Evaluation Of Feeding PotentialOfMexican Beetle (*Zygogrammabicolorata)*OnCarrot Grass (*Parthenium hysterophorus*) In Dehradun District, Uttarakhand, India

Abstract:

Zygogrammabicolorata is an efficient naturalcontrol 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, *Z.bicolorata* was studied under controlled conditions, at theDepartment 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 ofthe adult stage of the beetle was maximum in site 3 and lowest in site 6. The result showed in site 3 that he adult consumed 3.7gleaves of Parthenium at 20 °Cwhereas, the similar relevant statistics were 2.3 mg. The detrimentcaused by *Z. bicolorata* was more visible when it was used atahigher density and at theinitial 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:

*Zygogrammabicolorata*is typicallynamed as the Mexican Beetle or the Parthenium Beetle (Dhurgude,2022). Thisinsectbelongs tothe orderColeopteraandthefamily Chrysomelidae.Itis a smallbeetlecomprising a brown colored head, yellow colored graduated pronotum,and yellow-colored elytramarks along with special long brown stripes which also happen to be its characteristic feature.It was first observed inPune region of India aroundthe1950s by Professor Paranjape as a wild plant growing on garbage dumping sites and later Rao reported itas a new species thatevolved in India. With the widespread of this weed all across the globe, special efforts have been made by all the countriesto get rid of this harmful weed through various methods, including biological, chemical, mechanical,allelopathy andmanual control methodologies.Despitesomuchefforts,ithasbeen difficulttoeliminate this weed as every method employed has several disadvantages attached to it. Keeping in mindthe concept of environment protection and sustainable development people are more inclined

Comment [HG1]: Still the controlled conditions namely RH and temperature are not given

Comment [HG2]: No description on the larval instars in the materials and methods section to validate this observation

Comment [HG3]: Why did you delete the information on the *Parthenium* weed ?

Still introduction part failed to cite enough findings to fulfill the literature

towardsecofriendlybiologicalcontrolmethodssuchasthe useofnaturalenemies,bioherbicides,insects,nematodes, snails and some competitive plants which could outcast this dangerous weed completelywithout deteriorating the quality of the natural environment[19-21]. It is important to implement an integratedapproachalongwithbiologicalmethodstoimprovethemanagementofthisweed.ControlofPartheniumcannotbeachievedbyonesinglemethodkeepinginmindthevariousagricultural,environmentalandmedicalhazards ofParthenium(Jayanth(1996).

Materials and methods

StudyArea:

The area of Dehradunbasically lies in Doon Valley and has a variation in height from 410m inClement Town to above 600 m at Jakhan which is about 4 km from the region. However, the overallascent is 450 m above sea level. A place named Jakhan is at the starting point of Lesser Himalayan Rangethat extends upto Mussoorie and areas beyond. in Dehradun District at 3700m above the sea level. The hilly region of Mussoorie goes up to a height of 1870–2007metresabovesealevel.

Theselectedsitesformyresearchworkare:GarhiCantt,Kaulagarh,Raipur,Rajpur,Doiwala,Sahastradhara,PremNagar,Jamunwala,AnarwalaandJhajra.

ChoiceTest Experiment:

The food consumption of parthenium beetle for choice and non-choice test wasconducted inbiocontrol laboratory condition at temperature range of 25 to 30ºCelsius and 60 ±5%RH based onJaiswal*etal*2020 with little modification. Samples ofparthenium beetle wascollected from parthenium leaves and few wascollected fromflowers. For theselection of plant feeding study bowl (500 ml) was used. For the experiment 5beetles wereplaced in study bowl with 5g of parthenium leaves and each test replicatedthree times (n=3) with thecontrol. For the choice test parthenium leaves wasplaced after 0,24-, 48-,72-,96-,120-, 144- and 168-hour's total weight of parthenium leaves wasmeasured.

Comment [HG4]: ????

Comment [HG5]: Objective of the study is still missing

Jayanth (1996) is not in your reference list

Comment [HG6]: Your materials and methods still need the improvement. The difference between choice and non choice experimental methods are not clear.

If you have conducted two experiments, then the two sets of results should be there in your results with data

Comment [HG7]: Write clearly about the choice and non choice test

Which test was conducted in the lab

What experiments were conducted in several locations that you have selected

Comment [HG8]: This citation is not in your reference list

Comment [HG9]: What about statistical analysis ??

