REFERENCES

Agarwala, B. K. (2007). Phenotypic plasticity in aphids (Homoptera: Insecta): Components of variation and causative factors. *Current Science*, *93*(3).

Ahsan, S. M., Injamum-Ul-Hoque, M., Das, A. K., Rahman, M. M., Mollah, M. M. I., Paul, N. C., & Choi, H. W. (2024). Plant Entomopathogenic fungi interaction: recent progress and prospects on endophytism-mediated growth promotion and biocontrol. *Plants*, *13(10), 14*.

Allegrucci, N., Velazquez, M.-S., Russo, M.-L., Vianna, M.-F., Abarca, C., Scorsetti, A.-C., Allegrucci, N., Velazquez, M.-S., Russo, M.-L., Vianna, M.-F., Abarca, C., & Scorsetti, A.-C. (2020). Establishment of the entomopathogenic fungus *Beauveria bassiana* as an endophyte in Capsicum annuum and its effects on the aphid pest *Myzus persicae* (Homoptera: Aphididae). *Revista de Biología Tropical*, *68*(4), 1084–1094. https://doi.org/10.15517/RBT.V68I4.41218

Altaf, N., Muhammad, I. U., Muhammad, A., Muhammad, A., Sajjad, A., Muhammad, R., Laila A, A.-S., Seham, S. A., & Samy, S. (2023). Endophytic Colonization by *Beauveria bassiana* and *Metarhizium anisopliae* in Maize Plants Affects the Fitness of Spodoptera frugiperda (Lepidoptera : Noctuidae). *Microorganisms*, *11*(4), 1–14.

Anam Zahid, Gao Yike, Anam AbdulRazzaq, Muneeb Munawar, Fozia, Muhammad Ramzan, Bader O. Almutairi, & M. H. A. (2023). Foliar spray of salicylic acid and ascorbic acid ameliorates the biochemical compounds in hybrid chilies. *Journal of King Saud University-Science*, *35(5), 102*.

Archana Srivastava, S. S., and L. T. (2021). Extraction and estimation of chlorophyll from chili seedlings treated with *Trichoderma* isolates. *Bulletin of Environment, Pharmacology and Life Sciences*, *10*, 255–257.

Arévalo, T. C.-, Díaz, J. U. B., Romero, S. D., & Castro, I. Z. (2023). Isolation, Identification, and Morphometric Characterization of Native Isolates of Beauveria spp. from Banana Crops. *Scholars Journal of Agriculture and*

Veterinary Sciences, *10*(06), 43–56. https://doi.org/10.36347/sjavs.2023.v10i06.001

Arkhipov, S. (2016). Method for counting fungal spores. *Prieiga Internetu: Https://Www. Researchgate*.

Ashford, D. A., Smith, W. A., & Douglas, A. E. (2000). Living on a high sugar diet: the fate of sucrose ingested by a phloem-feeding insect, the pea aphid Acyrthosiphon pisum. *Journal of Insect Physiology*, *46*(3), 335–341. https://doi.org/10.1016/S0022-1910(99)00186-9

Atrchian, H., Mahdian, K., & Izadi, H. (2024). Compatibility of the Entomopathogenic Fungus *Metarhizium anisopliae* (Ascomycota: Hypocreales) and the Predatory Coccinellid Menochilus sexmaculatus (Col..: Coccinellidae) for Controlling *Aphis gossypii* (Hem.: Aphididae). *Neotropical Entomology*, *53*(4), 907–916. https://doi.org/10.1007/S13744-024-01163-4/METRICS

Ayele, B. A., Muleta, D., Venegas, J., & Assefa, F. (2020). Morphological, molecular, and pathogenicity characteristics of the native isolates of *Metarhizium anisopliae* against the tomato leafminer, Tuta absoluta (Meyrick 1917)(Lepidoptera: Gelechiidae) in Ethiopia. *Egyptian Journal of Biological Pest Control*, *30*(1), 59.

Baki, D., & Erler, F. (2024). Evaluation of indigenous isolates of *Beuveria bassiana* (Balsamo) Vuillemin (Deuteromycotina: Hyphomycetes) against the cotton aphid *Aphis gossypii* Glover. *Journal of Plant Diseases and Protection*, *0123456789*. https://doi.org/10.1007/s41348-024-00952-8

Bandeira, J. B., Rodrigues, J. N., de Oliveira, R. S., Pinto, I. O., Chagas-Júnior, A. F., Nascimento, V. L., Sarmento, M. I., de Moraes, C. B., & Sarmento, R. A. (2023). Endophytic colonization of five *Trichoderma* species and their effects on the growth of an Eucalyptus hybrid. *SpringerJB Bandeira, JN Rodrigues, RS De Oliveira, IO Pinto, AF Chagas-Júnior, VL NascimentoBrazilian Journal of Microbiology, 2023•Springer*, *54*(4), 3113–3125. https://doi.org/10.1007/S42770-023-01112-0

Barboza, G. E., García, C. C., González, S. L., Scaldaferro, M., & Reyes, X. (2019). Four new species of Capsicum (Solanaceae) from the tropical Andes and an update on the phylogeny of the genus. *PLOS ONE*, *14*(1), e0209792. https://doi.org/10.1371/JOURNAL.PONE.0209792

Barelli, L., Waller, A. S., Behie, S. W., & Bidochka, M. J. (2020). Plant microbiome analysis after *Metarhizium amendment* reveals increases in abundance of plant growth-promoting organisms and maintenance of disease-suppressive soil. *PLoS ONE*, *15*(4), 1–23. https://doi.org/10.1371/journal.pone.0231150

Barra, P. S., Rosso, L., Nesci, A. V., & Etcheverry, M. G. (2013). Isolation and Identification of possible entomopathogenic fungi and their evaluation of their effectiveness against Tribolium confusum, Sitophilus zea mais, and Rhyzoperta dominica, vectors of aflatoxigenic fungi in stored maize. *Pest. Sci*, *86(2):217–.*

Bayındır Erol, A., Abdelaziz, O., Birgücü, A. K., Senoussi, M. M., Oufroukh, A., & Karaca, İ. (2020a). Effects of some entomopathogenic fungi on the aphid species, *Aphis gossypii* Glover (Hemiptera: Aphididae). *Egyptian Journal of Biological Pest Control*, *30*(1). https://doi.org/10.1186/s41938-020-00311-3

Bayındır Erol, A., Abdelaziz, O., Birgücü, A. K., Senoussi, M. M., Oufroukh, A., & Karaca, İ. (2020b). Effects of some entomopathogenic fungi on the aphid species, *Aphis gossypii* Glover (Hemiptera: Aphididae). *Egyptian Journal of Biological Pest Control*, *30*(1). https://doi.org/10.1186/s41938-020-00311-3

Beris, E., Venios, X., Papachristos, D., Ponchon, M., Kontodimas, D., Korkas, E., Banilas, G., & Reineke, A. (2025). Grapevine Responses to the Entomopathogenic Fungi *Beauveria bassiana* and Isaria fumosorosea and the Effects of Salicylic Acid on Their Virulence Against the European Grapevine Moth, Lobesia botrana. *Microorganisms*, *13*(7), 1630. https://doi.org/10.3390/MICROORGANISMS13071630

Binti Japar, M. (2016). Effects of Inorganic Fertilizer Levels on Growth and Yield of Chili (Capsicum Annuum L.). *Doctoral Dissertation, Universiti Malaysia Sabah*.

Biryol, S. (2024). A mycoinsecticide from *Metarhizium anisopliae* (Ascomycota : Hypocreales) based on a solid-state fermentation method against some aphid species in Türkiye. 1–18.

Capinera, J. L. (2007). Melon aphid or cotton aphid - *Aphis gossypii* Glover. *Uf-Ifas Eeny-173*, *June*, 1–5.

Chen, Y., Verheggen, F. J., Sun, D., Wang, Z., Francis, F., & He, K. L. (2019). Differential wing polyphenism adaptation across life stages under extremely high temperatures in the corn leaf aphid. *Scientific Reports 2019 9:1*, *9*(1), 1–8. https://doi.org/10.1038/s41598-019-45045-x

Cocuzza, G. (2024). *Aphis gossypii* (cotton aphid) Summary Datasheet Type(s) KNOWLEDGE FOR LIFE Summary of Invasiveness.

Cokola, M. C., Ben Fekih, I., Bisimwa, E. B., Capparos Megido, R., Delvigne, F., & Francis, F. (2023). Natural occurrence of *Beauveria bassiana* (Ascomycota: Hypocreales) infecting Spodoptera frugiperda (J. E. Smith) (Lepidoptera: Noctuidae) and earwig in eastern DR Congo. *Egyptian Journal of Biological Pest Control*, *33*(1). https://doi.org/10.1186/s41938-023-00702-2

Cotes, B., Thöming, G., Amaya-Gómez, C. V., Novák, O., & Nansen, C. (2020). Root-associated entomopathogenic fungi manipulate host plants to attract herbivorous insects. *Scientific Reports*, *10*(1), 1–11. https://doi.org/10.1038/S41598-020-80123-5;SUBJMETA

Crawford, K. M., Land, J. M., & Rudgers, J. A. (2010). Fungal endophytes of native grasses decrease insect herbivore preference and performance. *Oecologia*, *164*(2), 431–444. https://doi.org/10.1007/S00442-010-1685-2/METRICS

Cua Basulto, M., Ruiz Sánchez, E., Ballina Gómez, H., Reyes Ramírez, A., Hernández Núñez, E., Valencia Yah, T., Martín Mex, R., & Chan Cupul, W. (2022). Physiological and molecular characterization of *Metarhizium* isolates and their acaricidal activity against Tetranychus urticae Koch (Trombidiformes: Tetranychidae). *Egyptian Journal of Biological Pest Control*, *32*(1). https://doi.org/10.1186/s41938-022-00530-w

Daryanto, A., Syukur, M., Maharijaya, A., & Hidayat, P. (2018). Diallel Analysis of Chili Pepper Resistance to Melon Aphid (*Aphis gossypii* Glover) Infestation in the Seedling Phase. *Agrotech Journal*, *3*(2), 61–68. https://doi.org/10.31327/atj.v3i2.868

de los Santos-Villalobos, S., Hernández-Rodríguez, L. E., Villaseñor-Ortega, F., & Peña-Cabriales, J. J. (2012). Production of Trichoderma asperellum T8a spores by a "home-made" solid-state fermentation of mango industrial wastes. *BioResources*, *7*(4), 4938–4951. https://doi.org/10.15376/biores.7.4.4938-4951

Dixon, A. F. G. (1977). Aphid ecology: life cycles, polymorphism, and population regulation. *Annual Review of Ecology and Systematics*. 329-353. https://www.jstor.org/stable/2096732

Ebert, T. A., & Cartwright, B. (1997). Biology and ecology of *Aphis gossypii* Glover (Homoptera: Aphididae). *Southwest. Entomol*, *22(1)*, *116*.

