www.czasopisma.pan.pl PAN POLSKA AKADEMIA NAUK www.journals.pan.pl

JOURNAL OF PLANT PROTECTION RESEARCH Vol. 50, No. 1 (2010)

DOI: 10.2478/v10045-010-0009-1

FIRST RECORD OF ENTOMOPATHOGEN *BEAUVERIA BASSIANA* (BALS.-CRIV.) VUILL. ON *ZYGOGRAMMA BICOLORATA* PALLISTER, A BIOCONTROL AGENT OF *PARTHENIUM HYSTEROPHORUS* L.

Poonam Dubey[1], Puja Ray[2], Akhilesh K. Pandey[2]*

[1]Forest Entomology Division, Tropical Forest Research Institute, Jabalpur- 482021 (M.P.), India
[2]Mycological Research Laboratory, Department of Biological Science, R.D. University, Jabalpur, (M.P.), India

Received: August 6, 2009
Accepted: November 12, 2009

Abstract: Entomopathogenic fungi have great potential as biological control agents against insect pests. So they are being developed worldwide for the control of many pests of agricultural importance. But their effect on non-target insects, such as natural enemies has been a matter of great concern. Recently we came across an entomopathogen infecting a laboratory culture of *Zygogramma bicolorata,* a potential biocontol agent of noxious weed, *Parthenium hysterophorus*. The pathogen was isolated from the grubs and beetles and identified as *Beauveria bassiana*. In the present paper, the entomopathogen, *B. bassiana* is reported and described for the first time from the laboratory culture of *Z. bicolorata*.

Key words: *Beauveria bassiana,* entomopathogen, non-target effect, *Parthenium hysterophorus*, *Zygogramma bicolorata*

INTRODUCTION

Entomopathogenic fungi, *Beauveria bassiana* (Bals.) Vuill. (Deuteromycetes: Moniliales) is a pathogen of many insect species (Khachatourians *et al.* 2002; Bhattacharya *et al.* 2003). It is capable of infecting a wide range of insects of the order Lepidoptera, Coleoptera and Hymenoptera, most of which are agricultural pests. So it received much attention for its potential use in the biological control of a variety of insect pests resulting in their mortality (Hajek *et al.* 1987; Johnson and Goettel 1993; Lord 2001). The biocontrol potentiality of this fungus has been exploited, making use of the local isolates collected from either soil or from dead insect hosts prevailing in different geographic areas (Padmaja and Kaur 2001). The insect disease caused by the fungus is called white muscardine disease. When the microscopic spores of the fungus come into contact with the body of an insect host, the fungal conidia become attached to the insect cuticle and, after germination, the hyphae penetrate the cuticle and proliferate in the insect's body. High humidity or free water is essential for conidial germination, and infection establishes between 24 and 48 h. The infected insect may live for three to five days after hyphal penetration. After death of the insect, the conidiophores bearing conidia are produced on cadaver. Different isolates of *B. bassiana* can have different host range varying from monospecific to infecting a wide range of insects (Fargues and Remaudiere 1977). But several isolates of *B. bassiana* cause mortality of non-target, economically important insects also (Goettel *et al.* 1990; Danfa and vander Valk 1999; Lord 2001).

The alien, invasive *Parthenium hysterophorus* L. (Asteraceae) has emerged as one of the major weeds in several tropical and subtropical regions of the world, including India. In last few decades, since being noticed in Pune in 1956 it has aggressively invaded wastelands, road and rail sides, along water channels, agricultural fields and forests rendering serious hazards to human and animal health, crop production and biodiversity (Evans 1997; Shabbir and Bajwa 2006). The host specific, phytopgagus Mexican beetle, *Z. bicolorata* Pallister (Coleoptera: Chrysomelidae), is a potential biocontrol agent for noxious invasive weeds. It was introduced in India in 1984 and proved to be a potential biological control agent of parthenium since 1988 (Jayanth and Bali 1994; Dhileepan 2001; Dhiman and Bhargava 2005).

During laboratory rearing, mortality of grubs and adults of *Z. bicolorata* due to the fungal pathogen was observed. Dead grubs and adults were found covered with white mycelial growth. The pathogen was isolated from beetles and identification was attempted.

MATERIALS AND METHODS

Mass rearing of *Z. bicolorata* was done under laboratory condition at 27±2°C and 75±10% relative humidity in insect rearing cages. Several grubs and adults of the beetle were found dead and covered with white mycelium was collected from the insect rearing boxes in the laboratory. The fungi were isolated from these cadavers and inoculated on potato dextrose agar medium (PDA) in

*Corresponding address:
puja.ray@gmail.com

sterilized laminar flow chamber (Butt and Goettel 2000). These plates were incubated in BOD incubator at 26°C under 12 h photoperiod. Slide culture of the fungi was also done and microscopic study was performed under 400x magnification using stereoscopic microscope (Sterio Zoom Leica Model WILD M3Z). Camera lucida diagrams were drawn while using Triumph Trinocular Microscope at 400x magnification.

