These observations suggest that chlordimeform causes a derangement of mandibular muscle coordination, resulting in a burst of mandibular activity which makes feeding impossible for the cabbage armyworm, *Mamestra brassicae*.

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Sterilization of the Melon Fly, *Dacus cucurbitae* COQUILLET (Diptera: Tephritidae), with Gamma-Radiation: Sterility of Flies Irradiated under a Low Temperature Condition¹

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As the percentage emergence of pupae of the melon fly, *Dacus cucurbitae* COQUILLET, is deleteriously affected by both high (over 27°C) and low (below 20°C) temperature during pupal life (NAKAMORI et al., 1978), temperature in the gamma irradiation facility is kept below 25°C in hot season. Experiments on sterilization of the melon fly with gamma-radiation have been already conducted at 25°C (TERUYA et al., 1975; TERUYA and ZUKEYAMA, 1979). On the other hand, the minimum temperature in winter in Naha, Japan, is 12.5°C. The present experiment was conducted to determine the lower limits of temperature at which the pupae may be kept before and during irradiation without affecting the degree of sterility.

Flies used for the experiment had been reared artificially for about 65 generations by the method described by NAKAMORI and KAKINOHANA (1980). Pupae were kept at 25±1°C, except when the pupae were irradiated. Under this temperature the duration of the pupal stage is 10 days for both sexes. A special cooling box maintained at 12°C by a coolant was used for keeping the pupae at a constant temperature during irradiation. A container made of Saran® net containing 1,000 pupae was placed inside the cooling box 1 hr prior to the start of irradiation to keep the pupae at 12°C during the irradiation. The pupae were gamma-irradiated with a dose of 7 kR 2 days before adult emergence in the Melon Fly Sterilization Facility of the Okinawa Prefectural Agricultural Experiment Station, Naha, Japan. After the irradiation, pupae were returned to 25°C within 5 min. As controls, 1,000 pupae irradiated at 25°C with the same dose and the same number of unirradiated pupae were prepared. One day after the emergence, adults of a known number were sexed, confined in 30×30×45 cm aluminum framed Saran® netted cages and reared with method described in TERUYA (1982 a). To check the fertility of treated flies, 50 treated flies of each sex were crossed with 50 untreated flies of the opposite sex in a similar cage. Fifty pairs of untreated females and males were confined also, as a

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control. The fertility of treated males is expressed by percentage hatchability of eggs laid by untreated females mated with males in question and that of treated females is expressed by percentage hatchability of eggs laid by treated females mated with untreated males. Eggs were collected weekly from 11 days to 47 days after adult emergence by an eggging device described by NAKAMORI and KAKINOHANA (1980), and their hatchability was examined. Mortality was determined daily until 50 days after emergence. All tests were replicated 3 times. Percent emergence of the pupae in each treatment was examined from the number of exuviae and dead pupae 1 week after the start of emergence.

There were no significant differences in adult emergence among the pupae irradiated with a dose of 7 kR 2 days before adult emergence, at 12°C and 25°C, and the untreated ones (Table 1).

No significant difference in longevity between adults irradiated with a dose of 7 kR at 12°C and 25°C in the pupal stage 2 days before adult emergence. From 40th day after emergence, survival of the females irradiated at both 12°C and 25°C became higher than that of untreated females, but the difference was not significant. On the other hand, the survival of males irradiated at both 12°C and 25°C became lower than that of untreated male from 30th day after adult emergence, but the difference was again not significant. The same trends in the longevity of irradiated flies were observed before (TERUYA, 1982 a).

Females irradiated with a dose of 7 kR at 12°C and 25°C during the pupal stage 2 days before adult emergence did not lay any eggs throughout the experiment (Table 2). Thus, even at 12°C an irradiation dose of 7 kR during the pupal stage might be enough to completely sterilize females of the melon fly, as was shown in the experiments conducted at 25°C condition by ANWAR et al. (1975), TERUYA et al. (1975), and TERUYA (1982 b).

