Journal of Biological Control, 24 (3): 288–290, 2010

Research Note

Natural biocontrol agents of *Aeginetia pedunculata* (Roxb.) Wall. (Orobanchaceae), a root holoparasitic angiosperm of sugarcane

BIKASH RANJAN RAY[1*] and MRINAL KANTI DASGUPTA[2]

[1]*Sugarcane Research Station, Bethuadahari 741 126, Nadia, West Bengal, India.*

[2]*Department of Plant Protection, Institute of Agriculture, Visva-Bharati, Sriniketan 731236, Birbhum, West Bengal, India.*

**Corresponding author E-mail*: brray2@yahoo.co.in

ABSTRACT: Root holoparasitic angiosperm, *Aeginetia pedunculata* (Roxb.) Wall. (Orobanchaceae) causes wilt disease in sugarcane around sugar factory areas at Plassey, West Bengal. Periodic surveys in the infected sugarcane plots revealed the occurrence of two insect herbivores, *Spilosoma obliqua* and *Gonocephalum depressum* and two fungal pathogens, *Fusarium oxysporum* and *Erysiphe cichoracearum* on *A. pedunculata*. It was estimated from field observations that these insect and fungal species reduced seed capacity of *A. pedunculata* by 25.1, 88.5, 80.0 and 50.9%, respectively. Though the insect species are polyphagous and the fungal pathogens are polytrophic in nature, these were found to reduce the seed production capacity of the root parasitic angiosperm causing wilt disease in sugarcane. A suitable strategy for enhancing the activities of these agents in nature and studying the specificity of *F. oxysporum* and *E. cichoracearum* to *A. pedunculata* may lead to the management of this parasitic angiosperm in the sugarcane ecosystem.

KEY WORDS: Sugarcane, parasitic weed, *Aeginetia pedunculata*, *Spilosoma obliqua*, *Gonocephalum depressum*, *Fusarium oxysporum*, *Erysiphe cichoracearum*

(Article chronicle: Received: 07.01.2010; Sent for revision: 14.05.2010; Accepted: 04.06.2010)

INTRODUCTION

Aeginetia pedunculata (Roxb.) Wall. (Orobanchaceae), is the causal organism associated with wilt in sugarcane around the command area of a sugar factory at Plassey in Nadia district of West Bengal, India. The crop loss in sugarcane was estimated at 51, 58 and 36% with respect to loss of brix, sucrose and commercial cane sugar, respectively (Ray and Dasgupta, 2006). In the absence of genetic resistance against *A. pedunculata* among sugarcane cultivars (Ray and Dasgupta, communicated), and its wild relatives such as *Saccharum spontaneum* (Ray and Dasgupta, 2009) and *Erianthus arundinaceus* (Ray and Dasgupta, 2010), the main options for management are hand weeding, use of herbicides and crop rotation with trap or catch crops. However, identification of natural enemies of *A. pedunculata* might be an important component to manage its severity in sugarcane ecosystem. Occurrence of insect herbivores was reported on *A. indica* L. and *Christisonia wightii* Elmer (both Orobanchaceae) that parasitized sugarcane in the Philippines. These include *Platyptilia* sp., which damaged 60-90% flower buds and *Daulia* sp. on the tender portion of stem of *A. indica* (Lee, 1931; Lee and Goseco, 1932). Both these insects were polyphagous and had short life span. Agromyzid fly, *Phytomyza orobanchia* Kalt. was successfully used to control *Orobanche cumana* Wallr. and *O. cernua* Loefl. in the former Soviet Union by inundative method (Klein and Kroschel, 2002). In India, a number of natural biocontrol agents were reported on *O. cernua* (Manjunath and Nagarkatti, 1977, Klein and Kroschel, 2002). The only fungal antagonist, *Sclerotium* sp. was reported on *C. wightii* that parasitized sugarcane in the Philippines (Goseco, 1932; Quisumbing, 1940) and fungal antagonists of the genus *Fusarium*, especially *F. oxysporum*, which have been isolated from diseased plants of *Striga hermonthica* and *Orobanche cumana* and these were highly host specific and non-pathogenic to a wide range of crops tested (Kroschel *et al*., 2000).