RESULTS AND DISCUSSION

The fungus infecting *Z. bicolorata* was identified as *B. bassiana*. The growth rate of the fungus is moderately rapid. The colony reaches a diameter of 8 cm following incubation at 25°C for 7 days on potato dextrose agar (PDA). The colony on PDA had a cottony texture and the surface was yellowish white while the reverse was white (Fig. 1).

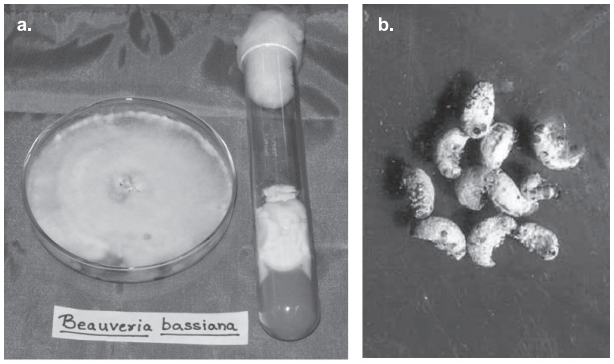

Fig. 1. *B. bassiana*: (a) culture; (b) larvae of *Z. bicolorata* covered by the pathogen

The hyphae were hyaline, septate (2.5 µm wide) and narrow. The conidiogenous cells on hyphae were typically flask shaped (2.5–3.75 µm long, 2.5 µm wide) with an inflation at the base and narrow zigzag filaments (3.75–5 µm long) at the apex. Laterally from the filaments conidia were produced from each bending point. This type of conidium production is called sympodial geniculate growth. Conidia were hyaline, one celled globose to ovoid in shape of 2.5 µm diameter. Conidiogenous cell tends to form dense clusters (Fig. 2). Several authors made similar observations on morphological characteristics, growth, colony characteristics, etc. (Thomas *et al.* 1987; Samson *et al.* 1988; Glare and Inwood 1998; Fernandes *et al.* 2009).

The damage caused by the pathogen to a laboratory culture of *Z. bicolorata* still needs to be determined in terms of both disease causing potential and economic losses. It was seen that the activity of bioagents is reduced specially because of continuous mass rearing under laboratory conditions for many generations. Much of this reduced activity can be attributed to an increase in entomopathogenic disease in the insects. Disease prevention is often a problem and is at times a limiting factor for mass rearing of the biocontrol agents. They may adversely affect many aspects of the insect biology including larval and pupal development, adult longevity, fecundity, diapause, etc. The importance of eliminating entomopathogens from the

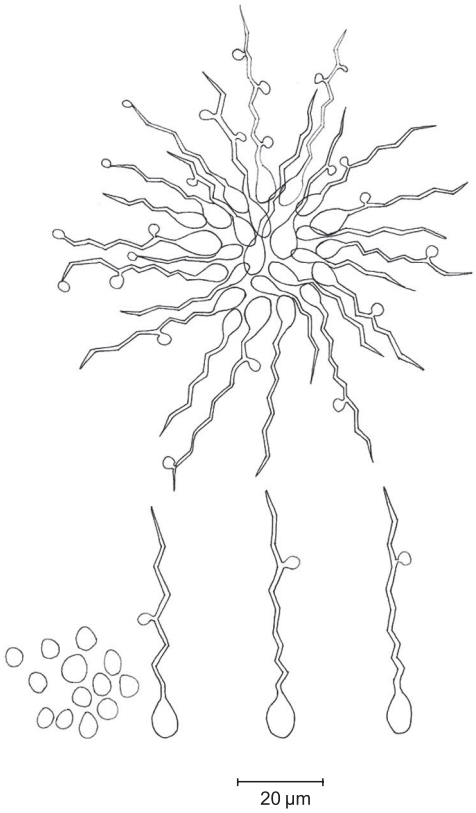

Fig. 2. *B. bassiana* – clusters of conidiophores

colony of the beetles can be debated as decontaminated population can acquire similar disease after release from the environment. However only the disease free individuals should be breed and released. Precautions should be implemented to prevent a concurrent introduction of a disease that may impair effectiveness of the beetles.

REFERENCES

Bhattacharya A.K., Mondal P., Ramamurthy V.V., Srivastava R.P. 2003. *Beuveria bassiana*: A potential bioagent for innovative integrated pest management programme. p 381–491. In: "Biopesticides and Bioagents in Integrated Pest Management of Agricultural Crops" (R.P. Srivastava, ed.). International Books Distributing Co., Lucknow, 860 pp.

Butt T.M., Goettel M.S. 2000. Bioassays of entomogenous fungi. p. 141–195. In: "Bioassays of Entomopathogenic Microbes and Nematodes" (A. Navon, K.R.S. Ascher, eds.). CABI Wallingford, UK., 324 pp.

Danfa A., vander Valk H.C.H.G. 1999. Laboratory testing of *Metarhizium* spp. and *Beauveria bassiana* on Sahelian non-target arthropods. Biocontrol Sci. Technol. (9): 187–198.

Dhileepan K. 2001. Effectiveness of introduced biocontrol insects on the weed *Parthenium hysterophorus* (Asteraceae) in Australia. Bull. Entomol. Res. 91: 167–176.

