TRIAL OF *BEAUVERIA BASSIANA* (BALS.) VUILL.—A PATHOGENIC FUNGUS AGAINST LARVAE OF *PIESMOPODA OBLIQUIFASCIELLA* (HMPS.) (PYRALIDAE-LEPIDOPTERA) A LEAF STITCHER OF *CASSIA FISTULA*

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Abstract: *Amaltas,* Cassia fistula *a beautiful ornamental and avenue tree, well known for its medicinal value and producing a very valuable timber is severely attacked by a leaf stitcher,* Piesmopoda obliquifasciella *(Hmps). Heavy infestations tarnish the beautiful look of the tree for which it is grown as well as destroy annual growth of the tree to the extent of 50-100% depending upon severity of infestation.*

For developing a control method safer to the environment a pathogenic fungus, Beauveria bassiana *(Bals.) Vuill. was tried against the larval stages of the pest. The fungus displayed its pathogenecity by killing 72.5-97.5% larvae in various treatments as against 50% natural mortality in check treatment. The method can safely be used against the pest on large scale.*

Introduction: *Cassia fistula* (Amaltas) is an important broad-leaved tree grown throughout the country mostly in plains as an ornamental plant. The plant yields very good durable timber used everywhere for house posts, bridge posts, wheels, stocks and shafts of carts, plough handles and boat building. The plant gives high class furniture wood and is excellent for pickaxe handles, mallet handles, tool handles, railway keys and similar articles where strength and toughness are primary considerations (Pearson and Brown, 1932). The bark is used in tanning and as mordant with alum. Wood ash is used as mordant in dyeing.

Various parts of the plant have medicinal importance. A red juice which oozes from stem hardens into a gummy substance called "Kamarkas", which is used as an astringent. Fruit pulp is used as purgative and cathartic. The pulp mixed with almond oil is a safe purgative for children and pregnant women, laxative in small dozes and purgative in larger doses. It is described as lenitive and useful in relieving thoracic obstructions. If combined with temarinds it is a good purge for adust bile. Externally it is used in gout and rheumatism. It is also employed in the essence of coffee. The flowers made to a confection (gulkand) are used in diabetes. The bark and leaves rubbed up and mixed with oil are applied to pustules. It is also used in skin diseases especially in ringworms. The infusion of leaves is used as purgative. The roots are strong purgative and used as tonic and febrifuge in Punjab. The pulp of the pods is used to flavour tobacco in Bengal (Watt, 1972).

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Unfortunately, this precious tree is very heavily infested with a leaf stitcher, *Piesmopoda obliquifascilla* Hmps. almost wherever the plant is grown. The infestation greatly hampers the photosynthetic activity of the plant and undermines the plant growth. Generally 50-75% or more foliage is destroyed by the leaf stitcher which apart from growth losses gives the plants a very bad appearance particularly on avenues.

The control of this pest is extremely important for healthy growth of this tree. Among control methods, the use of pesticides is hazardous, uneconomical and dangerous to the useful fauna present in the area of infestation. Biological methods of control besides being safer to the environment are cheaper and remain effective for longer durations. With this object in view *Beauveria bassiana*, a pathogenic fungus was tried against this pest.

Bassi (1835) demonstrated *B. bassiana* to be a pathogenic fungus. Since then many research workers like Vaney and Conte (1903). Barttlet and Lefebvre (1934), Pascalet (1939), Steinhaus (1956), Neilson (1957), Doane (1959), Turnock and Muldrew (1971), and Hafiz (1981) have found it effective against *Haltica* larvae; Corn borer, *Pyrausta nubilalis* (Hbn.); a wevil, *Stephanoderes hampei* Ferr; the housefly Musca domestica; Seagrape Sawfly, *Sericocera krugii* (Cresson); Silkworm; Codling moth; *Schizonycha profuga* Pering; Elm bark beetle, *Scolytis multistriata; Indarbela quadrinotata; Apriona cinerea* and *Aeolesthes sarta*. However in a few cases the attempts on biological control using *B. bassiana* did not succeed very much (Turnock and Muldrew, 1971).

