

Evaluation Of Feeding Potential Of Mexican Beetle (*Zygomma bicolorata*) On Carrot Grass (*Parthenium hysterophorus*) In Dehradun District, Uttarakhand, India

Comment [HG1]: Why the genus and species name is written in capital letters? It should be:

Zygomma bicolorata

Comment [HG2]: Follow the proper way to write botanical name

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Comment [HG3]: Mention the controlled conditions (RH and Temperature) here.

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Comment [HG4]: Not clear. Is it about the beetle?? If so, please mention it in the materials and methods section.

Could you please write this sentence in a meaningful way?

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Comment [HG5]: Mention the same in Materials and Methods

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Comment [HG6]: No data in the results section (Give the data set in figure/ table) in the Results and discussion section

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Comment [HG7]: Not clear

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Abstract:

Zygomma bicolorata is an efficient natural control agent that 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 of this vicious weed. The feeding capacity of Mexican beetle, *Zygomma bicolorata* was studied under controlled conditions at the 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 the 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 g 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 a higher density and at the 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:

Zygomma bicolorata is typically named as the Mexican Beetle or the *Parthenium* Beetle (Dhurgude, 2022). This insect belongs to the order Coleoptera and the 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 most prominent characteristic feature. This beetle has been named as *Zygomma 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). In 1953, Prallister gave this beetle the name *Zygomma bicolorata*. This Mexican-originated beetle was introduced to the Indian state of Bengaluru in 1984 (Chakravarthy and Bhat, 1997). This beetle has around a 100 days of life cycle with four instar stages leading to larval and pupal stages. They mostly lay their eggs on the ventral side of the leaves, stems 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 larvae are 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 larval and adult stages of the beetle.

Comment [HG10]: Repetition. Delete this.

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 the family Asteraceae and can be seen easily growing along roadsides. It is responsible for affecting farmlands, causing massive loss in crop yield. In many places it has been termed as "famine weed". It not only affects crop productivity and livestock but also has hazardous effects on human health. This plant is responsible for the production of biochemicals that affect the germination, growth, survival, and reproduction of other organisms. Hence, they are also called "allelo-chemicals". It is frequently responsible for pollen allergies. All this happens because of the toxin named "parthenin" found in the grass. It was first observed in Pune region of India around the 1950s by Professor Paranjape as a wild plant growing on garbage dumping sites, and later Rao reported it as a new species that evolved in India. With the widespread distribution 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 some such efforts, it has been difficult to eliminate this weed as every method employed has several disadvantages attached to it. Keeping in mind the concepts of environment protection and sustainable development people are more inclined towards eco-friendly biological control methods such as the use 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* (Jayanthi, 1996).

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Comment [HG11]: Beetle???

Please maintain the flow when you write the introduction.

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

Comment [HG12]: The highlighted sentences should be started in a different paragraph as they focus on the *Parthenium* weed.

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.

Comment [HG13]: Repetition. Delete this.

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 up to Mussoorie and areas beyond, in Dehradun District at 3700m above the sea level are 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, Sahastradhara, Prem Nagar, Jamunwala, Anarwala and Jhajra.

Comment [HG14]: Write a paragraph to justify your research. Include:
1) Knowledge gap
2) Problem statement
3) Objective/s your study

Comment [HG15]: Add 3 or 4 references for this paragraph

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Comment [HG16]: Better to add your GPS location for the study area

Comment [HG17]: Are the ??? Complete the sentence.

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Comment [HG19]: Could you draw a map to show these locations ?

Comment [HG20]: I couldn't follow you. What experiments were conducted at the selected sites???

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Comment [HG21]: You could add the images of your experimental set up for choice and no-choice tests.

Comment [HG22]: Write the little modifications that you have done

Comment [HG23]: Will be collected??? Or was collected??

Please use the correct tense to write the experiment.

Comment [HG24]: Why? Briefly explain why did you collect it from both leaves and flowers.

Comment [HG25]: Only male? Or mixture of both sex?

Comment [HG26]: Mention the maturity stage of the leaves.

Tender or old leaves ?
How did you select the leaves from a branch ??

Comment [HG27]: What is your control set up comprised of ??

Choice Test Experiment:

The food consumption of parthenium beetle for choice and non-choice test was conducted in biocontrol laboratory condition at temperature range of 25 to 30 °C and 60 ±5% RH based on Jaiswal et al 2020 with little modifications. Samples of parthenium beetle were collected from parthenium leaves and few were collected from flowers. For the selection of plant feeding study bowl (500 ml) was used. For experiment 5 beetles were placed in study bowl with 5 gm of parthenium leaves and each test replicated three times (n = 3) with the control. For the choice test

parthenium leaves ~~was will be~~ placed after 0, 24-, 48-, 72-, 96-, 120-, 144- and -168-hour's total weight of parthenium leaves ~~was will be~~ measured.

