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Research Article

Effectiveness of *Beauveria bassiana* (Ami Beauvero Star) as a Biological Control Agent for Thrips tabaci on Cotton Plants

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Abstract

Cotton (*Gossypium hirsutum* L.), an important commercial crop in India, suffers significant pest challenges, notably from Thrips tabaci, which can cause substantial output losses. This study examined the efficiency of the commercial entomopathogenic fungus Beauveria bassiana (Ami Beauvero Star) in inhibiting *T. tabaci* infestations on cotton plants in both field and laboratory conditions. Field studies demonstrated that treating cotton plants with Beauveria bassiana effectively increased plant growth. In comparison to the controls, the treated plants exhibited a root dry mass of 38 g, a shoot dry mass of 137g, a stalk dry weight of 43.11g, and a total dry mass of 168g. These results were substantiated by laboratory analysis, which showed that treated plants had more root dry mass (24.09g), shoot dry mass (126g), and stalk dry weight (29.07g). The mean total dry mass of the treated plants was 89 ± 14g, which was significantly higher than the 51 ± 5g recorded for the control plants. This study evaluated the effectiveness of *Beauveria bassiana*, a commercial entomopathogenic fungus, in reducing thrips damage on cotton plants over eighteen weeks. In comparison with untreated plants, the application of Ami Beauvero Star substantially reduced thrips-related damage. While control plants averaged 4 injuries in Week 2, treatment plants showed no injuries at all. In comparison to the control group, which had 9 injuries by Week 4, the treated plants had only 3. Throughout the trial, this pattern was maintained, with control plants showing a sustained increase in damage that by Week 10 averaged 17 injuries. Treating plants, on the other hand, showed continuously decreasing injury levels; by Week 18, only 2 injuries were recorded as opposed to 7 injuries in the control group.

Keywords: Ami Beauvero Star; Biopesticide; Cotton; Entomopathogenic; *Thrips tabaci*

Abbreviations

EPF: Entomopathogenic Fungi; IPM: Integrated Pest Management; ITCC: Indian Type Culture Collection

Introduction

Cotton (*Gossypium hirsutum L.*) is a crucial economic crop in India [1], known as the 'White Gold' and 'King of Fibre' [2]. With a high economic value, cotton is a significant crop that produces fiber worldwide [3]. It is cultivated economically in more than 100 nations in tropical and temperate conditions [4]. India is the major cotton-growing nation in the world [5]. It provides the raw material to related industries including, textile processing, garment making, and fabric manufacturing, among others, and thus provides an important contribution to the national economy [6]. However, cotton production faces severe challenges from a wide range of insect pests, with approximately 184 species reported in India, causing yield losses between 30% and 80% [7]. One of the most common pests among them is *Thrips tabaci Lindeman*, a global pest that feeds on a variety of crops, including cotton, cabbages, tomatoes, potatoes, onions, and garlic [8]. *Thrips tabaci Lindeman* functions as a vector for several plant viruses and infests cotton during the seedling stage [9]. It has recently become a serious pest [10].

Thrips tabaci is usually managed with synthetic pesticides; however, this method frequently results in concerns such as insecticide residues in food, resistance development, and high expense [11]. Farmers are looking for more environmentally friendly pest management alternatives, such as biological control techniques, as a result of growing concerns about the regular and excessive utilization of chemical pesticides [12]. Biological control is increasing in popularity in many developed nations as an eco-friendly and efficient part of integrated pest management [13]. Entomopathogenic fungi (EPF), which are mycoinsecticides, are becoming vital substitutes because they offer a more effective and sustainable approach [14].

Among these approaches, *Beauveria bassiana*, an entomopathogenic fungus, is an efficient biological insecticide [15]. The fungus can develop inside the host tissues by avoiding the host's immune system [16]. Eventually, the fungal hyphae will extend out to form spores on the host body [17]. The pathogenicity of entomogenous fungi is dependent on epidermal penetration, appressorium formation, and conidial adherence and germination [18]. *B. bassiana*, which is well-known for having a wide host range, has a vast range of potential for managing *T. tabaci* and other insect pests [19]. It interacts effectively with integrated pest management (IPM) techniques and offers a safe, efficient substitute for current chemical-based treatments [20].

