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Utilization of Plant Growth Regulators for Improving the Recovery Rate of Fertilizer in Rice-Effect of L-β-Phenyllactic Acid on Growth of Rice Seedlings-

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ABSTACT

We investigated the effects of L-β-Phenyllactic Acid (LBP) on growth of both shoot and root in rice seedlings. Rice seedlings were cultured in the seed packs^{TM} containing 1/100 strength MS nutrient solution with or without 100 mg/L LBP. Agronomical parameters were measured and the total root area was calculated according to the method proposed by Kimura (2001) after two weeks seeding. The plant age and plant height of rice seedlings were markedly enhanced by LBP treatment than those of control. The seminal root length of seedlings was also significantly ($P<0.05$) increased by 26% compared with that of control. In contrast, the root number per seedling was not affected by LBP treatments. Correlation between the total area of root, and the number of root or the seminal root length were not observed. It should be noted that LBP significantly ($P<0.05$) increased the total area of root of seedlings by increasing those of the thinner lateral root (less than 0.757 mm in diameter), not of the thicker one. In conclusion, the high recovery rate of fertilizer in *co-situs* application using a CRF (controlled-released fertilizer) is possible by using LBP.

INTRODUCTIONS

The term co-situs application refers to a technology that uses CRF (controlled-released fertilizer) along with the seeds or seedlings as the single application for the entire growing season without causing salt injury. This term was specified by Shoji and Gandeza (1992) to differentiate it from the contact placement of small amounts of conventional fertilizers (RAF: rapidly available fertilizer) to give crops a rapid start. This method has been studied mainly in relation to nitrogen nutrition. Tamura and Chang (1965) isolated L-β-Phenyllactic Acid (LBP) as a root growth promoter for rice and lettuce seedlings from culture filtrates of *Exobasidium symploci-japoniciae* which is a fungus pathogenic for *Symplopos japonica*. However, very little work is currently available in the published data on the subject. Expanding the root system including the total number, length and area of roots is efficient to obtain the high recovery rate of fertilizer,

especially in *co-situs* application using a CRF. Therefore we investigated the effects of L-β-Phenyllactic Acid (LBP) on growth of both shoot and root in rice seedlings, considering potential use of this substance for improving recovery rate of fertilizer including CRF.

MATERIAL AND METHODS

Rice (*Oryza sativa* L. cv. Koshihikari) was used in the experiment. Uniform rice seeds were sterilized with a thiuram and benomyl solution for 24 h according to instructions then immersed in water for 24 h. Two germinated seeds were planted in seed packs^{TM} containing 1/100 strength MS nutrient solution with or without 100 mg/L LBP. Six seeds packs were placed in a plastic case (8.7 x 11.1 x 10.5 cm). The seeds were incubated at 30C in the light. Fourteen days after incubation, the length of seminal root and plant height and the length of each seedling organ were measured. In addition, the total root area was calculated according to the method proposed by Kimura (2001) after two weeks seeding. The experiments were performed with 3 replications. LBP was purchased from Sigma Chemical Company (St. Louis, MO, USA).

RESULTS AND DISCUSSIONS

Figure 1 shows the effect of LBP on growth of rice seedlings. The plant age and plant height of rice seedlings were markedly enhanced by LBP treatment than those of control. The seminal root length of seedlings was also significantly ($P<0.05$) increased by 26% compared with that of control. In contrast, the root number per seedling was not affected by LBP treatments. Correlation between the total area of root, and the number of root or the seminal root length were not observed (Figure 2). Total surface area of root significantly ($P<0.05$) increased by LBP treatment (Figure 3). It should be noted that LBP significantly ($P<0.05$) increased the total area of root of seedlings though with those of the thinner lateral root (less than 0.757 mm in diameter), not of the thicker one (Figure 4). Lateral root is thought to be important in absorption of water and nutrition. These results imply that the high recovery rate of fertilizer in *co-situs* application using a CAF is possible by using LBP. To try checking the more effective use of LBP, water stress in the root system was induced by polyethylene glycol (PEG) 6000, in low water potential. LBP promoted the root growth as well as shoot growth even though together with PEG 6000. This effect is also clearly observed in total surface area of root (Figure 5). These results suggest that the promoting-effect of LBP on root growth is more pronounced under the low water potential, and that LBP induced the drought tolerance.

