[報文]

Effects of gamma irradiation on the emergence of larvae of *Curculio sikkimensis* (Heller) (Coleoptera: Curculionidae) and *Cydia kurokoi* (Amsel) (Lepidoptera: Tortricidae)

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ガンマ線照射によるクリシギゾウムシ (*Curculio sikkimensis* (Heller) (Coleoptera: Curculionidae)) とクリミガ (*Cydia kurokoi* (Amsel) (Lepidoptera: Tortricidae)) の幼虫の防除

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Summary

The effects of gamma irradiation on the emergence of larvae of the chestnut weevil, *Curculio sikkimensis* (Heller), were investigated. One hundred chestnuts were irradiated in a ^{60}Co irradiator (Gammacell 220, Nordion, Canada) at a dose rate of 0.40 kGy/h. The doses at which irradiation was carried out were 50, 100, 200, 300, 400, 500 and 1000 Gy. After treatment, the chestnuts were kept at 25°C, 70% RH and emerged larvae were counted daily. Larvae of the nut fruit moth, *Cydia kurokoi* (Amsel), also emerged from the chestnuts. The data on the chestnut weevil were subjected to probit analysis and the LD 99.9 of weevil larvae was estimated to be about 500 Gy.

Introduction

The chestnut weevil, *Curculio sikkimensis* (Heller) (Coleoptera: Curculionidae), is distributed over Japan, Korea and Russia. This weevil is a major pest of chestnuts in Japan. Female weevils oviposit into chestnut seeds before the chestnut seeds are harvested. The larvae grow within the seeds from which they emerge as last-instar larvae. The larvae cause damage to the quality of the chestnuts (Fig. 1).

The control of the chestnut weevil has up to now been dependent on fumigation of harvested chestnuts with methyl bromide. However, the usage of methyl bromide is to be phased out by 2005 in

developed countries for most purposes due to its ozone layer depleting effects. Hence, development of an alternative method is urgently needed. Irradiation by gamma rays is thought to be a safe and residue-free alternative. Numerous researcher have studied the efficacy of gamma irradiation on other weevils, such as the maize weevil (*Sitophilus zeamais* Motschulsky), the rice weevil (*S. oryzae* (L.)) and the granary weevil (*S. granarius* (L.))¹⁻³⁾. We predicted that gamma irradiation would effectively disinfest chestnuts contaminated with chestnut weevil larvae.

This paper reports on the effects of gamma irradiation on the emergence of chestnut weevil

Fig. 1 Damage to chestnuts by chestnut weevils: (a) Chestnut weevil larva within a chestnut; (b) Chestnut with holes made by chestnut weevil larvae.

larvae from chestnut seeds.

Materials and Methods

Chestnuts (variety 'Tsukuba') were harvested on 30 September 2002 in Ibaraki prefecture. Treatments were carried out on 2 and 3 October. One hundred chestnuts were irradiated in a ^{60}Co irradiator (Gammacell 220, Nordion, Canada) at a dose rate of 0.40 kGy/h. The doses were 50, 100, 200, 300, 400, 500 and 1000 Gy. After treatment, the chestnuts were

kept at 25 °C, 70% RH, and emerged larvae were counted daily. Treatments were replicated 3 times.

The data were subjected to probit analysis⁽⁴⁾ using the maximum likelihood method⁽⁵⁾.

Results and Discussion

Table 1 shows the number of emerged larvae from 100 chestnuts. Larvae of the nut fruit moth, *Cydia kurokoi* (Amsel) (Lepidoptera: Tortricidae), also emerged from the chestnuts. The number of emerged weevil larvae decreased with increasing dose, and no larvae emerged from chestnuts irradiated at doses of 400 Gy and higher. The number of emerged larvae of *C. kurokoi* also decreased with increasing dose, and no larvae emerged from chestnuts irradiated at doses of 300 Gy and higher, although few larvae emerged even from the untreated control.

The LD99.9 of the chestnut weevil larvae was estimated by probit analysis to be 497 Gy, so gamma irradiation would effectively disinfest chestnuts contaminated with chestnut weevil larvae at this dose. In this study, few larvae of *C. kurokoi* were observed, but this moth sometimes damages chestnuts more seriously than the chestnut weevil. Further research will be needed to estimate the LD99.9 of this moth.

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References

- 1) Aldryhim Y. N. and Adam E. E.: Efficacy of

Table 1 The number of emerged larvae of *C. sikkimensis* and *C. kurokoi* (mean $\pm$ SE) from 100 chestnuts

Dose (Gy)	0	50	100	200	300	400	500	1000
<i>C. sikkimensis</i>	55.0 $\pm$ 6.5	30.0 $\pm$ 7.0	20.7 $\pm$ 1.9	8.7 $\pm$ 2.7	0.7 $\pm$ 0.7	0	0	0
<i>C. kurokoi</i>	1.3 $\pm$ 0.7	2.3 $\pm$ 0.7	2.0 $\pm$ 0.0	0.3 $\pm$ 0.3	0	0	0	0

gamma irradiation against *Sitophilus granarius* (L.) (Coleoptera: Curculionidae), *J. Stored Prod. Res.*, **35**, 225-232(1999).

- 2) Brown G. A. et al.: Gamma radiation effects on *Sitophilus zeamais* and *S. granarius*, *J. Econ. Entomol.*, **65**, 203-205 (1972).
- 3) Tilton E. W. et al.: Effects of gamma radiation on *Rhyzopertha dominica*, *Sitophilus oryzae*, *Tribolium confusum* and *Lasioderma serricorne*, *J. Econ. Entomol.*, **59**, 1393-1368(1966).
- 4) Finney D. L.: Probit Analysis, 3rd Edition, Cambridge University Press, Cambridge (1971).
- 5) StatSoft Japan: STATISTICA™ User's Manual, 2nd Edition, StatSoft inc., Tokyo (in Japanese) (1999).

和文要旨

クリシギゾウムシ(*Curculio sikkimensis* (Heller))の幼虫の出現に対するガンマ照射の影響を調査した。⁶⁰Co ガンマ線照射装置 (Gammacell 220, Nordion, カナダ) を用い, 100 個のクリを, 0.40 kGy/h の線量率で, 50, 100, 200, 300, 400, 500 および 1000Gy で照射した。照射処理後のクリは 25℃, 70% RH で貯蔵し, 果実から出現する幼虫を毎日計数した。同時にクリミガ (*Cydia kurokoi* (Amsel)) に対する効果も観察した。クリシギゾウムシ幼虫の生残データをプロビット解析したところ, LD 99.9 は約 500Gy であると推測された。

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