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# Studying the biological features of development and the technology of breeding the *Orius laevigatus* Fieb Predatory Bug

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**ABSTRACT**

Some biological features of development and the technology of mass breeding of the *Orius laevigatus* predatory bug used in tomato biological protection from thrips have been studied. The indicators of practical importance — the fecundity and the longevity of the entomophage — have been determined. On the Kalanchoe daigremontiana feed substrate, the fecundity of *Orius* has been on average 39.0 larvae per female vs. 36.4 larvae on the Kalanchoe blossfeldiana feed substrate, and 34.2 larvae on the bean feed substrate. The quantitative yield of adults from the stage of nymphs was determined, depending on the feed type used. On mixed feed, the yield of imago has been 50.8 % vs. 29.3 % on the the eggs of *Sitotroga cerealella* and 19.9 % on flower pollen.

***Key words :*** *Bioagent, Entomophage, Breeding insects, Orius.*

## Introduction

The entomophage studies first started at the institute in 2012 to create a collection of well-known bioagents for protecting vegetable crops from pests and their further introduction into production. For this purpose, beneficial insects were searched for at local stations and agrobiocenoses, and the entomophages were delivered from other countries. Currently, the lab collection contains the following entomoacariphages: *Phytoseiulus persimilis*, *Encarsia formosa*, *Aphidius colemani*, *Orius laevigatus*, *Macrolophus nubilis*, *Nesidiocoris tenuis*, *Podisus maculiventris*, *Neoseiulus cucumeris*, *Amblyseius swirskii*, and *Chrysoperla carnea*.

Among the entomophages, the *Orius laevigatus* bug is the most effective when used against thrips on vegetable and flower crops (Saprykin and Pazyuk, 2003; Volkov, 2006). As a result of the studies, the methods of bug keeping were mastered, some biological peculiarities of bug development were studied, and the methods of bug breeding were tested.

The imago and larvae of the bug feed on thrips, ticks, and greenhouse whiteflies. This fact is very important, since the bioagent may be colonized simultaneously against a set of pests. The life cycle of the entomophage development includes the egg phase, five nymph phases, and the imago phase. To establish the indicators of fertility and life expectancy, the Kalanchoe daigremontiana, Kalanchoe blossfeldiana, and bean succulent plants were used as the substrate for egg-laying (Trapeznikova, 2010).

## Results

At the laboratory, previously cut leaves of fodder plants were placed in plastic containers, and the bugs were seated on them in pairs (a male and a female) for the females to lay eggs. The results of accounting for the fecundity of Orius on various fodder plants are shown in Table 1.

It was found that the number of Orius larvae in the variant with Kalanchoe daigremontiana was somewhat higher than in the variants with Kalanchoe blossfeldiana and bean. The duration of the bug development was found similarly. The obtained experimental data are shown in Table 2.

The obtained data showed that the duration of bug development, in contrast to their fecundity in all phases of development virtually, had not depended on the fodder plant species, except for a slight increase in the yield of imago in the case of using Kalanchoe daigremontiana.

The next stage of the studies was mastering the technology of keeping and further use of Orius for the biological protection from pests and developing the methods of breeding the entomophage. The performed experiments for determining the biological parameters of bug development (fecundity, longevity) became the basis for developing the method of bioconveyor breeding of the entomophage. In improving the breeding technology, various recommendations were used that had found practical use (Trapeznikova, 2012; Krasavina *et al.*, 2013). Due to the lack of a pronounced diapause in the bioagent, its culture was constantly maintained at the laboratory, which allowed performing experiments aimed at studying the peculiarities of development and the breeding technology (Tommasini, 2003). The basis was the technology of breeding Orius used at the All-Russian Institute of Plant Protection, where the eggs of Sitotroga cerealella were used as supplementary feed.

In bug breeding, the authors used bean instead of succulent plants, since this was economically advantageous and less laborious for the experiments, despite a slight decrease in the number of imagos. The fact that the duration of larvae development and the yield of bugs in the variants were not so significant was also taken into account (Trapeznikova, 2010). In mastering the technology of bug breeding, flower pollen and mixed feed consisting of a mixture of flower pollen and the eggs of Sitotroga

**Table 1.** Fecundity of Orius, depending on the fodder plant used (2017 – 2018)

| Variants | Years | The number of larvae per female in repetitions, bions | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Average |
| Kalanchoe daigremontiana | 2017 | 40 | 41 | 41 | 40 | 39 | 40.2 ± 0.4 |
| | 2018 | 36 | 38 | 37 | 39 | 39 | 37.8 ± 0.6 |
| Kalanchoe blossfeldiana | 2017 | 35 | 39 | 36 | 37 | 36 | 36.6 ± 0.7 |
| | 2018 | 34 | 38 | 38 | 37 | 38 | 36.2 ± 0.8 |
| beanstalks | 2017 | 33 | 32 | 33 | 32 | 32 | 32.4 ± 0.3 |
| | 2018 | 33 | 37 | 36 | 36 | 38 | 36.0 ± 0.9 |