To explore the possibilities of using natural agents for suppression of *A. pedunculata*, surveys were conducted in *A. pedunculata* infected sugarcane fields around Plassey sugar factory area (88°22'E; 23°36'N; and 15 m from mean sea level) during 2001-2007. The infected *A. pedunculata* plants were labelled in the field and data recorded at monthly interval on time of occurrence, plant parts damaged, intensity of damage and reduction in the

Table 1. Effect of naturally occurring insects and disease causing organisms on seed load of *A. pedunculata*

Natural biocontrol agent	Time of occurrence	Damaged plant part	Intensity of damage (%)	Seed load per plant ('000)	Reduction in seed load (%)
Spilosoma obliqua	Jul-Aug	Flower, bud	3.1	50.9	25.1
Gonocephalum depressum	Oct-Nov	Seed	94.7	7.8	88.5
Fusarium oxysporum	Jul-Sep	Entire plant	38.9	13.6	80.0
Erysiphe cichoracearum	Nov-Dec	Flower head	73.0	33.4	50.9
Control	–	–	–	68.0	
CD (5%)	–	–		13.0	
CV	–	–		117.7	

seed load of *A. pedunculata*. Data were also recorded from nearby *A. pedunculata*-free sugarcane fields for comparison. The method was replicated on at least ten *A. pedunculata* plants for each insect herbivore or fungal pathogen. The data were analyzed with randomised block design ($P = 0.05$).

The insect specimens collected were identified at Zoological Survey of India, Kolkata. For identification of the fungal pathogens, just emerged *A. pedunculata* buds with symptoms of fungal infection (e.g. browning, wilting or rot) and dead plants were collected from sugarcane fields, air dried, and brought to the laboratory. Diseased tubercles and juvenile *A. pedunculata* stalks were first washed with tap water, sterilized in 1% NaOCl for 5 min and rinsed several times with sterile distilled water. Tissue fragments were then placed on 6% water agar in Petri plates. The plates were incubated at 25°C and observed daily for fungal growth (Boari and Vurro, 2004). Chloramphenicol (155 mM) was added in the medium to prevent bacterial growth. Ten days later, colony forming units (CFUs) growing as fungal hyphae out of the parasite pieces were sub cultured on potato dextrose agar (PDA). Single spore isolates of each strain were sub cultured and one of the resulting colonies was used to inoculate several dishes (Amsellem *et al*., 2001). The fungal strain met Koch's postulates for primary pathogen and was maintained on PDA. Isolated fungal strains were taxonomically classified with the help of reference literature (Thomas *et al*., 1999). The insect herbivores and fungal pathogens occurring on *A. pedunculata* are described below:

Jute hairy caterpillar, Spilosoma obliqua *Walker* (*Lepidoptera: Arctiidae*)

Fourth instar larva of the jute hairy caterpillar migrated in swarms from adjacent jute field during August and fed voraciously upon the floral parts of *A. pedunculata* causing significant damage. The insect occurred only on a few *A. pedunculata* plants (3.1%) (Table 1) and was found associated for a short period of about two weeks. The insect had no effect on the *A. pedunculata* flower heads, which grew normally later on.

Dusty surface beetle, Gonocephalum depressum *Fab.* (*Coleoptera: Tenebrionidae*)

Adults of *G. depressum* congregate on the mature and dry *A. pedunculata* plants and feed selectively on the seeds of the capsule during October-November. The intensity of damage was very high (97.5%) and the reduction in *A. pedunculata* seed load was also the highest (88.5%) (Table 1). This insect is reported as a pest of seedlings of vegetables and pulses. Therefore, use of this insect herbivore for control of *A. pedunculata* remained uncertain. *G. depressum* is also reported to feed on the rootlets of crops such as sugarcane, coffee and tobacco (Ananth, 1962) and *O. cernua* in India (Manjunath and Nagarkatti, 1977).

Wilt (*c.o.* Fusarium oxysporum *Schlecht*)

During rainy season (July-September), wilting and rotting of *A. pedunculata* were observed in sugarcane field. The intensity of infection by *F. oxysporum* was 38.9% and effectively reduced the seed load of *A. pedunculata* by 80% in sugarcane field (Table 1). *Fusarium moniliforme* is also known as a causal organism of wilt in sugarcane.

Powdery mildew (*c.o.* Erysiphe cichoracearum *DC.*)

Symptom of powdery mildew was observed on young *A. pedunculata* flower heads in the sugarcane field during November-December resulting in no capsule or seed formation. The intensity of infection was 73% and reduction of seed load was 50.8% (Table 1).