Schaerffenberg (1957) stated that after *B. bassiana* infection circulation in insects slows down and ultimately stops. The slowing down is probably caused by the obstruction of the ostea by hyphal bodies. He further stated that *Leptinotarsa decemlineata* larvae could be infected via tracheae by *B. bassiana*. The findings of Conte and Levrat (1907), Pailot (1930), Lefebvre (1934) and Pilat (1938) suggest that the infection is not caused through the integument under laboratory conditions. Pilat (1938) states that *B. bassiana* infected larvae of *Loxostege stiticalis* through digestive tract, which also happens in *P. nubilalis* (Lefebvre, 1934). Hurpin and Vago (1958) reported that a number of *Beauveria* strains could infect *Melolontha melolontha* larvae which ingest the spores. The starved larvae of *Bathynoderes punctiventris* and silkworms easily succumbed to infection of *B. bassiana* (Gabriel, 1959). The infectivity of the fungus declines below 6°C whereas it succeeded at 8°C though slowly (Schaerffenberg, 1957). The mortality of codling moth due to this fungus at low temperature was not more than 2% (Neilson, 1957).

The effectiveness of *B. bassiana* was 92% against the larvae of *Scolytis multistriata* in humid habitats and only 4% in dry places (Doane 1959). Larvae of *Pyrausta nubilalis* became infected at lower relative humidity by *B. bassiana* (Jaynes and Marucci, 1947).

Materials and Methdos: The test insect larvae *(Piesmopoda obliquifasciella* Hmps) were collected from the infested leaves of *Cassia fistula* from Pakistan Forest Institute, Peshawar and reared on the leaves of host plant in the laboratory in sterilized petri dishes.

The infective material of *B. bassiana* was obtained from the dead larvae of *Indarbela quadrinotata* collected from Rawalpindi. A suspension of the fungal spores in 10 ml of distilled water was made and 3 dilutions of the same were prepared as below:

T_1	1.3×10^6
T_2	1.3×10^4
T_3	1.3×10^2

Caterpillars of *P. obliquifasciella* were released on *Cassia fistula* leaves sprayed with 5 ml of each suspension dose and placed in sterilized petri dishes. There were 10 larvae in each dish replicated 4 times under a complete randomised block design. In the check treatment to the leaves were sprayed with 5 ml of distilled water before release of larvae. The larvae were allowed to feed on the infected leaves for 2 - 5 days after which the fresh uninfected leaves were provided.

In order to avoid contamination sterilized apparatus was used at the time of each observation.

Infectivity and mortality of larvae was observed in each dish at every time of food change.

Results and Discussion: The fungus, *Beauveria bassiana* sprayed on the foliage of *Cassia fistula* infected the released larvae of *Piesmopoda obliquifasciella* probably through the digestive tract after the infected food was consumed by the larvae as stated by Hurpin and Vago (1958) and Pilat (1938) because it would not penetrate through the integument just by contact as mentioned by Conte and Levrat (1907), Paillot (1930) Lefebvre (1934) and Pilat (1938).

The infected test larvae showed sluggishness in the beginning later on stopping all movements. A white coating of fungal growth on the infected larval body appeared confirming their cause of death. The mortality of test larvae thus occurring in various treated dishes and the natural mortality of larvae occurring in check treatment was recorded and data compiled into a table presented below:

Table 1

Per cent Mortality of P. obliquifasciella *larvae in various doses of* B. bassiana *in the laboratory*

Doses	Larval mortality after (days)									Total	Mortality %
	5	11	15	18	20	23	25	26	29		
T_0	0	4	1	3	0	7	3	1	1	20	50.0
T_1	5	28	4	0	1	0	1	0	0	39	97.5
T_2	6	20	4	0	0	0	1	0	0	31	77.5
T_3	1	25	2	0	0	1	0	0	0	29	72.5

For the purpose of significance test of the results statistical analysis of the following data was carried out by applying "F" test and l.s.d. test.

Table 2

Mortality of test larvae in various treatments out of ten larvae in each replication

Treatment	R_1	R_2	R_3	R_4	Total	%
T_0	4	5	6	5	20	50.0
T_1	10	10	9	10	39	97.5
T_2	8	8	7	8	31	77.5
T_3	7	6	8	8	29	72.5

"F" test showed that treatments of doses are highly significant and comparison of 4 doses by l.s.d. test revealed that mortality due to T_1 dose is significantly higher than all other doses. T_0 being check treatment is the poorest and T_2 and T_3 are of the same nature.

