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Determination of Sunn Pest, *Eurygaster integriceps* Put. (Heteroptera: Scutelleridae)'s Preference of Laying eggs on Dry or Green Wheat Leaves and Different Color Papers

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ABSTRACT
In Turkey, species belonging to the genus Trissolcus (Hymenoptera: Scelionidae) known as egg parasitoid have been used since 2003 in the biological control of Sunn pest, Eurygaster integriceps Put. (Heteroptera: Scutelleridae). It is important to determine Sunn pest's egg laying preferences on different colors in order to contribute to the mass production of egg parasitoids and to reduce the labor force. For this purpose, 120 pairs of Sunn pest were cultivated in production containers have red, white, blue, pink, green and yellow colored papers as well as dry and green wheat leaves. The number of egg masses laid by Sunn pest fed in production containers on papers of different colors, dry and green wheat leaves were counted. The data obtained as a result of the experiment were compared statistically. As a result, it was determined that among the colored papers, it lays 33,4 ± 4,38 egg masses on blue color and 20,3 ± 2,89 egg masses on white colored papers at least. On the other hand, 52,8 ± 4,36 eggs were laid on dry wheat leaves and 11,9 ± 1,49 eggs were laid on green wheat leaves. It was determined that 71,4% of the egg masses were laid on colored papers, 23,3% on dry wheat leaves and 5,3% on green wheat leaves. Thus, according to the results obtained, it concluded that would be appropriate to use dry wheat leaves in the production containers in case of using Sunn pest eggs as host in the mass production of egg parasitoids under laboratory conditions.

KEY WORDS: *Color preference, egg mass, Eurygaster, Sunn pest, Trissolcus*

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I. INTRODUCTION

Wheat, *Triticum aestivum* L. (Poales: Poaceae) takes the first place among the plants grown in Turkey. There are many pests that cause problems in wheat production areas. Among these, the main pest is Sunn pest, *Eurygaster* spp. (Heteroptera: Scutelleridae) take the first place. If these pests are not taken under control, a significant amount of damage occurs in different phenological periods of wheat and barley. There are a large number of parasitoids and predators that significantly reduce the population of Sunn pest under natural conditions [3]. The egg parasitoids, *Trissolcus* spp. (Hymenoptera: Scelionidae) are the most common and the most important enemies. The first biological control studies on this pest were done in 1903 using *Trissolcus vassilievi* Mayr (Hymenoptera: Scelionidae) against *Eurygaster integriceps* Put. (Heteroptera: Scutelleridae) [9]. In the following years, egg parasitoids were mass reproduced in the laboratory conditions and they were released to the areas where the pest was a problem in ancient Russia and Iran [6, 7, 10, 14]. In our country, although the control management was started by releasing egg parasitoids to wheat-cultivated areas in Tekirdağ province for the first time, it was reported that no positive results were obtained due to the lack of release of parasitoids to the nature in the appropriate period [2]. After this attempting, the production of egg parasitoids was started in the province of Hatay in 1998 at Mustafa Kemal University [13]. In the same year, trial releases were made in the provinces of Hatay and Gaziantep and also positive results were reported [4, 11, 12].

Due to the successful results of the applications, approximately 1 million egg parasitoids were released to Gaziantep, Adıyaman and Konya Provinces [13]. In order to prevent the damage caused by this pest, some egg parasitoids, especially *Trissolcus semistriatus* Nees (Hymenoptera: Scelionidae), have been used in Turkey since 2003 [13]. With the support of the Ministry of Agriculture and Forestry, mass production of egg parasitoids has been continued in the insectariums established in Adana Plant Protection Research Institute, Konya Provincial Directorate of Agriculture and Kırklareli Provincial Directorate of Agriculture. Egg parasitoids releases to the areas where Sunn pest is a problem have been continuing every year in Turkey since 2003 until today. They were released into nature every year between 2003 and 2014. Between these years, at least 4 million and at most approximately 12 million egg parasitoids were released [8]. Sunn pest collected from overwintering areas are fed under laboratory conditions and their eggs are obtained. The mass production of egg parasitoids made by using these eggs and the egg parasitoids produced are released to the areas where the Sunn pest has been damaged in

previous years. In these studies, very intensive labor force is required for the collection of egg masses and their presentation to parasitoids.

It is known that eggs are generally laid under the leaves in egg surveys related to Sunn pest in nature. Until today, no information has been obtained about whether the leaves are dry or green and also the color preference for *E. integriceps* to lay its eggs. However, it has been determined that females of *Podisus maculiventris* (Say) (Heteroptera: Pentatomidae) can control the pigmentation of their eggs during ovulation as a response to environmental conditions [1].

