in Zone III was not clear. KAWAGUCHI (1938) also observed the degenerated oogonia in 3n larvae. Therefore, the inferiority of oogenesis in 3n larvae may be caused by the degeneration of oogonia.

HASIMOTO (1934) and KAWAGUCHI (1936) stated that the triploid females oviposited eggs irregular in shape or included large and small ones, while OOI (1962) reported that the triploid females from lethal spindle-shaped eggs, lay eggs which were uniform in size. Although these phenomena may be caused by the difference in strain, further investigations are necessary. As 3n larvae develop normally, the somatic division may be considered to be also normal. Accordingly, all cells in the various organs and systems of 3n larvae have an identical combination of chromosomes, and various germ cells in the ovarioles from the stage of oogonium should be identical. It is not clear why such a remarkable degeneration of germ cells occurred especially in the oogonia in 3n larvae. The histological observations in this study were limited to the 5th instar larva

and it is necessary to conduct a more detailed observation of oogenesis from the young larva to the adult.

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REFERENCES

- HASIMOTO, H. (1934) *Bull. Seric. exp. Sta.* **8** : 359-381.
 KAWAGUCHI, E. (1936) *Jour. Fac. Agr. Hokkaido Imp. Univ.* **38** : 111-136.
 KAWAGUCHI, E. (1938) *Cytologia* **9** : 38-54.
 MIYA, K., M. KURIHARA and I. TANIMURA (1970) *Jour. Fac. Agr. Iwate Univ.* **10** : 59-83.
 OOI, H. (1962) *Bull. Seric. exp. Sta.* **18** : 35-48.
 SUGAI, E. and H. SUGITA (1976) *Appl. Ent. Zool.* **11** : 176-181.
 TAMAZAWA, S. and Y. TAKIZAWA (1977) *Mem. Fac. Agr. Hokkaido Univ.* **10** : 272-283.
 TAMAZAWA, S. (1977) *Bull. Tōhoku Branch of Sericult. Sci. Jap.* **2** : 12.

Occurrence and Fecundity of Two Color Forms in *Aphis gossypii* GLOVER (Homoptera : Aphididae) on Dasheen Leaves¹

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Color variation ranging from light yellow to dark green in *Aphis gossypii* GLOVER has been repeatedly observed. WALL (1933) classified the body color into ten categories and reported minutely on the heredity of those color forms, and also related them to body size. The differences in color according to the host plant were observed carefully by INAZUMI (1968, 1970). Furthermore, some other scattered reports on the variability of color in this aphid are found.

Aphis gossypii GLOVER is an important insect

pest of dasheen, *Colocasia antiquorum* in southern Kyushu and in the apterous viviparae, three main color forms, greenish, yellowish and intermediate, are usually found during the growing period of the crop in the field.

In this paper the differences in population growth and reproductive rate of apterae between two striking color forms on dasheen were compared under different temperatures.

The population density of the aphid in dasheen fields increased towards summer and decreased in early autumn.

The yellowish form exceeded 60% at the peak period in June and July, but it was under 50% before June and after mid-August (Fig. 1).

When two each apterae of both color forms were liberated together and allowed to reproduce on a potted dasheen plant, yellowish individuals became more abundant under a high temperature of 27°C, but under 20°C the proportion of the two color forms was almost the same (Fig. 2).

Most of the offspring of greenish individuals

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Fig. 1. Seasonal abundance and ratio of yellowish form (broken line) of *A. gossypii* in a dasheen field, 1977.

became yellowish through their entire lives under a high temperature. It seems that the proportion of the yellowish form increases with rising temperature. This tendency was also found with *Veronica* sp. by INAIZUMI (1970). TANAKA (1967) stated that the greenish form changed to yellowish color from spring towards summer.

Reproductive rates of apterae of the two color forms were estimated from the survival rate of adults and the number of nymphs produced per day (Table 1). In this test, greenish females produced slightly lighter progeny under a mean temperature of 24.2°C, while yellowish females produced slightly darker progeny under 15°C. Thus, the offspring were not always the same color as the parents. However, if such color changes were disregarded, the yellowish form had a higher reproductive rate than the greenish at both temperatures, especially at 24.2°C. Although the net reproductive rate of the yellowish form at 15°C was lower than that of the greenish form, the reproductive rate converted into the intrinsic rate of natural increase became higher

Fig. 2. Population increase of two color forms of *A. gossypii* on 10 potted dasheen plants under different constant temperatures. Two apterous females (4th instar) of each color form were liberated on each plant. ○: yellowish, ●: greenish, —: 27°C, ---: 20°C.

because of the shortness of the time of generation. The yellowish form is smaller and less rich in body size than the greenish form (WALL, 1933; etc.), but the proliferative capacity may offset these handicaps.

