

Evaluation Of Feeding Potential Of Mexican Beetle (*ZYGROGAMMA BICOLORATA*) On Carrot Grass (*PARTHENIUM HYSTEROPHORUS*) In Dehradun District, Uttarakhand

Abstract:

Zygogramma bicolorata is an efficient natural control agent which can be used against *Parthenium hysterophorus*, a very common and allergic weed found in the Dehradun belt of Uttarakhand region. It is responsible for asthma, bronchitis, skin lesions, rashes, contact dermatitis, hay fever and various respiratory ailments. *Z. bicolorata* is a natural predator to this vicious weed. The feeding capacity of Mexican beetle, *Zygogramma bicolorata* was studied under controlled conditions, Department of Zoology, S.G.R.R. University, Dehradun, Uttarakhand 2023. Ten different sites were chosen from the Dehradun district considering the widespread availability of Parthenium weed in the region. It was detected that the feeding capacity of adult stage of the beetle was maximum in site 3 and lowest in site 6. The result showed in site 3 that the adult consumed 3.7 gm leaves of Parthenium at 20 °C whereas, the similar relevant statistics were 2.3 mg. The detriment caused by *Z. bicolorata* was more visible when it was used at higher density and at initial growing stages of Parthenium. The fully mature stages were preferred less in comparison to the younger ones. This technique can be highly useful if implemented wisely in the management of *Parthenium* weed and contributes towards achieving the goal of sustainable development.

Keywords: Mexican beetle, parthenium, feeding potential, defoliation, sustainable development

Introduction:

Zygogramma bicolorata is typically named as the Mexican Beetle or the Parthenium Beetle (Dhurgude, 2022). This insect belongs to the order Coleoptera and family Chrysomelidae. It is a small beetle comprising of a brown colored head, yellow colored graduated pronotum and has yellow-colored elytra marks along with special long brown stripes which also happen to be its characteristic feature. This beetle has been named as *Zygogramma bicolorata* by Pallister in 1953. This beetle was of Mexican origin and was introduced in Bengaluru state of India in 1984 (Chakravarthy and Bhat, 1997). It was first observed in Pune region of India around 1950s by Professor Paranjape as a wild plant growing on garbage dumping sites and later Rao reported it as a new species evolved in India. With the widespread of this weed all across the globe, special efforts have been made by all the countries to get rid of this harmful weed through

various methods including biological, chemical, mechanical, allelopathy and manual control methodologies. Despite of so many efforts, it has been difficult to eliminate this weed as every method employed has several disadvantages attached to it. Keeping in mind the concept of environment protection and sustainable development people are more inclined towards ecofriendly biological control methods such as usage of natural enemies, bioherbicides, insects, nematodes, snails and some competitive plants which could outcast this dangerous weed completely without deteriorating the quality of the natural environment. It is important to implement an integrated approach along with biological methods to improve the management of this weed. Control of *Parthenium* cannot be achieved by one single method keeping in mind the various agricultural, environmental and medical hazards of *Parthenium* (Jayanth (1996)).

This beetle has around a 100 days of life cycle with four instar stages leading to larval and pupa stages. They mostly lay their eggs on the ventral side of the leaves, stem and flowers of the grass. Their eggs are elongated, cylindrical or oblong in appearance with color varying from yellow to orange. They are initially yellow in color and slowly turn pale with progressive growth. After feeding on leaves for 10 to 15 days mature larva is formed which pupates into the soil for about 15 cm. This entire life cycle process takes around 100 days and this beetle too has enemies. Two bugs act as predators for this beetle named *Andrallus spinidens* and *Eocanthecona furcellata* which feed on both the larva and adult stages of the beetle. *Parthenium hysterophorus* is a common weed found in different parts of India (Dhurgude.2022). This plant is American in origin and grows as an invasive species in parts of India, Australia and Africa (King, 2008). This plant belongs to family Asteraceae and can be seen easily growing along roadsides. It is responsible for affecting farmlands, causing massive loss of crop yield. In many places it has been termed as “famine weed”. It not only affects crop productivity and livestock but also has hazardous effect on human health. This plant is responsible for the production of biochemicals which affect germination, growth, survival and reproduction of other organisms. Hence, they are also called “allelochemicals”. It is frequently responsible for pollen allergy. All this happens because of the toxin named “parthenin” found in the grass.

