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# Life table of the Mexican beetle, *Zygogramma bicolorata* Pallister on parthenium and sunflower

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**ABSTRACT: Life-table of the Mexican beetle, *Zygogramma bicolorata* Pallister feeding on parthenium leaves, parthenium leaves smeared with sunflower extract, sunflower leaves and sunflower leaves smeared with parthenium leaf extract have been constructed. The longevity and intrinsic rate of natural increase ($r_m$) varied with extract treated and their respective hosts. The intrinsic rate of natural increase did not change considerably when fed on parthenium leaves and parthenium leaves smeared with sunflower extract ($r_m$ = 0.44). The beetles fed on sunflower leaves ($r_m$ = 0.37) and sunflower leaves smeared with parthenium extract ($r_m$ = 0.35) were also not very different. Shorter generation time was obtained when fed with parthenium and parthenium leaves smeared with sunflower extract.**

**KEY WORDS** : Intrinsic rate of natural increase, life table, *Parthenium hysterophorus*, sunflower, *Zygogramma bicolorata*

*Parthenium hysterophorus* L. (Asteraceae) is an annual weed, native to semi-arid and sub-humid regions of the America. This weed got accidentally introduced into India in early 1950's along with imported food grains (Vartak, 1968). It is an aggressive invader, distributed on cultivated and open land and was declared as a noxious weed in India in the 1970's. In addition to reducing land productivity, the weed causes acute allergic dermatitis and rhinitis in susceptible human beings (Towers and Subba Rao, 1992).

The Mexican beetle, *Zygogramma bicolorata* Pallister was introduced into India in 1984 for biological control of the weed and released in the field after host

specificity tests in 1985 (Jayanth, 1987). The beetle has spread to about 200,000 square kilometre area in Karnataka, Tamil Nadu, parts of Andhra Pradesh and in certain pockets of Madhya Pradesh and Punjab (Jayanth and Ganga Vishalakshy, 1994). Eventhough, the beetle is well established on parthenium, it has been reported feeding on sunflower in isolated plots in Karnataka *viz.*, Arsikere (Chickmagalur District), Kolar (Kolar District), Javagal and Yemmadoddy (Hassan District). The beetle, after complete defoliation of parthenium, moved to the adjoining area of sunflower and fed on border row plants (Anon., 1997). This work was carried out to know the pest potential of *Z. bicolorata* and the possible threat to sunflower.

## MATERIALS AND METHODS

Hundred freshly laid eggs were used for each experiment. Freshly emerged larvae were reared in rectangular (10x4.5cm) plastic containers with copper wire mesh windows on all the sides. To study the fecundity, freshly emerged adults were reared in pairs (1M: 1F) and provided with mature (≤ 10 days old) parthenium leaves, parthenium leaves smeared with sunflower leaf extract (10% aqueous), sunflower leaves and sunflower leaves smeared with parthenium leaf extract. The experiment was carried out under laboratory conditions (28 ± 1°C; 45-65% RH ) at the Project Directorate of Biological Control, Bangalore during 1996-97. The number of eggs laid daily by the females, were noted. In case of death of the male partner, another male was substituted. Each experimental unit (comprising a male and a female) was terminated with the natural death of the female. Life table parameters were computed to study the natural mortality rate in relation to the age of the individual as well as the growth rate of biocontrol agent, *Z. bicolorata* on natural host, *P. hysterophorus*, non-host sunflower leaves and their extracts smeared on the leaf surface of each other.

## RESULTS AND DISCUSSION

The results indicated that the longevity of *Z. bicolorata* showed a significant variation when fed with parthenium, parthenium leaves smeared with sunflower extract, sunflower leaves and sunflower leaf smeared with parthenium leaf extract, mean values being 27.11, 13.44, 12.88, and 13.29 weeks, respectively. The maximum net reproductive rate ($R_o$) was 702.62, 702.0 130.06 and 370.58 and the mean generation time was 16.13, 16.13, 13.52 and 13.69 weeks, respectively, in the above mentioned treatments. The mortality occurring among cohorts is depicted in Figure 1a to d. A comparative analysis of survivorship curves of *Z. bicolorata* indicated that the female mortality occurred late when reared on parthenium and parthenium leaves smeared with sunflower extract and sudden increase in mortality was recorded in sunflower fed individuals.