**Table 2.** The timeframes of individual phases of Orius development, depending on the type of substrate (2017 – 2018)

| Substrate | Years | The timeframes of individual phases of Orius development on various substrates, days | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Egg | Age 1 nymph | Age 2 nymph | Age 3 nymph | Age 4 nymph | Age 5 nymph | Imago |
| Kalanchoe daigremontiana | 2017 | 4.3 ± 0.3 | 3.6 ± 0.3 | 3.6 ± 1.1 | 2.3 ± 0.2 | 3.0 ± 0 | 2.6 ± 0.2 | 20.0 ± 1.0 |
| | 2018 | 4.0 ± 0 | 3.0 ± 0 | 3.3 ± 0.3 | 2.6 ± 0.2 | 3.0 ± 0 | 3.3 ± 0.3 | 18.0 ± 1.0 |
| Kalanchoe blossfeldiana | 2017 | 4.0 ± 0 | 4.6 ± 0.3 | 3.6 ± 0.3 | 2.0 ± 0.5 | 2.3 ± 0.7 | 3.0 ± 0.5 | 20.1 ± 0.6 |
| | 2018 | 3.6 ± 0.3 | 3.6 ± 0.3 | 3.3 ± 0.3 | 3.0 ± 0 | 3.3 ± 0.3 | 3.0 ± 0.5 | 18.6 ± 0.6 |
| Bean | 2017 | 4.3 ± 0.3 | 4.0 ± 0.5 | 3.3 ± 0.3 | 2.7 ± 0.2 | 3.0 ± 0.5 | 3.3 ± 0.3 | 19.3 ± 0.6 |
| | 2018 | 4.0 ± 0 | 3.6 ± 0.3 | 3.3 ± 0.3 | 3.6 ± 0.3 | 3.3 ± 0.3 | 3.6 ± 0.3 | 18.0 ± 0.5 |

cerealella (in the ratio of 1:1) were tested for feeding the entomophages along with the eggs of Sitotroga cerealella alone. Given the high cost of the technology for obtaining the eggs of Sitotroga cerealella, the authors took this feed for the standard. At the same time, flower pollen and mixed feed were tested as the experimental feed for determining the possibility of using them in mass bug breeding.

In the laboratory experiments, one beanstalk 9.5 – 10 cm long was used for the bugs to lay eggs and nymphs, while the root of the plant was washed, wrapped in damp cotton, and covered with food wrap on top to prevent stem withering. Next, the plant was placed in a 552.6 $cm^3$ container, and the bugs were placed in it to lay eggs. For mass breeding, five or more beanstalks in a bunch were used, which were placed in a 2,571.6 $cm^3$ cage.

The beanstalks with the eggs laid were kept in cages until the larvae developed to adult bugs. Creating favorable conditions for the bugs made it possible to increase their fecundity and, therefore, to increase the yield of adult bugs per unit area. Therefore, in 2018 – 2019, various types of feed had been tested as additional feed for the larvae and the imagos. For the experiments, bions with the best characteristics were chosen, and five pairs of bugs (a male and a female) were selected from each of the three generations. Stalks of the Korolevsky bean cultivar were used as the substrate for laying eggs. The feed for the bugs in the cages was in the form of sliced paper cards smeared with honey and the feed applied to them. The humidity in the cages was maintained with the use of the Oasis floral foam, and slices of germinated wheat grains were used to prevent cannibalism. The temperature of 25 °C, the humidity of 70 %, and the light day duration of 16 hours were maintained at the laboratory. The number of laid eggs, the timeframes of their development, and the number of nymphs transformed to imagos in each of the three generations were accounted for, depending on the type of additional feed (Table 3). The experiments aimed at determining the effect of additional nutrition on the development of Orius in 2018 were performed in the first generation in the period from April 21 to May 23, in the second generation — from May 25 to June 27, and in the third generation — from June 26 to August 3. In 2019, the experiments were performed in the first generation from April 19 to May 25, in the second generation — from May 23 to June 28, and in the third generation — from June 26 to August 2.

The data obtained showed that the largest number of laid eggs in the first generation had been noted in the variant with feeding the bugs on mixed feed and had amounted on average for the two years to 2,222 vs. 1,753 in the variant with feeding on the eggs of Sitotroga cerealella and 1,422 in the variant with feeding on flower pollen. In the case of using mixed feed, the number of nymphs that transformed to imagos was significantly higher and amounted to 1,710 individuals, while in the case of feeding on the eggs of Sitotroga cerealella, their number was 1,145, and in the case of feeding on pollen, it was only 708.

The number of eggs laid by the bugs and the emergence of imagos from the eggs and nymphs in the second generation showed the same regularity as in the first generation. Egg-laying increased by 52.8 % in the variant with mixed feed, and by 24.2 % in the variant with the eggs of Sitotroga cerealella. In the variant with mixed feed, a high rate of bug emergence from the nymph to imago phase was also noted.