Dhiman S.C., Bhargava M.L. 2005. Seasonal occurrence and biocontrol efficacy of *Zygogramma bicolorata* Pallister (*Coleoptera: Chrysomelidae*) on *Parthenium hysterophorus*. Ann. Plant Protect. Sci. 13: 81–84.

Evans H.C. 1997. *Parthenium hysterophorus*: a review of its weed status and the possibilities for biological control. Biocontrol News Inf. 18: 89–98.

Fargues J., Remaudiere G. 1977. Considerations on the specificity of entomopathogenic fungi. Mycopathologia 62: 31–37.

Fernandes E.K.K., Moraes A.M.L., Pacheco R.S., Rangel D.E.N., Miller M.P., Bittencourt V.R.E.P., Roberts D.W. 2009. Genetic diversity among Brazilian isolates of *Beauveria bassiana*: comparisons with non-Brazilian isolates and other *Beauveria* species. J. Appl. Microbiol. 107 (3): 760–774.

Glare T.R., Inwood A.L. 1998. Morphological and genetic characterisation of *Beauveria* spp. from New Zealand. Mycol. Res. 102: 250–256.

Goettel M.S., Poprawski T.J., Vandenberg J.D., Li Z., Roberts D.W. 1990. Safety to non-target invertebrates of fungal biocontrol agents. p. 209–231 In: "Safety of Microbial Insecticides" (M. Laird, L.A. Lacey, E.W. Davidson, eds.). CRC Press, Boca Raton, FL, 272 pp.

Hajek A.E, Soper S.R., Roberts D.W, Anderson T.E, Biever K.D., Ferro N.D., LeBrun R.A., Storch R.H. 1987. Foliar applications of *Beauveria bassiana* (Balsamo) Vuillemin for control of the colorado potato beetle, *Leptinotarsa decemlineata* (Say) (*Coleoptera: Chrysomelidae*): an overview of pilot test results from the northern United States. Can. Entomol. 119 (11): 959–974.

Jayanth K.P., Bali G. 1994. Biological control of *Parthenium hysterophorus* by beetle *Zygogramma bicolorata* in India. FAO Plant Protect. Bull. 42 (4): 207–212.

Johnson D.L., Goettel M.S. 1993. Reduction of grasshopper populations following field application of the fungus *Beauveria bassiana*. Biocontrol Sci. Technol. 3 (2): 165–175.

Khachatourians G.G, Valencia E.P., Miranpuri G.S. 2002. *Beuveria bassiana* and other entomopatrhogenic fungi in the management of insect pests. p. 239–275. In: "Microbial Biopesticides" (O. Koul, G.S. Dhaliwal, eds.). Taylor and Francis, London, 340 pp.

Lord J.C. 2001. Response of the wasp *Cephalonomia tarsalis* (Hymenoptera: Bethylidae) to *Beauveria bassiana* (*Hyphomycetes: Moniliales*) as free conidia or infection in its host, the sawtoothed grain beetle, *Oryzaephilus surinamensis* (Coleoptera: Silvanidae). Biol. Control (21): 300–304.

Padmaja A.V., Kaur G. 2001. Use of the fungus *Beauveria bassiana* (Bals.) Vuill (*Moniliales: Deuteromycetes*) for controlling termites. Curr. Sci. 81 (6): 645–647.

Samson R.A., Evans H.C., Latge T.P. 1988. Atlas of Entomopathogenic Fungi. Springer-Verlag, Netherlands, 187 pp.

Shabbir A., Bajwa R. 2006. Distribution of parthenium weed (*Parthenium hysterophorus* L.), an alien invasive weed species threatening the biodiversity of Islamabad. Weed Biol. Manage. 6: 89–95.

Thomas K.C., Khachatourians G.G., Ingledew W.M. 1987. Production and properties of *Beauveria bassiana* conidia cultivated in submerged culture. Can. J. Microbiol. 33: 12–20.

POLISH SUMMARY

PIERWSZE DONIESIENIE O ENTOMOPATOGENIE *BEAUVERIA BASSIANA* (BALS.-CRIV.) VUILL. NA *ZYGOGRAMMA BIOCOLORATA* PALLISTER, CZYNNIKU BIOLOGICZNEGO ZWALCZANIA *PARTHENIUM HYSTEROPHORUS* L.

Grzyby entomopatogeniczne mają duży potencjał jako czynniki biologicznego zwalczania szkodników owadów, co spowodowało, że zainteresowano się ich rozwojem, w celu zwalczania wielu ważnych szkodników w rolnictwie. Są one ich naturalnymi wrogami. Ostatnio wykryto entomopatogena infekującego laboratoryjną kulturę *Zygogamma bicolorata*, który jest potencjalnym czynnikiem biologicznego zwalczania szkodliwego chwastu *Parthenium hysterophorus*. Patogen ten został wyosobniony z larw chrząszczy i określony jako *Beauveria bassiana*. Artykuł jest pierwszym doniesieniem i pierwszym opisem *Z. bicolorata* z kultury laboratoryjnej.