Another study evaluated the effectiveness of chemical insecticides and entomopathogenic fungi (EPF) against *Bemisia tabaci* nymphs on Bt cotton. The results showed that under polyhouse conditions, *Beauveria bassiana* achieved the highest mortality rate, with 85.1% [21]. The present study indicate the effectiveness of the commercial entomopathogenic fungus *Beauveria bassiana* (Ami Beauvero Star) in managing *Thrips tabaci Lindeman* on cotton plants under both field and laboratory conditions, comparing treated plants with untreated controls.

Materials and Methods

Experimental field

The experiment was conducted from 2022 to 2023 at the Ami Experimental Farm in Ahmedabad, Gujarat (22° 54' 57.7" N, 72° 32' 34.3" E).

Experimental crop

A research study on cotton plants was carried out between 2020 and 2023 to evaluate the efficacy of Ami Beauvero Star in controlling thrips infection, which commonly causes damage to these crops. *Beauveria bassiana*, a fungus known for its biocontrol activities against pests like thrips [22], was obtained particularly from the Indian Type Culture Collection (ITCC). This collection is an essential resource for maintaining and extending microbial cultures, ensuring the purity and efficacy of fungal strains utilized in agricultural applications and research.

Seed preparation and inoculation

Cotton seeds were surface-sterilized by soaking them in 0.5% sodium hypochlorite for two minutes, and then in 70% ethanol for another two minutes. The seeds were then washed three times with sterile distilled water. Seeds were immersed in the fungal solution for 60 minutes at 25 °C to inoculate them. The seeds were allowed five minutes to dry on filter paper in Petri plates following inoculation. As a control, seeds were submerged in distilled water that had been autoclaved and mixed with 0.05% Tween 80.

Experimental design, planting conditions, and plants insect resistant assessment

In this study, plant growth and insect resistance were evaluated using a randomized experimental method. Three seeds per pot, both control and inoculated, were sown in soil and under-regulated lab settings, including synthetic illumination (180 μmol $m^{-2}s^{-1}$), 75% moisture, 27°C, and a 12-hour light period. The plants were washed with sterilized water as necessary. After three days, the seeds were moved to the field and irrigated two times per day. The plants were washed with sterilized water as necessary. After three days, the seeds were moved to the field and irrigated twice a day. Growth factors such as the height of plants, root dry weight, shoot dry mass, and total dry weight were determined in the lab, whereas field conditions focused on height, total dry mass, and pod number. The bottom of the plant to the top of its upper portion was used to measure its height. Harvested plants were washed and allowed to air dry in an oven using forced air for 72 hours at 50°C. The lab study included 12 plants (6 control, 6 treatment), and the field study had 20 plants (10 control, 10 treatment).

Pest resistance was examined for 18 weeks, from the early stages of vegetative growth to the reproduction phase, the ability to resist insect attack in field conditions was observed three times in week. The early morning and late day intervals of the day both saw observations. Insect samples were obtained for identification using taxonomic keys, and records of pest prevalence and damage were produced. Hard-to-catch species were obtained using entomological glue traps, Thrips and Beetles were caught using a manual vacuum. To identify the pests, data from previous works was compared with observed damage.

Statistical analysis

The analysis of variance was applied to the biometric data, which included the plant height, the root dry weight, the shoot dry weight, and the total dry weight of the plants. ($p < 0.05$).

Result and Discussion

Effectiveness of Ami Beauvero Star on the cotton plant in field conditions

Dry mass of root (g)

Under field conditions, applying Ami Beauvero Star at a rate of 40g per 15 liters of water resulted in a considerable increase in the dry mass of cotton plant roots compared to the control. The treated plants exhibited a notably higher mean root dry mass (38 ± 10) than the control plants (20 ± 3 grams), as shown in Figure 1. Similar study indicates that the root dry weight of bean plants treated with *Beauveria bassiana* is 0.54 grams [23]. The entomopathogenic endophytic fungus, specifically *Beauveria bassiana*, when injected into chive plant roots in a greenhouse resulted in an average dry weight of 0.48 grams, with a standard variation of 0.09 grams [24].

