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Original Research Article

To Work out the Feeding Potential of Mexican beetle, *Zygogramma bicolorata* P. under Laboratory Conditions

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Keywords

Mexican beetle, *Zygogramma bicolorata* P., feeding potential, different age stage of *Parthenium hysterophorus* L.

A B S T R A C T

The feeding potential of Mexican beetle, *Zygogramma bicolorata* P. was conducted under laboratory conditions, Department of Entomology, IGKV, Raipur District in Chhattisgarh during 2016 and 2017. The feeding potential of Mexican beetle on three age stages: early stage, pre-reproductive and reproductive of Parthenium grass on the basis of all over mean day time taken of two years the data indicated that feeding efficiency of *Z. bicolorata* on different age of host plant i.e. early stage, pre-reproductive and reproductive treatments were sown significantly superior. The lowest time taken (5.17 days) for complete defoliation by five pairs of Mexican beetle followed by three pairs (13.00) and highest in two pairs (14.83 days)). The damage inflicted by *Z. bicolorata* was more pronounced when it was applied in higher density and at early growth stages of the weed.

Introduction

Parthenium hysterophorus L. is a highly invasive plant of global significance. It is a herb of geotropically origin which now has spread to many parts of the world (Adkins and Shabbir 2014). The weed was accidentally introduced to India in 1955 through the imported food grains and at present it has invaded throughout India in about 35 million hactares of land (Sushilkumar and Varshney 2009, Sushil kumar 2014). It is notorious for causing allergic reactions (Kologi *et al.,* 1997) besides a threat to biodiversity and loss of crop productivity (Adkins and Shabbir 2014, Sushilkumar, 2014) management of *Parthenium*. Although manual and chemical methods are effective strategies to control the weed in agricultural fields, but these are not economical in pastures and large natural areas or wastelands (Krishnamurthy *et al.,* 1977).

Biological control of *Parthenium* weed is considered to be the most cost effective, environmentally safe and ecologically viable method (Dhileepan *et al.,* 2000). It was documented to control *Parthenium* worth of Rs 10 million in terms of herbicide cost after initial release of bioagent *Zygogramma bicolorata* Pallister at Jabalpur, India (Sushsilkumar 2006) and it was estimated that this bioagent has checked the spread of Parthenium in about eight million hactares of land since its release in India

(Sushikumar and Yaduraju, 2015). In Pakistan, *Z. bicolorata* fortuitously arrived from India to Pakistan, by either flying or eggs or beetles carried on vehicles like it has been suspected in Nepal (Shrestha *et al.*, 2015).

Its possible entry in Pakistan was surmised by Sushilkumar (2005) due to its presence in abundance near Wagah border of India and Pakistan (Sushilkumar 2014). This beetle was first reported form the Changa Manga plantation near the district of Lahore (Javaid and Shabbir 2007) and more recently in six more districts including the capital Islamabad (Shabbir *et al.*, 2012). *Zygogramma bicolorata* was first introduced to India in 1984 where it became abundant within 3 years after its release, resulting in a significant reduction in *Parthenium* weed densities in localized areas (Jayanth1987, Jayanth and Bali 1994, Jayanth and Ganga-Visalakshy 1996).

Materials and Methods

Location of study

The feeding potential of Mexican beetle, Zygogramma bicolorata P. was conducted under laboratory conditions, Department of Entomology, IGKV, Raipur District in Chhattisgarh.

Experimental details

The Mexican beetle were collected from the IGKV fields and maintained in the lab which was used for at different growth stages of parthenium weeds. The different stages of Parthenium weeds i e early, pre-reproductive, and reproductive stages were grown on to pots and confined with each different stages of weeds by nets and equal numbers of them were released on the potted weed plants for feeding were allowed for accommodate themselves on plant. Separate sets for each of the three stages were prepared for thrice replications and four treatments i.e. 2, 3, 4 and 5 pairs were released on different three age stages of potted host plant and were applied over all the plants and insects and Observations were recorded on every alternate day for the number of insects established, mortality and time taken (number of days) for complete defoliation of plant at each stage. One seedling of *Parthenium plant*/pot was transplanted carefully in the middle of pots. First set was labelled as "early stage' because the aim was to apply the biological control agent, *Z. bicolorata* at a time when these plants would be at the early stage of their growth. There were four treatments, 2, 3, 4and 5 pairs of *Z. bicolorata* adults to be applied on replicated *Parthenium* plants and Second set was labelled as 'pre-reproductive stage' and fourth set was designated as 'reproductive stage'. To stop the escape of adult beetles, the individual pots were covered with an insect proof net caged. Throughout the experiment, the level of insect defoliation inflicted upon the *Parthenium* weed plants was monitored on alternate day basis. A scale was developed to assess the time taken mean days of defoliation caused by the beetle.