Materials and methods

Study Area:

The area of Dehradun basically lies in Doon Valley and has a variation in height from 410m in Clement Town to above 600 m at Jakhan which is about 4 km from the region. However, the overall ascent is 450 m above the sea level. A place named Jakhan is at the starting point of Lesser Himalayan Range that extends upto Mussoorie and areas beyond. In Dehradun District at 3700m above the sea level are the . The hilly region of Mussoorie goes up to a height of 1870–2007 metres above sea level. These selected sites for my research work are: Garhi Cantt, Kaulagarh, Raipur, Rajpur, Doiwala, Sahasradhara, Prem Nagar, Jamunwala, Anarwala and Jhajra.

Choice Test Experiment:

The food consumption of parthenium beetle for choice and non-choice test is conducted in biocontrol laboratory condition at temperature range of 25 to 30 degree Celsius and 60 ±5% RH on the basis of Jaiswal *et al* 2020 with little modifications. Samples of parthenium beetle will be collected from parthenium leaves and few will be collected from flowers. For selection of plant feeding study bowl (500 ml) will be used. For experiment 5 beetles will be placed in study bowl with 5 gm of parthenium leaves and each test replicated three times (n-3) with control. For choice test parthenium leaves will be placed after 0, 24-, 48-, 72-, 96-, 120-, 144-, 168-hour's total weight of parthenium leaves will be measured.

Result And Discussion:

It was observed that the feeding potential of adult stage of the insect was highest in site 3 and lowest in site 6. The result showed in site 3 that the adult consumed 3.7 gm parthenium leaves at 20 °C whereas, the corresponding figures were 2.3 mg. The damage inflicted by *Z. bicolorata* was more pronounced when it was applied in higher density and at early growth stages of the weed. The work will not only help us to curb the growth of Parthenium using eco-friendly bio control method via Mexican beetle promoting the concept of sustainable development in our region with minimum environmental degradation. Adult males consumed less in comparison to the females which may be attributed to the larger size and life span of the females. The males fed to the tune of 3.5-4.5 mg, whereas, the females were found to be consuming more in comparison to the males and recorded 4-5 mg. Our study was in agreement with Chandravanshi (2018) studied that the food consumption of Mexican beetle, *Zygodontia bicolorata* was conducted under laboratory conditions at 25- 30°C and

60 ± 5% RH. The parthenium leaves consumed by first instar larvae at 25 0C was in the range of 2-3 mg. and the second instar consumed at a higher rate and recorded 2-3mg. The third instar larvae consumed more voraciously and at faster rate and the recorded consumed leaves by them was to the tune of 3-4mg. In the fourth instar, 4-5mg. This may be due to the approaching stoppage in the feeding as the larvae entered the pre-pupal stage. Adult males consume less in comparison to the females which may be attributed to the larger size and life span of the females. The males were observed to be feeding to the tune of 3-4mg, whereas, the females were found to be consuming more in comparison to the males and recorded 4-5mg. Our finding is in corroborate with Swamiappan (1997) for the feeding behavior of *Z. bicolorata*. Adult males consumed less in comparison to the females which may be attributed to the larger size and life span of the females.

Conclusion:

It will help in minimizing the asthmatic disorders, bronchitis, dermatitis and various kind of allergies which are extremely prevalent. The need of the hour is to serve mankind without causing any harm to our surroundings at a minimum cost. This study can aid in examining the potential in the relevant subject. Increased usage of chemical control agents not only contributes to the deterioration of the environment quality but also possess hazardous impact to human health. The usage of biocontrol agent can be a great initiative towards our ultimate goal of environmental conservation

References:

AbuShaara, H.F.I. (2010). Morphological characters of honeybee *Apis mellifera* L., population in El-Beheira Governorate. J. Agric. & Env. Sci. Alex. Univ, Egypt, 9(2), 25-42.