Ek-Ramos, M. J., Tamez-Guerra, P., & Zavala-Garcia, F. (2021). Entomopathogenic Fungi Tested in Planta on Pepper and in Field on Sorghum, to Control Commercially Important Species of Aphids. https://doi.org/10.21203/rs.3.rs-745448/v1

Emaru, A., Nyaanga, J. G., & Saidi, M. (2024). Integrating *Metarhizium anisopliae* entomopathogenic fungi with border cropping reduces black bean aphid (Aphis fabae) damage and enhances the yield and quality of French bean. *Heliyon*, *10*, 13.

Esparza-Reynoso, S., Pelagio-Flores, R., & López-Bucio, J. (2023). Role of Volatile Organic Compounds in Establishment of the *Trichoderma*–Plant Interaction. *In Plant Relationships: Fungal-Plant Interactions* (pp. 239-252). Cham: Springer International Publishing.

Fancelli, M., Dias, A. B., Delalibera Júnior, I., Jesus, S. C. De, Nascimento, A. S. Do, Silva, S. D. O. E., Caldas, R. C., & Ledo, C. A. D. S. (2013). *Beauveria bassiana* Strains for Biological Control of Cosmopolites sordidus (Germ..) (Coleoptera: Curculionidae) in Plantain. *BioMed Research International*, *2013*(1), 184756. https://doi.org/10.1155/2013/184756

Geedi, R., Canas, L., Reding, M. E., & Ranger, C. M. (2023). Attraction of *Myzus persicae* (Hemiptera: Aphididae) to volatiles emitted from the entomopathogenic fungus *Beauveria bassiana*. *Environmental Entomology*, *52(1)*, 31–38.

Gençer, D., & Bayramoğlu, Z. (2022). Characterization and pathogenicity of *Beauveria bassiana* strains isolated from Galleria mellonella L. (Lepidoptera: Pyralidae) in Turkey. *Egyptian Journal of Biological Pest Control*, *32*(1). https://doi.org/10.1186/s41938-022-00599-3

Geremew, D., Shiberu, T., & Leta, A. (2024). Isolation, morphological characterization, and screening for virulence of *Beauveria bassiana* and *Metarhizium robertsii* fungal isolates on Galleria mellonella. *F1000Research*, *12*, *827*. https://doi.org/doi: 10.12688/f1000research.134020.5

Geremew, D., Shiberu, T., & Leta, A. (2023). Isolation, morphological characterization, and screening for the virulence of *Beauveria bassiana* and *Metarhizium robertsii* as bioagents. *F1000Research, 12,* 827. https://doi.org/10.12688/f1000research.134020.1

Gielen, R., Ude, K., Kaasik, A., Põldmaa, K., Teder, T., & Tammaru, T. (2024). Entomopathogenic fungi as mortality agents in insect populations: A review. *Ecology and Evolution*, *14*(12), e70666.

González-Mas, N., Gutiérrez-Sánchez, F., Sánchez-Ortiz, A., Grandi, L., Turlings, T. C. J., Manuel Muñoz-Redondo, J., Moreno-Rojas, J. M., & Quesada-Moraga, E. (2021). Endophytic Colonization by the Entomopathogenic Fungus *Beauveria Bassiana* Affects Plant Volatile Emissions in the Presence or Absence of Chewing and Sap-Sucking Insects. *Frontiers in Plant Science*, *12*(July), 1–13. https://doi.org/10.3389/fpls.2021.660460

Guerrieri, E., & Digilio, M. C. (2008). Aphid-plant interactions: a review. *Journal of Plant Interactions*, *3(4)*(3(4), 223–232).

Guo, R., Wang, Z., Zhou, C., Liu, Z., Zhang, P., & Fan, H. (2020). Transcriptomic analysis reveals biocontrol mechanisms of *Trichoderma harzianum* ACCC30371 under eight culture conditions. *Journal of Forestry Research*, *31*(5), 1863–1873. https://doi.org/10.1007/s11676-019-00912-1

Harman, G. E. (2024). Integrated Benefits to Agriculture with *Trichoderma* and Other Endophytic or Root-Associated Microbes. *Microorganisms*, *12*(7). https://doi.org/10.3390/microorganisms12071409

Hatano, E., Kunert, G., & Weisser, W. W. (2010). Aphid Wing Induction and Ecological Costs of Alarm Pheromone Emission under Field Conditions. *PLOS ONE*, *5*(6), e11188. https://doi.org/10.1371/JOURNAL.PONE.0011188

Herlinda, S., Darma Utama, M., Pujiastuti, Y., & Suwandi, S. (2006). Kerapatan Dan Viabilitas Spora *Beauveria Bassiana* (Bals.) Akibat Subkultur Dan Pengayaan Media, Serta Virulensinya Terhadap Larva Plutella Xylostella (Linn.). *Jurnal Hama Dan Penyakit Tumbuhan Tropika*, *6*(2), 70–78. https://doi.org/10.23960/j.hptt.2670-78

HERLINDA, S., IRSAN, C., MAYASARI, R., & SEPTARIANI, S. (2010). Identification and Selection of Entomopathogenic Fungi as Biocontrol Agents for Aphis gossypii from South Sumatra. *Microbiology Indonesia*, *4*(3), 137–142. https://doi.org/10.5454/mi.4.3.7

Himawan, T., Rahayu, T., & Widjayanti, T. (2021). Leaf and Flower Extracts of Tithonia diversifolia Against *Aphis gosypii* in Red Chili Plant. *Journal of Tropical Plant Protection*, *2*(1), 26–32. https://doi.org/10.21776/ub.jtpp.2021.002.1.5

Hiscox, J. D., & Israelstam, G. F. (1979). A method for the extraction of chlorophyll from leaf tissue without maceration. *Canadian Journal of Botany*, *57(12)*, 1332–1334.

Homepage, J., Kareem, A. A., Raghad, H., & Daham, S. (2022). Tikrit Journal for Agricultural Sciences Muhammad Shaker Mansour Field evaluation of some entomopathogenic fungi and the pesticide Dominant and its combinations on Myzus persicae and their effect on growth and yield of cold pepper. *Tikrit Journal for Agricultural Sciences*, *22*(3), 120–129. https://doi.org/10.25130/tjas.22.3.14

Humber, R. A. (2012). Identification of entomopathogenic fungi. *Manual of Techniques in Invertebrate Pathology, 2, 151–187*.

Ibrahim, E., Firmansyah, F., & Panikkai, S. (2021). The effectiveness of the entomopathogenic fungus *Metarhizium anisopliae* in controlling the green leaf hopper (Nephotettix virescens). *IOP Conference Series: Earth and Environmental Science*, *911*(1). https://doi.org/10.1088/1755-1315/911/1/012061

Jandricic, S. E., Filotas, M., Sanderson, J. P., & Wraight, S. P. (2014). Pathogenicity of conidia-based preparations of entomopathogenic fungi against the greenhouse pest aphids *Myzus persicae*, *Aphis gossypii*, and Aulacorthum solani (Hemiptera: Aphididae). *Journal of Invertebrate Pathology*, *118*(April 2018), 34–46. https://doi.org/10.1016/j.jip.2014.02.003

Jin, L., Jin, N., Wang, S., Meng, X., Xie, Y., Li, Z., Zhang, G., Yin, X., Lyu, J., Zhong, Y., & Yu, J. (2023). Comparing the morphological characteristics and nutritional composition of 23 pepper (Capsicum annuum L.) varieties. *European Food Research and Technology*, *249*(4), 963–974. https://doi.org/10.1007/S00217-022-04187-5/METRICS

Kataria, R., & Kumar, D. (2015). Population dynamics, biology of cotton aphid, *Aphis gossypii* (Glover), and its associated natural enemies in Vadodara, Gujarat. *6*(3), 411–420.

Keppanan, R., Sivaperumal, S., Ramos Aguila, L. C., Hussain, M., Bamisile, B. S., Dash, C. K., & Wang, L. (2018). Isolation and characterization of *Metarhizium anisopliae* TK29 and its mycoinsecticide effects against the subterranean termite Coptotermes formosanus. *Microbial Pathogenesis*, *123*(June), 52–59. https://doi.org/10.1016/j.micpath.2018.06.040

Kislow, C. J., & Edwards, L. J. (1972). Repellent odor in aphids [8]. *Nature*, *235*(5333), 108. https://doi.org/10.1038/235108A0

Kotta-Loizou, I., & Coutts, R. H. A. (2017). Studies on the Virome of the Entomopathogenic Fungus *Beauveria bassiana* Reveal Novel dsRNA Elements and Mild Hypervirulence. *PLoS Pathogens*, *13*(1).

https://doi.org/10.1371/journal.ppat.1006183

Kunert, G., Otto, S., Röse, U. S. R., Gershenzon, J., & Weisser, W. W. (2005). Alarm pheromone mediates production of winged dispersal morphs in aphids. *Ecology Letters*, *8*(6), 596–603. https://doi.org/10.1111/J.1461-0248.2005.00754.X

Kunert, G., & Weisser, W. W. (2005). The importance of antennae for pea aphid wing induction in the presence of natural enemies. *Bulletin of Entomological Research*, *95*(2), 125–131. https://doi.org/10.1079/BER2004342

Lambers, D. H. R. (1966). Polymorphism in Aphididae. *Annual Review of Entomology*, *11*(Volume 11, 1966), 47–78. https://doi.org/10.1146/ANNUREV.EN.11.010166.000403

Li, Q., Xie, Q. G., Smith-Becker, J., Navarre, D. A., & Kaloshian, I. (2006). Mi-1-mediated aphid resistance involves salicylic acid and mitogen-activated protein kinase signaling cascades. *Molecular Plant-Microbe Interactions*, *19*(6), 655–664.

Li, Z. Y., Ma, N., Sun, P., Zhang, F. J., Li, L., Li, H., ... & Zhang, Z. (2024). Fungal invasion-induced accumulation of salicylic acid promotes anthocyanin biosynthesis through MdNPR1-MdTGA2. 2 module in apple fruits. *The Plant Journal*, *119(4), 18.*

Li, X., Zhang, W., Niu, D., Science, X. L.-P. (2024). Effects of abiotic stress on chlorophyll metabolism. *Plant Science*, *342*, 112030.

Liu, Y., Yang, Y., & Wang, B. (2022). Entomopathogenic fungi *Beauveria bassiana* and *Metarhizium anisopliae* play a role in maize (Zea mays) growth promotion. *Scientific Reports*, *12*(1), 1–10. https://doi.org/10.1038/s41598-022-19899-7

Ma, Y., Li, Y., Yang, S., Li, Y., & Zhu, Z. (2023). Biocontrol potential of *Trichoderma asperellum* strain 576 against Exserohilum turcicum in Zea mays. *Ournal of Fungi*, *9(9), 936.*

Magdalena saragih. (2024). Aplikasi cendawan *beauveria bassiana* (balsamo) vuillemin untuk menginduksi ketahanan tanaman cabal (capsicum annuum l.)

terhadap kutu kebul (bemisia tabaci genn.) dan kutu daun (*Myzus persicae suiz*, dan *Aphis gossypii* glov.) [Andalas University]. http://scholar.unand.ac.id/id/eprint/478181

Mansour, M. S., Hassan, A. A. K., & Daham, R. S. (2022). Field evaluation of some entomopathogenic fungi and the pesticide Dominant and its combinations on Myzus persicae and their effect on the growth and yield of cold pepper. *Tikrit Journal for Agricultural Sciences*, *22*(3), 120–129.

