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Substrata Impact on Mass Rearing of the Reduviid Predator *Rhynocoris marginatus* (Fabricius) (Insecta: Heteroptera: Reduviidae)

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Abstract

The present research project was conducted to study the effects of varied substrata on the development of *R. marginatus*. *Rhynocoris marginatus* was mass reared on five different substrata viz., untreated plastic, tissue and glutting papers, sand and stone, litter and strip, and green leave and stem. The stadial periods of nymphal instars of *R. marginatus* reared on dry litter with strip ad green leaves with stem were greatly shortened over plastic, tissue and glutting papers, and sand with stone substrata. Green leaves with stem supported better survival than substrata such as plastic, sand with stone, tissue and glutting papers and dry litter with strip. Preoviposition period was shortened in the green leaves with stem and tissue and glutting papers substrata. The fresh adult body weights were slightly higher for *R. marginatus* reared on four varied substrata than those reared on untreated plastic substrata. Significantly the highest fecundity was found in the green leaves with stem substrate category.

Introduction

Chemical control of insect pests seems to be unsuccessful with instances of pest resurgence and economic loss. Hence, attention has been paid to Integrated Pest Management (IPM), an ideal approach to utilize all the components in a harmonious manner with special reference to utilization of natural enemies like insect predators to secure sustainable crop protection (Grenier *et al*., 1995). In the light of current needs, it seems that mass production of heteropteran predators would be most helpful and welcome in IPM (Lakkudi and Parshad, 1987; Richards, 1992; Volkovich and Saulich, 1992; De Clercq and Degheele, 1993; Cohen and Staten, 1994). *Rhynocoris marginatus* (F.) (Heteroptera: Reduviidae) is one of the most abundant reduviid predators associated with crops, such as cotton, okra, groundnut, pigeonpea and chickpea in south India (Bhatnagar *et al*., 1983; Ambrose, 1995, 1999; Sahayaraj, 1995). The life history of the predator was studied by Ambrose and Livinstone (1986) and its predatory efficiency was studied by Ambrose and Claver (1996). Biocontrol potential of this species was evaluated in field cages against noctuid larvae, beetles and bugs (Ambrose, 1995, 1999). It has been mass-reared in the laboratory for its subsequent release in the IPM. Though, grouping of this gragarious species might extent positive influence upon survival, development and morpho-functional characters (Peters and Barbosa, 1977; Clever *et al*., 1996), more information on the influence of substrata on mass-rearing on this predator is needed to better understand its efficient mass-multiplication strategies. Though it is a known fact that substrata could influence the multiplication of the predator population, information on the role of substrata on the life cycle and to laboratory rearing of predator on different substrata and predator's substrata preference are scanty. Keeping in view of the above facts, an attempt was made to study the effects of varied substrata on the development of *R. marginatus*. Such information would enable us to select the most acceptable rearing substratum for reduviid multiplication in the laboratory. The present paper compares the influence of five rearing substrata viz,. untreated plastic, tissue and glutting papers, sand and stone, litter and strip and green leaves and stem on stadial period, nymphal survival, adult weight, sex ratio and fecundity in the mass rearing of *R. marginatus*.

Materials and Methods

A laboratory colony *R. marginatus* was established from nymphs and adults collected from the Sivanthipatti semiarid zone bordering agroecosystem, 8 km away from Palayankottai. (77"47'E and 8.'30'N). *R. marginatus* was maintained at 25 ± 2°C, 68 ± 5 percent and a 13:11 (L:D) photoperiod in 9x3 cm plastic containers, individually. Twenty five newly laid eggs were placed in group in 15 cm diameter plastic troughs and nymphs were transferred to 30 x 25 cm diameter plastic troughs upon reaching second instars. Throughout their development adults and nymphs of *R. marginatus* received a constant daily supply of larvae of *Corcyra cephalonica* Stainton (Lepidoptera Pyralidae). Prey colonies were maintained at 25 ± 2° humidity with 68 ± 5 and a photoperiod of 13:11 (L:D) as proposed by Kalyanasundaram (1992). The following substrata types were tested.

1. Untreated plastic trough.
2. Tissue and glutting papers (tissue paper was lined to the floor of the troughs and a bit of multi folded glutting paper was placed on the tissue paper for reduviids to hide).
3. Dry sand and stone (sand was spread uniformly in the trough upto 2cm height and stones (approx. 5 x 3 cm size) were placed on it and care was taken for placing concave side of the stone facing the earth to facilitate the hiding of reduviids).