The test insect is a leaf stitcher and lives among two or more stitched leaves for most part of its life. In this experiment the insect had to be disturbed after every 2 - 5 days for food change and observation hence it had to construct its new abode every time by stitching the leaves therefore higher natural mortality occurred. But it is quite evident that the fungus treatments showed significantly clear distinction between the treated and untreated lots indicating the efficacy of *Beauveria bassiana* against the test insect.

Conclusion: The fungus, *B. bassiana* of *Indarbela quadrinotata* has proved its pathogenicity against *P. oblequifasciella* in this trial. This pathogenic fungus can therefore be used for the control of this serious leaf stitcher of *Cassia fistula* in the field. The spraying of fungus is not going to cause any environmental hazard or pollution and is very safe against birds, mamals, fish and other useful fauna apart from being very cheap method of control.

References

1. BARTTLET, K.A. and LEFEBVRE, C.L. 1934. Field observations with *Beauveria bassiana* (Bals.) Vuill., a fungus attacking the European corn borer, J. Econ. Ent. 27: 1147-1157.

2. BASSI, A. 1835. Del mal sengo calcinaccio o mascardino malattia che offlige i bachi da. I. Teorica Tip. Orcesi, Lodi.

3. CONTE. A., and LEVRAT, D. 1907. Les maladies du ver a soie. Rappt. Lab. Soie, Lyon, 13.

4. DOANE, C.C. 1959. *Beauveria bassiana* as a pathogen of *Scolytus multistriata.* Ann. Entomol. Soc. America, 52: 109-111.

5. GABRIEL, B.P. 1959. Fungus infection of insects via the alimentary tract. J. Insect Pathol. 1: 319-330.

6. HAFIZ, I.A. 1981. A Preliminary Study on the Microbial Control of Poplar Borers; *Indarbela quadrinotata*, *Apriona cinera* and *Aeolesthes sarta*, M.Sc. Thesis. Dept. Zool., Univ. Peshawar.

7. HURPIN, B., and VAGO, C. 1958. Les maladies du honneton. Commun *(Melolontha melolontha* L.) (Coleoptera—Sacarabaeidae). Entomophaga, 3: 285-330.

8. JAYNES, H.A. and MARUCCI, P.E. 1947. Effect of artificial control practices on the parasites and predators of the dodling moth. J. Econ. Entomol., 40: 9-25.

9. LEFEBVRE, C.C. 1934. Penetration and development of the fungus *Beauveria bassiana* (Bals.) Vuill. in the tissue of the corn borer. Ann. Botany (London), 48: 441-452.

10. NEILSON, C.L. 1957. Handbook of the main economic insects of British Columbia, Part 4. Entomol. Branch, Dep. Agric. Brit. Columb.

11. PAILLOT, A. 1930. "Traite des moladies du ver a soie, 279 pp. Doin, Paris.

12. PASCALET, P. 1939. La lutte biologique contre *Stephanoderes hampei* ou scolyte du cafeier Cameroun. Rev. botan. appl. et agr. trop., 19: 753-764.

13. PEARSON, R.S., and BROWN, H.P. 1932. Commercial Timbers of India Vol. I. pp. 403-406.

14. PILAT, M.V. 1938. Permeability of the chitin of insects to entomogenous fungi. (In Russia). Lenin Acad. Agri. Sci. (Med.) (U.S.S.R.) 8: 73-75.

15. SCHAERFFENBERG, B. 1957. *Beauveria bassiana* (Vuill.) Link. als Parasit des Kartoffelkafers *(Leptinotarsa decemlineata* Say). Anz. Schadlingskunde, 30: 69-75.

16. STEINHAUS, E.A. 1956. Microbial control—the emergence of an idea. Calif. Agri. Expt. Sta. Hillgardia, 26: 107-160.

17. TURNOCK, W.J., and MULDREW, J.A. 1971. *Pristiphora erichsonii* (Hartig), larch sawfly. C.I.B.C. Tech. Bull, 4: 175-180.

18. VANEY, C., and CONTE. A. 1903. The use of entomogenous fungi in destroying fleabeetle larvae. C.R. Acad. Sci. Paris, 136.

19. WATT, G. 1972. A Dictionary of Economic Products of India, II: 217-219.