Mao, L., Song, Q., Li, X., Zheng, H., & Zhu, X. G. (2024). Would reducing chlorophyll content result in a higher photosynthesis nitrogen use efficiency in crops? *Food and Energy Security*, *13*(4), e576.

Marannino, P., Santiago-Álvarez, C., de Lillo, E., & Quesada-Moraga, E. (2006). A new bioassay method reveals pathogenicity of *Metarhizium anisopliae* and *Beauveria bassiana* against early stages of Capnodis tenebrionis (Coleoptera; Buprestidae). *Journal of Invertebrate Pathology*, *93*(3), 210–213. https://doi.org/10.1016/j.jip.2006.08.002

Mariappan, K., Samuel, J. N., Uthandi, S., Sevugapperumal, N., Subbarayalu, M., & Krishnamoorthi, P. (2025). Harnessing the potential of indigenous entomopathogenic fungi isolated from the soils of Tamil Nadu, India, for the management of the cotton aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae). *Journal of Cotton Research*, *8*(1), 34.

Mariyono, J. (2017). Agro-Ecological and Socio-Economic Aspects of Crop Protection in Chili-Based Agribusiness in Central Java. *Agriekonomika*, *6*(2), 120. https://doi.org/10.21107/agriekonomika.v6i2.2294

Mariyono, J. (2018). Empowering rural livelihoods through farmers' field school on vegetable production in Aceh province-Indonesia. *Journal of Rural Development*, *37*(1), 129–145. https://doi.org/10.25175/jrd/2018/v37/i1/122696.

Markus Rawung, J.B., Atman, Sahara, D., Indrasti, R., Idaryani, Mustaha, M. A., Fadwiwati, A. Y., & Yapanto, L. M. (2021). Increasing Fruit Yields And Income Of Red Chili Farming By Using Chemical And Biological Fertilizers

In Rainfed Rice Fields. *Academy of Strategic Management Journal*, *20*(Special Issue 2), 1–10.

Mittler, T. E. (1973). Aphid polymorphism as affected by diet. https://www.cabidigitallibrary.org/doi/full/10.5555/19730510920

Mittler, T. E., & Sutherland, O. R. W. (1969). Dietary influences on aphid polymorphism. *Entomologia Experimentalis et Applicata*, *12*(5), 703–713. https://doi.org/10.1111/J.1570-7458.1969.TB02563.X

Mňahončáková, E., Valný, P., & Horčinová Sedláčková, V. (2020). Morphological Features of Fruits of Various Species of Chili Peppers. *Agrobiodiversity for Improving Nutrition, Health and Life Quality*, 159–175. https://doi.org/10.15414/agrobiodiversity.2020.2585-8246.159-175

Mongkolsamrit, S., Khonsanit, A., Thanakitpipattana, D., Tasanathai, K., Noisripoom, W., Lamlertthon, S., Himaman, W., Houbraken, J., Samson, R. A., & Luangsa-ard, J. (2020). Revisiting *Metarhizium* and the description of new species from Thailand. *Studies in Mycology*, *95*(May), 171–251. https://doi.org/10.1016/j.simyco.2020.04.001

Mukherjee, A., & Ghosh, S. K. (2023). An eco-friendly approach to biocontrol of aphid (*Aphis gossypii* Glover) by *Trichoderma harzianum*. *Environmental Monitoring and Assessment*, *195*(1), 1–15. https://doi.org/10.1007/S10661-022-10726-0/METRICS

Muljowati, J.S., Oedjijono, O., Dewi, R.S., Mariana, A., & Chemeltorit, P. (2025). Exploration and morphological characterization of *Trichoderma* spp from organic waste at TPST Rempoah-Baturraden, Banyumas Regency. *In E3S Web of Conferences*, *Vol. 609*.

Müller, C. B., Williams, I. S., & Hardie, J. (2001). The role of nutrition, crowding, and interspecific interactions in the development of winged aphids. *Ecological Entomology*, *26*(3), 330–340. https://doi.org/10.1046/J.1365-2311.2001.00321.X

Mweke, A., Ulrichs, C., Nana, P., Akutse, K. S., Fiaboe, K. K. M., Maniania, N. K., & Ekesi, S. (2018). Evaluation of the Entomopathogenic Fungi

Metarhizium anisopliae, *Beauveria bassiana*, and Isaria sp. for the Management of *Aphis craccivora* (Hemiptera: Aphididdae). *Journal of Economic Entomology*, *111*(4), 1587–1594. https://doi.org/10.1093/JEE/TOY135

Navarro-Barranco, H., Brunner-Mendoza, C., Del Rocío Reyes-Montes, M., Duarte-Escalante, E., & Toriello, C. (2019). Phenotypic and molecular analysis of Mexican *Metarhizium* anisopliae strains. *Revista Mexicana de Biodiversidad*, *90*. https://doi.org/10.22201/ib.20078706e.2019.90.2643

Nawaz, A., Razzaq, F., Razzaq, A., Gogi, M. D., Fernández-Grandon, G. M., Tayib, M., Ayub, M. A., Sufyan, M., Shahid, M. R., Qayyum, M. A., Naveed, M., Ijaz, A., & Arif, M. J. (2022). Compatibility and synergistic interactions of fungi, *Metarhizium anisopliae*, and insecticide combinations against the cotton aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae). *Scientific Reports*, *12*(1), 1–10. https://doi.org/10.1038/s41598-022-08841-6

Nurhayati, W., & Haryadi, N. T. (2022). Synergism of Lecanicillium lecanii (Zimm) and Chromolaena odorata L. Leaf Extract to Control *Aphis gossypii* (Glover) in Chili Plants. *Life Sci*, *12*(1).

Omkar. (2020). Sucking Pests of Crops. In *Sucking Pests of Crops*. Springer Singapore. https://doi.org/10.1007/978-981-15-6149-8

Omkar. (2021). Polyphagous Pests of Crops. In *Polyphagous Pests of Crops*. Springer Singapore. https://doi.org/10.1007/978-981-15-8075-8

Ortiz-Urquiza, A., & Keyhani, N. O. (2013). Action on the Surface: Entomopathogenic Fungi versus the Insect Cuticle. *Insects 2013, Vol. 4, Pages 357-374*, *4*(3), 357–374. https://doi.org/10.3390/INSECTS4030357

Pacheco-Trejo, J., Aquino-Torres, E., Reyes-Santamaría, M. I., Islas-Pelcastre, M., Pérez-Ríos, S. R., Madariaga-Navarrete, A., & Saucedo-García, M. (2022). Plant defensive responses triggered by *Trichoderma* spp. *As Tools to Face Stressful Conditions. Horticulturae, 8(12), 118.*

Peñuela, M., Arias, L. L., Viáfara-Vega, R., Rivera Franco, N., & Cárdenas, H. (2021). Morphological and molecular description of three commercial

Capsicum varieties: a look at the correlation of traits and genetic distancing. *Genetic Resources and Crop Evolution*, *68*(1), 261–277. https://doi.org/10.1007/s10722-020-00983-8

Pickett, J. A., & Griffiths, D. C. (1980). Composition of aphid alarm pheromones. *Journal of Chemical Ecology*, *6*(2), 349–360. https://doi.org/10.1007/BF01402913/METRICS

Popovich, D. G., Sia, S. Y., Zhang, W., & Lim, M. L. (2014). The color and size of chili peppers (Capsicum annuum) influence Hep-G2 cell growth. *International Journal of Food Sciences and Nutrition*, *65*(7), 881–885. https://doi.org/10.3109/09637486.2014.931358

Poveda, J. (2021). *Trichoderma* as a biocontrol agent against pests: New uses for a mycoparasite. *Biological Control*, *159*, *10463*. 10.1016/j.biocontrol.2021.104634

Quesada-Moraga, E., Garrido-Jurado, I., González-Mas, N., & Yousef-Yousef, M. (2023). Ecosystem services of entomopathogenic ascomycetes. *Journal of Invertebrate Pathology*, *201*, 108015. https://doi.org/10.1016/J.JIP.2023.108015

Quesada-Moraga, E., Garrido-Jurado, I., Yousef-Yousef, M., & González-Mas, N. (2022). Multitrophic interactions of entomopathogenic fungi in BioControl. *BioControl*, *67*(5), 457–472. https://doi.org/10.1007/s10526-022-10163-5

Ramos, Y., Taibo, A. D., Jiménez, J. A., & Portal, O. (2020). Endophytic establishment of *Beauveria bassiana* and *Metarhizium anisopliae* in maize plants and its effect against Spodoptera frugiperda (J. E. Smith) (Lepidoptera: Noctuidae) larvae. *Egyptian Journal of Biological Pest Control*, *30*(1). https://doi.org/10.1186/s41938-020-00223-2

Rasool, S., Vidkjær, N. H., Hooshmand, K., Jensen, B., Fomsgaard, I. S., & Meyling, N. V. (2021). Seed inoculations with entomopathogenic fungi affect aphid populations, coinciding with the modulation of plant secondary metabolite profiles across plant families. *The New Phytologist*, *229*(3), 1715-1727.

Ratih Damayanti, R., Himawan, T., & Pantja Astuti Jurusan Hama dan Penyakit Tumbuhan, L. (2013). Penghambatan reproduksi rhyzopertha dominica f. (coleoptera: bostrichidae) menggunakan fumigan tablet berbasis minyak mimba. *Jurnal HPT (Hama Penyakit Tumbuhan)*, *1*(3), 18–26. https://jurnalhpt.ub.ac.id/index.php/jhpt/article/view/30

Raturi, H. C., Uppal, G. S., Harish, C., Raturi, C., Uppal, S., Singh, S. K., & Kachwaya, D. S. (2019). Effect of organic and inorganic nutrient sources on growth, yield, and quality of bell pepper (Capsicum annuum L.) grown under polyhouse conditions. *~ 1788 ~ Journal of Pharmacognosy and Phytochemistry*, *8*(1), 1788–1792.

Ríos Martínez, A. F., & Costamagna, A. C. (2018). Effects of crowding and host plant quality on morph determination in the soybean aphid, *Aphis glycines*. *Entomologia Experimentalis et Applicata*, *166*(1), 53–62. https://doi.org/10.1111/EEA.12637

Rodríguez-Barajas, N., … E. M.-G.-F. S. and, & 2023, undefined. (n.d.). Chili and Pepper Byproducts. *Sii.Ecosur.Mx, E Montalvo-González, Z Villagrán, S González-Torres, A Villaruel-López, LMA EsparzaFood Science and Technology, 2023•sii.Ecosur.Mx*. Retrieved January 8, 2025, from https://sii.ecosur.mx/Content/ProductosActividades/archivos/53277/textocompleto-12-07-2023-16-17.pdf#page=87

Rodríguez, Velastequí, M. (2019). *No 主観的健康感を中心とした在宅高齢者における 健康関連指標に関する共分散構造分析Title*. 1–23.