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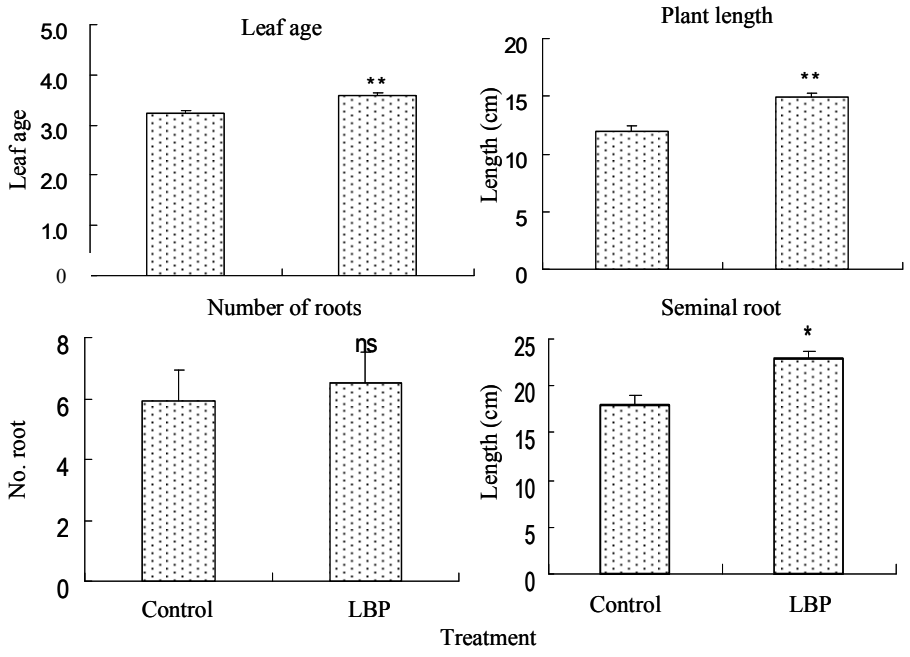

Figure 1 Effect of LBP on agronomical parameters of rice seedling .
* and * * mean significant at P=0.05 and 0.01, respectively.

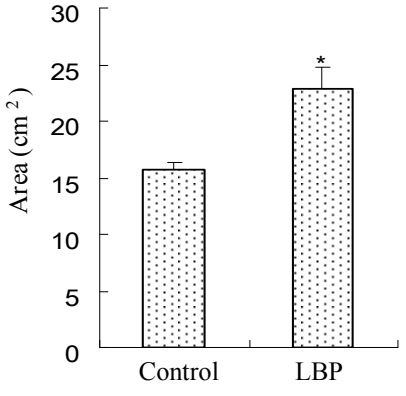

Figure 2 Effect of LBP on total surface area of root in rice seedling
* : significant at P=0.05 .

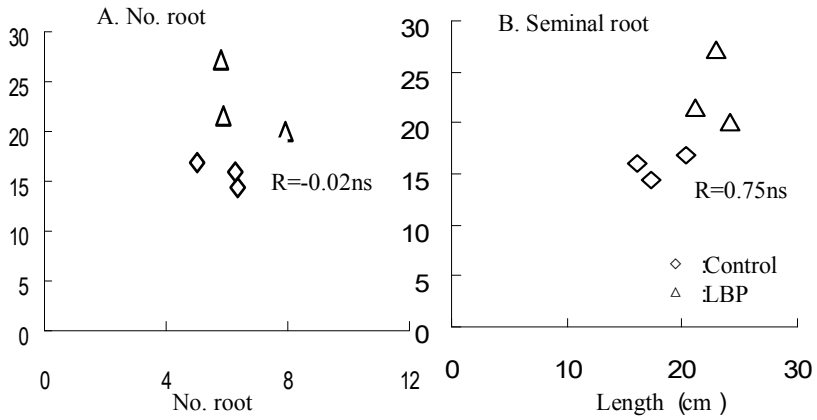

Figure 3 Correlation between the total area of root, and the number of root or the seminal root length .