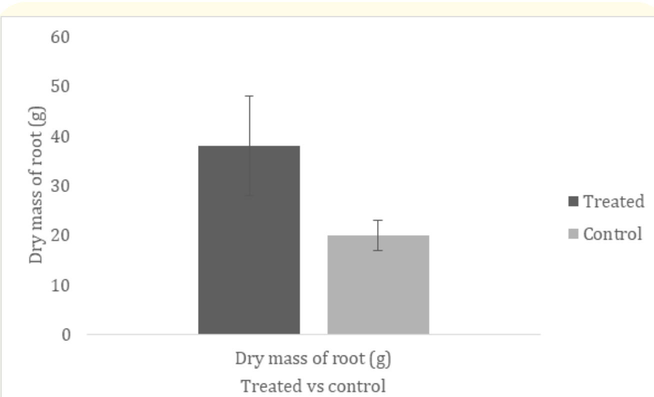

Figure 1: Efficacy of Ami Beauvero Star on dry root mass of cotton plants.

Dry mass of shoot (g)

The cotton plant shoots' dry mass was considerably enhanced by Ami Beauvero Star; treated plants indicated an average of 137 ± 12 grams, whereas control plants showed a mean of 61 ± 9 grams demonstrated in Figure 2. A beneficial effect on shoot development is shown by this notable difference. When *Beauveria bassiana* was applied to tissue-cultured bananas damaged by banana weevils, the dry shoot weight of the bananas was 36.4 grams (± 3.3 grams) [25]. Other studies, displayed that cowpea plants treated with *Beauveria bassiana* (1×10^8) had a shoot dry weight of 11.6 grams in comparison to 7.0 grams in the control group [26].

Figure 2: Efficacy of Ami Beauvero Star on dry shoot mass (cotton plant).

Dry weight of stalk (g)

The dry weight of cotton stalks was 43.11 grams in treated plants against 11.3 grams in control plants, as illustrated in Figure 3. This considerable difference indicates that Ami Beauvero Star promotes stalk growth in cotton plants. In previous research, using *Beauveria bassiana* significantly affected the growth characteristics of bell peppers. The treated group exhibited a stem dry weight of 10.49 ± 0.80 grams, while the control group had 6.62 ± 1.05 grams [27].

Total dry mass of whole plant (g)

Ami Beauvero Star *significantly* increased the total dry weight of cotton plants. The treated plants had a substantially larger average dry mass (168 ± 23 grams) than the control plants (72 ± 11 grams) depicted in Figure 4. Another research demonstrated that endophyte-free sorghum plants (controls) had a total biomass of 117 ± 13.8 grams after harvest. Sorghum plants infected with *Beauveria bassiana* had a higher total biomass (123.6 ± 14.3 g) [28].

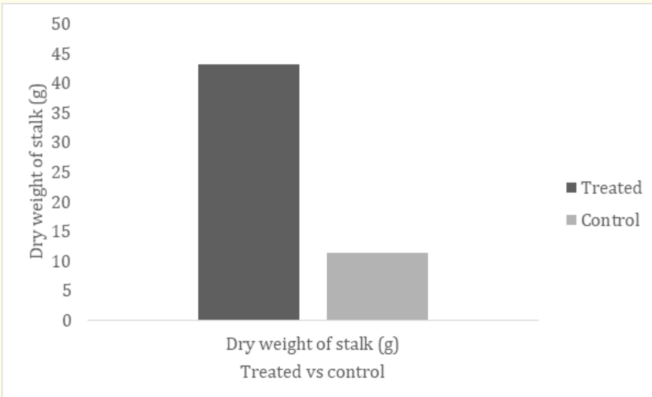

Figure 3: Efficacy of Ami Beauvero Star on dry weight of stalk (cotton plant).

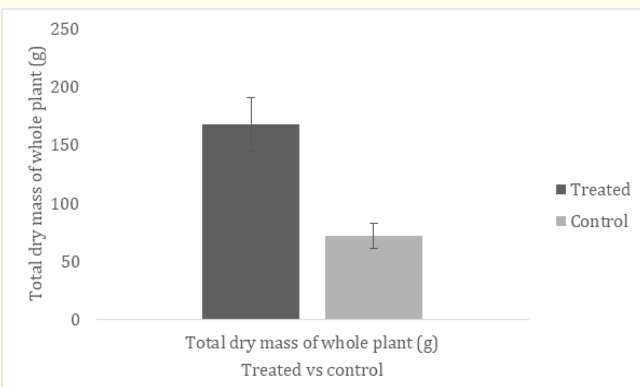

Figure 4: Efficacy of Ami Beauvero Star on total dry mass of whole cotton plant.