Saif, Iqra, Muhammad Sufyan, Irfan Baboo, Muhammad Jabbar, Ahsan Shafiq, Rida Nosheen Saif, Umer Liaqat, and M. L. (2024). Efficacy of *Beauveria bassiana* and *Metarhizium anisopliae* against wheat aphid. *Eurobiotech*, *J 8*, no. *1*.

Sam-On, M. F. S., Mustafa, S., Yusof, M. T., Hashim, A. M., & Aizuddin, K. N. A. K. (2024). Exploring the global trends of Bacillus, *Trichoderma*, and entomopathogenic fungi for pathogen and pest control in chili cultivation. *Saudi Journal of Biological Sciences*, *31*(8), 104046.

Samuels, G. J., Lieckfeldt, E. L. K. E., & Nirenberg, H. I. (1999). *Trichoderma asperellum*, a new species with warted conidia, and redescription of *T. viride*. *Vol. 51, N*.

Satar, S., Kersting, U., & Uygun, N. (2005). Effect of temperature on development and fecundity of *Aphis gossypii* Glover (Homoptera: Aphididae) on cucumber. *Journal of Pest Science*, *78*(3), 133–137. https://doi.org/10.1007/S10340-005-0082-9/METRICS

Schirmer, S. S. C. & B. P. (2008). Influence of abiotic factors on some biological and ecological characteristics of the aphid parasitoid *Aphelinus asychis* (Hymenoptera: Aphelinidae) parasitizing Aphis gossypii (Sternorrhyncha: Aphididae). *European Journal of Entomology*. https://www.eje.cz/pdfs/eje/2008/01/17.pdf

Schoonmaker, A. N., Hulse-Kemp, A. M., Youngblood, R. C., Rahmat, Z., Atif Iqbal, M., Rahman, M. U., ... & Scheffler, J. A. (2023). Detecting Cotton leaf curl virus resistance quantitative trait loci in Gossypium hirsutum and iCottonQTL, a new R/Shiny app to streamline genetic mapping. *Plants*, *12*(5), 1153.

Sebumpan, R., Guiritan, K. R., Suan, M., Abapo, C. J., Bhat, A. H., Machado, R. A. R., Nimkingrat, P., & Sumaya, N. H. (2022). Morphological and molecular identification of *Trichoderma asperellum* isolated from a dragon fruit farm in the southern Philippines and its pathogenicity against the larvae of the super worm, Zophobas morio (Fabricius, 1776) (Coleoptera: Tenebrionidae). *Egyptian Journal of Biological Pest Control*, *32*(1). https://doi.org/10.1186/s41938-022-00548-0

Sepúlveda, M., Vargas, M., Gerding, M., Ceballos, R., & Oyarzúa, P. (2016). Molecular, morphological, and pathogenic characterization of six strains of *Metarhizium* spp. (Deuteromycotina: Hyphomycetes) for the control of Aegorhinus superciliosus (Coleoptera: Curculionidae). *Chilean Journal of Agricultural Research*, *76*(1), 77–83. https://doi.org/10.4067/S0718-58392016000100011

Shakeri, J., & Foster, H. A. (2007). Proteolytic activity and antibiotic production by

Trichoderma harzianum in relation to pathogenicity to insects. *Enzyme and Microbial Technology*, *40*(4), 961–968. https://doi.org/10.1016/j.enzmictec.2006.07.041

Sharma, I., Raina, A., Choudhary, M., Apra, Kaul, S., & Dhar, M. K. (2023). Fungal endophyte bioinoculants as a green alternative towards sustainable agriculture. *Heliyon*, *9*(9), e19487. https://doi.org/10.1016/j.heliyon.2023.e19487

Sharma, R., & Sharma, P. (2021). Fungal entomopathogens: a systematic review. *Egyptian Journal of Biological Pest Control*, *31*(1). https://doi.org/10.1186/s41938-021-00404-7

Singh, G., Singh, N. P., & Singh, R. (2014). Food plants of a major agricultural pest, *Aphis gossypii* Glover (Homoptera: Aphididae) from India: an updated checklist. *Www.Ijlbpr.Com*, *3*(2). http://www.ijlbpr.com/currentissue.php

Singh, R., & Singh, G. (2016). Aphids and Their Biocontrol. In *Ecofriendly Pest Management for Food Security*. https://doi.org/10.1016/B978-0-12-803265-7.00003-8

Singh, S. N. P. and R. S. (2014). Food Plants of a Major Agricultural Pest Aphis *Gossypii Glover* (Homoptera : Aphididae) From India : *International Journal of Life Sciences, Biotechnology and Pharma Research*, *3*(2).

Sirait, D. D. N., Tobing, M. C., & Safni, I. (2018). Morphology Variation of *Metarhizium Anisopliae* From Soil in North Sumatra Areas. *Journal of Community Research and Service*, *1*(2), 31. https://doi.org/10.24114/jcrs.v1i2.9627

Sullivan, C. F., Parker, B. L., & Skinner, M. (2022). A Review of Commercial *Metarhizium*- and *Beauveria*-Based Biopesticides for the Biological Control of Ticks in the USA. *Insects*, *13*(3), 260. https://doi.org/10.3390/INSECTS13030260

Sun, M., Voorrips, R. E., & Vosman, B. (2020). Aphid populations showing differential levels of virulence on Capsicum accessions. *Insect Science*, *27(2)*, 336 348.

Sundari, M. T., Darsono, Sutrisno, J., & Antriyandarti, E. (2023). Analysis of trade potential and factors influencing chili export in Indonesia. *Open Agriculture*, *8*(1). https://doi.org/10.1515/opag-2022-0205

Supartha, I. W., Roifiq, A., Susila, I. W., Damriyasa, I. M., Tulung, M., Yudha, I. K. W., Utama, I. W. E. K., & Wiradana, P. A. (2022). Population Structure of Thrips parvispinus Karny (Thysanoptera: Thripidae) and Population Abundance of Predatory Insect on Red Chili (Capsicum annuum L.) Treated with Imidacloprid Insecticide. *Nature Environment and Pollution Technology*, *21*(4), 1665–1671. https://doi.org/10.46488/NEPT.2022.v21i04.019

Suwandi, S., Irsan, C., Muslim, A., & Herlinda, S. (2020). Protection of chili pepper from mosaic virus disease and *Aphis gossypii* by a fermented water extract of compost. *IOP Conference Series: Earth and Environmental Science*, *468*(1), 012043. https://doi.org/10.1088/1755-1315/468/1/012043

Syazwan, S. A., Lee, S. Y., Sajap, A. S., Lau, W. H., Omar, D., & Mohamed, R. (2021). Interaction between *Metarhizium anisopliae* and Its Host, the Subterranean Termite Coptotermes curvignathus during the Infection Process. *Biology 2021, Vol. 10, Page 263*, *10*(4), 263. https://doi.org/10.3390/BIOLOGY10040263

Thilak J. C., Ajjappalavara P. S. Ganiger V. M., Sandhyarani N., Ramangouda S. H., Abdul Kareem M., Vinutha D. B., and C. V. K. (2023). Estimation of Phytochemicals in Chili (Capsicum annuum L.) Accessions under Northern Transition Zone of Karnataka, India. *Int. J. Environ. Clim. Change*, *13*(11), 539–548.

Tobing, O. L., Mulyaningsih, Y., & Safitri, A. D. (2023). The Effect of Concentration and Frequency of Neem Leaf Extract on Aphid Attacks on Chili Plants. *Indonesian Journal of Applied Research (IJAR)*, *4*(2), 146–158. https://doi.org/10.30997/ijar.v4i2.329

U, N., D, N., B E., & D B. (2019). Morphological and molecular identification of *Beauveria bassiana* from agricultural soils. *Mongolian Journal of Agricultural Sciences*, *27*(02), 20–24. https://doi.org/10.5564/mjas.v27i02.1280

Urja B Solanki, YM Shukla, BP Chauhan, J. D., and N. P. (2024). Biochemical changes in chili (Capsicum annuum L.) leaves infected with chili leaf curl virus (CLCV). *International Journal of Advanced Biochemistry Research*, *8*(7), 617–626. https://doi.org/https://doi.org/10.33545/26174693.2024.v8.i7h.1558

Vandermoten, S., Mescher, M. C., Francis, F., Haubruge, E., & Verheggen, F. J. (2012). Aphid alarm pheromone: An overview of current knowledge on biosynthesis and functions. *Insect Biochemistry and Molecular Biology*, *42*(3), 155–163. https://doi.org/10.1016/J.IBMB.2011.11.008

Vega, F. E. (2018). The use of fungal entomopathogens as endophytes in biological control: a review. *Mycologia*, *110*(1), 4–30.

Wargane, V., Parate, S., … S. B.-J. Of, & 2020, undefined. (2019). Cultural and morphological characterizations of Beauveria bassiana. *Phytojournal.ComVS Wargane, SRL Parate, SB Bramhankar, PN Rakhonde, BD Sonune, KK Mane, NV LavheJournal of Pharmacognosy and Phytochemistry, 2020•phytojournal.Com*, *8*(6), 591–594. https://www.phytojournal.com/archives?year=2020&vol=9&issue=1&ArticleId=10507

Watt, M., & Hales, D. F. (1996). Dwarf Phenotype of the Cotton Aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae). *Australian Journal of Entomology*, *35*(2), 153–159. https://doi.org/10.1111/J.1440-6055.1996.TB01380.X

Wilberts Id, L., Zsef Vuts, J., Caulfield, J. C., Id, G. T., Birkett, M. A., Herrera-Malaver, B., Verstrepen, K. J., Sobhy, I. S., Jacquemyn, H., & Lievens, B. (2022). Impact of endophytic colonization by entomopathogenic fungi on the behavior and life history of the tobacco peach aphid *Myzus persicae* var. nicotianae. *PLoS One*, *17*(9), e0273791. https://doi.org/10.1371/journal.pone.0273791

Will, T., & Van Bel, A. J. E. (2006). Physical and chemical interactions between aphids and plants. *Journal of Experimental Botany*, *57*(4), 729–737. https://doi.org/10.1093/JXB/ERJ089

Wohlers, P. (1982). Effect of alarm pheromone (E)-β-farnesene on aphid behavior during flight and after landing on plants. *Zeitschrift Für Angewandte Entomologie*, *93*(1–5), 102–108. https://doi.org/10.1111/J.1439-0418.1982.TB03575.X

Xiang, X., Yu, S., Ofori, A. D., Liu, S., Yang, Q., & Shang, J. (2024). Screening of the highly pathogenic *Beauveria bassiana* BEdy1 against Sogatella furcifera and exploration of its infection mode. *Frontiers in Microbiology*, *15*, 1469255. https://doi.org/10.3389/FMICB.2024.1469255/BIBTEX

Xiong, Q., Xie, Y., Zhu, Y., Xue, J., Li, J., & Fan, R. (2013). Morphological and ultrastructural characterization of Carposina sasakii larvae (Lepidoptera: Carposinidae) infected by *Beauveria bassiana* (Ascomycota: Hypocreales: Clavicipitaceae). *Micron*, *44*(1), 303–311. https://doi.org/10.1016/j.micron.2012.08.002

