COMPATABILITY AND VIRULENCE RESPONSE OF CERTAIN CONSORTIA ON *Spodopteralitura* (Fabricius)ENTOMOPATHOGENIC

Comment [H1]: Delete

Comment [H2]: Entomopathogenic Fungi

Abstract :

The tobacco caterpillar, *Spodopteralitura* (Fabricius), is a widespread polyphagous pest impacting numerous field and horticultural crops across Asia. This study investigates the compatibility and development of consortia among four entomopathogenic fungi: *Beauveriabassiana*, *Verticilliumleccani*, *Metarhiziumanisopliae*, and *Metarhiziumrileyi*, aiming to enhance control measures against *S. litura*. Through visual observation of fungal interactions in petri dishes, different combinations were assessed for compatibility, revealing varying degrees of intermingling and inhibition. Partial compatibility was noted between *Beauveriabassiana*, *Verticilliumleccani*, *Metarhiziumanisopliae*which can be grouped to a consortia.

Comment [H3]: ***Leacanicilliumlecanii***

Comment [H4]: *Lecanicilliumlecanii*

Keywords: *entomopathogenic fungi, compatibility, visual observation, consortia*

1. INTRODUCTION

The tobacco caterpillar, *Spodopteralitura* (Fabricius) is a regular polyphagous pest of field and horticultural crops (Shankar *et al.*, 2006). This pest is next to *Helicoverpaarmigera* (Hubner) in economic importance, both at national and global level. *Spodopteralitura* has emerged as a serious pest causing enormous losses to many economically important cultivated crops such as cotton, soybean, groundnut, tobacco, vegetables etc. (Qin *et al.*, 2004). It infests more than 112 crop plants belonging to 44 families in the world, of which 40 cultivated plants as well as 24 wild plants are known from India. The major host plants known from India are tobacco, cotton, cabbage, groundnut, sunflower, castor, lucerne, chilli, potato, soybean, cauliflower, tomato, beans etc. *S. litura* is primarily a defoliator but also feeds on buds, flower and pods of legumes (Krishnamurthy Rao *et al.*, 1983). Several synthetic pesticides have been tested and recommended for control of *S. litura*, which have caused serious concern due to their adverse impacts like health hazard, resistance build-up, residue problem, environment pollution etc.

Most of insect pest are becoming resistant to chemical pesticides due to its indiscriminate and excessive use which also affect the natural enemies of insect pest adversely and disturb the ecosystem. In such conditions bioagents play an important and effective role. Biopesticides offer several advantages over the chemical pesticides *viz.* safety, targeted activity to the desired pests, effective in lower quantities thereby offering lower exposure and quick decomposition to leave no residues and allowing field re-entry immediately after application and amenability to use in rotation with chemical pesticides as part of IPM programs. If the two entomopathogens complement each other, or act synergistically, a beneficial effect can be obtained. One of the limitations of fungi as microbial control agents is that, each species and strains within a species are usually efficacious in a narrow window of climatic conditions. Theoretically, this issue could partly be addressed through the development of an appropriate co-formulation of two or more fungi or fungal strains with different host ranges and ecological tolerances (Wang et al., 2002). In the current study, we have investigated the compatibility between various entomopathogenic fungi to develop a consortia that can effectively control the *S. litura*.

2. MATERIALS AND METHODS

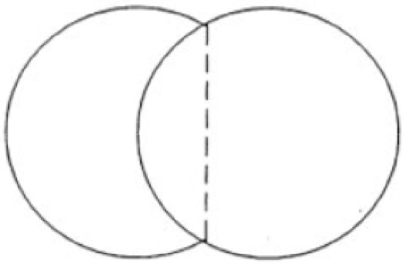
Four entomopathogenic fungi that were reported to cause mortality in *S. lituraviz.*, *Beauveriabassiana*, *Verticilliumleccani*, and *Metarhiziumanisopliae*, *Metarhiziumrileyi*were selected to study the compatibility and to develop a consortia. All the four fungi were first grown separately in petriplates and inoculated for co-culturing as per the procedure described by Upamanya*et al.*, 2020. The four fungi were divided into two groups, fast-growing and slow-growing fungi. The fungi that covered the whole petriplate within 5 days of inoculation were considered fast-growing and fungi that took more than 5 days after inoculation were considered as slow-growing. *Beauveriabassiana*, *Verticilliumleccani*, and *Metarhiziumanisopliae* were considered as fast-growing and *Metarhiziumrileyi*was considered to be slow-growing fungi. The *M. rileyi* was inoculated first in all the treatment combinations (table -1) containing it by placing a 5mm disc on petriplate lined with potato dextrose agar (PDA) and incubated at 28±2°Cfor 5 days and the other two fast-growing fungi were inoculated at an equidistance after 5 days in a similar way under aseptic conditions in laminar airflow. In fourth combination where all fast-growing fungi were present, all the three fungi were inoculated at a same time in an equal distance and the growth was observed for 14 days.