The innate capacity for increase ($r_c$) and intrinsic rate of natural increase ($r_m$) of *Z. bicolorta* on different treatments are given in Table 1. A comparison of the value indicates that the '$r_m$' value and the generation time were higher on parthenium

Table 1. Life table studies on *Z. bicolorata* on different host plants

| Host | Reproductive rate ($R_0$) | Mean generation time (in weeks) $T_c = \frac{\Sigma lxmx}{R_0}$ | Innate capacity for natural increase $r_c = \frac{\log.R_0}{T_c}$ | Connectedrm $\Sigma lxmx$ X=1096.6 (f/*f* week) | Connceted generation $T = \frac{\log.R_0}{r_m}$ | Finite rate of increase $l = \frac{\text{Antilog}_e}{T_m}$ |
|---|---|---|---|---|---|---|
| Parthenium leaves | 702.62 | 16.13 | 0.406 | 0.437 | 15.00 | 1.548 |
| Parthenium leaves smeared with sunflower extract | 702.00 | 16.13 | 0.406 | 0.437 | 15.00 | 1.548 |
| Sunflower leaves | 130.06 | 13.52 | 0.360 | 0.374 | 13.00 | 1.454 |
| Sunflower leaves smeared with parthenium extract | 370.58 | 13.69 | 0.432 | 0.348 | 17.00 | 1.416 |