All these naturally occurring agents are first reports in respect of *A. pedunculata*. There are limitations in using these polyphagous insects as biocontrol agents and for these polytrophic fungal pathogens as mycoherbicide without studying the specificity of *F. oxysporum* and *E. cichoracearum* for *A. pedunculata*. Still this finding raises

the hope that a suitable strategy can be developed for enhancing the activity of these agents in nature to augment the management of the parasite.

ACKNOWLEDGEMENTS

The authors are grateful to the Joint Director, Central National Herbarium, Botanical Survey of India, Botanical Garden, Howrah, West Bengal, India for identification of *Aeginetia* sp. and to the Director, Zoological Survey of India, Kolkata, for identification of the insect species.

REFERENCES

Amsellem, Z., Kleifeld, Y., Kerenyi, Z., Hornok, L., Goldwasser, Y. and Gressel, J. 2001. Isolation, identification and activity of mycoherbicidal pathogens from juvenile broomrape plants. *Biological Control*, **21**: 274–284.

Ananth, K. C. 1962. Occurrence of *Gonocephalum bilineatum* Walk. (Col.: Tenebrionidae) in coffee soils. *Current Science*, **8**: 341.

Boari, A. and Vurro, M. 2004. Evaluation of *Fusarium* spp. and other fungi as biological control agents of broomrape (*Orobanche ramosa*). *Biological Control*, **30**: 212–219.

Goseco, F. P. 1932. Preliminary report on *Christisonia wightii* Elmer, a new plant parasite of sugarcane. *Sugar News*, **13**: 73–74.

Klein, O. and Kroschel, J. 2002. Biological control of *Orobanche* spp. with *Phytomyza orobanchia*: A review. *BioControl*, **47**: 245–277.

Kroschel, J., Mueller-Stoever, D., Elzein, A. and Sauerborn, J. 2000. The development of mycoherbicides for the management of parasitic weeds of the genus *Striga* and *Orobanche* – a review and recent results, pp. 139 – 140. *Proceedings of the X International Symposium on Biological Control of Weeds,* 4-14 July 1999, Montana State University, USA.

Lee, A. 1931. Studies of the flowering parasite, *Aeginetia indica*, pp. 272–287. Annual Report of Division of Research, Philippine Sugar Association, Manila, The Philippines.

Lee, A. and Goseco, F. 1932. Studies of the sugarcane root parasite, *Aeginetia indica*. *Proceedings of International Society of Sugar Cane Technologists (ISSCT) Congress (San Juan)*. **4**: 1–12.

Manjunath, T. M. and Nagarkatti, S. 1977. Natural enemies of *Orobanche* in India and possibilities of its biological control. *Technical Bulletin of the Commonwealth Institute of Biological Control*, **18**: 75–83.

Quisumbing, E. 1940. On *Christisonia wightii* Elmer, a parasite of sugarcane. *The Philippine Journal of Agriculture*, **11**: 397–401.

Ray, B. R. and Dasgupta, M. K. 2003. First report of *Aeginetia pedunculata* causing sugarcane wilt in India. *Haustorium*, **44**: 2–3.

Ray, B. R. and Dasgupta, M. K. 2006. Sugarcane crop loss due to wilt caused by parasitic angiosperm *Aeginetia pedunculata* (Roxb.) Wall. (Orobanchaceae). *Journal of Mycology and Plant Pathology*, **36**: 31–34.

Ray, B. R. and Dasgupta, M. K. 2009. Three newly recorded natural hosts of *Aeginetia pedunculata* (Roxb.) Wall. (Orobanchaceae). *Journal of Mycology and Plant Pathology*, **39**: 163–165.

Ray, B. R. and Dasgupta, M. K. 2010. *Erianthus arundinaceus*: a new host of *Aeginetia pedunculata*. *Journal of Mycology and Plant Pathology*, **40**: 283–286.

Thomas, H., Heller, A., Sauerborn, J. and Müller-Stöver, D. 1999. *Fusarium oxysporum* f. sp. *orthoceras*, a potential mycoherbicide, parasitizes seeds of *Orobanche cumana* (sunflower broomrape): a cytological study. *Annals of Botany*, **83**: 453–458.