Yan, H., Wang, D., Zhao, X., Huang, D., & Ma, X. (2011). Observation of the infection process of *Metarhizium anisopliae* on the cuticle of Anoplophora glabripennis larvae with scanning electron microscopy. *Frontiers of Agriculture in China*, *5*(4), 662–665. https://doi.org/10.1007/s11703-011-1134-y

Yang, Y., Fang, B., Feng, S., Wang, Z., Luo, Z., Yao, Z., ... & Huang, L. (2021). Isolation and identification of *Trichoderma asperellum*, the novel causal agent of green mold disease in sweetpotato. *Plant Diease, 105(6), 17.*

Yao, X., Guo, H., Zhang, K., Zhao, M., Ruan, J., & Chen, J. (2023). *Trichoderma* and its role in biological control of plant fungal and nematode disease. In *Frontiers in Microbiology* (Vol. 14). Frontiers Media S.A. https://doi.org/10.3389/fmicb.2023.1160551

Yogananda, T., Ramanagouda, S. H., Venkateshalu, B., Jamunarani, G. S., Rashmi, S. H., Awati, M., & Hadimani, H. P. (2023). Colonization and endophytic effect of *Beauveria bassiana* (Bals.-Criv.) Vuill. UHSB-END1 against *Myzus persicae* (Sulzer) and Plutella xylostella (L.) in cabbage. *Egyptian Journal of Biological Pest Control*, *33*(1). https://doi.org/10.1186/s41938-023-00698-9

Yogesh Patel. (2013). Effect of environmental factors on population dynamics of

Aphis gossypii (Glover)(Aphididae; Hemiptera), in cotton under agroclimatic conditions of Madhya Pradesh. *International Journal of Plant Protection*. https://www.cabidigitallibrary.org/doi/full/10.5555/20143235085

Zamani, A. A., Talebi, A. A., Fathipour, Y., & Baniameri, V. (2006). Effect of temperature on biology and population growth parameters of *Aphis gossypii* Glover (Hom., Aphididae) on greenhouse cucumber. *Journal of Applied Entomology*, *130*(8), 453–460. https://doi.org/10.1111/J.1439-0418.2006.01088.X

APPENDICES

Appendix 1. Research schedule

No	Activity	March				April				May				June				July				August			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1	Register proposal																								
2	**Seminar proposal**																								
3	Refine the thesis proposal.																								
4	Make a letter to start research to the dean.																								
5	Make a laboratory registration letter.																								

No	Activity	March				April				May				June				July				August			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
6	Isolation of entomopathogenic fungi																								
8	Prepare a concentration of entomopathogenic fungi.																								
9	Proceed to sow chili seeds.																								
10	Transplant the tree into a poly-bag																								
11	Collect harmful aphids on chili and propagate them in the laboratory.																								

No	Activity	March				April				May				June				July				August			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
12	Testing and evaluating aphid resistance under laboratory conditions of entomopathogenic fungi																								
13	Testing and evaluating the ability of entomopathogenic fungi to resist leafhoppers in greenhouse conditions of entomopathogenic fungi																								

No	Activity	March				April				May				June				July				August			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
14	Collect data on red chili pepper.																								
15	Handle data																								
16	Writing thesis																								
17	**Thesis seminar results**																								
18	Adjust thesis results																								

Appendix 2. Experimental design diagram

Experiment 2

B 10^{10}	A 10^{10}	A 10^{4}	B 10^{4}
D 10^{10}	C 10^{10}	D 10^{4}	C 10^{4}
D 10^{8}	C 10^{8}	D 10^{6}	C 10^{6}
B 10^{8}	A 10^{8}	A 10^{6}	B 10^{6}

* Note:Treatment A: (Control)**:** Using distilled water.
Treatment B: Using *B. bassiana*
Treatment C: Using *M. anisopliae*
Treatment D**:** Using *T. asperellum*

Experiment 3

A	
B	E
C	D

* Note:Treatment A: (Control)**:** Using distilled water.
Treatment B: Using Insecticide
Treatment C: Using *B. bassiana*
Treatment D: Using *M. anisopliae*
Treatment E: Using *T. asperellum*

Appendix 3. Statistix data of Table 4. Radial growth rate of *B. Bassiana*, *M. Anisopliae, and T. asperellum* isolates at different time intervals

ANOVA Table for Diameter Day 4 by Fungi

Source	DF	SS	MS	F	P
Fungi	2	14931.7	7465.85	2723	0.0000
Error	12	32.9	2.74		
Total	14	14964.6			
Grand Mean	45.497				
CV	3.64				

Germination rate

Source	DF	SS	MS	F	P
Fungi	2	2.836	1.4181	0.12	0.8874
Error	12	141.097	11.7581		
Total	14	143.933			
Grand Mean	96.657				
CV	3.55				

ANOVA Table for Radial Growth by Fungi

Source	DF	SS	MS	F	P
Fungi	2	933.232	466.616	4926	0.0000
Error	12	1.137	0.095		
Total	14	934.369			
Grand Mean:	11.374				
CV	2.71				

Appendix 4. Statistix data of Table 6: Mortality rate of fungi by 10 days
Analysis of Variance Table for MORTALITY

Source	DF	SS	MS	F	P
Concentration	3	95.062	31.687	44.74	0.0000
Fungi	3	605.729	201.910	285.05	0.0000
Concentration × fungi	9	38.521	4.280	6.04	0.0001
Error	32	22.667	0.708		
Total	47	761.979			
Grand Mean:	57.083				
CV (%):	16.77				

Appendix 5. Statistix data of Table 7:
Lethal concentrations (LC_{50} and LC_{95}) of *B. bassiana*

Source	Deviance	Df	P-Value
Model	54.6587	1	0,0000
Residual	3.49378	13	0,9955
Total (corr.)	58.1525	14	

Lethal concentrations (LC_{50} and LC_{95}) *M. anisopliae*

Source	Deviance	Df	P-Value
Model	59,2496	1	0,0000
Residual	3,97734	13	0,9914
Total (corr.)	63,227	14	

Lethal concentrations (LC_{50} and LC_{95}) *T. asperellum*

Source	Deviance	Df	P-Value
Model	126,582	1	0,0000
Residual	18,1376	13	0,1524
Total (corr.)	144,719	14	

Appendix 6. Statistix data of Table 8: Mortality time of fungi
Analysis of Variance Table for Mortality Time

Source	DF	SS	MS	F	P
Concentration	3	11.089	3.6962	3	11.089
Fungi	3	106.567	35.5224	3	106.567
Concentration × fungi	9	12.721	1.4134	9	12.721
Error	32	1.076	0.0336	32	1.076
Total	47	131.453			
Grand Mean:	2.5729				
CV (%):	7.13				

Appendix 7. Statistix data of Table 9 and Table 10
Lethal time (LT_{50} and LT_{95}) of *B. bassiana* 10^4

Source	Deviance	Df	P-Value
Model	9,21777	1	0,0024
Residual	11,078	28	0,9982
Total (corr.)	20,2958	29	

Lethal time (LT_{50} and LT_{95}) of *B. bassiana* 10^6

Source	Deviance	Df	P-Value
Model	24,9693	1	0,0000
Residual	26,5237	28	0,5443
Total (corr.)	51,493	29	

Lethal time (LT_{50} and LT_{95}) of *B. bassiana* 10^8

Source	Deviance	Df	P-Value
Model	64,2531	1	0,0000
Residual	33,5892	28	0,2147
Total (corr.)	97,8424	29	

Lethal time (LT_{50} and LT_{95}) of *B. bassiana* 10^{10}

Source	Deviance	Df	P-Value
Model	92,0667	1	0,0000
Residual	7,33495	28	1,0000
Total (corr.)	99,4017	29	

Lethal time (LT_{50} and LT_{95}) of *M. anisopliae* 10^4

Source	Deviance	Df	P-Value
Model	6,94307	1	0,0084
Residual	9,68055	28	0,9995
Total (corr.)	16,6236	29	

Lethal time (LT_{50} and LT_{95}) of *M. anisopliae* 10^6

Source	Deviance	Df	P-Value
Model	43,8002	1	0,0000
Residual	18,2645	28	0,9193
Total (corr.)	62,0646	29	

Lethal time (LT_{50} and LT_{95}) of *M. anisopliae* 10^8

Source	Deviance	Df	P-Value
Model	28,4993	1	0,0000
Residual	15,4151	28	0,9737
Total (corr.)	43,9143	29	

Lethal time (LT_{50} and LT_{95}) of *M. anisopliae* 10^{10}

Source	Deviance	Df	P-Value
Model	49,4021	1	0,0000
Residual	15,2661	28	0,9755
Total (corr.)	64,6682	29	

Lethal time (LT_{50} and LT_{95}) of *T. asperellum* 10^4

Source	Deviance	Df	P-Value
Model	7,8303	1	0,0051
Residual	17,3046	28	0,9423
Total (corr.)	25,1349	29	

Lethal time (LT_{50} and LT_{95}) of *T. asperellum* 10^6

Source	Deviance	Df	P-Value
Model	41,1946	1	0,0000
Residual	29,5248	28	0,3863
Total (corr.)	70,7194	29	

Lethal time (LT_{50} and LT_{95}) of *T. asperellum* 10^8

Source	Deviance	Df	P-Value
Model	52,2583	1	0,0000
Residual	28,6066	28	0,4327
Total (corr.)	80,8649	29	

Lethal time (LT_{50} and LT_{95}) of *T. asperellum* 10^{10}

Source	Deviance	Df	P-Value
Model	47,432	1	0,0000
Residual	8,86856	28	0,9998
Total (corr.)	56,3006	29	

Appendix 8. Statistix data of Table 11: Effect of different concentrations of EPF on the reproduction of *Aphis gossypii* under greenhouse conditions

Analysis of Variance Table for reproduction

Source	DF	SS	MS	F-value	P-value
Concentration	3	23009.4	7669.8	802.07	0.0000
Fungi	3	57570.7	19190.2	2006.82	0.0000
Concentration × fungi	9	8296.4	921.8	96.40	0.0000
Error	32	306.0	9.6		
Total	47	89182.5			
Grand Mean:	59.896				
CV	5.16				

Appendix 9. Statistix data of Table 12: Percentage of attack *Aphis gossypii*
Analysis of Variance Table for Percentage of attack by *Aphis gossypii*

Source	DF	SS	MS	F-value	P-value
Concentration	3	6203.9	2068.0	19.86	0.0000
Fungi	3	48240.2	16080.1	154.39	0.0000
Concentration × fungi	9	2499.9	277.8	2.67	0.0197
Error	32	3332.8	104.1		
Total	47	60276.8			
Grand Mean:	45.833				
CV	22.27				

Appendix 10. Statistix data of Table 13 Leaf Curl Rate of Chili Plants 30 Days After *Aphis gossypii*

Source	DF	SS	MS	F-value	P-value
Concentration	3	17054.4	5684.79	81.87	0.0000
Fungi	3	24832.4	8277.47	119.21	0.0000
Concentration × fungi	9	6857.7	761.97	10.97	0.0000
Error	32	2221.9	69.43		
Total	47	50966.4			
Grand Mean:	62.153				
CV	13.41				

