Utilization of Insect on Garden Cropping

By MORIMI KOBAYASHI

Environment Division, Horticultural Experiment Station, Iwate Prefecture

Since ancient days some attempt has been made to multiply useful insects and utilize them for agriculture. Recently close attention has been drawn to utilization of pollinator (flower visiting insect) for garden crop because the bearing rate of crop has declined owing to the decrease of pollinator.

The yield and quality of crop have suffered very much from restrained pollination because of the forcing culture for winter or early spring production of vegetable crop in plastic greenhouse, which is carried out under the condition of being shut out from outside air during the season of no active insect.

Therefore, hard work is necessary for artificial pollination (or crossing) at present. The utilization of natural pollinator is very important to improve the situation.

From such point of view, the multiplication and utilization of pollinator for garden crop are described hereunder mainly focussing on drone fly (*Eristalis cerealis* Fabricius) which was selected from flower visiting insects except the well-known honeybee (*Apis mellifera* Linne).

Varieties of flower visiting insects

All the flower visiting insects are not always useful; there are many varieties, each of which has its own flower visiting object; namely, to gather pollen and honey, to maintain their lives, to prey upon other flower visiting insects, to take a rest on flower and to eat flowers.

Table 1. Assortment of flower-visiting insects collected in orchards

	Order	Family	Species
Apple	Lepidoptera	4	5
	Coleoptera	6	10
	Diptera	12	34
	Hymenoptera	8	17
	Hemiptera	1	1
Japanese pear	Lepidoptera	3	3
	Coleoptera	6	11
	Diptera	6	19
	Hymenoptera	2	2
Pear	Lepidoptera	1	1
	Coleoptera	5	7
	Diptera	4	11
	Hymenoptera	8	8
Plum	Lepidoptera	3	3
	Coleoptera	4	9
	Diptera	7	24
	Hymenoptera	2	4
Peach	Lepidoptera	1	1
	Diptera	3	5
	Hymenoptera	3	3
Cherry	Lepidoptera	2	2
	Coleoptera	2	4
	Diptera	3	6
	Hymenoptera	1	1

Table 1 shows the assortment of flower visiting insects collected on the trees of flowers in orchards.

Though many species of insects which visit apple, Japanese pear, pear and plum are listed

in this table, the actually useful insects are of Diptera and Hymenoptera.

Present condition of utilization of pollinator

Though almost all crop plants bearing heavily depending upon pollinator are the garden crop such as fruit tree or vegetable, some of the field crops also need a pollinator and it is indiespensable for seed production.

But available insects have been scarcely found except the honeybee; nevertheless, these crops need a pollinator. Even the honeybee has been hardly used only as a pollinator. It has been employed principally for nectar collection and used secondary as a pollinator.

On the utilization of the honeybee in an orchard, a hive of a brood (consists of about 20,000 bees) is usually set per an area of one to four ha at the blooming stage of trees. As for the utilization of a plastic greenhouse, though the capacities of the houses vary, generally about 1,000 bees are used per a house.

Though the easiness in migration by a large swarm of honeybees may be an advantageous point, many problems are encountered in raising honeybees, that is, bees are apt to fly away from subjected flowers to others, they are intolerable against low temperature and are dangerous for human being and cattle.

As for the utilization of the bee other than honeybee, Mamekobachi (Osmia cornifrons R.) has been found. This is not dangerous, and its hive can be made easily with some simple bamboo tubes. But its utility value is not so high except in orchards because it emerges only once a year, and it could not pervade so widely because of its low biotic potential and high parasitic rate of the natural enemy.

Multiplication and utilization of *Eristali cerealis* Fabricius

The mass rearing method of *Eristalis cerealis* F., which had been selected from the various flower visiting insects described in Table 1,

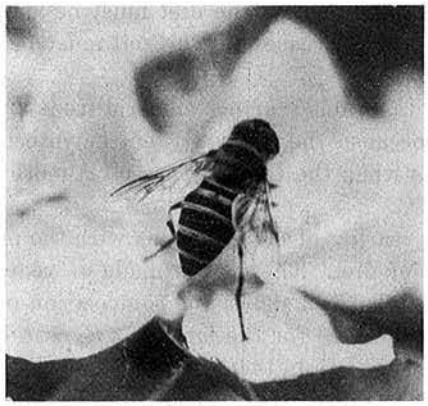

Fig. 1. Adult (♀) *E. cerealis* Fabricius

was established in 1966, and its industrial production system was realized after practical examinations.

Eristalis cerealis F. is widely used in the natural world visiting various flowers.

It is resistible against low temperature, renders no harm to man and beast and possesses high reproductivity. It is used for fruit tree, vegetable and for seed production and can be utilized throughout the year because its multiplied individuals are preservable.

Artificial rearing method

Fundamentally, artificial rearing method can be divided into adult rearing and larval rearing, and adult is fed on the pollen of camellia, apple and daffodil. There are, however, favorable and unfavorable pollen among several kinds of plants. The pollen is collected and preserved before rearing, and besides honey is stocked up as a diet. Such diet and some wet soil contained in a vessel are given to the insects in the rearing cage.

The insects commence to lay eggs about 14 days after rearing begins when they feed on the daffodil pollen and about 10 days with that of camellia. About 200 eggs are deposited collectively per one female in the wet soil, and practically all the eggs hatch out two days after oviposition. To colect the eggs, the soil containing the eggs is spooned and immersed into water, and then the floated eggs are gathered with filter paper. During the rearing, the

pollen and honey as the diet must be supplied when they decrease and the soil must be kept wet always.

