Plant Prod. Sci. 7 (2) : 189 — 190 (2004)

【Short Report】

Release Level of Momilactone B from Rice Plants

Hisashi Kato-Noguchi and Takeshi Ino

(Department of Biochemistry and Food Science, Faculty of Agriculture, Kagawa University, Miki, Kagawa 761-0795, Japan)

Key words : Allelopathy, Growth inhibitor, Momilactone B, *Oryza sativa*, Rice, Root exudate.

In one of the recent trials searching for rice allelochemicals, a putative compound causing the growth inhibitory effect was isolated from root exudates of rice seedlings and identified as momilactone B from its spectral data (Kato-Noguchi et al., 2002). In addition, momilactone B was found to be released from rice seedlings at an early developmental stage (Kato-Noguchi et al., 2003). These findings together with the growth inhibiting activity of momilactone B suggest that momilactone B might play an important role in rice allelopathy. However, there is no information whether developmental rice plants release momilactone B into neighboring environment.

Momilactone B was first isolated together with momilactone A from rice husks as growth inhibitors involved in seed dormancy (Kato et al., 1973; Takahashi et al., 1976), and both momilactones were later found in rice leaves and straw as phytoalexins (Cartwright et al., 1977; 1981; Kodama et al., 1988). The function of momilactone A has been extensively studied (Nojiri et al., 1996; Araki et al., 1999; Takahashi et al., 1999; Tamogami et al., 2000; Agrawal et al., 2002). Although the inhibitory activity of momilactone B is much greater than that of momilactone A (Takahashi et al., 1976; Kato et al., 1977), the function of momilactone B is obscure.

In this paper, the concentrations of momilactone B in 80-day-old rice plants and the level of momilactone B released from the plants into the culture solution were determined, and the possible involvement of momilactone B in rice allelopathy was discussed.

Materials and Methods

Seeds of rice (*Oryza sativa* L. cv. Koshihikari) were surface sterilized in 3 mM solution of methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate (Dupont, Wilmington, Delaware) for 24 h, rinsed several times with distilled water and germinated at 25 °C under a 12-h photoperiod for 3 days as described by Kato-Noguchi et al. (2002). Then, three uniform seedlings were transferred onto a plastic float in a plastic pot containing 3 L of one-half-strength Kimura B culture solution (0.18 mM $(NH_4)_2SO_4$, 0.27 mM $MgSO_4 \cdot 7H_2O$, 0.09 mM KNO_3, 0.09 mM KH_2PO_4, 0.05 mM K_2SO_4, 0.18 mM $Ca(NO_3)_2 \cdot 4H_2O$, 0.04 mM Na EDTA-Fe_3H_2O and 0.8 mM Na_2SiO_3; pH 5.0) in a plastic pot (24 cm id x 30 cm height), and grown for 80 days (from May to July, 2002) in greenhouse under natural day light condition. The culture solution in the pot was renewed every two days and only the roots of the rice plants were immersed in the solution during the incubation.

According to the methods described by Kato-Noguchi et al. (2003), release level of momilactone B from 80-day-old rice plants into the culture solution and concentrations of momilactone B in shoots and roots of the rice plants were determined.

Results and discussion

Momilactone B, 12.5 μg, was detected in culture solution in which three 80-day-old rice plants were grown hydroponically. At this time, the stage of these rice plants was panicle initiation, and length of their shoots and roots was about 110 and 35 cm, respectively. Since the culture solutions were renewed every two days during the experiment, one rice plant considered releasing 2.1μg of momilactone B into the solution per day (Fig. 1). This release probably occurred from their roots because only the rice roots were immersed in the culture solution as described in Materials and Methods.

Momilactone B was detected in shoots and roots of 80-day-old rice plants and the concentration of momilactone in the shoots was 3.5-fold greater than that in the roots (Fig. 1). Momilactone B had already been found in rice leaves and straw (Cartwright et al., 1977; 1981; Kodama et al., 1988; Lee et al., 1999), however, it was first reported by Kato-Noguchi et al. (2003) that roots of rice seedlings contain momilactone B. The present result suggests that roots of developmental rice plants also have momilactone B.

Plants are usually stressed and competing with neighboring plants for resources such as light, nutrients and water in the natural ecosystems. As one

Received 16 June 2003. Accepted 12 October 2003. Corresponding author: H. Kato-Noguchi (hisashi@ag.kagawa-u.ac.jp, fax +81-87-891-3086).