Effectiveness of Ami Beauvero Star on the cotton plant under lab conditions

Dry mass of root (g)

In laboratory conditions, applying Ami Beauvero Star at a rate of 40g per 15 liters of water resulted in a considerable increase in the dry mass of cotton plant roots. Treated plants exhibited a greater mean root dry mass (24.09 ± 1.1 grams) than control plants (17.01 ± 2.43 grams) presented in Figure 5. In similar research when compared to the control, the root dry weight of common beans increased considerably with the application of *Beauveria bassiana*. The plants that were treated demonstrated a root dry mass of 10.72 ± 1.609 grams [29]. The addition of *Beauveria bassiana* (1×10^8 conidia mL^{-1}) had a positive effect on *Lactuca sativa*'s root dry weight. The root dry weight of the treated plants was 3.32 ± 0.10 grams, whereas the root dry weight of the control group was 3.18 ± 0.12 grams [30].

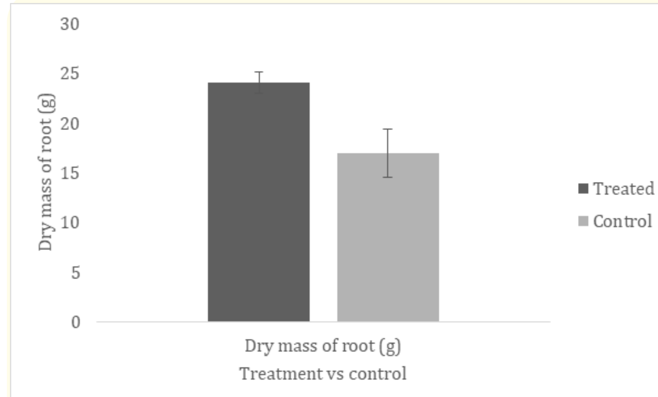

Figure 5: Efficacy of Ami Beauvero Star on dry root mass of cotton plants in laboratory condition.

Dry mass of shoot (g)

Beauveria bassiana greatly increased the dry mass of cotton plant shoots. The treated plants showed a considerably larger mean dry mass (126 ± 9 grams) than the control plants (45 ± 11 grams), as demonstrated in Figure 6. In the comparable research the effect of three *Beauveria bassiana* inoculation treatments on seedling development was determined using dry shoot biomass measurements. The results showed that seed imbibition resulted in a biomass of 45.25 grams; soil drenching generated a biomass of 75.35 grams; and leaf spraying achieved the highest biomass of 152.63 grams [31].

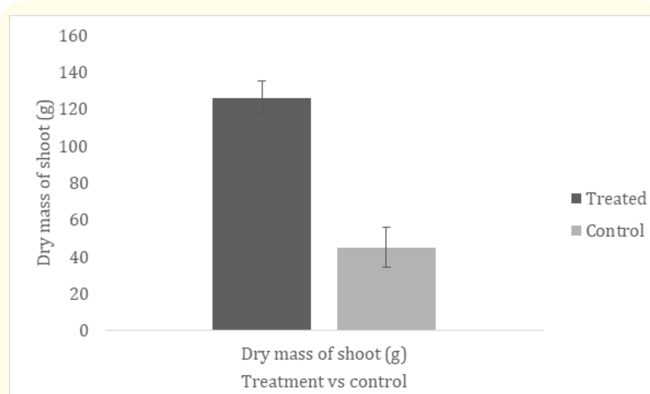

Figure 6: Efficacy of Ami Beauvero Star on dry shoot mass of cotton plant in lab condition.

Dry weight of stalk (g)

The addition of Ami Beauvero Star, at 40 grams per 15 liters of water, effectively increased the dry weight of cotton plant stalks in a controlled laboratory condition. In particular, compared to the 9.02 grams per stalk seen in the control group, the average dry weight of the treated plants was considerably higher at 29.07 grams per stalk, as shown in Figure 7. Additional studies demonstrated that *Beauveria bassiana* endophytic strains considerably increase plant growth. Particularly, the stem dry weight of the grapevines (*Vitis vinifera*) was 19.03 ± 8.72 in the control group and 22.59 ± 12.99 in the treatment group [32].