The defoliation level of *Parthenium* increased gradually with the time and this effect was seen in all treatment pairs of the agent applied. The Insect count data were calculated in the form of average. The transformation was made to normalize the data before conducting analysis of variance, the data obtained from completely randomize design experiments were analyzed statistically. Total data of mean Mexican beetle population were analyzed after square root transformation $\sqrt{X} + 0.5$ where, x is the value of Mexican beetle population.

Fig.1a The mean day's data sowing feeding potential of Mexican beetle, *Zygogramma bicolorata* P. under laboratory conditions during 2016 &2017

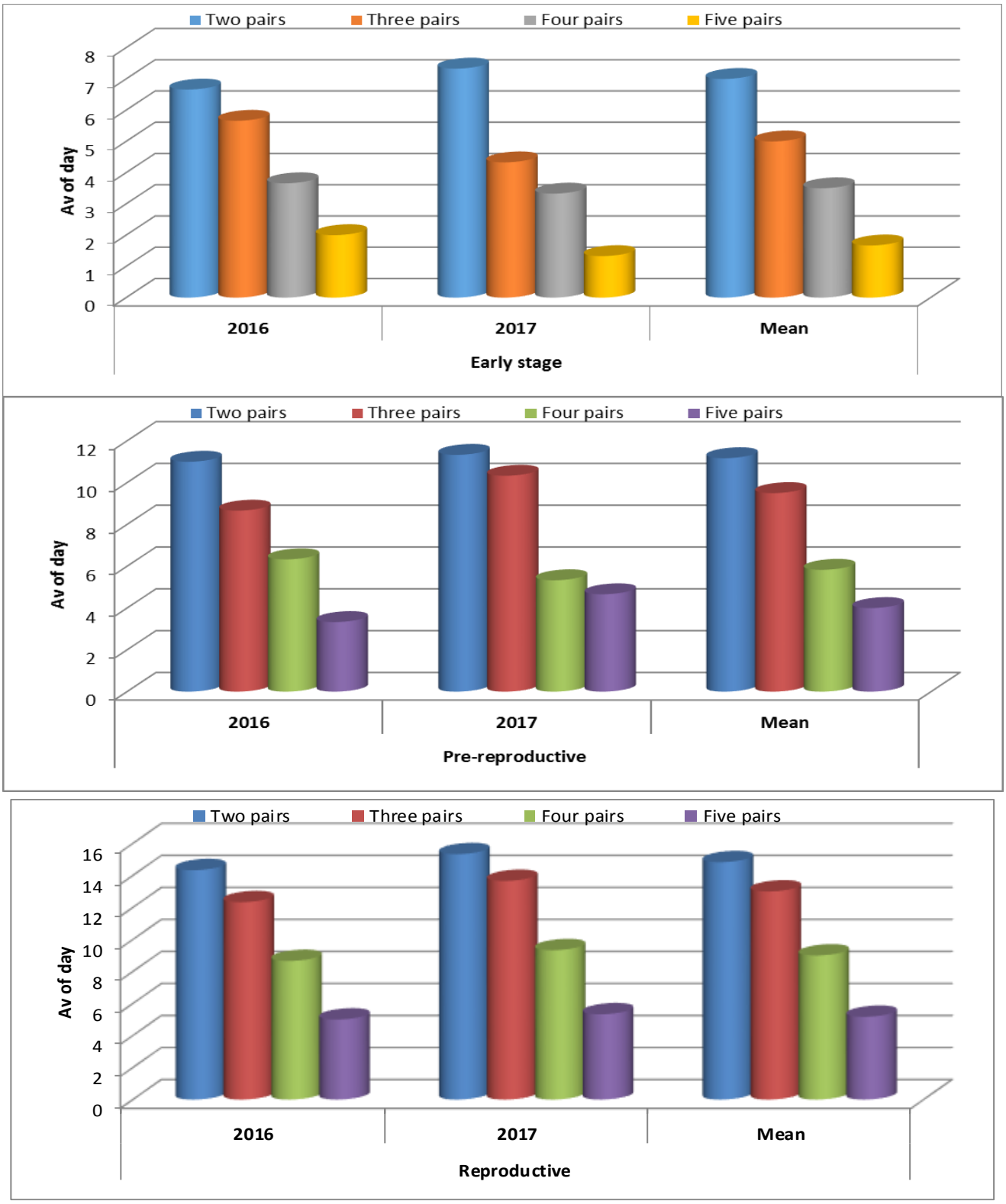

Fig.1b The pooled mean day's data sowing different pairs of Mexican beetle feeding potential on different ages of parthenium weeds during 2016 & 2017

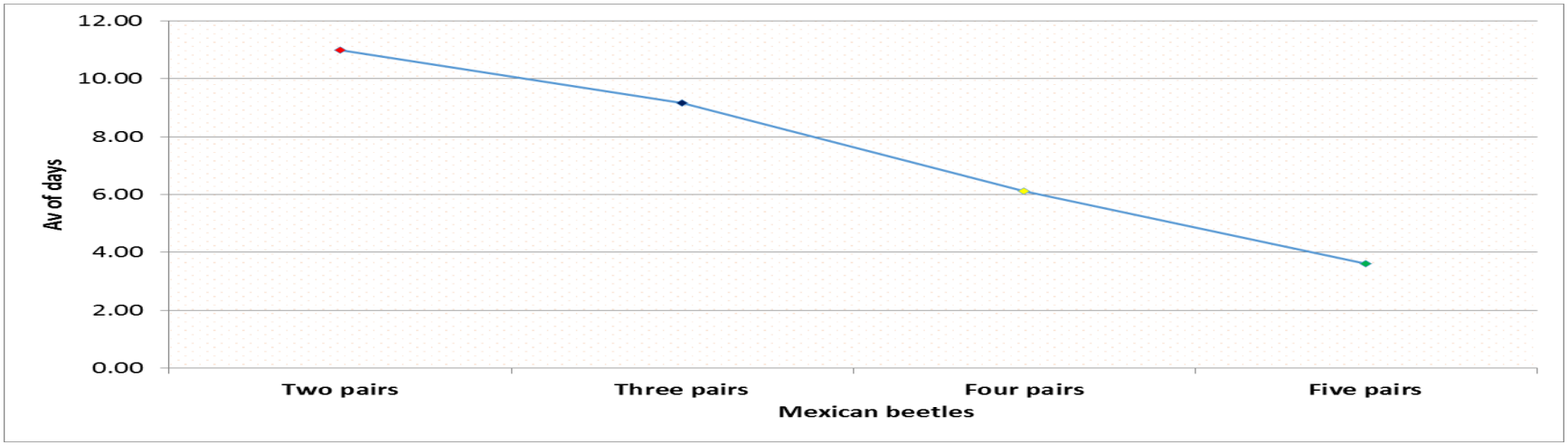