Comment [HG28]: Follow the correct tense to write the procedure

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Comment [HG29]: Refer the following article;

Cowie, B. W., Witkowski, E. T., Byrne, M. J., Strathie, L. W., Goodall, J. M., & Venter, N. (2018). Physiological response of *Parthenium hysterophorus* to defoliation by the leaf-feeding beetle *Zygomma bicolorata*. *Biological Control*, 117, 35-42.

Comment [HG30]: Where is your results with data???

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 3.7gm 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,whereas~~ the females were found to be consuming more in comparison to the males and recorded 4-5mg. Our study was in agreement with Chandravanshi (2018) ~~who studied that~~ the food consumption of Mexican beetle, *Zygomma bicolorata* ~~was conducted~~ under laboratory conditions at ~~the temperature~~ 25- 30°C and 60 ± 5% RH. The parthenium leaves consumed by first instar larvae at 25 °C 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 ~~fastera 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,whereas~~ the females were found to be consuming more in comparison to the males and ~~reecorded~~—4recorded 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.

Comment [HG31]: The details of the adult male and female is not given in the experiment. Could you please rewrite the methods of experiment conducted in the selected 10 regions and the laboratory experiment separately.

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Comment [HG32]: Rewrite this paragraph as it showed highest similarities with the other articles. See attached plagiarism report for further information.

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Conclusion:

It will help in minimizing ~~the asthmatic~~asthmatic disorders, bronchitis, dermatitis and various kinds of allergies which our 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~~ possesses hazardous impact to human health. The usage of biocontrol agent can be a great initiative towards our ultimate goal of environmental conservation

Comment [HG33]: This is not the conclusion derived from your experiment.

Rewrite the conclusion part with your findings align with your objective/s of your study

References:

AbuShaara,H-F.I.(2010).Morphologicalcharactersofhoneybeehoneybee*Apis mellifera*L.,populationinEl-BeheiraGovernorate. J.Agric.&Env. Sci.Alex. Univ,Egypt, 2010;9(2):25-42.

Comment [HG34]: Follow the General Guideline for Authors provided in the journal website

Ex:

Hilly M, Adams ML, Nelson SC. A study of digit fusion in the mouse embryo. Clin Exp Allergy. 2002;32(4):489-98.

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Chakravarthy, A.K, and Bhat, N.S. (1997). Ecology of beetle *Zygogrammacunjuncta*(Roger)on *Partheniumhysterophorus*Linn.In Proceedingof FirstInternational Conference onParthenium Management held at Universityof Agricultural Sciences, Dharwad, Karnataka,India,74-77.

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Dhurgude, S.S,Patait, D.D., Kharat, G.S., Neharkar, P.S. and Badgujar, A.G. (2022) Biology of*Zyogrammbicolorata*Pallisterondifferentpartsof*Partheniumhysterophorus*Linn.underlaboratoryconditions.*ThePharmaInnovationJournal*,11(12):687-691

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Comment [HG35]: Abbreviate the journal name According to the authors guidelines of the journal;

Journal name abbreviations should be those found in the NCBI databases (Link: <http://www.ncbi.nlm.nih.gov/nlmcatalog/journals>).

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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.

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El-Aw,M.A.,Draz,K.A.,Eid,K.S.A.,andAbou-Shaara,H.(2012).Measuringthemorphological characters of ~~honey-bee~~honeybee (*Apis Mellifera* L.) Using a simple semi-automatictechnique,*Journalof AmericanScience*,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~~ honeybee's populations
(*Apis mellifera* L.) in Iran. *Journal of Entomology and Zoology Studies*, 4(1), 47-53. ~~3~~

Comment [HG36]: Follow the correct referencing style of the journal

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

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HelenKing(2008)TharmalPhysiologicalandpredictedDistributionof*Zygogrammabicolorata* (Chlysolmelidae), A promising agent for the biological control of the invasive andweed*partheniumhysterophoursin*SouthAfrica.

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I. Ribera, D.I. Micraken, G.N. Foster, I.S. Downie, V.I. Abernathy (2006): Morphologicaldiversity of beetles (coleoptera: Carabidae) in Scottish agricultural Land. *Journal of Zoology*,<https://doi.org/10.0000.1469-27998.1999.tb00188.x>

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Comment [HG38]: Follow the authors guidelines to write the references

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Kausar Saeed Muhammad Nasir Khan Khattak, Fayaz Khan FalakNaz and Naveed Akhter(2016) Morphological characteristics of beetle (coleoptera: Coccinellidae) of FistrictBunerKhyberRakhtunkhwa,Pakistan.

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Development of
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:644-650.

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