Figure 7: Efficacy of Ami Beauvero Star on dry weight of stalk in laboratory condition.

Total dry mass of whole plant (g)

The plants treated with Ami Beauvero Star exhibited an average dry mass of 89 ± 14 grams, a much higher amount than the 51 ± 5 grams noted for the control plants exhibited in Figure 8. Other studies documented that the use of *Beauveria bassiana* as a seed covering substantially improved growth properties. The total dry biomass increased from 1.69 ± 1.12 grams in the control group to 5.48 ± 1.84 grams in the treatment group [33].

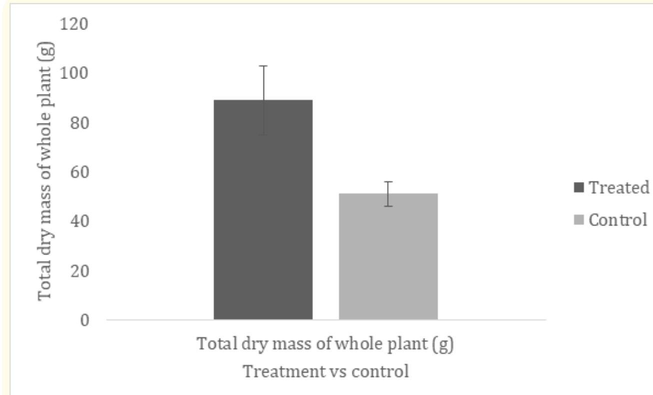

Figure 8: Efficacy of Ami Beauvero Star on total dry mass of whole cotton plant in laboratory condition.

Efficacy of Ami Beauvero Star on Cotton plant

During eighteen weeks, cotton plant thrips damage was considerably decreased by the application of commercial entomopathogenic fungus *Beauveria bassiana* (Table 1). In Week 2, there were no injuries on the treated plants, but the control plants had an average of four injuries. By Week 4, the average number of injuries in the control group had substantially increased to 9, whereas the treated plants had significantly decreased to an average of just 3. By Week 6, this effect persisted, with 4 injuries in the treatment group and 11 in the control plants. By Week 8, the injured plants in the control group had increased to 14, whereas the injured plants in the treatment group had increased less sharply, to 6. By the tenth week, the treated plants had only 11 injuries, compared to 17 in the control group. The significant increase in injuries in week 10 for both control and treated groups could be attributed to environmental factors such as peak pest activity due to favorable weather conditions or the crop's developmental stage, which might have made it more susceptible to pest attacks. In comparison, the treated plants had an average of 4 injuries at Week 12, compared to the control plants' average of 15. In Week 14, the treated plants had an increase in injuries to 5, whereas the control plants exhibited a minimal decrease in injuries to 13. However, the damaged levels in the treated plants were lower than in the controls. The treated plants showed a more notable decrease, with an average of just 3 injuries by Week 16, whereas the control plants had further decreased to 11 injuries by the same week. When control and *Beauveria bassiana*-treated cotton plants are compared at Week 18, it is demonstrated that the treatment has significantly reduced thrips damage. The treated plants showed a much-reduced average of 2 injuries compared to the control plants' average of 7 injuries.

Conclusions

The study evaluated the efficiency of Ami Beauvero Star in treating thrips infections on cotton plants in both field and laboratory conditions and found substantial improvements. The treatment with Ami Beauvero Star resulted in notable increases in plant

No. of weeks	Laboratory condition		Field condition	
	No. of plants with Thrips injuries		No. of plants with Thrips injuries	
	Control	Treated	Control	Treated
2	1 ± 1	0 ± 1	4 ± 2	0 ± 1
4	5 ± 1	4 ± 1	9 ± 1	3 ± 1
6	8 ± 2	5 ± 2	11 ± 2	4 ± 2
8	10 ± 3	4 ± 1	14 ± 3	6 ± 1
10	15 ± 4	8 ± 2	17 ± 4	11 ± 2
12	17 ± 4	11 ± 2	15 ± 4	4 ± 2
14	18 ± 3	12 ± 1	13 ± 3	5 ± 1
16	21 ± 2	16 ± 2	11 ± 2	3 ± 2
18	24 ± 2	5 ± 1	7 ± 2	2 ± 1