It is certain within the limits of these experiments that the tendency of the yellowish form to increase under a higher temperature is due not only to the color change in the progeny of greenish individuals but also the higher intrinsic reproductive rate of yellowish individuals. The author wishes to thank Dr. TANAKA and Dr. INAIZUMI, Utsunomiya University, for their kind advices.

REFERENCES

INAIZUMI, M. (1968) *Kontyû* 36: 259–268.

Table 1. REPRODUCTIVE RATES OF APTEROUS FEMALES OF TWO COLOR FORMS OF *A. gossypii* REARED ON MATURE LEAVES OF DASHEEN UNDER DIFFERENT TEMPERATURES

Temperature °C	Color	No. of aphids tested	Net reproductive rate per genera- tion (R_0)	Time of generation (T)	Intrinsic rate of natural increase (r) ^a
15	Greenish	40	32.77	13.01 day	0.268/♀/day
	Yellowish	38	29.04	10.88	0.310
Mean	Greenish	26	20.22	6.94	0.433
24.2	Yellowish	23	24.50	5.17	0.619

^a $\ln R_0/T$

- INAIZUMI, M. (1970) *Jap. J. appl. Ent. Zool.* **14**: 29-38.
 TANAKA, T. (1967) *Shokubutsu Boeki* **21**: 249-

254.

- WALL, R. E. (1933) *Ann. ent. Soc. Amer.* **26**: 425-436.

Individual Variation of
 Acetylcholinesterase Sensitivity to
 Propoxur in the Green Rice
 Leafhopper, *Nephotettix cincticeps*
 UHLER (Hemiptera: Deltocephalidae)¹

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It has been shown that carbamate resistance in the green rice leafhopper is mainly due to much reduced sensitivity of acetylcholinesterase (AChE) to inhibition by carbamates and it is controlled by a single gene (HAMA and IWATA, 1971, 1978; IWATA and HAMA, 1972). It was also proved that much reduced AChE sensitivity was attributed to the appearance of a mutant enzyme, i.e., a modified AChE, which could be distinguished from a wild enzyme, i.e., a normal AChE, by DEAE-cellulose column chromatography (HAMA, 1976). Recently, the enzyme of a multiple-resistant Nakagawara strain (N) used as a parent resistant strain in genetic study (HAMA and IWATA, 1978) was found to consist of two different enzymes, i.e., normal and modified AChE's, with an activity ratio of about 1:1 (HAMA et al., 1980).

In other words, the N strain seemed homozygous for carbamate resistance but not homozygous for reduced sensitivity of AChE. Then, sensitivity of AChE to an inhibitor was measured individually to get further information and two different patterns were found in individual varia-

tion of AChE sensitivity in this insect.

Strains of the green rice leafhopper used are listed in Table 1. All strains except for the N strain have been reared without insecticidal selection pressure. The N strain has been continuously selected in several generations with Bassa (2-sec-butylphenyl methylcarbamate) and more recently with propoxur (2-isopropoxyphenyl methylcarbamate). Three- to eight-days-old adults were used.

Sensitivity of AChE to an inhibitor was determined by the same technique as in OPPENOORTH et al. (1977), which was based on Ellman's method (ELLMAN et al., 1961), with slight modifications. A head of an adult was homogenized in 0.22 ml of distilled water on a ground glass and the homogenate was used as the enzyme preparation. Enzyme preparation (0.15 ml), 1.24 ml of 0.1 M phosphate buffer, pH 7.4, and 0.05 ml of 0.011 M 5,5'-dithiobis(2-nitrobenzoic acid) were taken into a cuvette (10×5 mm), while all reagents except for enzyme preparation, which was replaced by distilled water, were taken in a reference cuvette. Both cuvettes were kept at 30°C in a spectrophotometer (Hitachi 556) connected with a recorder (Hitachi 056). A few minutes later 0.05 ml of 0.015 M acetylthiocholine iodide (a final concentration of 5×10^{-4} M) was added to both cuvettes and stirred quickly and absorbance change at 412 nm was recorded at a chart speed of 10 mm/min. A few minutes later 0.01 ml of 10^{-1} M propoxur in acetone (a final concentration of 6.7×10^{-4} M) was injected into a sample cuvette and absorbance change was continuously recorded. The amount of acetone added resulted in a few percent increase in AChE activity.

Although absorbance change increased linearly with time prior to the addition of an inhibitor, it later varied from samples tested. Absorbance change was completely suppressed, moderately suppressed or hardly suppressed. In the cases

¹ Appl. Ent. Zool. **16** (1): 52-54 (1981).