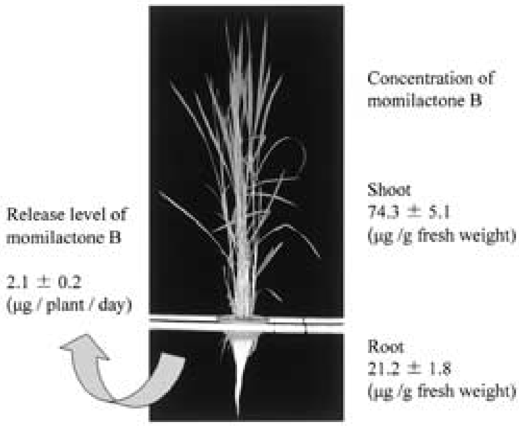

Fig. 1. Diagram of concentration and release level of momilactone B from rice plants. The concentration of momilactone B in shoots and roots of 80-day-old rice plants, and release level of momilactone B into the culture solution from the rice plants are determined. Means ± SE from three independent experiments with three assays for each determination are shown.

of the strategies for survival, many plant species release allelochemicals to inhibit the germination and growth of their neighboring plants (Rice, 1984; Putnam et al., 1986). Rice was also found to produce and release growth inhibiting allelochemical(s) into their neighboring environments (Dilday et al., 1994; 1998; Olofsdotter et al., 1995; 1999; Hassan et al., 1998; Mattice et al., 1988; Kim et al., 1999; Azmi et al., 2000). However, the chemical structures of these allelochemicals are still unknown.

Momilactone B inhibited the germination and growth of other plant species, and the inhibitory activity was comparable to that of ABA (Takahashi et al., 1976; Kato et al., 1977). The rice seedlings at an early developmental stage released momilactone B into their neighboring environment and the level released was enough to inhibit the growth of their neighboring plants (Kato-Noguchi et al., 2002; Kato-Noguchi et al., 2003). In the present research, we found that developmental rice plants also produce momilactone B and release momilactone B into their neighboring environment. Thus, momilactone B may act as an allelochemical and play an important role in the competition with neighboring plants.

References

Agrawal, G. K. et al. 2002. Plant Physiol. Biochem. 40 : 1061-1069.
Araki, Y. et al. 1999. J. Pesti. Sci. 24 : 369-374.
Azmi, M. et al. 2000. J. Tropi. Agric. Food Sci. 28 : 39-54.
Cartwright, D. et al. 1977. Nature 267 : 511-513.
Cartwright, D.W. et al. 1981. Phytochemistry 20 : 535-537.
Dilday, R.H. et al. 1994. Aust. J. Exp. Agric. 34 : 907-910.
Dilday, R.H. et al. 1998. In M. Olofsdotter ed., Allelopathy in Rice. International Rice Research Institute, Manila. 7-26.
Hassan, S.M. et al. 1998. In M. Olofsdotter ed., Allelopathy in Rice. International Rice Research Institute, Manila. 27-37.
Kato, T. et al. 1973. Tetrahedron Lett. 39 : 3861-3864.
Kato, T. et al. 1977. Phytochemistry 16 : 45-48.
Kato-Noguchi, H. et al. 2002. Physiol. Plant. 115 : 401-405.
Kato-Noguchi, H. et al. 2003. Phytochemistry 63 : 551-554.
Kim, K.U. et al. 1999. Korean J. Weed Sci. 19 : 1-9.
Kodama, O. et al. 1988. Agric. Biol. Chem. 52 : 2469-2473.
Lee, C.W. et al. 1999. Biosci. Biotechnol. Biochem. 63 : 1318-1320.
Mattice, J. et al. 1998. In M. Olofsdotter ed., Allelopathy in Rice. International Rice Research Institute, Manila. 81-98.
Nojiri, H. et al. 1996. Plant Physiol. 110 : 387-392.
Olofsdotter, M. et al. 1995. Ann. Appl. Biol. 127 : 543-560.
Olofsdotter, M. et al. 1999. Weed Res. 39 : 441-454.
Putnam, A.R. et al. 1986. The Science of Allelopathy. John Wiley and Sons, New York.
Rice, E.L. 1984. Allelopathy, 2nd ed. Academic Press, Orlando, Florida.
Takahashi, N. et al. 1976. Jap. J. Breed. 26 : 91-98.
Takahashi, A. et al. 1999. Plant J. 17 : 535-545.
Tamogami, S. et al. 2000. Phytochemistry 54 : 689-694.