applicable for CRD.

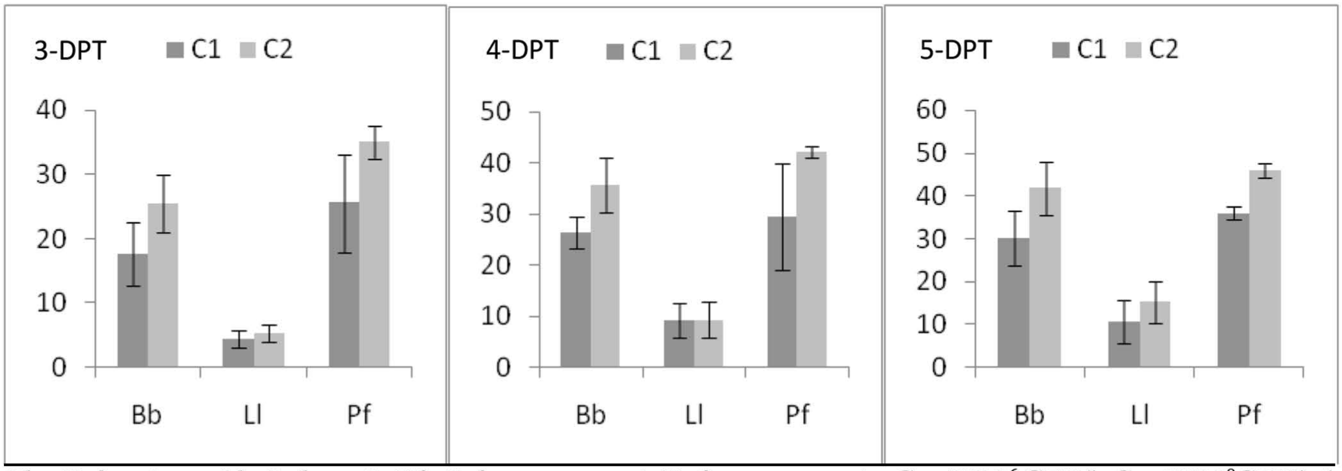
On the basis of pre-treatment population and post-treatment mycosis and death overall mortality (%) was calculated. In both the concentrations, Pf and Bb recorded significantly higher mortality of yellow mite than Ll. At 3-days post treatment (DPT) significantly highest mortality was observed in Pf (30.35%) followed by Bb (21.59%) and Ll (4.87%) (Table 1). Further at 4-DPT, the infectivity of all the EPF increased. The mortality percentage in Pf formulation was highest (35.90%) at par with the mycosis recorded in Bb formulation (31.12%). The pathogenicity in Ll formulation was very poor exhibiting only 9.18% mycosis which was significantly lower than the mortality caused in other two EPF formulations i.e., Pf and Bb. At 5-DPT, Pf recorded maximum cumulative mortality (40.92%) at par with Bb (35.99%) and significantly higher than Ll (12.92%). At 4 and 5-DPT period the level of mortality in Pf and Bb treated population was at par but significantly higher than Ll. Irrespective of the EPF formulations at all the stages of post infection period, the mortality in higher concentration varied from 21.95% to 34.35% where as in lower concentration it ranged from 15.92 to 25.57% indicating significantly higher infectivity in higher concentration.Significantly higher cumulative mortality at $6x10^8$ CFU/l concentration during 5 days post treatment was 34.35%. The infectivity of talc based formulation of Ll at both the concentrations was significantly less than Pf and Bb.

The mortality/mycosis pattern at different intervals of observation indicated that initial mortality (25.59%) caused due to the infection of Pf even at lower concentration ($4x10^6$ CFU/l) was at par with the higher concentration ($6x10^6$ CFU/l) of Bb (25.45%) (Fig. 1). Irrespective of concentration of the EPF formulations the infectivity of Pf at 3DPT was significantly more than Bb, although in

Table 1. Post-treatment infection of entomopathogens on yellow mite of jute

EPFs	Mycosis/ mortality (%)								
	3-DPT			4-DPT			5-DPT		
	C1	C2	Mean	C1	C2	Mean	C1	C2	Mean
Bb	17.73	25.45	21.59	26.36	35.69	31.02	30.12	41.37	35.99
Ll	4.47	5.29	4.87	9.10	9.27	9.18	10.59	15.25	12.92
Pf	25.59	35.11	30.35	29.57	42.23	35.90	36.01	45.92	40.92
Mean	15.92	21.95		21.73	29.01		25.57	34.35	
CD (P=0.05)	EPFs- 6.68, C- 5.45 EPFs X C - 9.45			EPFs- 7.86, C- 6.42 EPFs X C - 11.13			EPFs- 10.40, C- 8.49 EPFs X C - 14.71		

Bb - Beauveria bassiana; Ll - Lecanicillium lecanii; Pf - Isaria fumosorosea (=Paecilomysces fumosoroseus); C_1 - $4x10^6$ CFU/l; C_2 – $6x10^8$CFU/ml; DPT- Days post treatment



Bb - B. bassiana, Ll - L. lecanii, Pf- I. fumosorosea (=P. fumosoroseus) ; C_1- 4X10^6 CFU/l, C_2- 6X10^8CFU/ml,

Fig. 1. Effect of EPF at different concentrations on mite mortality (%)

later stages there was no significant difference in mortality between Bb and Pf.The infection caused by Pf on broad mite in faster and quicker as compared to other EPFs which may be the reason for high rate of mycosis and mortality in case of Pf. Compared to Bb, the strains of Pf showed greater pathogenicity with quick infection on yellow mite that caused 50% mortality after 2.78 and 3.35 days of infection by the strains of Pf and Bb respectively (Nugroho and Ibrahim, 2004). Higher infectivity of Pf was also observed on red spider mite (Wei-Bing and Ming-Guang, 2004).

Laboratory assay confirmed the pathogenicity of Bb and Pf against whitefly even at humidity as low as 25% at 23-25°C temperature. Field applications at the rate of 5x10^3 at 7 days interval controlled the whitefly damage by more than 90% (Wright *et al*., 2000). In laboratory, formulation of entomopathogenic fungi, *Paecilomyces fumosoroseus* @ 3.39 to 5.97x10^5 conidia/l infected the larvae, nymphs, and adults of citrus brown mite *Eutetranychus orientalis* that caused 50% mortality of each stages (El-Sharabasy, 2015). This formulation can be considered as an environmentally friendly alternative for biocontrol of *E. orientalis*. Entomopathogenic fungi have produced positive results in the control of *P. latus*, and studies in the laboratory and greenhouses have demonstrated the potential of entomopathogenic fungi, particularly *Beauveria bassiana*, against this mite species (Alves *et al*., 2010). However, field studies on using entomopathogenic fungi to control mites are scarce and non-existent for *P. latus*. The potential of the fungus to control the mite has been studied which provides incremental biological control. Compared with the effects of chemical acaricides, the effectiveness of the biological control of mites is increased by predatory mites, which are not affected by the fungus and thus are preserved in the agro-ecosystem (Alves *et al*., 2008).

On the basis of the preliminary studies, it reveals that the talc-based formulation of *Isaria fumosorosea* (=*Paecilomyces fumosoroseus)* has higher infectivity on yellow mite which may be useful as effective entomopathogen for the control of yellow mite in jute because of its potential for quick infection process and ability to cause higher mycosis and mortality on the larval and nymphal stage of the mite.

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