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## Effect of Female's Age on the Progeny Production and Sex Ratio of *Ooencyrtus nezarae*, an Egg Parasitoid of the Bean Bug *Riptortus clavatus*

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*Ooencyrtus nezarae* is a facultative gregarious egg parasitoid and attacks a wide variety of several hemipterian bugs. In the present study, the influence of female parasitoid's age to progeny production and sex ratio of *O. nezarae* was evaluated under laboratory tests. The percentage parasitism and the number of progeny were significantly decreased in old female. The optimal age of *O. nezarae* for successful parasitism ranged from 1–4 days, and sex ratio and clutch size were not affected by female parasitoid's age. The reproductive potential of 4-day-old and 1-day-old females was significantly higher than 20-day-old females. At the same time, 4-day-old females are more fecund within short duration than 1-day-old female. Our findings revealed the optimal female's age for efficient reproduction of *O. nezarae* which can be useful for biological control program as well as for mass rearing to optimize its efficiency.

### INTRODUCTION

Knowledge of reproductive rates of natural enemies including parasitoids is important to assess their potential as biological control agents. Because the reproductive rates depend on biological parameters like size, age, experience, and egg load of female parasitoids and environmental parameters like host density and availability, such parameters should be considered when assessing the optimization of lifetime reproductive success of a parasitoid (Godfray *et al.*, 1991).

Age is an important determinant of reproduction among the parameters. Resource allocation to egg production (Siansky and Rodriguez, 1987; Karlsson, 1987) and clutch size (Begon and Parker, 1986) should vary with maternal age in insects. Although female age is considered to influence clutch size decisions in parasitoids, few experimental studies have investigated in detail the effects of female age on clutch size in gregarious parasitoids (Jelmer *et al.*, 2005).

*Ooencyrtus nezarae* Ishii (Hymenoptera: Encyrtidae) is an egg parasitoid wasp of several phytophagous Hemiptera including the bean bug, *Riptortus clavatus* Thunberg (Takasu and Hirose, 1985, 1986; Noda, 1993; Mizutani *et al.*, 1996). It is a synovigenic species and the females emerge from the host without mature eggs (Aung *et al.*, unpublished). Preliminary observations suggest that the female lays 3–5 eggs with a sex ratio of 1 male: 3 females.

The present study has been conducted to observe the effect of parasitoid age on the clutch size and sex ratio of *O. nezarae* with a view to maximize the parasiti-

zation. Knowledge of the oviposition behavior of *O. nezarae* may provide clues to design efficient systems for mass rearing and field release of this parasitoid.

### MATERIALS AND METHODS

The host *Riptortus clavatus* was collected from Kyushu University campus, and the parasitoid *Ooencyrtus nezarae* was obtained from the laboratory culture maintained at Bioresource and Management Laboratory. The host and parasitoid were reared as described by Takasu and Hirose (1988).

To assess the effect of female age on parasitization and fecundity, we set up three groups of females: (1) 1-day-old females (2) 4-day-old females and (3) 20-day-old females. Newly emerged females after mating were individually put into test tubes (1.5 cm diameter and 10.5 cm long), in which a droplet of honey was placed as a food source. Test tubes were kept at 25 °C under a 16L:8D photoregime. After females reached a given age (1, 4 or 20-days-old), they were divided into the three groups. Individual female from each group was placed in each test tube which contained with droplets of honey and provided with 5 young host eggs (which were collected after 24 h) per day for 10 consecutive days. The tubes were kept at 25 °C under a 16L:8D photoregime. The numbers of parasitized hosts and adult parasitoids emerged were recorded. Also, the sex ratio of the parasitoids was noted. Fifteen females were tested for each female group.

In the second experiment, we examined the efficient duration of female parasitoid's reproductive capability to access the potential use within the short duration. The total progeny productions of different female ages were examined as follows: 1-day-old-hosts for 14 days, 4-day-old hosts for 10 days and 20-day-old hosts for 14 days. Fifteen females were conducted for each treatment. Other experimental procedures were the same with the

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first experiment.

