

Evaluation of food consumption of *Zygogramma bicolorata* Pallister 1953, on *Parthenium hysterophorus* in Dehradun, Uttarakhand, India

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ABSTRACT: The feeding potential and non-feeding potential of Mexican beetle, *Zygogramma bicolorata* Pallister, 1953 (Coleoptera, Chrysomelidae) were studied on a common weed *Parthenium hysterophorus*, under laboratory conditions (temperature 25 to 30 °C and RH 60 to 65%). Ten different sites were chosen from the Dehradun district considering the widespread availability of *Parthenium* weed in the region. It was observed that the feeding potential of the adult was highest in site 7 (Prem nagar). The feeding rates at the site 7 were, 0±0.00 at 0 hours, 1.8±0.11 at 24 hours, 2.77±0.14 at 48 hours, 3.87±0.03 at 72 hours, 2.74±0.11 at 96 hours, 2.6±0.05 at 120 hours, 0±0.00 at 144 hours and at 2.67±0.07 at 168 hours. *Z. bicolorata* was more active when it was used in higher density and at initial growing stages of the weed. The fully matured adult stages of *Z. bicolorata* were less potential in comparison to the younger ones. Non-feeding potential was tested on different weeds and grasses indicated that the beetles were exclusive feeders of *Parthenium* weed and contributes towards achieving the goal of sustainable development.

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KEY WORDS: Feeding potential, defoliation, non-feeding potential, behaviour

Parthenium hysterophorus is a troublesome annual unwanted weed in agricultural fields, grazing lands and fallows in India. India has joined the list of heavily affected by *P. hysterophorus* nations in the world as this weed has widely spread in most of the states of the country in both cultivable, barren and pasture lands (Vartak, 1968). The weed *P. hysterophorus* is from the family Asteraceae is an international weed and is one of the worst weeds found in the world. This weed is a 1-2m tall herb with simple, grey-green, deeply lobed and hairy alternate leaves. It bears cream-

colored flowers about 4mm in diameter at the tip of each branch and its seeds germinate profusely after rain (Aneja *et al.*, 1991; Uniyal *et al.*, 2001). This reduces forage production in grasslands by 70 percent and makes the land less fertile (Vartak, 1968). This weed has been reported as a serious health risk, especially for agricultural workers. Since then, the weed has become a menace in various parts of the country, various methods have been used for its eradication such as manual removal of plants (Joshi 1990), use of herbicides cultural practices such as intercropping

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and breeding of competing plants such as forage sorghum or maize (Joshi, 1990), self-seeding species such as *Cassia sericea* SW (Joshi and Mahadevappa, 1986) and biological control using insects is recommended to its control. *Zygogramma bicolorata* Pallister, 1953 (Coleoptera, Chrysomelidae), feed on *P. hystrophorus* leaves and flowers. Beetles are creamish brown in colour with dark brown and black longitudinal markings on the elytra, measuring about 6 to 7mm in length. They lay elongated oval yellow-colored eggs on the ventral side of the leaves. It is followed by the larval stage which includes first instar, second instar, third instar and fourth instar stage. The larval stages feeds for around two weeks and then pupate into the soil. New adults appear after almost 15 to 20 days. Single beetle is able to complete its cycle in around 30 to 40 days depending on the environmental conditions. The insect can have up to 6 generations in the field. The female insect has the capacity of laying 2000 to 3000 eggs in its lifetime. *P. hystrophorus* has been found to cause serious health problems in humans and animals (Sushilkumar, 2005). The feeding potential and non-feeding potential of the beetle were undertaken on *Parthenium hystrophorus*, in ten different sites chosen from the Dehradun district considering the widespread availability of Parthenium weed in the region.

The study area is surrounded by the Himalayan ranges on the outer sides and Shivalik hills. The deposits of the Doon Valley, having their origin Himalayan comprise of heavy boulders of gravels, coated with thin covering of soil, which shows frequent outcrops of its rocky subsoil. The city is situated in the middle of the valley at the altitude of 636m. Ten study sites are selected in Dehradun region on the basis of survey of beetle in the surrounding areas. The sites are site 1 (Garhi Cantt), site 2 (Kaulagarh), site 3 (Raipur), site 4 (Rajpur), site 5 (Doiwala), site 6 (Sahastradhara), site 7 (Prem Nagar), site 8 (Jamunwala), site 9 (Anarwala) and site 10 (Jhajra).

The adult beetles collected from parthenium leaves and flowers were reared from December to May in the laboratory under simulation conditions ($27 \pm 5^\circ\text{C}$

and RH $35 \pm 5\%$), in the plastic jars. For selection of plant feeding study bowl (500 ml) were used. Temperature (25 to 30°C) and RH (60 to 65%) were maintained using desert cooler in the laboratory at Shri Guru Ram Rai University. The experiment conducted in laboratory on the basis of Jaiswal *et al.* (2023) with minor modifications.

Choice test: For the experiment 5 beetles were placed in each study bowl with 500ml capacity with 5g of parthenium leaves and each test replicated three times ($n=3$) with the control. Weighing scale is used to take accurate and same quantity of Parthenium in every bowl. For the choice test parthenium leaves was placed after 0, 24, 48, 72, 96, 120, 144 and 168 hour's total weight of parthenium leaves was measured 5g Parthenium weight is considered as its control weight for the experiment. Food was changed every third day.

