

Project Title: Entomopathogenic fungi and diatomaceous earths for the control of *Tribolium castaneum* (Herbst.) (Coleoptera: Tenebrionidae) on stored wheat

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Alternative control measures are necessary to be explored for stored grain insect pests due to increased societal concerns and demand for residues free and safe food for humans. Keeping these goals in mind for safer storage of food commodities, this project was designed to evaluate different indigenous isolates of entomopathogenic fungi and available diatomaceous earths (DEs) against the adults of *Tribolium castaneum* (Herbst.) (Coleoptera: Tenebrionidae). The detailed survey of different crop, fruits, vegetables fields and forests was conducted to collect soil samples for the possible associated fungi isolation using *Galleria* bait method. The grain samples were also collected and total 25,720 insects of different species were sieved and processed for the isolation of fungal species. Among 220 soil samples 168 fungal isolates were recovered and identified with 98 from forests, 32 from vegetables, 30 from field crops and 8 from fruits. On the other hand, 195 isolates of different fungi were isolated from the cadavers of various insect species. Then, 38 autochthonous isolates of entomopathogenic fungi were tested against adults of *T. castaneum* @ 109 conidia/ml. The six isolates of *B. bassiana*, three of *M. anisopliae* and one of *P. lilacinus* exhibited >70% mortality and considered for the further virulence studies. In further assays four isolates belonging to different fungal genera exhibited highest percentage of adult mortality after 14 days at 108 conidia mg/kg. In another set of experiments, performance of 19 available DE formulations obtained from different geographical regions of the world were screened at different dose rates. The most promising eight DEs were further evaluated with four dose rates and at three exposure intervals. The results confirmed the lethal action of DE formulations exhibiting different levels of efficacy against *T. castaneum*. The impact of entomopathogenic fungi (*Beauveria bassiana* and *Metarhizium anisopliae*) alone and in combinations with enhanced DE (DEA - diatomaceous earth + abamectin) assays were executed. The results revealed that the combination of DE with two entomopathogenic fungi increased the mortality rate of *T. castaneum* compared with alone treatments. *Beauveria bassiana* and *M. anisopliae* + DEA dose combinations resulted in higher mortality of *T. castaneum* compared with other treatments at all exposure periods. Dusting proved most effective method compared to spray while jute bags and concrete were most effective surfaces. The persistence bioassays showed that the combined applications of high dose rate of *B. bassiana* with DEA exhibited greatest mortality during all the five bioassays until 120 day of grains storage. Over all, the present study clearly indicates that DE formulations and entomopathogenic fungi can be effectively used for the long term protection of stored grains against *T. castaneum* and other stored grain insect pests. Further research is required for the (a) field evaluation and their toxic effects on the stored grains (b) which components exhibit synergistic properties and (c) physiological basis of such type of phenomenon etc. In this way, plenty of data will be generated to guide the farmers and managers to incorporate DEs and fungi for successful and sustainable protection of stored grains/commodities against insect pests and there is possibility for the development of safe commercial formulation so to lessen the reliance on residual insecticides.