Table 1: Effectiveness of Ami Beauvero Star on Cotton plant.

growth parameters, such as increased root and shoot dry mass, stalk dry weight, and total dry mass, indicating improved whole health and growth of the plants. Furthermore, thrips damage was significantly decreased in the treated plants, indicating the biocontrol agent's efficiency in decreasing pest injuries. These results demonstrate the benefits of Ami Beauvero Star for farmers since it provides less pest damage in addition to improved plant health and increased yield potential. By reducing the adverse impacts of chemical residues and resistance, Ami Beauvero Star acts as an environmentally friendly alternative to chemical pesticides, promoting sustainable pest management and offering a more sustainable method of controlling pests while encouraging healthier and more productive cotton crops.

Bibliography

1. Rajpoot Sudhir K., *et al*. "Cotton (Gossypium hirsutum) establishment methods based systemintensification: Effects on Bt cotton growth, weed suppression, system crop and water productivity, system-profitability and landâ€"use efficiency in Indoâ€"Gangetic plains region". *The Indian Journal of Agricultural Sciences* 89.2 (2019): 253-260.

2. Sajjan Srividyarani S and NM Kerur. "To assess the brand preference in hybrid cotton seeds in North Karnataka". *International Journal of Commerce and Business Management* 11.1 (2018): 75-80.

3. Shahrajabian Mohamad Hesam., *et al*. "Considering white gold, cotton, for its fiber, seed oil, traditional and modern health benefits". (2020).

4. Khan Muhammad Azam., *et al*. "World cotton production and consumption: An overview". *Cotton Production and Uses: Agronomy, Crop Protection, and Postharvest Technologies* (2020): 1-7.

5. Beeraladinn I., *et al*. "Dimensions of growth and development of cotton: A global scenario of Bt cotton growing countries". *Compendium of Lead and Invited Papers* (2018): 421.

6. Wang Hua., *et al*. "Physical structure, properties and quality of cotton". *Cotton Science and Processing Technology: Gene, Ginning, Garment and Green Recycling* (2020): 79-97.

7. Naik V., *et al*. "Impact of newer pesticides and botanicals on sucking pest management in cotton under high density planting system (HDPS) in India". *Journal of Entomology and Zoology Studies* 5.6 (2017): 1083-1087.

8. Raut A M., *et al*. "Population dynamics of onion thrips (Thrips tabaci lindeman, Thysanoptera; Thripidae) and varietal response of onion cultivars against onion thrips". *Journal of Entomological Research* 44.4 (2020): 547-554.

9. Singh Subash., *et al*. "Population dynamics of thrips Thrips tabaci Lindeman in Bt cotton". (2021): 589-591.

10. Mannan Hira., *et al*. "Efficacy of Synthetic Pesticides Against Thrips, Thrips tabaci Lindeman (Thysanoptera: Thripidae) on Okra Abelmoschus esculentus (L.) Moench". *Journal of Agricultural Science* 13.9 (2021): 148.

11. Nouroz Faisal., *et al*. "Study of bio pesticide comparison with synthetic pesticides to control onion thrips". *International Journal of Applied Agricultural Sciences* 7.2 (2015).

12. Rani AT., *et al*. "Biopesticides: An alternative to synthetic insecticides". *Microbial Technology for Sustainable Environment* (2021): 439-466.

13. Jaiswal Durgesh Kumar., *et al*. "Biocontrol strategies: an eco-smart tool for integrated pest and diseases management". *BMC Microbiology* 22.1 (2022): 324.

14. Sharma Anjney, *et al*. "Entomopathogenic fungi: a potential source for biological control of insect pests". *Phytobiomes: Current Insights and Future Vistas* (2020): 225-250.

15. Dannon H Fabrice., *et al*. "Toward the efficient use of Beauveria bassiana in integrated cotton insect pest management". *Journal of Cotton Research* 3 (2020): 1-21.

16. Qu Shuang and Sibao Wang. "Interaction of entomopathogenic fungi with the host immune system". *Developmental and Comparative Immunology* 83 (2018): 96-103.