Appendix 11. Statistix data of Table 14: Feeding preference of *Aphis Gossypii*
Analysis of Variance Table for Feeding Preference of *Aphis Gossypii*

Source	DF	SS	MS	F-value	P-value
Concentration	3	125.8	41.95	0.05	0.9846
Fungi	3	4842.8	1614.27	1.97	0.1291
Concentration × fungi	9	11928.0	1325.33	1.62	0.1329
Error	56	45913.2	819.88		
Total	71				
Grand Mean:	47.405				
CV	60.40				

Statistix12. Data of Table 15: Analysis of Variance Table: The impact of different concentrations of entomopathogenic fungi on Plant height

Source	DF	SS	MS	F-value	P-value
Concentration	3	327.67	109.224	71.47	0.0000
Fungi	3	704.99	234.996	153.78	0.0000
Concentration × fungi	9	174.93	19.437	12.72	0.0000
Error	32	48.90	1.528		
Total	47	1256.49			
Grand Mean:	26.883				
CV	4.60				

Statistix13. Data of Table 16: Analysis of Variance Table: The impact of different concentrations of entomopathogenic fungi on Plant Root length

Source	DF	SS	MS	F-value	P-value
Concentration	3	86.19	28.731	22.79	0.0000
Fungi	3	1145.94	381.981	302.96	0.0000
Concentration × fungi	9	55.41	6.157	4.88	0.0004
Error	32	40.35	1.261		
Total	47	1327.90			
Grand Mean:	20.608				
CV	5.45				

Statistix14. Data of Table 17: Analysis of Variance Table: The impact of different concentrations of entomopathogenic fungi on Plant fresh weight

Source	DF	SS	MS	F-value	P-value
Concentration	3	86.534	28.8446	349.09	0.0000
Fungi	3	127.351	42.4504	513.76	0.0000
Concentration × fungi	9	78.814	8.7571	105.98	0.0000
Error	32	2.644	0.0826		
Total	3	86.534	28.8446	349.09	0.0000
Grand Mean:	5.8908				
CV	4.88				

Statistix15. Data of Table 18: Analysis of Variance Table: The impact of different concentrations of entomopathogenic fungi on Plant Dry Weight

Source	DF	SS	MS	F-value	P-value
Concentration	3	4.8909	1.63030	564.20	0.0000
Fungi	3	3.3151	1.10502	382.42	0.0000
Concentration × fungi	9	1.8586	0.20651	71.47	0.0000
Error	32	0.0925	0.00289		
Total	47	10.1570			
Grand Mean:	0.8685				
CV	6.19				

Appendix 16. Statistix data of Table 19: Mortality rate and mortality time of *A. gossypii*

Mortality rate

Source	DF	SS	MS	F	P
Treatment	4	73,792.0	18,448.0	301	0.0000
Error	45	2,760.0	61.3		
Total	49	76,552.0			
Grand Mean	76.400				
CV	10.25				

Time mortality

Source	DF	SS	MS	F	P
Treatment	4	67.9910	16.9977	478	0.0000
Error	45	1.6003	0.0356		
Total	49	69.5912			

Source	DF	SS	MS	F	P
Grand Mean	1.9650				
CV	9.60				

Appendix 17. Statistix data of Table 20 Value LC_{50} LC_{95}

Treatment B

Source	Deviance	Df	P-Value
Model	147,6	1	0,0000
Residual	17,7082	98	1,0000
Total (corr.)	165,309	99	

Treatment C

Source	Deviance	Df	P-Value
Model	126,711	1	0,0000
Residual	158,949	98	0,0001
Total (corr.)	285,66	99	

Treatment D

Source	Deviance	Df	P-Value
Model	99,3671	1	0,0000
Residual	222,479	98	0,0000
Total (corr.)	321,846	99	

Treatment E

Source	Deviance	Df	P-Value
Model	73,2072	1	0,0000
Residual	179,946	98	0,0000
Total (corr.)	253,153	99	

Appendix 18. Statistix data of Table 21

Number of aphids produced

Source	DF	SS	MS	F	P
Treatment	4	246,079	61,519.6	4,883	0.0000
Error	45	567.0	12.6		
Total	49	246,646			
Grand Mean	48.640				
CV	7.30				

Mortality of Offspring

Source	DF	SS	MS	F	P
Treatment	4	924.200	231.050	753	0.0000
Error	45	13.800	0.307		
Total	49	938.000			

Source	DF	SS	MS	F	P
Grand Mean	4.6000				
CV	12.04				

Appendix 19. Statistix data of Table 22

Chlorophyll a

Source	DF	SS	MS	F	P
Treatment	4	2.13457	0.53364	7.26	0.0052
Error	10	0.73554	0.07355		
Total	14	2.87012			
Grand Mean		5.0816			
CV	5.34				

Chlorophyll b

Source	DF	SS	MS	F	P
Treatment	4	1.40594	0.35148	8.92	0.0025
Error	10	0.39418	0.03942		
Total	14	1.80012			
Grand Mean		2.3957			
CV	8.29				

Chlorophyll total

Source	DF	SS	MS	F	P
Treatment	4	6.99343	1.74836	9.29	0.0021
Error	10	1.88273	0.18827		
Total	14	8.87616			
Grand Mean		7.4773			
CV	5.80				

Appendix 20. Statistix data of Table 23
Salicylic acid

Source	DF	SS	MS	F	P
Treatment	4	3.35668	0.83917	42.4	0.0000
Error	10	0.19788	0.01979		
Total	14	3.55456			

Source	DF	SS	MS	F	P
Grand Mean		4.7415			
CV		2.97			

Appendix 21. Statistix data of Table 24

Plant height 90 days

Source	DF	SS	MS	F	P
Treatment	4	1463.96	365.990	52.9	0.0000
Error	20	138.35	6.917		
Total	24	1602.31			
Grand Mean		49.504			
CV	5.31				

Leaves height 90 days

Source	DF	SS	MS	F	P
Treatment	4	10620.6	2655.14	63.0	0.0000
Error	20	842.8	42.14		
Total	24	11463.4			
Grand Mean	103.34				
CV	6.28				

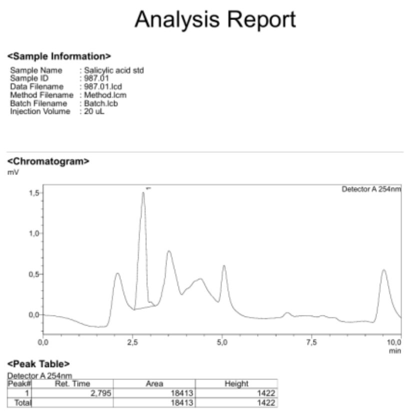
Flowers of a plant 90 days

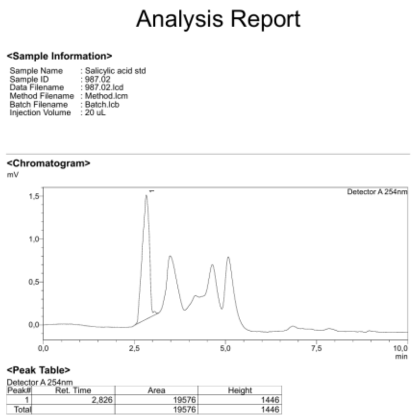
Source	DF	SS	MS	F	P
Treatment	4	3321.04	830.260	324	0.0000
Error	20	51.20	2.560		
Total	24	3372.24			
Grand Mean	21.480				
CV	7.45				

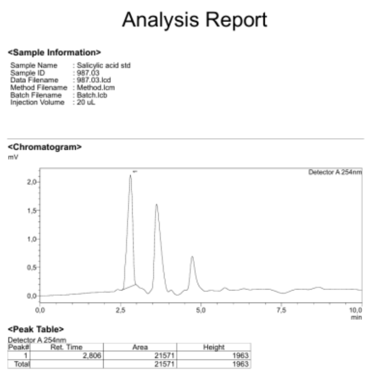
Fruit of a plant in 90 days

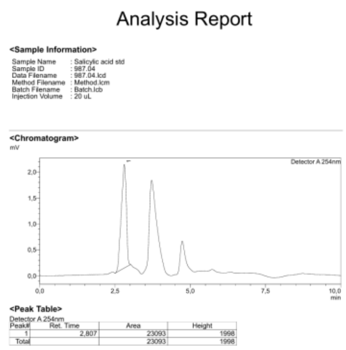
Source	DF	SS	MS	F	P
Treatment	4	2284.80	571.200	492	0.0000
Error	20	23.20	1.160		
Total	24	2308.00			
Grand Mean	17.200				
CV	6.26				

Appendix 22. Statistix Data Salicylic acid by HPLC device







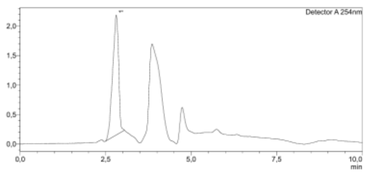


Analysis Report

<Sample Information>

Sample Name	: Salicylic acid std
Sample ID	: 987.05
Data Filename	: 987.05.lcd
Method Filename	: Method.lcm
Batch Filename	: Batch.lcb
Injection Volume	: 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

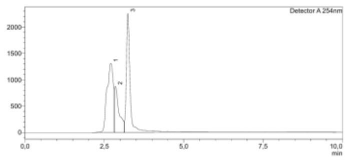
Peak#	Ret. Time	Area	Height
1	2,807	24543	2035
Total		24543	2035

Analysis Report

<Sample Information>

Sample Name	: A1
Sample ID	: 987.06.1
Data Filename	: 987.06.1.lcd
Method Filename	: Method.lcm
Batch Filename	: Batch.lcb
Injection Volume	: 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

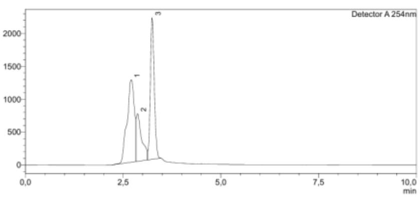
Peak#	Ret. Time	Area	Height
1	2,704	18033936	1307138
2	2,846	8803220	873791
3	3,237	20317189	2254330
Total		47154345	4435259

Analysis Report

<Sample Information>

Sample Name	: A2
Sample ID	: 987.06.2
Data Filename	: 987.06.2.lcd
Method Filename	: Method.lcm
Batch Filename	: Batch.lcb
Injection Volume	: 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

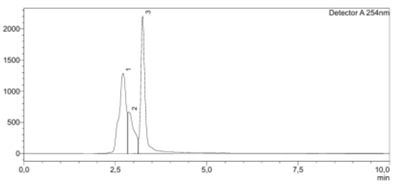
Peak#	Ret. Time	Area	Height
1	2,708	16270114	1253252
2	2,869	7062299	724069
3	3,239	14906571	2154759
Total		38238984	4132080

Analysis Report

<Sample Information>

Sample Name	: A3
Sample ID	: 987.06.3
Data Filename	: 987.06.3.lcd
Method Filename	: Method.lcm
Batch Filename	: Batch.lcb
Injection Volume	: 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