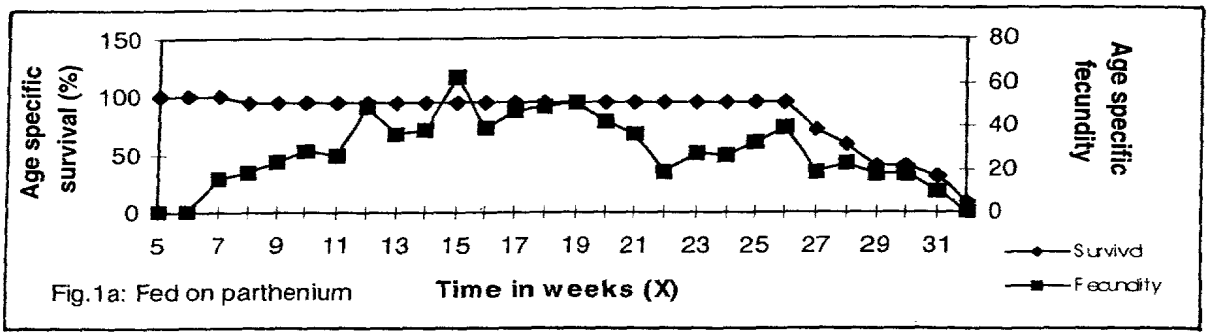


Fig.1a: Fed on parthenium

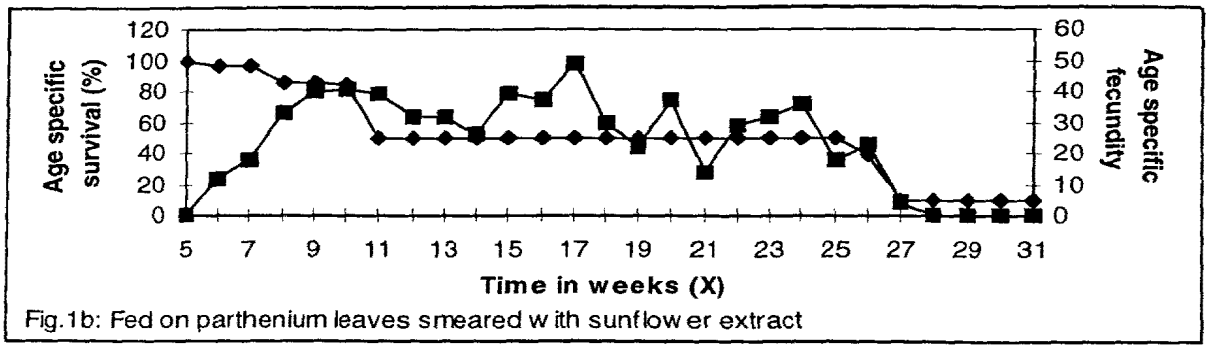


Fig.1b: Fed on parthenium leaves smeared w ith sunflow er extract

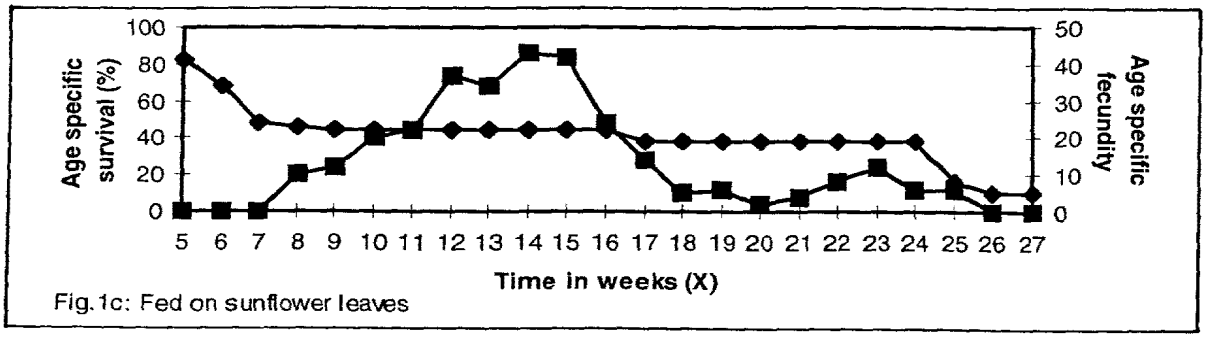


Fig.1c: Fed on sunflower leaves

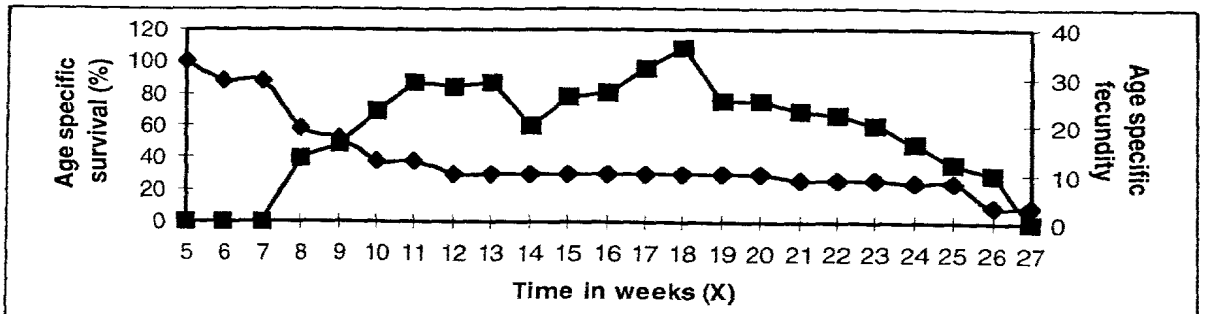


Fig.1d: Fed on sunflower leaves smeared with parthenium extract

Fig. 1. Age specific survival and parthenium of *Z. bicolorata*

and parthenium leaves smeared with sunflower leaf extract than that on sunflower and sunflower smeared with parthenium leaf extract. The onset of egg laying and egg laying period was influenced more by natural host than the non-host or non-host smeared with host leaf extract. The egg laying pattern in relation to host and non-host leaves are presented in Figure 1. Early reproduction was evident when reared on natural host namely parthenium leaves or parthenium leaves smeared with sunflower extract.

Life tables of chrysomelids have been studied on the natural host by Jayanth and Bali (1994). In the present investigation, life table parameters of an insect were analysed and compared on natural host and non-host (sunflower). Parthenium was highly preferred to sunflower and sunflower leaves smeared with parthenium extract. *Zygogramma bicolorata* can clearly discriminate between natural host, non-host and host smeared with non-host and non-host smeared with host extract. Jayanth and Ganga Vishalakshy (1994) reported that among 15 different varieties of sunflower evaluated in the field for susceptibility to *Z. bicolorata,* the beetle was able to feed (5 - 15%) only on certain varieties *viz.*, MSFH-8, EPRO-1 and IAHS-1 and laid only negligible number of eggs. The basis of discrimination has not been studied. In the context of chemical co-evolution hypothesis, the secondary plant metabolites are capable of altering the suitability of host plants for herbivores and consequentially affecting plant-herbivore interactions. Specialist herbivores may sequester such compounds and in due course become a pest in natural conditions by modifying their trophic levels to suit the host (Bernays and Chapman, 1994). Kumar (1992) reported feeding of the Mexican beetle, *Z. bicolorata* on *Xanthium strumarium* and also on its ability to oviposit and complete its life cycle, which indicates the expanding host range (as stenophagy) by the Mexican beetle. The results call for further studies on allelochemical interactions of *Z. bicolorata* with several members of the family Asteraceae to resolve the conflict of the ability of this insect to become a pest of sunflower under field conditions.

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