Non-choice test: For the experiment 5 beetles were placed in each study bowl with 500ml capacity with 5g of other weed and grasses (*Cynodon dactylon* and *Lantana camara*) and each test replicated three times ($n=3$) with the control. Weighing scale is used to take accurate and same quantity of grasses in every bowl. For the non-choice test grass leaves was placed after 0, 24, 48, 72, 96, 120, 144 and 168 hour's total weight of grass leaves was measured. Five gram grass weight is considered as its control weight for the experiment. Food was changed every third day.

Effect of feeding rate = Control Weight of leaves – Weight of leaves feeding by beetles

In the choice test maximum consumption of *P. hystrophorus* was occurred in site 7 (Prem nagar) and minimum in site 2 (Kaulagarh). The feeding consumption ranged from 1.8 ± 0.05 to 1 ± 0.11 , maximum at site 7 (1.8 ± 0.11), followed by site 10 (1.74 ± 0.03) and minimum at site 1 (1 ± 0.11) at 24 hours. At 48 hours, food consumption ranged from 2.77 ± 0.14 to 2.24 ± 0.12 , most at site 7 (2.77 ± 0.14), followed by site 4 (2.74 ± 0.08) and least at site 1 (2.24 ± 0.12). At 72 hours, consumption ranged from 3.87 ± 0.03 to 3.24 ± 0.08 , maximum at site 7 (3.87 ± 0.03), followed by 3.77 ± 0.03 at site 10 and least at site 1 (3.24 ± 0.08). At 96 hours, food

Table 1. Consumption of *Z. bicolorata* at different hours on *P. hysterophorus* during Choice Test (Mean±SE)

Site/ hour	24	48	72	96	120	144	168
1-Garhi Cantt	1.00±0.11	2.24±0.12	3.24±0.08	2.54±0.18	3.6±0.05	0.00±0.00	2.3±0.20
2-Kaulagarh	1.54±0.17	2.50±0.11	3.37±0.08	1.17±0.18	2.44±0.12	0.00±0.00	1.9±0.11
3-Raipur	1.44±0.20	2.57±0.00	3.54±0.12	1.64±0.17	2.5±0.12	0.00±0.00	2.3±0.10
4-Rajpur	1.27±0.08	2.74±0.08	3.67±0.08	1.5±0.11	2.7±0.11	0.00±0.00	1.54±0.17
5-Doiwala	1.80±0.05	2.7±0.05	3.64±0.08	1.27±0.08	2.47±0.08	0.00±0.00	1.47±0.08
6-Sahastrdhara	1.50±0.05	2.54±0.12	3.7±0.11	1.54±0.12	3.1±0.15	0.00±0.00	2.2±0.15
7-Premnagar	1.80±0.11	2.77±0.14	3.87±0.03	2.74±0.12	3.6±0.05	0.00±0.00	2.67±0.07
8-Jamunwala	1.64±0.14	2.74±0.14	3.54±0.12	1.47±0.14	2.64±0.08	0.00±0.00	2.47±0.08
9-Anarwala	1.57±0.18	2.67±0.12	3.74±0.03	1.14±0.08	2.67±0.14	0.00±0.00	1.84±0.12
10-Jhajra	1.74±0.03	2.57±0.14	3.77±0.03	1.27±0.08	2.67±0.12	0.00±0.00	2.1±0.05

consumption ranged from 2.74±0.11 to 1.17±0.18, maximum at site 7 (2.74±0.11), followed by site 1 (2.54±0.18) and least at site 9 (1.14±0.08). At 120 hours, the feeding ranged from 3.6±0.05 to 2.44±0.02, with maximum at site 7 (3.6±0.05), followed by site 6 (3.1±0.15) and least at site 2 (2.44±0.02). At 144 hours no food was given so the reading comes to 0±0.00. At 168 hours, food consumption ranged from 2.67±0.07 to 1.47±0.08, maximum eaten at site 7 (2.67±0.07), followed by 2.3±0.2 at site 1 and least at site 5 (1.47±0.08) (Table 1).

In non-choice test, no food was consumed in all the ten sites. Leaves of grasses given in the feeding bowl at the beginning remained unconsumed till the end. At 144 hours, no leaves were placed and at 168 hours also food consumption remained zero. This indicated the host specific nature of *Z. bicolorata*, meaning it only consumed *P. hysterophorus*.

Similar observations were made by Jaiswal *et al.* (2021) who studied the *Parthenium* consumption rate of *Z. bicolorata* at both adult and grub stage. Food consumption analysis of *Z. bicolorata* was also done by Saha *et al.* (2017), who did similar work and did their analysis over a period of thirty days and analyzed the impact of *Z. bicolorata* on *P. hysterophorus*. Chandravanshi *et al.* (2018) too analyzed the impact of *Z. bicolorata* and how it can be used in *Parthenium* management. It was

released in the year 1984 and since then, it has spread over an area of more than 200,000km² around Bengaluru. Chakravarthy and Bhan (1997) observed the beetle emergence during May at Bengaluru, Tumkur, Hassan and Chikmaglore. Number of adults at each time interval suggested that the beetle underwent four overlapping generations from June to August with an average of almost twenty days for completion of each generation.

This weed has led to a decline in the crop production (nearly 40%) of India (Khosla and Sobti, 1981). Maharjan *et al.* (2007) showed that it acts as an invasive weed hindering the growth of all the plants of the region and deteriorating the soil quality of the area as well. Due to its allelopathic effect it greatly affects the germination rate of crops causing a decline in the productivity as well as natural vegetation of the affected area. Using a bio-control agent is a strategic way of weed management contributing both to the society and environment.

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