

Age-specific Fecundity and Intrinsic Rate of Natural Increase in the Mexican Beetle *Zygogramma bicolorata* at Bangalore, India

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Parthenium hysterophorus L. (Asteraceae) is a serious weed of agroecosystems, pastures and waste lands in India. The Mexican beetle *Zygogramma bicolorata* Palister (Coleoptera : Chrysomelidae) was released in Bangalore in 1984 for biological control trials against this weed. The insect started building up to damaging population levels from 1988 (Jayanth and Bali, 1990). The present studies were conducted under laboratory conditions to make a critical assessment of the biological control potential of this insect.

The study was initiated with 10 pairs of freshly emerged adults of *Z. bicolorata*. The paired adults were released in separate transparent plastic jars (11x14 cm) with wire-mesh windows on their lids for aeration. *Parthenium* leaves were provided for feeding and oviposition. The cut ends of the leaves were inserted through a hole in the lid of a small plastic container with water, to keep the leaves fresh, and placed inside each cage. Fresh leaves were provided and the fecundity was recorded twice every week.

For determining the age - specific fecundity, life tables were constructed with the x column representing the pivotal age in weeks and l_x column representing the number of females active during a given age interval, as a fraction of one. The m_x column, or age-specific fertility that records the number of living females born per female in each age interval, was added on the basis of observations (Andrewartha and Birch, 1974, Southwood, 1978).

Adults of *Z. bicolorata* were observed to mate from the fifth day after emergence. The females did not mate during the first week. Pre-oviposition period generally lasted for 10-15 days, but occasionally extended up to 28 or 70 days. Egg laying was observed throughout the day and the oviposition period extended from 89 to 138 days. The post-oviposition period was short (1-21 days). The total number of eggs laid ranged from 1695-3360 with a mean of 2520.90 ± 548.41 per female.

The life table incorporating x , l_x and m_x for *Z. bicolorata* is presented in table 1. The females lived for 29 weeks (129.30 ± 30.81 days) after emergence. They were capable of laying up to 45 eggs per day and 300 eggs per week. The rate of egg laying remained high between the 3rd and 28th weeks, except for slight dips during the 5th and 23rd weeks. Peak egg laying was noticed between the 8th and 11th weeks after emergence.

The net reproductive rate (R_0) for the number of live female progeny per generation was 688.29 and the mean duration of generation (T) was 79.42 days. The calculated finite rate of increase (λ) showed that the population of *Z. bicolorata* increased by 1.085 females per day. The inherent capacity for maximum rate of increase in the presence of abundant food and space (intrinsic rate of natural increase = r_m) was found to be 0.082.

The present studies indicated that *Z. bicolorata* has the capacity for rapid population build up and is therefore a potential

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Table 1. Life-table (female) for age-specific fecundity of *Z.bicolorata* during January to October 1989.

| Weeks | x (pivotal age-days) | lx (No. of active females) | mx Living females born/female | lx mx | x lx mx |
|-------|----------------------------|-------------------------------------|--|--------|----------|
| 1 | 7 | 1.00 | 0.00 | 0.00 | 0.00 |
| 2 | 14 | 1.00 | 6.04 | 6.04 | 84.56 |
| 3 | 21 | 1.00 | 25.20 | 25.20 | 529.20 |
| 4 | 28 | 1.00 | 27.25 | 27.25 | 763.00 |
| 5 | 35 | 1.00 | 13.51 | 13.51 | 472.85 |
| 6 | 42 | 1.00 | 25.65 | 25.65 | 1077.30 |
| 7 | 49 | 1.00 | 32.37 | 32.37 | 1586.13 |
| 8 | 56 | 1.00 | 68.22 | 58.22 | 3820.32 |
| 9 | 63 | 1.00 | 64.18 | 64.18 | 4043.34 |
| 10 | 70 | 1.00 | 76.37 | 76.37 | 5345.90 |
| 11 | 77 | 1.00 | 65.30 | 65.30 | 5028.10 |
| 12 | 84 | 1.00 | 32.68 | 32.68 | 2745.12 |
| 13 | 91 | 1.00 | 48.04 | 48.04 | 4371.64 |
| 14 | 98 | 1.00 | 54.31 | 54.31 | 5322.38 |
| 15 | 105 | 1.00 | 40.49 | 40.49 | 4251.45 |
| 16 | 112 | 0.80 | 23.18 | 18.54 | 2076.48 |
| 17 | 119 | 0.40 | 22.48 | 9.00 | 1071.00 |
| 18 | 126 | 0.40 | 40.60 | 16.24 | 2046.24 |
| 19 | 133 | 0.30 | 56.28 | 16.88 | 2245.04 |
| 20 | 140 | 0.30 | 34.28 | 10.28 | 1439.20 |
| 21 | 147 | 0.30 | 24.16 | 7.25 | 1065.75 |
| 22 | 154 | 0.20 | 31.75 | 6.35 | 977.90 |
| 23 | 161 | 0.20 | 12.22 | 2.44 | 392.84 |
| 24 | 168 | 0.10 | 58.16 | 5.82 | 977.76 |
| 25 | 175 | 0.10 | 50.58 | 5.06 | 885.50 |
| 26 | 182 | 0.10 | 44.96 | 4.50 | 819.00 |
| 27 | 189 | 0.10 | 27.82 | 2.78 | 525.42 |
| 28 | 192 | 0.10 | 28.66 | 2.87 | 562.52 |
| 29 | 203 | 0.10 | 6.74 | 0.67 | 138.00 |
| | | | | 688.29 | 54663.96 |

1. Net reproductive rate (R_0) = 688.29 females/generation

2. Mean length of generation (T) $\left(\frac{\sum x l m x}{R_0} \right) = 79.42$ days

3. Intrinsic growth rate (rm) $\left(\frac{\log e r_0}{T} \right) = 0.082$

4. Finite rate of increase (λ) (antilog e-rm) = 1.085 females/day

biological control agent of *P. hysterophorus* under field conditions in Bangalore.

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KEY WORDS : *Zygogramma bicolorata*, *Parthenium hysterophorus*, biological control, intrinsic rate of increase

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