The aim of this study is to determine Sunn pest's egg laying preferences on different colored papers and dry or green wheat leaves in order to contribute to the mass production of the Sunn pest egg parasitoids and to reduce the labor force.

II. MATERIAL AND METHOD

The material of the study consists of overwintered adult Sunn pets collected from wheat cultivated areas in Nurdağı district of Gaziantep province and their egg masses, production containers, ice box, petri dishes and krapon papers in different colors.

In this study, it is aimed to determine Sunn pest's preferences of laying eggs on different colored papers in order to contribute to the mass production of egg parasitoids and to reduce the labor force in the biological control of Sunn pest. The experiment was established using the wintered adult Sunn pest collected from the wheat cultivated areas of Nurdağı district of Gaziantep. For this purpose, 8 x 25 cm sized red, white, blue, pink, green and yellow krapon papers were cut and prepared. These were laid on the lower part of the 17 x 27,5 x 40 cm production containers in the same number and after leaving dry and green wheat parts on them, colored papers were left on the top again. 120 pairs of Sunn pest were left in the production containers (Figure 1) where the experiments were carried out and cultured. Ventilation holes are made on the lids of the production containers. The experiment was carried out in room conditions with four replications. Once every three days, egg mass on different colored paper and dry or green wheat leaves in the containers were counted and taken. Colored papers and dry or green wheat leaves were placed again in the containers once every three day. In this way, three counts were performed in each container. The data obtained as a result of the experiment were compared statistically.

Figure 1. Production containers in which trials are carried out

It has been stated that *E. integriceps* is very difficult to diagnose taxonomically without dissecting the male genital structure [5, 3]. Accordingly, the taxonomic distinction of *E. integriceps* species was made by the first author, taking into account the structure of the aedeagus (Figure 2), which has 4 internal spines. The photographs given in the study were taken with the help of an Olympus SZX10 stereo microscope and an Olympus SC30 camera integrated onto it.

The means and standard errors were calculated by applying one-way analysis of variance (ANOVA) to the obtained numerical data. Comparisons of these means were made. Thus, the values were evaluated statistically at the confidence limit of P= 0,05 using the "Duncan Test" and groups were formed.

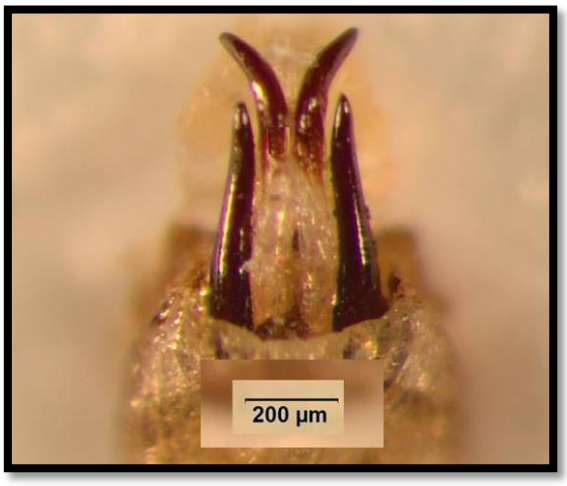

Figure 2. Aedeagus structure of *Eurygaster integriceps* with 4 internal spines

III. RESULTS AND DISCUSSIONS

The data obtained as a result of the experiments conducted are given in Figure 3. As can be seen here, a statistical difference was found between the average number of egg masses of *E. integriceps* left on different colored papers, dry and green wheat leaves ($F_{7,95}$ = 13,309, P = 0,00).