Table.1 To work out the feeding potential of Mexican beetle, *Zygogramma bicolorata* P. under laboratory conditions during 2016 & 2017

S. No.	Treatments	Early stage			Pre-reproductive			Reproductive			GT
		2016	2017	Mean	2016	2017	Mean	2016	2017	Mean	
1	Two pairs	6.66 (2.68)	7.33 (2.80)	7.00	11.00 (3.39)	11.33 (3.44)	11.17	14.33 (3.85)	15.33 (2.98)	14.83	11.00
2	Three pairs	5.66 (2.48)	4.33 (2.20)	5.00	8.66 (3.03)	10.33 (3.29)	9.50	12.33 (3.58)	13.66 (3.76)	13.00	9.17
3	Four pairs	3.66 (2.04)	3.33 (1.96)	3.50	6.33 (2.61)	5.33 (2.41)	5.83	8.66 (3.03)	9.33 (3.14)	9.00	6.11
4	Five pairs	2.00 (1.58)	1.33 (1.35)	1.67	3.33 (1.96)	4.66 (2.27)	4.00	5.00 (2.35)	5.33 (2.41)	5.17	3.61
Total		**17.98**	**16.32**	**17.15**	**29.32**	**31.65**	**30.49**	**40.32**	**43.65**	**41.99**	**29.89**
SEM		**0.408**	**0.333**		**0.645**	**0.527**		**0.500**	**0.527**		
CD @ 5%		**0.743**	**0.606**		**1.174**	**0.959**		**0.910**	**0.959**		
CV (%)		**15.713**	**13.856**		**15.246**	**11.531**		**8.589**	**8.362**		