Table 1: Influence of five different substrata on some biological attributes of *Rhynocoris marginatus* (n = 20, ± SE)

Biological attributes	Substrata				
	UP	TG	SS	LS	GS
Incubation period (days)	9.6±0.89	10.3±1.12	8.90±1.43	9.60±1.44	9.1±0.49
Stadial period (days)	64.1±5.48	68.28±2.92	61.4±2.31	59.6±4.34	50.4±3.57
Nymphal survival (%)	52.1	57.4	60.5	71.6	72.3
Sex ratio (male:female)	1:1.1	1:1.3	1:1:1-	1:1.2	1:1.2
Adult weight (mg)	131 .4±231	26.1±1.85	23.8±1.58	23.4±2.14	22.31±2.42
Preoviposition period (days)	28.3±2.31	26.1±1.85	23.8±1.58	23.4 -±2.14	22.31±2.42
Fecundity (egg/female)	132.4±5.32ab	129.6±9.94a	134.4±7.21ab	151.6±10.3ab	167.57±9.43b

UP: Untreated plastic trough, TC: Tissue and glutting papers, SS: Sand and stones, LS: Litter and strips, GS: Green leaves and stem (values followed by similar alphabets are not significant)

4. Dry litter and strips (litter was filled in the troughs upto 4 cm height and some small strips were placed over it for easy movement of reduviids).
5. Green leaves with stem (fresh cotton branch with leaves was placed inside the trough and adequately replaced At regular interval at least once in 2 days to keep the leaves fresh).

The troughs were observed daily for recording, moulting and for measuring duration of instars (Table 1). Biological attributes, such as incubation, stadia and preoviposition periods, nymhal survival, sex ratio of emerging adults and fresh weight of neonate male and female were recorded I each category. We paired *R. marginatus* males and/emales in 15 x 10 cm containers within 3 day of adult emergence and allowed them to mate. Four days later males were removed and mated females received their respective rearing substrate for oviposition. Total egg counts of five gravid females reared per substrate were recorded. These mass rearing experiment and observations were conducted on five different rearing substrata in four replication during 1996-1997. Substrata impacts on fecundity were compared using analysis of variance.

Results and Discussion

Though substrata did not influence the incubation period, the stadial periods of nymphal instars of *R. marginatus* reared on dry litter with strip and green leave with stem were greatly shortened over three categories. Debach and Hagen (1964), Watson (1964), Ali and Watson (1978), Braman *et al*. (1984) and Whitcomb (1994) pointed out that developmental duration of predators prolonged when their abiotic factors were varied. Moreover, Eigenbrode *et al*. (1996) stated that the developmental period prolonged when sensillae of tarsi of anthocorid *Orius insidiosus* (Say) were damaged or coated with debris while working on polished surface or wax layered plants.

Green leaves with stem supported better survival than did other substrata. This difference was probably because of higher nymphal cannibalism at untreated plastic substrata and sand with stone substrata. Similarly Yadav *et al*. (1998) reported higher survival of chrysopid larval predators on bioassay substrata over iron sheet and plastic substrata. McPheerson *et al*. (1982) stated that fallen dead leaves could form conducive micro habitats for reduviids high biological activity and survival. Moreover, King and Morriso (1984) stated that insect survival was dependent on the habitat suitability of substrata and also their level of phenotypic and somatic plasticity.

Preoviposition period was shortened in the green leaves with stem and tissue and glutting papers substrata. But it did not differ significantly among all other treatments. But, Drukker *et al*. (1995) stated that plastic and its odour reduced the possibility of oviposition of an anthocorid *O. insidiosus* that might be the reason for the extension of oviposition period in untreated plastic substrate. Moreover, Evans (1976) and Ferran *et al*. (1996) stated that sensillae of rostrum receive physical (superficial texture) and/or chemical (local humidity, plant secretion, gas exchange) information from plants and this information would motivate female predatory bugs for oviposition, but lack of such plant substrata or a deficiency of qualitative or quantitative cues from the plant would delay or avoid oviposition.

The fresh adult body weights were slightly higher for *R. marginatus* reared on four varied substrata than those reared on untreated plastic substrata. Decrease in adult body weight of *R. marginatus* reared in plain plastic containers could be attributed to the negative impact of plastic containers (Drukker *et al*., 1995). Murdie (1969) reported a 20 percent reduction in male weight and a 35 percent in female weight of pea aphild due to rearing habitat stress. Evans (1982) further stressed that body weight is a major determinant of egg production in predatory stink bugs.

The sex ratio was a slightly female biased in all the tested mass-rearing conditions. Similar female biased sex ratio as a function of mass-rearing was reported for *R. marginatus*, *R. kumarii* Ambrose and Livingstone and *R. fuscipes* (Fabricius) (Ambrose, 1995; Clever *et al*., 1996). Moreover, Long and Zaher (1958) reported that insect mass-rearing produced larger adults with a greater effect on females.

Significantly the highest fecundity was found in the green leaves with stem substrate category. Gautam (1990)

also reported that predaceous coccinellid beetle preferred to deposits their eggs on the cotton and folded tissue paper rather than on other glass and plastic substrata. Moreover, Naranjo and Stimac (1987), Snodgrass and McWilliams (1992) and Ferran *et al*. (1996) stated that oviposition non-preference appeared to be important for predatory bugs population in certain substrate, where adults colonize but do not reproduce well. Furthermore, Hegde and Patil (1995) and Karuppachamy *et al*. (1988) reported that the multiplication of predator was faster in preferred green leaves provided on substrate. This might be an important reason for the higher fecundity registered on green leaves and stem substrate.

The present findings suggest that mass-rearing of reduviid predators, such as *R. marginatus* in plain plastic trough is not advisable and inclusion like leaves and green stem as substrata could enhance its mass rearing.

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