Mean percentage hatchability of eggs laid during the experiment period by unirradiated females mated with males irradiated at 12°C and 25°C, were 1.6 and 0.5, respectively. No significant difference was found between these two values and the values were almost same as our previous results obtained at 25°C (TERUYA and ZUKEYAMA, 1979; TERUYA and ISOBE, 1982; TERUYA, 1982 b). LANGLEY and MALY (1971) reported that in *Ceratitis capitata* the survival of males irradiated at 4°C was not different significantly from that at 25°C.

Table 1. Percentages of adult emergence of pupae irradiated 2 days before adult emergence at 12°C or 25°C temperature

Temperature (°C)	Dose (kR)	Percentage of adult emergence ^a
12	7	96.3 a
25	7	98.0 a
25	0	96.5 a

^a Values followed by the same letter are not significantly different at 5% level (binomial distribution test).

Table 2. Fecundity and fertility of adults irradiated with a dose of 7 kR at 12°C or 25°C conditions during the pupal stage 2 days before adult emergence

Temperature (°C)	Dose (kR)	Mean fecundity of female ^a	Mean fertility of male ^b
12	7	0	0.5 b
25	7	0	1.6 b
25	0	8.8	91.7 aa

^a Expressed by no. of eggs/day/female laid by treated females mated with untreated males.

^b Expressed by % hatchability of eggs laid by untreated females mated with treated males. Values in the same column followed by the same letter are not significantly different at the 5% level (*t*-test after angular transformation).

They also found that lower fertility of the males occurred in flies irradiated at 4°C than 25°C, and concluded that the effect of chilling is due to oxygen-dependent factors, citing "cooling increases the solubility oxygen in the tissues" from MULLER (1954). WAKID et al. (1982) reported that in *Ceratitis capitata* pupal exposure to 5°C or 15°C prior to irradiation affected survival of this species with similar results. On the other hand, they found a significant increase in fertility compared with 25°C. While CURTIS and LANGLEY (1972) reported that the deleterious effect of irradiation on survival was greater when doses were applied at 2°C than at 20°C with *Glossina morsitans*. The fertility of the flies was similar to the result reported by LANGLEY and MALY (1971).

Trends of influence of low temperature at which pupae were exposed before and/or during irradiation

tion on longevity and fertility were different in each report cited above. However, in the melon fly no evidence of influences of low temperature of 12°C during irradiation on longevity and fertility were observed.

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Colonization of *Torymus sinensis* KAMIJO
(Hymenoptera: Torymidae), a Para-
sitoid of the Chestnut Gall Wasp,
Dryocosmus kuriphilus YASUMATSU
(Hymenoptera: Cynipidae),
Introduced from China^{1,2}

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Torymus sinensis KAMIJO, which was described as a new species in 1982 (KAMIJO, 1982), has been introduced 3 times from China to Japan to control the chestnut gall wasp, *Dryocosmus kuriphilus* YASUMATSU. The first introduction, however, was not successful chiefly because the number of parasitoids introduced was too small (MURAKAMI et al., 1977). Subsequently, in 1979, Dr. Y. MURAKAMI, Kyushu University, brought approximately 2,200 galls of *D. kuriphilus* with torymid larvae which had been collected in the Hobei Province (MURAKAMI

et al., 1980). Thereafter, in 1981, M. SHIGA, one of the present authors visited the Hobei Province and sent *D. kuriphilus* galls to Japan by courtesy of the Government of China.

The galls of the second and third introductions were kept at the Fruit Tree Research Station, Yatabe, Ibaraki Prefecture, and adult parasitoids which emerged in the next spring were released in nylon-mesh bags covering branches or potted young trees of the Japanese chestnut, *Castanea crenata* SIEB. et ZUCC., on which *D. kuriphilus* galls were formed. Since the torymid has one generation a year and its life cycle is well synchronized with that of *D. kuriphilus*, the parasitoid females released were expected to immediately attack the galls in their early stage of development. Three parasitoid females were usually released with males in a bag and the bag was removed in mid-summer.

In the spring of 1980, a total of 36 parasitoid females (*fr*) were released in 11 bags, and in the next spring, 120 female adults (*fy*) emerged from galls collected on the branches and young trees that were bagged (*fy/fr*=3.33). Then, in the spring of 1981, 99 females (*fr*) were released in 29 bags and and 347 female adults (*fy*) were obtained in the next spring (*fy/fr*=3.51) (MORIYA et al., unpub-

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