*The pretenses are shows square root transformation
*The data shows Av of three replications

Results and Discussion

The various numbers of beetles i.e. 2, 3, 4 and 5 pairs were released on different three age stages of host plant (early stage, pre-reproductive and reproductive) of Parthenium grass. Observations were recorded on every alternate day for the number of insects established, mortality and time taken (number of days) for complete defoliation of plant at each stage are presented in table-1 and fig.-1a&1bas follows:

Early stage

In first year, the test the feeding efficiency of *Z. bicolorata* at early age of host plants of *P. hysterophorus* under these experiments. The maximum time taken (6.6 days) for complete defoliation by two pairs followed by (3.66) in three pairs while minimum time taken (2.00) in five pairs. During second year, the maximum time taken (7.33 days) for complete defoliation by two pairs followed by (4.33) in three pairs whereas, minimum time taken (1.33) in five pairs. The results of these experiments were sown significantly superior overall treatments.

Pre-reproductive

During 2016, the test the feeding efficiency of *Z. bicolorata* at pre- reproductive age of host plants under these experiments.

The maximum time taken (11.00 days) for complete defoliation by two pairs followed by (8.66) in three pairs while minimum time taken (3.33) in five pairs. During 2017, the maximum time taken (11.33 days) for complete defoliation by two pairs followed by (10.33) in three pairs whereas, minimum time taken (4.66) in five pairs. The results of these experiments were sown significantly superior overall treatments.

Reproductive

During 2016, the test the feeding efficiency of *Z. bicolorata* at reproductive age of host plants under these experiments. The maximum time taken (14.33 days) for complete defoliation by two pairs followed by (12.33) in three pairs while minimum time taken (5.00) in five pairs. During 2017, the maximum time taken (15.33 days) for complete defoliation by two pairs followed by (13.66) in three pairs whereas, minimum time taken (5.33) in five pairs. The results of these experiments were sown significantly superior overall treatments.

On the basis of all over mean day of two years the data indicated that feeding efficiency of *Z. bicolorata* on different age of host plant i.e. early stage, pre-reproductive and reproductive treatments were sown significantly superior. The highest time taken (14.83 days) for complete defoliation by two pairs followed by (13.00) in three pairs whereas, minimum time taken by five pairs of Mexican beetle (5.17 days).

Not accurate but similar finding given by Reznik *et al.,* 1994, defoliation resulting in significant reduction in weed height, biomass and seed production. In central Queensland, Australia, some similar results were also documented by Dhileepan *et al.,* (2000). Likewise, feeding by an introduced *Z. saturalis* reduced the biomass and plant height in ragweed (Kovalev and Medvedev 1983). The effectiveness of the agent was found to be density dependent, as defoliation and seed suppression was highest when three pairs of *Z. bicolorata* were applied at different growth stages of the weed. In field this will depend upon the population dynamics of agent and suitable climatic conditions as exhibited by *Z. saturalis* on rag weed (*Ambrosia artimissifolia* L.) a close relative of *Parthenium* weed

The feeding potential of Mexican beetle, *Zygogramma*, the various numbers of beetles i.e. 2, 3, 4 and 5 pairs were released on different three age stages of host plant (early stage, pre-reproductive and reproductive) of Parthenium grass. Observations were recorded on every alternate day for the number of insects established, mortality and time taken (number of days) for complete defoliation of plant at each stage The highest time taken (14.83 days) for complete defoliation by two pairs followed by (13.00) in three pairs whereas, minimum time taken by five pairs of Mexican beetle (5.17 days).

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