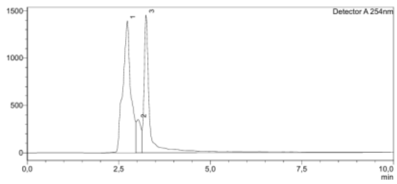
Peak#	Ret. Time	Area	Height
1	2,710	17185159	1290466
2	2,869	7910144	663855
3	3,241	20370543	2209495
Total		45465845	4163816

Analysis Report

<Sample Information>

Sample Name	: B1
Sample ID	: 987.07.1
Data Filename	: 987.07.1.lcd
Method Filename	: Method.lcm
Batch Filename	: Batch.lcb
Injection Volume	: 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

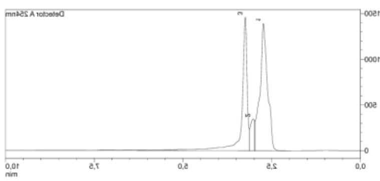
Peak#	Ret. Time	Area	Height
1	2,733	20925175	1392528
2	3,026	3107993	349723
3	3,242	16116680	1455039
Total		40149848	3197291

Analysis Report

<Sample Information>

Sample Name	: B2
Sample ID	: 987.07.2
Data Filename	: 987.07.2.lcd
Method Filename	: Method.lcm
Batch Filename	: Batch.lcb
Injection Volume	: 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

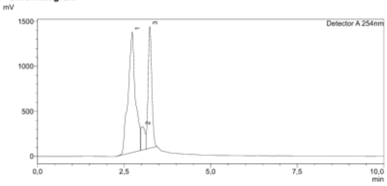
Peak#	Ret. Time	Area	Height
1	2,733	21053231	1393245
2	3,024	2924986	346147
3	3,242	15830592	1461211
Total		39808810	3200603

Analysis Report

<Sample Information>

Sample Name : B3
Sample ID : 987.07.3
Data Filename : 987.07.3.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

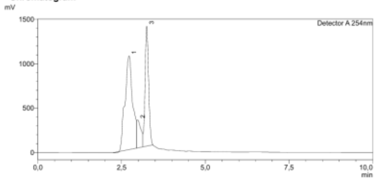
Peak#	Ret. Time	Area	Height
1	2,732	19492082	1338638
2	3,030	2189958	260133
3	3,241	9945784	1352563
Total		31627825	2951334

Analysis Report

<Sample Information>

Sample Name : C1
Sample ID : 987.08.1
Data Filename : 987.08.1.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

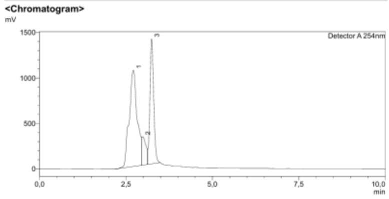
Peak#	Ret. Time	Area	Height
1	2,724	16748989	1053579
2	2,978	2654467	313917
3	3,249	9906052	1349557
Total		29309508	2717052

Analysis Report

<Sample Information>

Sample Name : C2
Sample ID : 987.08.2
Data Filename : 987.08.2.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

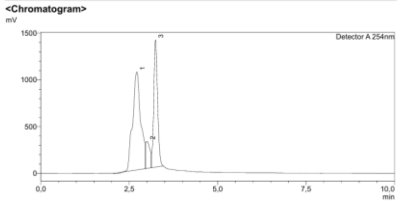
Peak#	Ret. Time	Area	Height
1	2,715	17088037	1058295
2	2,985	2643885	312196
3	3,241	10330468	1372895
Total		30062390	2743386

Analysis Report

<Sample Information>

Sample Name : C3
Sample ID : 987.08.3
Data Filename : 987.08.3.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

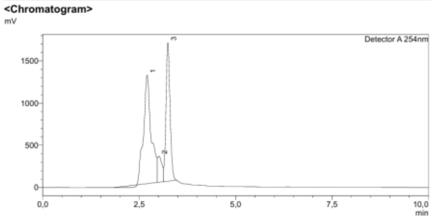
Peak#	Ret. Time	Area	Height
1	2,715	16758077	1048390
2	3,003	2393313	289388
3	3,241	10173016	1362072
Total		29324407	2699851

Analysis Report

<Sample Information>

Sample Name : D1
Sample ID : 987.09.1
Data Filename : 987.09.1.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

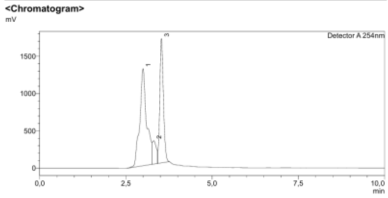
Peak#	Ret. Time	Area	Height
1	2,707	17537075	1288514
2	3,012	2529478	310783
3	3,241	12006740	1644333
Total		32073292	3243629

Analysis Report

<Sample Information>

Sample Name : D2
Sample ID : 987.09.2
Data Filename : 987.09.2.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

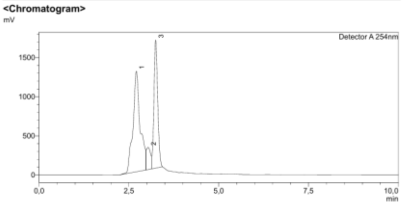
Peak#	Ret. Time	Area	Height
1	2,997	18371476	1301407
2	3,305	2485957	313723
3	3,530	12142631	1664759
Total		33000064	3279889

Analysis Report

<Sample Information>

Sample Name : D3
Sample ID : 987.09.3
Data Filename : 987.09.3.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

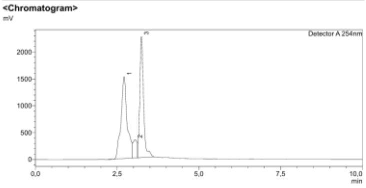
Peak#	Ret. Time	Area	Height
1	2,708	17995647	1287496
2	3,034	2294328	283266
3	3,243	11837600	1639210
Total		32127576	3209972

Analysis Report

<Sample Information>

Sample Name : E1
Sample ID : 987.10.1
Data Filename : 987.10.1.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

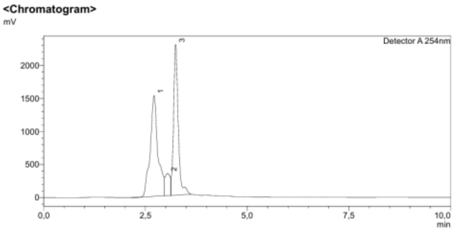
Peak#	Ret. Time	Area	Height
1	2,713	20120105	1520430
2	3,047	2963798	338908
3	3,239	17980507	2251619
Total		41064411	4110958

Analysis Report

<Sample Information>

Sample Name : E2
Sample ID : 987.10.2
Data Filename : 987.10.2.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

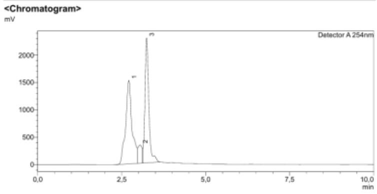
Peak#	Ret. Time	Area	Height
1	2,712	20092079	1524898
2	3,044	2925158	336452
3	3,238	18056533	2277404
Total		41073770	4138754

Analysis Report

<Sample Information>

Sample Name : E3
Sample ID : 987.10.3
Data Filename : 987.10.3.lcd
Method Filename : Method.lcm
Batch Filename : Batch.lcb
Injection Volume : 20 uL

<Chromatogram>



<Peak Table>

Detector A 254nm

Peak#	Ret. Time	Area	Height
1	2,712	20186888	1524638
2	3,044	2897787	333887
3	3,239	18231947	2279624
Total		41316622	4138149

Appendix 23. Experimental I

Experiment I

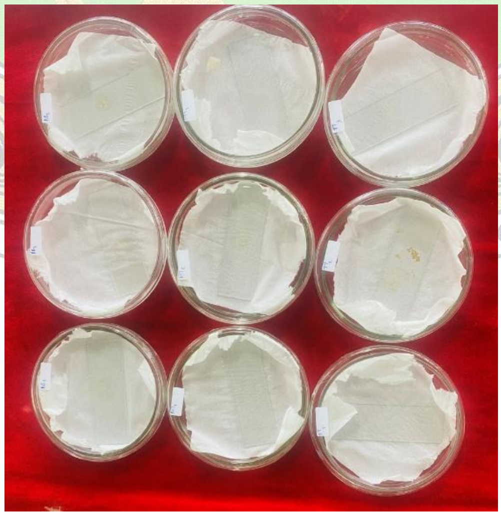


Figure 21. Germination Test of Entomopathogenic Fungi

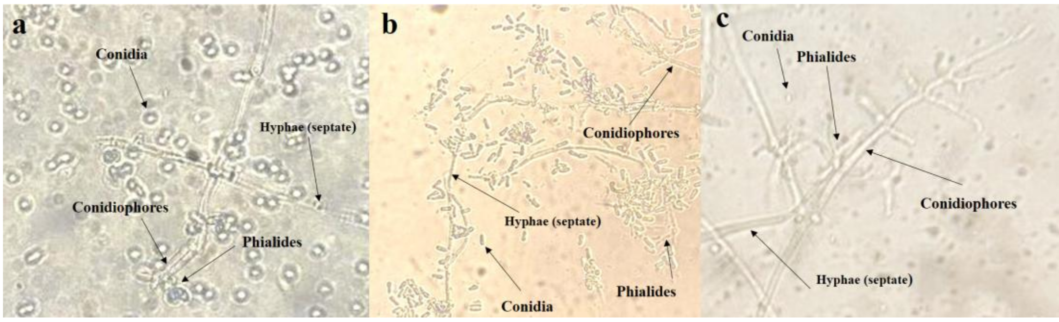


Figure 22. Morphological characteristics of colonia forms of three entomopathogen fungi. (a) Colonia form of *B. bassiana*; (b) Colonia form of *M. anisopliae*;(c) Colonia form of *T. asperellum.*

Appendicex 24. Experiment II

Figure 23. Prepare seedlings for experiment I

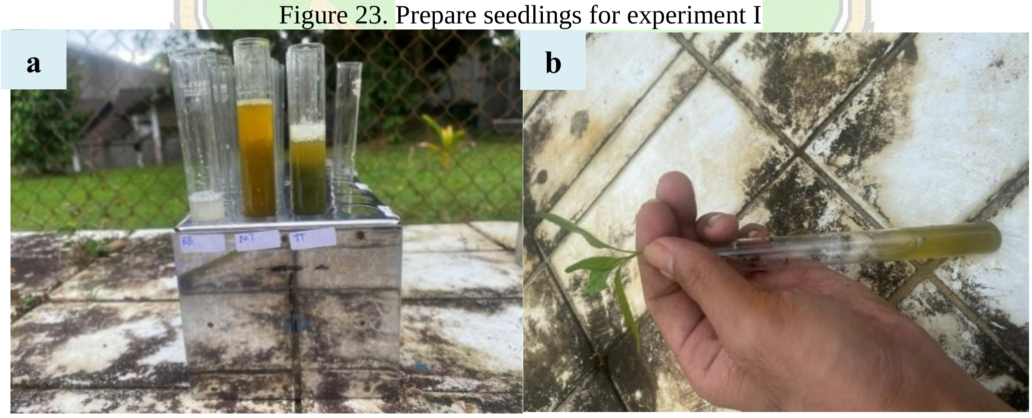


Figure 24. Preparation of fungal extracts and seedling treatment before transplantation. (a) Liquid culture extracts of *B. bassiana* (BB), *M. anisopliae* (MT), and *T. asperellum* (TT) were prepared for root dipping; (b) Root immersion of chili seedlings in fungal extract solution before transplanting into soil pots.