(A) *Z.bicolorata* (B)Feeding bowls from ten different sites

(C) Feeding bowls with *Z.bicolorata from*a site. (D) Parthenium damaged by *Z.bicolorata*

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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

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life spam 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 4-5mg. Our study was in agreement with Chandravanshi (2018)whostudiedthatthe food consumption of Mexican beetle, *Z.~~ygogramma~~bicolorata*under laboratory conditions at the temperature25- 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 spam 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 spam of the females.

Title???

S.No.	Site	Treatment/Hours	R1	R2	R3	TOTAL	MEAN	SD	SEM
1	SITE1	0 Hr	5	5	5	15	5.00	0.00	0.00
		24 Hr	4.1	4.4	3.9	12.4	4.13	0.25	0.08
		48 Hr	2.7	2.9	2.3	7.9	2.63	0.31	0.10
		72 Hr	1.9	1.7	1.5	5.1	1.70	0.20	0.07
		96 Hr	2.9	2.5	2.2	7.6	2.53	0.35	0.12
		120 Hr	1.3	1.5	1.2	4	1.33	0.15	0.05
		144 Hr	0	0	0	0	0.00	0.00	0.00
		168 Hr	2.2	2.8	3	8	2.67	0.42	0.14
2	SITE2	0 Hr	5	5	5	15	5.00	0.00	0.00
		24 Hr	3.6	3.3	3.6	10.5	3.50	0.17	0.06
		48 Hr	2.4	2.6	2.9	7.9	2.63	0.25	0.08
		72 Hr	1.3	1.8	1.6	4.7	1.57	0.25	0.08
		96 Hr	3.7	3.9	4.1	11.7	3.90	0.20	0.07
		120 Hr	2.5	2.7	2.9	8.1	2.70	0.20	0.07
		144 Hr	0	0	0	0	0.00	0.00	0.00
		168 Hr	3.1	3	2.9	9	3.00	0.10	0.03
3	SITE3	0 Hr	5	5	5	15	5.00	0.00	0.00
		24 Hr	3.5	3.9	3.7	11.1	3.70	0.20	0.07
		48 Hr	2.3	2.5	2.4	7.2	2.40	0.10	0.03
		72 Hr	1.1	1.3	1.7	4.1	1.37	0.31	0.10
		96 Hr	3.9	3.5	3.1	10.5	3.50	0.40	0.13
		120 Hr	2	2.1	2.4	6.5	2.17	0.21	0.07
		~~144 Hr~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0.00~~	~~0.00~~	~~0.00~~

Comment [HG11]: No details in the methods

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Comment [HG13]: No information in your materials and methods to show the readers about how did you do the experiments to find out the difference in consumption pattern of the 1st and 3rd instar larvae.

You only written about the introduction of 5 mature beetles without even mention sex

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Comment [HG15]: Give the table title

