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The Role of *Paragus quadri-fasciatus* Meigen on Aphid Control And the Observations of its Biological Characteristics

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Abstract Four-strip small syrphid fly, *Paragus quadri-fasciatus* Meigen is the important natural enemy of aphids in our region. A fly can eat about 800 aphids during its whole life. There are more than 10 kinds of aphids can be food of this fly, such as soybean aphid, Chinese sorghum aphid and radish aphid etc. The fly has 3~4 generations each year in Tonghua county, Jilin province. The adult of the first generation appears after the last ten-day period of April each year. It takes 30~35 days to complete one generation.

The fly can oviposit 84~124 eggs in its whole life. Major natural enemies of the fly are ichneumon wasps, spiders, lacewings and etc.

Key words *Paragus quadri-fasciatus* Meigen; habit; biological characteristic

Four-strip small syrphid fly, *Paragus quadri-fasciatus* Meigen, is the important natural enemy of aphids in southwestern slope of Chang Bai Mountain. The findings of the field trial from 1985 to 1994 are described as follows.

1. Food range of four-strip small syrphid fly and its role of aphid control

According to the data of counting in field, a fly in its larva stages can eat about 800 aphids. On average, each larva of the fly can eat 53~67 aphids every day. The first instar of larva eats 3~5 aphids a day, the 2nd instar of larva eats 10~30 aphids, the 3rd instar of larva eats 50~80 aphids. The favorite food of the fly is the 3rd and 4th instar of aphid larvae.

The larvae of four-strip small syrphid fly mainly eat soybean aphid, Chinese sorghum (*kaoliang*) aphid, corn aphid, grain aphid, radish aphid, a kind of aphids on Chuanjun grass, an other kind of aphids in two kinds of artemisia, willow aphid and Yitian grass aphid etc.

2. Biological characteristics of four-strip small syrphid fly (*Paragus quadri-gasciatus* Meigen)

2.1 The occurrence and development periods of four-strip small syrphid fly (*Paragus quadri-gasciatus* Meigen)

Occurrence period: After hibernation, the adults of first generation emerge from the last ten-day period of April to the first ten-day period of May each year. The first generation occurs mainly among aphids on weed, and the second generation occurs among aphid groups in crop fields. The adult occurrence has two peaks per year in Tonghua county. The first peak is from late of May to late of June. The second peak appears in late August. The fly has 3~4 generations each year in the above mentioned areas.

When the temperature is 20°C the egg stage is about 3~4d, the larval stage is about 10~13 days and the pupa stage is about 12days. It takes 30~35days to complete one generation.

2.2 Adult habit of four-strip small syrphid fly (*Paragus quadri-gasciatus* Meigen)

The female and male flies start to mate after two to three days of emerging. Mating is done several times. The oviposition period is 3~5d and the peak period is 2~4 days after mating.

The eggs are oviposited solitarily in the dense colony of aphids. Each adult of the fly can lay 84~124 eggs in its overall life. The adult is most active around 8~11am and around 3~6pm. The adult moves slowly or does not move at all if the temperature is lower than 13°C and higher than 30°C.

The larva of the fly can be found among aphids on weed in the mid of May. The first generation of larva enters into soil and pupates from the last ten day period of May to the first of June. Every stage of larva can be found in field from the last of June to the mid of July. From end of July to mid of August, the amount of aphids decreases because rainy season starts in the location. During the rainy season the fly drills into the soil, pupates and starts its diapause in order to overcome the bad weather condition. The fly appears again in crop fields, vegetable fields and weed at the end of August. The fly follows aphid population closely. The adult fly and its eggs can be found 2~4 days after aphid appears. The fly larva eats the 2~3 instar larvae of aphids immediately after its emergence. While the amount of the aphids increases the amount of fly larva increases too.

2.3 Natural enemy of four-strip small syrphid fly (*Paragus quadri-gasciatus* Meigen)

The main natural enemy of the fly, ichneumon wasp has a significant effect on the reproduction of the fly. Besides, there are other natural enemies like the insects in the family of coccinellidae, spiders, lacewings and etc. These natural enemies of the fly mainly eat fly larval. Although the above-mentioned natural enemies feed on the fly,

they have other alternative feeding sources. Therefore they do not harm significantly the existence of the fly.

2.4 Environment selection by four-strip small syrphid fly (*Paragus quadri-gasciatus* Meigen)

The fly does not demand a highly specific environment. The investigation from 1989 to May of 1994 stated that the fly could be found where aphids occur. The fly population is increases with the increase of aphid population. Different methods used in crop cultivation have obvious influence on the occurrence of the fly. The details are shown in table 1.

Tab. 1 Different environmental conditions impact on the fly distribution

Environmental conditions	The number of flies per ten thousands of aphids (head)					
	1989	1990	1991	1992	1993	1994
Soybean field without intercropping	4.7	2.9	4.4	6.3	4.9	6.7
Soybean field with intercropping	8.7	6.7	7.5	8.6	7.6	9.4
Soybean field near hill	2.7	1.9	1.6	3.1	2.7	3.7
Soybean field near river	8.7	7.4	6.3	8.7	9.2	10.3
Weed near hill	11.4	8.4	9.7	10.3	9.8	11.6
Weed near river	1.7	2.4	1.8	3.1	1.4	3.7

From table 1, it can be concluded that the different cultural cropping practices have an influence of the occurrence of the fly. The number of the flies in soybean field with intercropping is higher than that in soybean field without intercropping. The number of the flies is higher in soybean filed near the river compared to the soybean fields near the hill. The soybean in the field near water source grew well comparing the one in the field far from river, but near the hill.

2.5 Sex ratio and reproduction capacity in different generations of four-strip small syrphid fly (*Paragus quadri-gasciatus* Meigen)

The sex ratio of the fly in each generation shows an obvious difference. The sex ratio of the first generation after hibernation is 1:2.8. The emergence rate of the adult is 54%. Each female adult can oviposit 87 eggs. The sex ratio of the second generation is 1:1.1. The emergence rate of the adult is 89%. Each female adult can lay 137 eggs. The sex ratio of the third generation is 1:1.19. The emergence rate of the adult is 94%. Each female adult can oviposit 115 eggs.