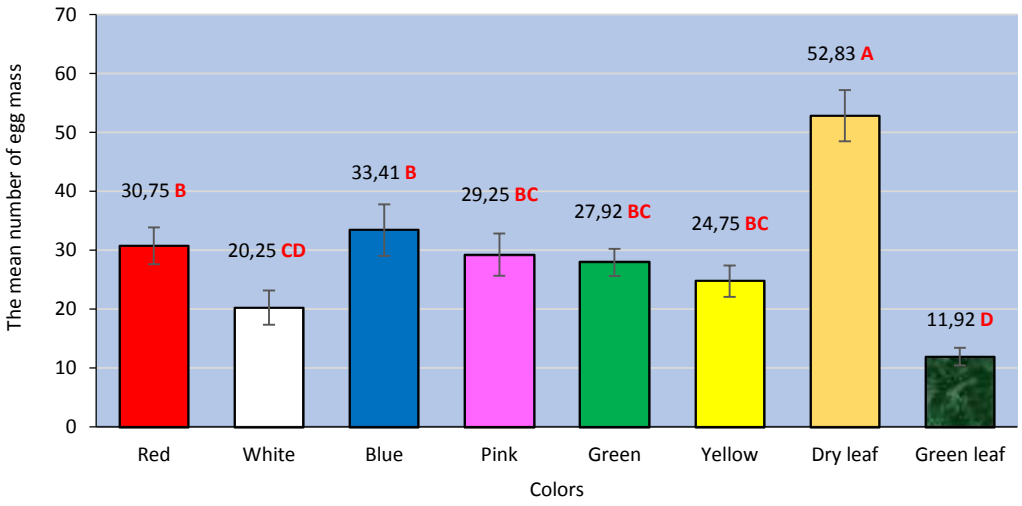

Figure 3. The mean numbers of egg masses laid on different colored papers, dry and green wheat leaves

The rates of egg masses laid on different colored papers, dry and green wheat leaves are given in Figure 4. As seen in the Figure 4, 71,4% of the eggs masses were laid on colored paper, 23,3% on dry and 5,3% on green wheat leaves. It seems that Sunn pest prefers to lay a high percentage of their eggs on paper. It is interesting that it is the least preferred green plant. Sunn pest glues its eggs to the place where it lays. The surface of green wheat leaves has a wet surface due to transpration. This situation may cause negativity in adhering the eggs. Therefore, placing egg masses may not be preferred there. It would be appropriate to consider that the humidity of the environment and the wetness of the materials used will affect laying egg masses and to investigate the possible effect on these rates.

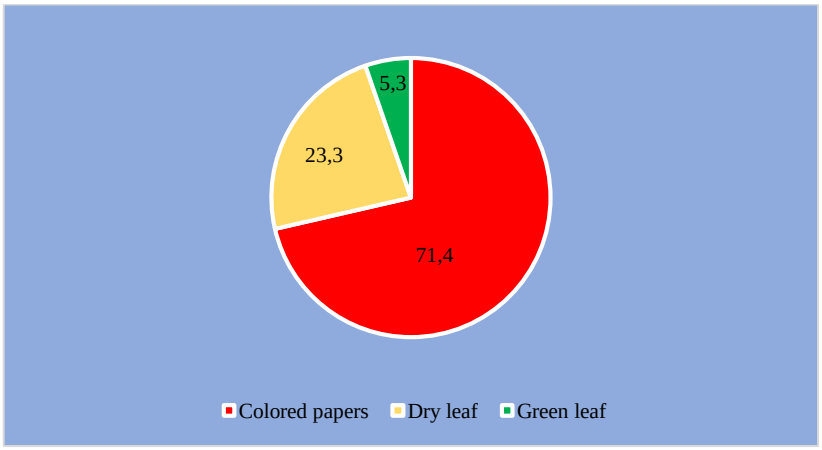

Figure 4. The rates (%) of egg mass left on different colored papers, dry and green wheat leaves

In nature, *E. integriceps* usually lays its eggs on the underside of the leaves. It is generally accepted that this situation provides a sheltered environment for embryos to thrive and provides protection against wind, rain, overheating and drying [1].

It is known that there is a high rates of parasitism in the eggs of Sunn pest both in Turkey and many other countries. Egg parasitoids are used within the framework of Integrated Pest Management programs against Sunn pest, which causes significant damage in wheat cultivated areas in Turkey [13]. The use of chemical pesticides in control against this pest, besides its negative effects on human and environmental health, causes the occurrence of new pests and resistant individuals. In addition, chemical control against Sunn pest is a very expensive method in developing countries. This method is the most common control method, but its intensive using increases production costs and often results in a decrease in the population of beneficial predators and parasitoids. Thus, the natural balance is destroyed and the rate of damage caused by pests increases further. It is better understood today that this method also causes other environmental problems. In order to reduce or eliminate the aforementioned problems, it is important to produce eggs parasitoids in the laboratory conditions and release them to problem areas for control against Sunn pest.

According to the data obtained in the study, it was concluded that the Sunn pests lay their eggs on different colored papers at a rate of 71,4%. In addition, they left the most eggs on the dry leaves of wheat with 23,3%. It was understood that it preferred to lay egg masses in blue and red at least white colored paper. When the colored paper and plant material were compared, it was concluded that the least eggs were laid on the green leaves of wheat. Considering these data, if Sunn pest eggs are used as hosts in the mass production of egg parasitoids, it will be appropriate to use dry leaves of wheat for labor savings and convenience in egg harvesting.

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