## RESULTS AND DISCUSSION

4 days old females parasitized significantly more hosts than 1-day-old or 20-day-old females did ( $p < 0.001$ ). Although there was no significant difference in progeny production between 1-day-old and 4-day old females, significantly fewer progenies were produced by 20-day-old females than by 1-day-old or 4-day-old females ( $p < 0.001$ ). The sex ratio and the clutch size of the offspring parasitoids on the other hand did not differ among the different female age groups ( $p > 0.05$ ) (Table 1).

The total progeny production of the 1-day-old females over 14 day period ( $62.5 \pm 2.8$ ) or that of 4-day-old females for 10 day period ( $78.2 \pm 4.3$ ) was significantly higher ( $p < 0.001$ ) than that of 20-day-old female ( $47.9 \pm 2.4$ ) over 14 day period (Fig. 1). When the number of progeny produced during the first 10 days was calculated, 4-day-old females produced the same number of progeny within short duration (10 days) than those of 1-day-old females (14 days) and 20-day-old females (14 days).

The current study demonstrated that the total progeny production and parasitization were depended on female parasitoid's age. A younger parasitoid is more fecund than the older ones. Likewise, the effect of age of the parasitoid on their ability to parasitize their host has been documented on some parasitoids (Hentz *et al.*, 1998; Honda *et al.*, 1998). For instance, the optimum

age for *Cotesia marginiventris* to successfully parasitize larvae of *Spodoptera frugiperda* ranges from 48 h to 96 h since emergence (Rajapakse, 1992). *C. marginiventris* that were younger or older than the above age class were not able to parasitize a host. A similar result has been demonstrated in our study where females of 1–4 days show higher reproductive activity than old females. Understanding of the efficient age of parasitoids is very important to obtain effective and successful parasitism in field release program as well as for mass production.

According to the present result, a larger number of progeny can be produced with the 4-day-old females within short duration. So, by using the 4-day-old females, time and labor resource required can be reduced upon mass rearing as well as for field release program.

Generally, it has frequently shown that, in gregarious parasitoids, progeny sex ratio is female biased though it can be male biased during the declining fecundity period (Orr *et al.*, 1986; Mendel *et al.*, 1987). Our result contradicts with their findings, and the sex ratio of *O. nezarae* is not affected by female parasitoid's age. This fact may suggest that this parasitoid can be an important biological control agent.

Our study on biological information is worth in evaluating the potential of *O. nezarae* in the biological control of the bean bugs.

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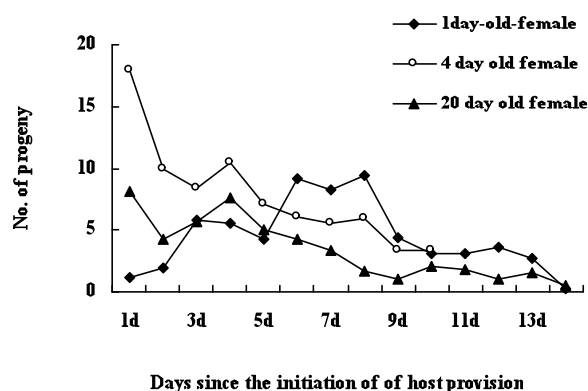
## REFERENCES