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		168 Hr		2.7	2.6	2.9	8.2	2.73	0.15	0.05
4	**SITE4**	**0 Hr**		5	5	5	15	5.00	0.00	0.00
		24 Hr		3.8	3.6	3.9	11.3	3.77	0.15	0.05
		48 Hr		2.3	2.5	2.1	6.9	2.30	0.20	0.07
		72 Hr		1.2	1.4	1.5	4.1	1.37	0.15	0.05
		96 Hr		3.8	3.5	3.2	10.5	3.50	0.30	0.10
		120 Hr		2.1	2.3	2.6	7	2.33	0.25	0.08
		144 Hr		0	0	0	0	0.00	0.00	0.00
		168 Hr		3.7	3.3	3.1	10.1	3.37	0.31	0.10
5	**SITE5**	**0 Hr**		5	5	5	15	5.00	0.00	0.00
		24 Hr		3.4	3.1	3.5	10	3.33	0.21	0.07
		48 Hr		2.5	2.2	2	6.7	2.23	0.25	0.08
		72 Hr		1.4	1.6	1.3	4.3	1.43	0.15	0.05
		96 Hr		4	3.7	3.8	11.5	3.83	0.15	0.05
		120 Hr		2.6	2.4	2.5	7.5	2.50	0.10	0.03
		144 Hr		0	0	0	0	0.00	0.00	0.00
		168 Hr		3.8	3.7	3.5	11	3.67	0.15	0.05
6	**SITE6**	**0 Hr**		5	5	5	15	5.00	0.00	0.00
		24 Hr		3.7	3.5	3.2	10.4	3.47	0.25	0.08
		48 Hr		2.2	2.5	2.3	7	2.33	0.15	0.05
		72 Hr		1.3	1.7	1.1	4.1	1.37	0.31	0.10
		96 Hr		3.3	3.7	3.3	10.3	3.43	0.23	0.08
		120 Hr		1.7	2	2.2	5.9	1.97	0.25	0.08
		144 Hr		0	0	0	0	0.00	0.00	0.00
		168 Hr		2.8	3	2.6	8.4	2.80	0.20	0.07
7	**SITE7**	**0 Hr**		5	5	5	15	5.00	0.00	0.00
		24 Hr		3.5	3.1	3.3	9.9	3.30	0.20	0.07
		48 Hr		2.3	2.5	2.2	7	2.33	0.15	0.05
		72 Hr		1.4	1.2	1.1	3.7	1.23	0.15	0.05
		96 Hr		3.2	3.5	3.1	9.8	3.27	0.21	0.07
		120 Hr		2.3	2.1	2.5	6.9	2.30	0.20	0.07
		144 Hr		0	0	0	0	0.00	0.00	0.00
		168 Hr		2.5	2.2	2.6	7.3	2.43	0.21	0.07
8	**SITE8**	**0 Hr**		5	5	5	15	5.00	0.00	0.00
		24 Hr		3.7	3.4	3.3	10.4	3.47	0.21	0.07
		48 Hr		2.3	2.1	2.5	6.9	2.30	0.20	0.07
		72 Hr		1.3	1.4	1.7	4.4	1.47	0.21	0.07
		96 Hr		3.7	3.5	3.2	10.4	3.47	0.25	0.08
		120 Hr		2.3	2.5	2.7	7.5	2.50	0.20	0.07
		144 Hr		0	0	0	0	0.00	0.00	0.00
		168 Hr		2.6	2.5	2.9	8	2.67	0.21	0.07
9	**SITE9**	**0 Hr**		5	5	5	15	5.00	0.00	0.00
		24 Hr		3.2	3.4	3.8	10.4	3.47	0.31	0.10
		48 Hr		2.3	2.4	2.5	7.2	2.40	0.10	0.03
		72 Hr		1.2	1.5	1.3	4	1.33	0.15	0.05

		96 Hr		3.7	3.9	4	11.6	3.87	0.15	0.05
		120 Hr		2.6	2.2	2.1	6.9	2.30	0.26	0.09
		144 Hr		0	0	0	0	0.00	0.00	0.00
		168 Hr		3.2	3.1	3	9.3	3.10	0.10	0.03
10	**SITE10**	**0 Hr**		5	5	5	15	5.00	0.00	0.00
		24 Hr		3.2	3.4	3.5	10.1	3.37	0.15	0.05
		48 Hr		2.2	2.4	2.7	7.3	2.43	0.25	0.08
		72 Hr		1.2	1.5	1.4	4.1	1.37	0.15	0.05
		96 Hr		3.9	3.6	3.8	11.3	3.77	0.15	0.05
		120 Hr		2.2	2.4	2.6	7.2	2.40	0.20	0.07
		144 Hr		0	0	0	0	0.00	0.00	0.00
		168 Hr		3.1	2.8	3	8.9	2.97	0.15	0.05

Comment [HG16]: Any statistical analysis related data to prove there is significant or non significant differences in these selecetd areas??

Conclusion:

It will help in minimizingasthmatic disorders, bronchitis, dermatitis and various kind 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 possesses hazardous impact to human health. The usage of biocontrol agent can be a great initiative towards our ultimate goal of environmental conservation.

Comment [HG17]: Same conclusion with general statement.
Not corrected or rewritten according to the reviewers comments

Disclaimer:

Scanned for plagiarism at GRAMMARLY. No plagiarism found.Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT,COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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Comment [HG18]: Except Dhurgude at al., 2022, the references in the list are not cited in the text in your manuscript

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Comment [HG19]: Where is the citation?

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