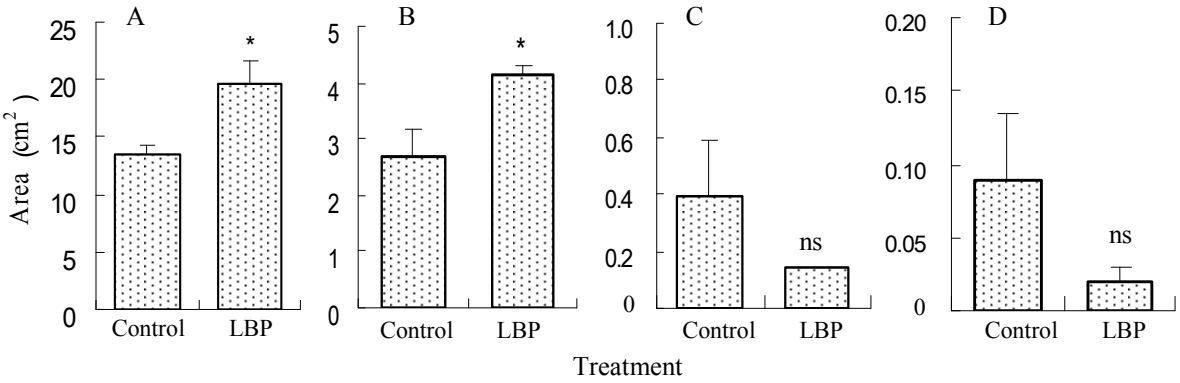

Figure 4 Effect of LBP on total surface area of root in rice seedling at diifereent diameter of root.
A :~ 0.379 , B :0.379 ~ 0.757 , C :0.757 ~ 1.185 , D :1.185 ~ 1.982mm * : significant at P=0.05 .

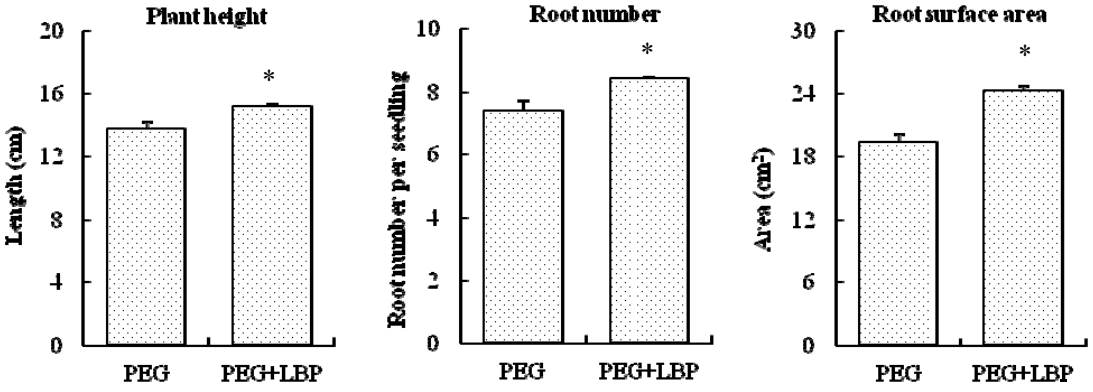

Figure 5 Effect of LBP with or without PEG on agronomical parameters of rice seedling .
* : significant at P=0.05.