- Begon, M. and G. A. Parker 1986 Should egg size decrease with age? *Oikos*, **47**: 293–302
- Godfray, H. C. J., L. Partridge and P. H. Harvey 1991 Clutch size. *Annu. Rev. Eco. Sys.*, **22**: 409–429
- Hentz, M. G., P. C. Ellsworth, S. E. Naranjo and T. F. Watson 1998 Development, longevity, and fecundity of *Chelonus sp. nr. curvumaculatus* (Hymenoptera: Braconidae), an egg-larval parasitoid of pink bollworm (Lepidoptera: Gelechiidae). *Env. Entomol.*, **27**: 443–449
- Honda, T., Y. Kainoh and H. Honda 1998 Enhancement of learned response to plant chemicals by the egg-larval parasitoids, *Ascogaster reticulatus* Watanabe (Hymenoptera: Braconidae). *Appl. Entomol. Zool.*, **33**: 271–276
- Jelmer, A., J. Elzinga, A. Harvey and B. Arjen 2005 Age-dependent clutch size in a koinobiont parasitoid. *Ecol. Entomol.*, **30**: 17–27
- Karlsson, B. 1987 Variation in egg weight, oviposition rate and reproductive reserves with female age in a natural population of the speckled wood butterfly, *Pararge aegeria*. *Ecol. Entomol.*, **12**: 473–476
- Mendel, M. J., P. B. Shaw and J. C. Owens 1987 Life history characteristics of *Anastatus semiflavus* (Hym: Eupelmidae) an egg parasitoid of the range caterpillar, *Hemileuca oliviae* (Lep: Saturniidae) over a range of temperatures. *Environ. Entomol.*, **16**: 1035–1041
- Mizutani, N., Y. Hirose, H. Higuchi and T. Wada 1996 Seasonal abundance of *Ooencyrtus nezarae* Ishii (Hymenoptera:

**Table 1.** Effect of female's age on parasitization, clutch size and sex ratio of *O. nezarae* over 10 days period

Types of females	No. of host parasitized	Clutch size	Sex ratio (% male)
1-day-old	14±6.7a	4.0±0.7a	19.6±4a
4-day-old	18±3.5b	4.3±0.4a	18.7±3a
20-day-old	13±7.9a	3.3±0.6a	19.9±4a

Mean values followed by the same letter within a column are not significantly different ( $p > 0.05$ –Tukey–Kramer HSD test) (Mean ± SD)



**Fig. 3.** Effect of female's age of *O. nezarae* on progeny production over 14 days period.

- Encyrtidae), an egg parasitoid of phytophagous bugs, in summer soybean fields. *Jpn. J. Appl. Entomol. Zool.*, **40**: 199–204 (in Japanese with English summary)
- Noda, T. 1993 Ovipositional strategy of *Gryon japonicum* (Hymenoptera: Scelionidae). *Bull. Natl. Inst. Agro-Environ. Sci.*, **9**: 1–51 (in Japanese with English summary)
- Orr, D. B., J. S. Russin and D. J. Boethel 1986 Reproductive biology and behavior of *Telenomus calvus* (Hym: Scelionidae), a phoretic egg parasitoid of *Podisum maculiventris* (Hemiptera: Pentatomidae). *Can. Entomol.*, **118**: 1063–1072
- Rajapakse, R. H. S. 1992 Effect of host age, parasitoid age, and temperature on interspecific competition between *Chelonus insularis* Cresson, *Cotesia marginiventris* Cresson and *Microplitis manilae* Ashmead. *Insect. Sci. Appl.*, **13**: 87–94
- Siansky, F. and D. G. Rodriguez 1987 Nutritional ecology of insects, mites, spiders, and related invertebrates: An overview. In "Nutri. Ecol. Insect, Mites, Spiders, and Related Vertebrates" ed. by F. Siansky, Jr. & d. G. Rodriguez, Wiley & Sons, NY, pp. 1–69
- Takasu, K. and Y. Hirose 1985 Seasonal egg parasitism of phytophagous stink bugs in a soybean field in Fukuoka. *Proce. Assoc. Plant. Prot. Kyushu.*, **31**: 127–131 (in Japanese with English summary)
- Takasu K, Hirose Y. 1986. Kudzu–vine community as a breeding site of *Ooencyrtus nezarae* Ishii (Hymenoptera: Encyrtidae), an egg parasitoid of bugs attacking soybean. *Jpn. J. Appl. Entomol. Zool.* **30**: 302–304 (in Japanese with English abstract)
- Takasu, K. and Y. Hirose 1988 Host discrimination in the parasitoid *Ooencyrtus nezarae*: the role of the egg stalk as an external marker. *Entomol. Exp. Appl.*, **47**: 45–48