17. Sephton-Clark, Poppy CS, and Kerstin Voelz. "Spore germination of pathogenic filamentous fungi". *Advances in Applied Microbiology* 102 (2018): 117-157.

18. Keyhani Nemat O. "Lipid biology in fungal stress and virulence: Entomopathogenic fungi". *Fungal Biology* 122.6 (2018): 420-429.

19. Khadija Javed., *et al*. "Efficacy of Beauveria bassiana and Verticillium lecanii for the management of whitefly and aphid". (2019): 669-674.

20. Bhattacharyya Pranaba Nanda., *et al*. "Perspectives of Beauveria bassiana, an entomopathogenic fungus for the control of insect-pests in tea [Camellia sinensis (L.) O. Kuntze]: opportunities and challenges". *International Journal of Tropical Insect Science* 43.1 (2023): 1-19.

21. Sain Satish Kumar., *et al*. "Evaluation of bioefficacy potential of entomopathogenic fungi against the whitefly (Bemisia tabaci Genn.) On cotton under polyhouse and field conditions". *Journal of Invertebrate Pathology* 183 (2021): 107618.

22. Mousavi E S., *et al*. "Efficacy of the Entomopathogenic Fungus, Beauveria bassiana against the Western Flower Thrips, Frankliniella occidentalis (Pergande) (Thysanoptera: Thripidae) under Greenhouse Conditions". *Egyptian Journal of Biological Pest Control* 27.1 (2017).

23. Canassa Fernanda., *et al*. "Effects of bean seed treatment by the entomopathogenic fungi Metarhizium robertsii and Beauveria bassiana on plant growth, spider mite populations and behavior of predatory mites". *Biological Control* 132 (2019): 199-208.

24. Espinoza Friederike., *et al*. "Effects of Beauveria bassiana (Hypocreales) on plant growth and secondary metabolites of extracts of hydroponically cultivated chive (Allium schoenoprasum L.[Amaryllidaceae])". *Heliyon* 5.12 (2019).

25. Akello Juliet, *et al*. "Effect of endophytic Beauveria bassiana on populations of the banana weevil, Cosmopolites sordidus, and their damage in tissue-cultured banana plants". *Entomologia experimentalis et Applicata* 129.2 (2008): 157-165.

26. Youssef Mahmoud MA., *et al*. "Evaluation of the fungal activity of Beauveria bassiana, Metarhizium anisopliae and Paecilomyces lilacinus as biocontrol agents against root-knot nematode, Meloidogyne incognita on cowpea". *Bulletin of the National Research Centre* 44 (2020): 1-11.

27. Liu Jian-Feng., *et al*. "Provisioning predatory mites with entomopathogenic fungi or pollen improves biological control of a greenhouse psyllid pest". *Pest Management Science* 75.12 (2019): 3200-3209.

28. Mantzoukas Spiridon., *et al*. "Effects of three endophytic entomopathogens on sweet sorghum and on the larvae of the stalk borer S esamia nonagrioides". *Entomologia Experimentalis et Applicata* 154.1 (2015): 78-87.

29. Alves Gabriel Sousa., *et al*. "Fungal endophytes inoculation improves soil nutrient availability, arbuscular mycorrhizal colonization and common bean growth". *Rhizosphere* 18 (2021): 100330.

30. Macuphe Neo., *et al*. "Evaluating the endophytic activities of Beauveria bassiana on the physiology, growth, and antioxidant activities of extracts of lettuce (Lactuca sativa L.)". *Plants* 10.6 (2021): 1178.

31. Motholo Lisemelo F., *et al*. "Comparison of wheat growth-response to endophytic'Beauveria bassiana' (Hypocreales: Cordycipitaceae) derived from an insect versus plant host". *Australian Journal of Crop Science* 13.11 (2019): 1793-1802.

32. Mantzoukas Spiridon., *et al*. "Beauveria bassiana endophytic strain as plant growth promoter: The case of the grape vine Vitis vinifera". *Journal of Fungi* 7.2 (2021): 142.

33. Mantzoukas Spiridon., *et al*. "Biostimulant and bioinsecticidal effect of coating cotton seeds with endophytic Beauveria bassiana in semi-field conditions". *Microorganisms* 11.8 (2023): 2050.