Similar results on the number of eggs laid by the bugs and the rate of imago emergence from the nymph phase were also obtained in the third gen-

**Table 3.** The number of the eggs laid by the bugs and the number of nymphs transformed to imagos, depending on the type of feed (2018 – 2019)

| Generation | The number of the eggs laid by the bugs and the number of nymphs transformed to imagos, depending on the type of feed | | | | | |
|---|---|---|---|---|---|---|
| | The eggs of Sitotroga Cerealella | | Flower pollen | | Mixed feed | |
| | The eggs laid | Transformed to imago, bions | The eggs laid | Transformed to imago, bions | The eggs laid | Transformed to imago, bions |
| Generation 1 | 1,753.0 ± 16.9 | 1,145.0 ± 9.8 | 1,422.3 ± 9.7 | 708.6 ± 8.2 | 2,222.3 ± 10.9 | 1,710 ± 8.5 |
| Generation 2 | 2,178 ± 11.6 | 1,831 ± 8.2 | 1,467 ± 10.1 | 1246 ± 7.1 | 3,397 ± 13.6 | 3,169 ± 9.2 |
| Generation 3 | 2,842 ± 11.7 | 2,652 ± 7.6 | 2,553 ± 11.5 | 2,177 ± 6.7 | 3,567 ± 13.5 | 3,295 ± 7.8 |

eration. An increase in the number of laid eggs and a high number of imagos that emerged from the nymph phase were observed in all the variants of the experiment, except for the variant with feeding the bioagent on flower pollen, where only 708 bions emerged from the nymph stage. This was probably due to the peculiarities of flower pollen composition, which did not provide sufficiently complete nutrition, like that in the eggs of Sitotroga cerealella. Thus, feeding bugs and larvae on mixed feed provided a high level of fecundity and, accordingly, the yield of imagos, compared to feeding on the eggs of Sitotroga cerealella and pollen separately. In organizing mass bug breeding, in the cages into which five beanstalks had been placed as the substrate for laying eggs, and the larvae and imagos had been additionally fed on mixed feed, the imago yield on average amounted to 400 – 450 imagos per cage. Therefore, in practice, the accumulation of the required amount of biomaterial depended on the timely organized bioconveyor for breeding the entomophage. For this purpose, an appropriate number of cages should be provided and timely additional feeding of the bioagents should be organized while maintaining appropriate temperature and humidity.

## Conclusion

Based on the results of the above research related to studying the biological peculiarities of the Orius bug (*Orius laevigatus*) development and the methods of its breeding, the following conclusions may be made:

1. A slight decrease in the fertility and the longevity of the Orius bug in the case of using bean as the feed substrate, compared to Kalanchoe daigremontiana, does not have a practical effect on the results of mass entomophage breeding.
2. The use of bean as the fodder plant, despite a slight decrease in the yield of imagos, is advisable from an economic standpoint and is less time-consuming in laboratory experiments and mass bioagent breeding for practical purposes.
3. Additional Orius feeding on mixed feed has ensured a high yield of the biomaterial. The ratio of the bug yield in the case of using mixed feed to the bug yield in the case of using the eggs of Sitotroga cerealella and flower pollen was 50.8% vs. 36.6 % and 26.8%, respectively.

## References

Krasavina, L. P., Trapeznikova, O. V. and Orlova, G. S. 2013. Razvedenie i primenenie *Orius laevigatus* protiv tripsov [Breeding and using *Orius laevigatus* against thrips]. *Plant Protection and Quarantine.* 2 : 47-48.

Saprykin, A. A. and Pazyuk, I. M. 2003. Biologicheskaya borba s tripsami: primenenie, razvedenie khishchnykh klopov oriusov [Biological thrips control: using and breeding. *Orius predatory bugs*]. *Gavrish*. 3 : 14-16.

Tommasini, M. G., Burgio, G., Mazzoni, F. and Maini, S. 2003.On intra-guild predation and cannibalism in *Orius insidiosus* and *Orius laevigatus* (Rhynchota Anthocoridae): laboratory experiments. *Bulletin of Insectology*. 55(1-2): 49-54.

Trapeznikova, O. V. 2010. Optimizatsiya massovogo razvedeniya klopov roda *Orius* [Optimization of mass breeding of the bugs of the *Orius* genus]. *Plant Protection and Quarantine*. 1 : 48-49.

Trapeznikova, O. V. 2010. Selektsiya khishchnogo klopa *Orius laevigatus* Fieb. na povyshenie plodovitosti pri razvedenii na rastenii-sukkulente Kalanchoe daigremontiana Hamet & Perrier [Breeding the *Orius laevigatus* Fieb. predatory bug for increasing its fecundity in the case of breeding on the *Kalanchoe daigremontiana* Hamet & Perrier succulent plant]. *Bulletin of Plant Protection* 1: 52-56.

Trapeznikova, O. V. 2012. Biologicheskoe obosnovanie massovogo razvedeniya klopa *Orius laevigatus* Fieb. (Heteroptera, Anthocoridae) [Biological substantiation of the *Orius laevigatus* Fieb. bug (Heteroptera, Anthocoridae) mass breeding]: abstract for the degree of candidate of biological sciences. SSI All-Russian Institute of Plant Protection of the Russian Academy of Agriculture, St. Petersburg.

Volkov, O. G. 2006. Kontrol tripsov v zakrytom grunte [Thrips control in greenhouses]. *Plant Protection and Quarantine* 1: 23-25.