The favorable rearing temperature is around 20°C because the mortality of the insects increases when the temperature rises more than 27–28°C.

The rearing of larvae begins with the preparation of diet. The diet is made of vegetable matter. Table 2 shows the composition of the man-made feed for the larvae of *E. cerealis* F. Composition II is the best as an effective and economical diet. The preparation of this diet is as follows;

Table 2. Composition of man-made feed for the *E. cerealis* F. larvae

Ingredient	Measure (g)		
	Composition I	Composition II	Composition III
Water	1300	500	300
Sodium propionate	20	5	1
Dehydroacetic acid	2	—	—
Casein (Soybean)	300	—	—
Barnyard grass	—	200	—
Wood meal	—	—	200
Dry yeast	10	5	10
Agar	80	50	—

Water→Sodium propionate→Barnyard grass→Mixing→Boiling→Cooling=Accomplished
Dry yeast
Agar

After the accomplished matter is hardened, it is roughly smashed and put in the rearing cage and water is added to a depth of about 1 cm above the surface of the diet. The eggs are inoculated upon the small pieces of absorbent cotton put on the water above the diet. The larvae mature after about 14 days at 20°C and then the larvae are removed on a net with the diet and only the larvae are collected by washing in the water. During the rearing, the water of the diet is supplied when it is dried, and the favorable temperature is about 20°C.

The larve pupate when they are disposed on wet sawdust in a vessel, and after about 10 days the adults emerge. The vessel must be covered with net during pupation. If the whole life cycle of this insect is kept at about 20°C, 15 generations can be reared in a year. The long-distance transportation of pupae and larvae is possible; therefore, this insect is practically available in a vast area from the warm to the cold regions.

Utilization method

Fig. 1 shows an example of practical effect in an orchard of apple. When 1,500 adults were dispersed per 10 a at the blooming stage in the comparison of the variety Jonathan, the fruit set percentage of central fruit of cluster was 45 per cent while that of in the orchard no insect was dispersed was about 15 per cent; therefore, the effect of insect utilization is evident.

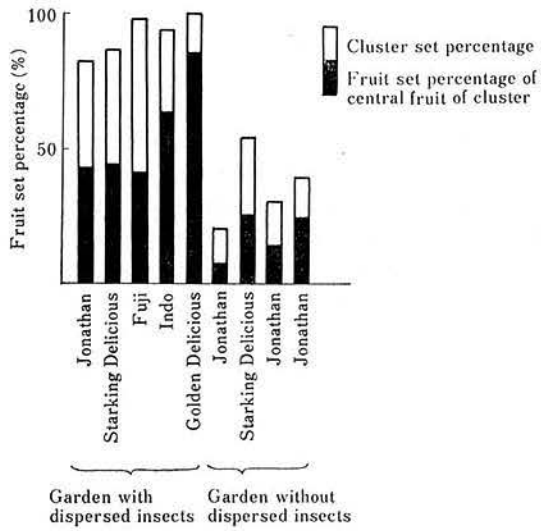

Fig. 2. Comparison of fruit set percentage in an apple garden (1971)

The pollination faculty of *E. cerealis F.* was examined cutting off the stamen of the strawberry grown in a plastic greenhouse as shown in Table 3; namely, the fruit set percentage of the strawberry garden to which the insects were dispersed was 100 per cent with normal shape fruits, while that of no insect was dis-

Table 3. Pollination ability of *E. cerealis* F. on strawberry cultivated in green house (1972)

Plot	Examined flower	Ripened fruit	Normal fruit	Malformed fruit	Sterile
Plot with dispersed insects	15	15(100%)	15(100%)	0	0
Plot without dispersed insects	15	10(66.7%)	0	10(66.7%)	5(33.3%)

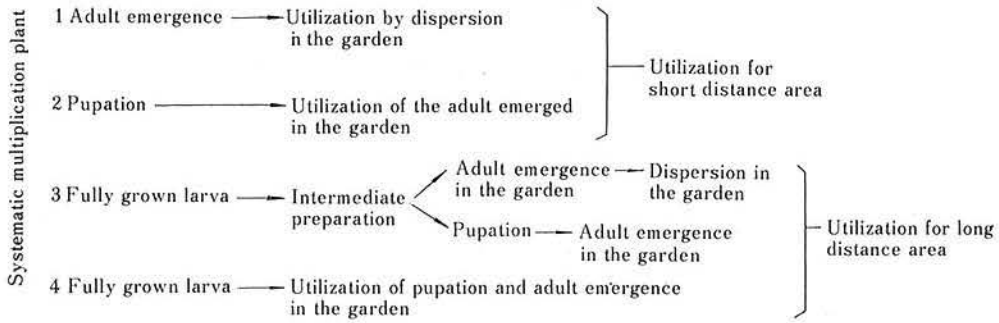

Fig. 3. Utilization system of *E. cerealis* F. in the garden

persed was 66.7 per cent whose commercial value was practically lost.

Though strawberries cultivated in a plastic greenhouse art apt to cause many malformations attributed to incomplete pollination which is the greatest obstacle in cultivation, the quality and yield can be increased by the utilization of *E. cerealis* F.; namely, by dispersing twice each ten adult insects per 3.3 m^2 at the beginning of blooming and after 10 days hence.

When this new secondary flower visiting insect, *E. cerealis* F. is used on garden crops by any one of the four utilization methods of the insects multiplied in a systematic plant as in Fig. 2, remarkable laborsaving and production stabilized by the improvement of quality can be achieved.