A brief review of *Zygogramma bicolorata* as a potential biocontrol agent of parthenium in India

Vipul
Department of Agricultural Entomology
Anand Agricultural University, Anand - 388110, Gujarat, India
Corresponding author: vipulbhatia9870@gmail.com

Zygogramma bicolorata Pallister, parthenium beetle so called for their feeding behavior on parthenium weed belongs to order: Coleoptera family: Chrysomelidae. Parthenium weed, *Parthenium hysterophorus* L., family: Asteraceae (Compositae), is also called as carrot weed or congress grass in India. It is a noxious herbaceous annual weed mainly found in agricultural fields, pastures and wastelands worldwide. Although this devastating weed could be controlled by mechanical and chemical methods these are most labour intensive and not cost effective methods. Chemical methods cause environment and soil hazards. Further chemical methods are practically unsuitable for large area and also not effective for long term use. Biological control is the only next best attractive option available.

Zygogramma bicolorata was introduced to India from Mexico in 1984 to control parthenium weed and since then only the leaf-feeding beetle *Z. bicolorata* has been introduced (Jayanth, 1987). In Australia eight species of insects and one rust fungi have been introduced from 1977 *viz.*, leaf feeding beetle *Zygogramma bicolorata*, stem boring weevil *Listronotus setosipennis*, stem galling moth *Epiblema strenuana*, leaf mining moth *Bucculatrix parthenica*, seed feeding weevil *Smicronyx lutulentus*, sap feeding bug *Stobaera concinna*, stem galling moth *Platphalonidia mystica*, stem gall weevil *Conotrachelus* sp. and rust fungus *Puccinia abrupta* var. *partheniicola*. Among them, six species of insects and one rust fungi have been successfully established as biological control agents but stem galling moth *Platphalonidia mystica* and stem gall weevil *Conotrachelus sp.* is not established so far (Dhileepan and McFadyen, 1997). The female beetle lays about 650-700 yellow eggs either singly or in groups on leaves, flower, stems and terminal buds of plant. Larvae hatched after 1.5 to 3 days. Larvae voraciously feed on the leaves for 12 to 16 days. After 4th instar it enters the soil and pupates below the soil. The beetles emerged after 8-10 days and completed their life cycle in 25 to 28 days. Both adults and larvae are damaging stages and are capable of feeding on the parthenium leaves (Singh *et al.,* 2017).

Adults of *Z. bicolorata* burrow the soil and entered into diapause from period of July-Dec and emerge in May-June when rain commences. *Zygogramma. bicolorata* has peculiarity in their feeding behavior which makes it an efficient biological control agent (BCA). Firstly, it defoliates parthenium plants in a particular area and then migrates and feed on plants of new area. As a result, beetles can control parthenium weed over large area. Secondly, since diapause takes place throughout the breeding season some diapausing adults are left behind at each location where newly emerged beetle tackle the recurrent growth of the weed during the following year. It eliminates the necessity of reintroduction of the beetle in the area where it was once introduced. It is not clear what triggers diapause behaviour in *Z. bicolorata*, because it also entered in diapause stage even when abundant food was available and weather conditions was favourable. But diapause can be broken by continuously exposing adults to temperatures of 30°C, 35°C and 40°C for 22 days, nine days and 10 hours, respectively during February-March (Jayanth and Bali, 1993).

Although this beetle proved as promising biological control agent resulting in up to 99.5% reduction in the parthenium weed density in Bangalore region (Jayanth and Visalakshy, 1996), soon after its introduction to India it started feeding on an important oilseed crop, sunflower *Helianthus annuus* (Sridhar, 1991). This report brought biocontrol programme to a halt. Jayanth *et al.,* (1998) then reported that this feeding was only due to falling of pollen of parthenium plant on sunflower crop. Pollen and flower of parthenium contain parthenin which is a phagostimulant specific only to *P. hysterophorus*. Adult beetle which regularly feed on parthenium crop is unable to oviposit on sunflower crop and also larva could not feed on sunflower because this parthenin content causes degeneration of ovaries in beetles. Further many host specificity tests have confirmed that *Z. bicolorata* is specialised to feed on parthenium rather than cultivated crops. Few reports of attack of beetle on other crops are also present but damage to those plants is negligible (Jayanth and Nagarkatti, 1987). Thus we can say that *Z. bicolorata* is most effective and promising BCA to eradicate *P. hysterophous* in India till now. In future more BCA should be imported to India in the line of Australia.

References:

Dhileepan, K., and McFadyen, R. E. 1997. Biological control of parthenium in Australia–progress and prospects. In *Proceedings of the First International Conference on Parthenium Management*. The University of Agricultural Sciences. 1, 40-44

Jayanth, K. P. 1987. Introduction and establishment of *Zygogramma bicolorata* on *Parthenium hysterophorus* at Bangalore, India. *Current Science, 56*(7), 310-311.

Jayanth, K. P., and Bali, G. 1993. Diapause behaviour of *Zygogramma bicolorata* (Coleoptera: Chrysomelidae), a biological control agent for *Parthenium hysterophorus* (Asteraceae), in Bangalore, India. *Bulletin of entomological research, 83*(3), 383-388.

Jayanth, K. P., and Ganga Visalakshy, P. N. 1996. Succession of vegetation after suppression of parthenium weed by *Zygogramma bicolorata* in Bangalore, India. *Biological Agriculture and Horticulture*, *12*(4), 303-309.

Jayanth, K. P., and Nagarkatti, S. 1987. Investigations on the host-specificity and damage potential of *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae) introduced into India for the biological control of *Parthenium hysterophorus*. *Entomon, 12*(2), 141-145.

Jayanth, K. P., Visalakshy, P. G., Chaudhary, M., and Ghosh, S. K. 1998. Age-related feeding by the parthenium beetle *Zygogramma bicolorata* on sunflower and its effect on survival and reproduction. *Biocontrol Science and Technology*, *8*(1), 117-123.

Singh, S., Gill, P. K., Dhaliwal, H. S., and Kumar, V. 2017. Life cycle and effectiveness of *Zygogramma bicolorata* Pallister (Chrysomelidae: Coleoptera) on *Parthenium hysterophorus* eradication. *Journal of Global Agriculture and Ecology, 7*(2), 60-65.

Sridhar, S. 1991. A cure no more, under attack the sunflower crop. *Frontline*, *100,* 9-22.