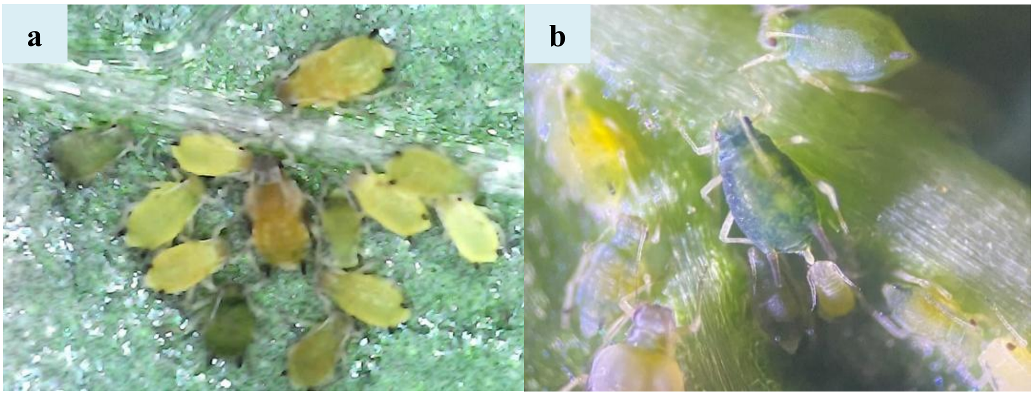


Figure 25. Morphological characteristics of *Aphis gossypii* reared on chili pepper plants for experimental use. (a) Nymphal and adult stages showing typical yellow phenotype; (b) Dark green morph observed on mature leaves.

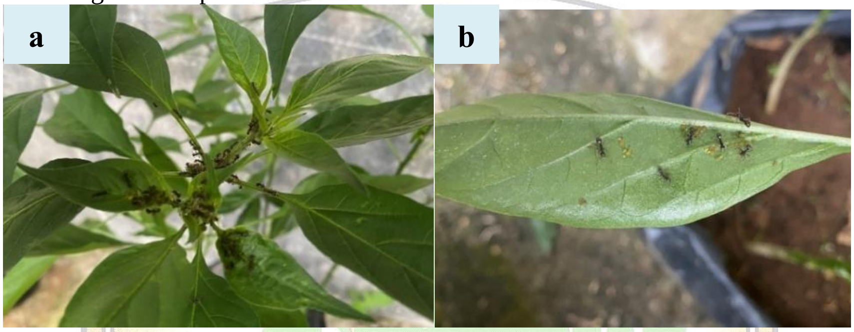


Figure 26. Natural infestation of *Aphis gossypii* on chili pepper plants used for aphid collection. (a) Aphid colonies concentrated on young shoots and buds; (b) Close-up of aphids on the abaxial leaf surface before collection for experiment.

Figure 27. (a) Adult *Aphis gossypii* maintained on chili leaf; (b) Adult and nymphal stages with molting exuviae observed during laboratory rearing.

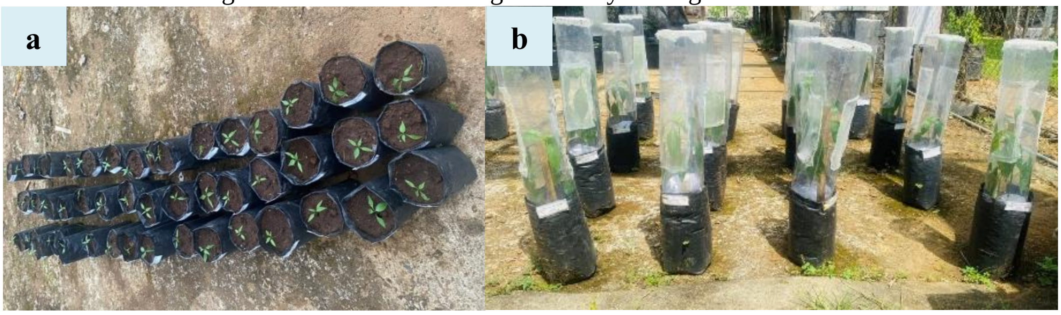


Figure 28. Chili plants were prepared for experiment II. (a) Chili seedlings prepared for infestation; (b) Plants covered with plastic cylinders during aphid release in Experiment II.

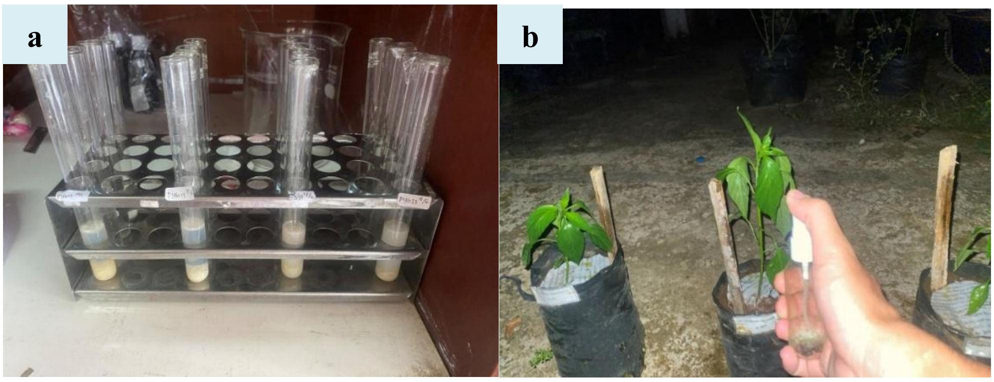


Figure 29. Preparation and application of entomopathogenic fungal suspension for Experiment II. (a) Preparation of the fungal suspension before application. (b) Application of the fungal suspension onto chili seedlings.

Figure 30. Aphids killed by entomopathogenic fungi (EPF) on chili leaves.

Figure 31. Host plant choice experiment of *Aphis gossypii*.

Figure 32. Cadavers of *Aphis gossypii* collected after EPF treatment after 24 hours

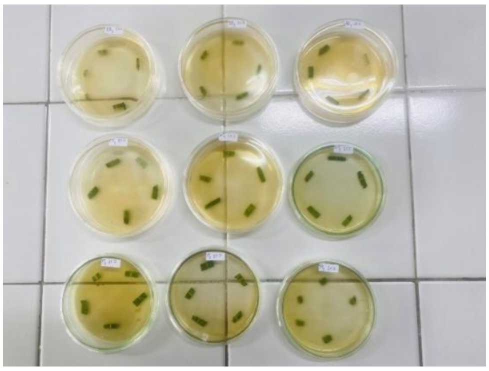


Figure 33. Evaluation of Entomopathogenic fungi colonization on chili leaves 30 days after treatment.

Appendix 25. Experiment III

Figure 34. Chili seeds were surface-sterilized using sterile distilled water and 70% ethanol before immersion in the entomopathogenic fungi suspension.

Figure 35. A synthetic insecticide was applied as a chemical control in Experiment III.

Figure 36. A commercial variety of *Capsicum annuum* (Chili Kencana) was used in this study.

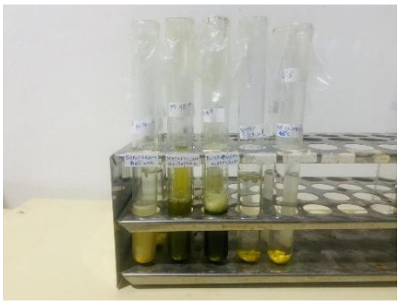
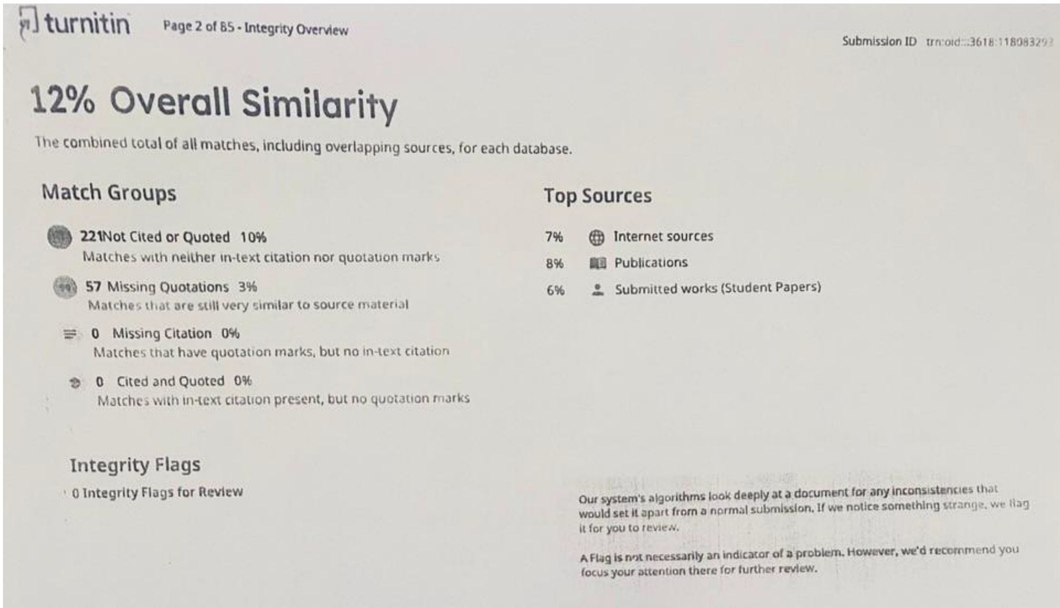


Figure 37. Preparation of entomopathogenic fungal crude extracts for bioassay against *Aphis gossypii* in Experiment III.

Figure 38. Preparation of chili plants and application of fungal suspension against *Aphis gossypii* for experiment III. (a) Chili seedlings before treatment. (b) Chili plants covered with plastic cylinders for aphid protection and fungal suspension spraying under greenhouse conditions.

Figure 39. Preparation of chili leaf extracts for the determination of salicylic acid content.

Figure 40. Effect of treatments in Experiment III on the growth performance of chili plants (*Capsicum annuum*).



turnitin Page 2 of 85 - Integrity Overview

Submission ID trn:oid:::3618:118083293

12% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Match Groups

221 Not Cited or Quoted 10%
Matches with neither in-text citation nor quotation marks

57 Missing Quotations 3%
Matches that are still very similar to source material

0 Missing Citation 0%
Matches that have quotation marks, but no in-text citation

0 Cited and Quoted 0%
Matches with in-text citation present, but no quotation marks

Top Sources

7% Internet sources
8% Publications
6% Submitted works (Student Papers)

Integrity Flags

0 Integrity Flags for Review

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.