Chakravarthy, A.K, and Bhat, N.S. (1997). Ecology of beetle *Zygogramma conjuncta* (Roger) on *Parthenium hysterophorus* Linn. In Proceeding of First International Conference on Parthenium Management held at University of Agricultural Sciences, Dharwad, Karnataka, India, 74-77.

Dhurgude, S.S, Patait, D.D., Kharat, G.S., Neharkar, P.S. and Badgujar, A.G. (2022) Biology of *Zygogramma bicolorata* Pallister on different parts of *Parthenium hysterophorus* Linn. under laboratory conditions. *The Pharma Innovation Journal*, 11(12):687-691

Dhileepan K. (2009). Managing *Parthenium hysterophorus* across landscapes: limitations and prospects. In S. Inderjit (Eds.), *Management of Invasive Weeds, Invading Nature* Springer Series in Invasion Ecology Vol.5, Springer Science, Knoxville, 227-260.

Dhileepan, K., & McFadyen, R.E. (1997). Biological control of parthenium in Australia: Progress and prospects. In: First International Conference on Parthenium Management. 6-October. Dharwad (Karnataka), 1, 40-44.

Dhiman, C. S. and Bhargava, L. M. 2010. Bio-control efficiency of *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae) after field release in district Saharanpur. *J. Exp. Zool. India*. 13(2):341-347.

El-Aw, M.A., Draz, K.A., Eid, K.S.A., and Abou-Shaara, H. (2012). Measuring the morphological characters of honey bee (*Apis Mellifera* L.) Using a simple semi-automatic technique. *Journal of American Science*, 8(3), 558-564.

Gomeh, H., Rafie, J.N. and Modaber, M. (2016). Comparison of standard and geometric morphometric methods for discrimination of honey bee's populations (*Apis mellifera* L.) in Iran. *Journal of Entomology and Zoology Studies*, 4(1), 47-53.

Gupta, R. K., Khan, M. S., Bal, K., Monobrullah, M. D. and Bhagat, R. M. 2004. Predatory bugs of *Zygogramma bicolorata*: An exotic beetle for biological suppression of *Parthenium hysterophorus* L. *Bio-control Lab, Division of Entomology. Current Sciences*. 87(7): 1005-1010.

Helen King (2008) Thermal Physiological and predicted Distribution of *Zygogramma bicolorata* (Chrysomelidae), A promising agent for the biological control of the invasive and weed *parthenium hysterophorus* in South Africa.

I. Ribera, D.I. Micraken, G.N. Foster, I.S. Downie, V.I. Abernathy (2006): Morphological diversity of beetles (coleoptera: Carabidae) in Scottish agricultural Land. *Journal of Zoology*, <https://doi.org/10.1000/1469-27998.1999.tb00188.x>

Kausar Saeed Muhammad Nasir Khan Khattak, Fayaz Khan Falak Naz and Naveed Akhter (2016) Morphological characteristics of beetle (coleoptera: Coccinellidae) of District Buner Khyber Pakhtunkhwa, Pakistan.

Kulkarni, K.A., and Kulkarni, N.S. (2000). Survey of *Zygogramma bicolorata* Pallister on *Parthenium* in North Karnataka. *Insect environment*, 6(1), 20.

Kumar, H. and Chaudhary, D. (2005). Studies on the effect of weather parameters on the population dynamics of *Z. bicolorata* on *Parthenium hysterophorus*. *Indian J. Appl. Ent.* 19(2): 150-151.

Mahna, K. and Sharma, U.S. (2005). Biology of the Mexican beetle, *Zygogramma bicolorata* on *Parthenium hysterophorus*. *Indian J. Appl. Ent.* 19(2): 129-131.

Shreshtha, B. B., Paudel, A., Karki, D., Gautam, R. D. and Jha, P. K. (2010). Fortuitous Biological Control of *Parthenium hysterophorus* by *Zygogramma bicolorata* in Nepal. *J. Nat. Hist. Mus.* 25:333-321.

Vyas, S., Sharma, N. and Shrivastava, S. (2017). Impact of Temperature and Relative Humidity on Development of *Zygogramma bicolorata*. *International Journal of Advanced Research in Science and Technology*. 6(1):644-650.

UNDER PEER REVIEW