The compatibility between the fungi was studied by visually observing the interaction between the colonies after 14 days as per the procedure described by Mohammad *et al.* (2011) (Fig 7).

Comment [H5]: *Lecanicilliumlecanii*

Comment [H6]: *Lecanicilliumlecanii*

Comment [H7]: Were the Relative humidity(RH) Because Entomopathogenic fungi vary in humidity to achieve the highest growth rate



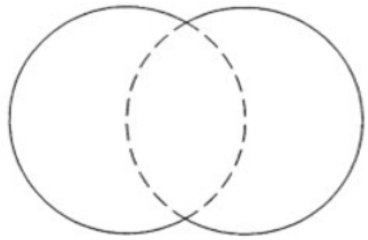
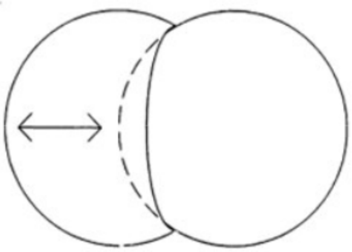


Fig 1 Mutual intermingling (Compatible) **fig 2 : Partial intermingling (Partial Compatible)**



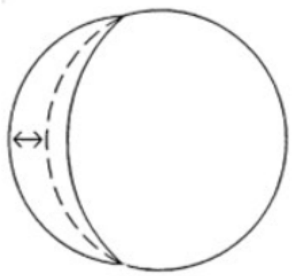
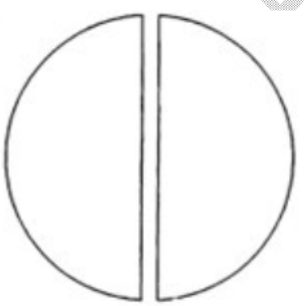


Fig 3 : Invasion/Replacement (Early Stage) **fig 4 : Invasion/Replacement (Final Stage)**



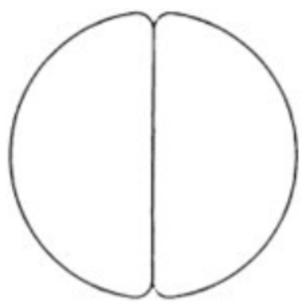


Fig 5 : Inhibition/deadlock (at touching point) **fig 6 : Inhibition/deadlock (at distance)**

3. RESULTS AND DISCUSSION

3.1. Combination 1 (*Beauveriabassiana* + *Metarhiziumanisopliae* + *Metarhiziumriyeli*)

The *Metarhiziumriyeli*was inoculated on potato dextrose agar and after 5 days of inoculating*Mriyeli*, *Beauveriabassiana*and *Metarhizumanisopliae* was inoculated at an equal

Comment [H8]: *M. riyeli For all Scientific names*

Comment [H9]: *M.*

Comment [H10]: *B. bassiana*

Comment [H11]: *M. anisopliae*

distance in a petriplate. After 12 days and a zone of inhibition was observed around *Metarhiziumriyeli*and no intermingling was observed between *Metarhiziumriyeli* and other two fungi. The treatment is found to be incompatible by observing visually.

Comment [H12]: Modes of interaction between fungi and need a picture

3.2 Combination 2 (*Beauveriabassiana* + *Metarhiziumriyeli*+ *Leacanicilliumlecanii*)

After 5 days of inoculating the *Metarhiziumriyeli*on PDA, *Leacanicilliumlecanii*and *Beauveriabassiana*were inoculated at the same time in an equal distance and after 12 days no intermingling of *Metarhiziumriyeli*with other two fungi was observed visually and a zone of inhibition was observed around the*Metarhiziumriyeli*.

Comment [H13]: Modes of interaction between fungi and need a picture

3.3 Combination 3 (*Beauveriabassiana* + *Metarhiziumanisopliae*+ *Leacanicilliumlecanii*)

Beauveriabassiana, *Metarhiziumanisopliae* and *Leacanicilliumlecanii*were inoculated at the same time at an equal distance in a petriplate and after 12 days partial intermingling of three fungi was observed visually as described by Mohammad *et al.* (2011). The treatment was noted to be partially compatible (fig7).

Comment [H14]: Need for picture

3.4 Combination 4 (*Metarhiziumanisopliae* + *Metarhiziumriyeli*+ *Leacanicilliumlecanii*)

*Metarhiziumanisopliae*and *Leacanicilliumlecanii*were inoculated after 5 days of growing the *Metarhiziumriyeli*. No intermingling of *Metarhiziumriyeli*was observed with other two fungi with a zone of inhibition present around the *Metarhiziumriyeli*.

Comment [H15]: Modes of interaction between fungi and need a picture

The current findings are in accordance with Sumalatha *et al.* (2017) who evaluated the compatibility of *L.lecanii* with other entomopathogenic fungi and reported that the *B. bassiana* is compatible with *L. lecanii*. Mohammad *et al.* (2011) divided six fungal isolates with the ability to compost an oil palm industrial waste into fast and slow-growing fungal groups and inoculated them at different times and observed the growth for a few days. Based on the visual observation they reported that *Trichodermaviride* and *Penicillium* sp. (Tv/P), *T. viride* and Basidiomycete M1 (Tv/M1), *Trichodermareesei* and *Panustigrinus* M609RQY (Tr/M6) were compatible.

The current findings are in accordance also with Upamanya*et al.* (2020) where they reported that there is a compatibility of *B. bassiana* with *M. anisopliae* and *Trichodermaharzianum*. They formed two combinations of compatible biocontrol agents with combination-I containing *T. harzianum* +*B. bassiana*; *T. harzianum*+ *M. anisopliae*; *B. bassiana* + *M. anisopliae* and *T. harzianum* +*B. bassiana*+ *M. anisopliae* and the combination-II containing *T. asperellum* +*B. bassiana*; *T. asperellum* + *M. anisopliae*; *B. bassiana* + *M. anisopliae* and *T.asperellum* +*B. bassiana*+ *M. anisopliae* and used these combinations to control the insect pest and diseases in brinjal crop.

Karthiba*et al.* (2010) by dual culture technique, have streaked the *Pseudomonas* strain on one side of a petri dish and placed a mycelial disc of a seven-day-old culture of *B. bassiana* on the opposite side perpendicular to bacteria and found that there is no growth hindrance of any of the organisms and the combination effectively reduced the leaf folder and sheath blight incidence in rice plants. Thakkar A and Saraf M (2015) have noted the compatibility between antagonistic fungi and bacteria by co-culturing at 30°C them on PDA after inoculating them 2 cm apart from each other and reported that *Trichodermacitrinoviride*was compatible with *Pseudomonas aeruginosa*, *Bacillus cereus* and can be used as an consortia against *Macrophominaphaseolina*and *Sclerontiniasclerotiorum*.

Comment [H16]: Delete Because about anther microbiology (Bacteria)

Comment [H17]:

Comment [H18]: Delete Because about anther microbiology (Bacteria)

Table -1: Treatment combinations

Combination – 1	*Beauveriabassiana* + *Metarhiziumanisopliae* + *Metarhiziumriyeli*
Combination - 2	*Beauveriabassiana* + *Metarhiziumriyeli* + *Lecanicilliumlecanii*
Combination – 3	*Beauveriabassiana* + *Metarhiziumanisopliae* + *Lecanicilliumlecanii*
Combination - 4	*Metarhiziumanisopliae* + *Metarhiziumriyeli* + *Lecanicilliumlecanii*

Comment [H19]: Must put picture for four combinations to see the Result (Compatible mixed cultures)

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