

Short Report

**Relationship between Mesocotyl Length and
Crown Root Growth Direction in Rice**

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イネにおけるメソコチルの伸長量と冠根の伸長方向との関係 : 上埜喜八・佐藤雅志* (東京農業大学生物産業学部・*東北大学遺伝生態研究センター)

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Although seminal roots of rice cultivars grow in a downward direction, varietal difference exists in the growth directions of rice crown roots, which evolve in darkness, just after seeding⁴⁾. The crown roots of most Indian rice ecotypes, for example, tend to grow horizontally. Japanese rice crown roots, on the other hand, grow downward, except at the internodal elongation stage, at which point Japanese rice crown roots also grow horizontally¹⁾. Indian rice cultivars generally have greater mesocotyl length³⁾, suggesting a relationship between internodal length and horizontal crown root growth.

In this experiment, we examined first the relationship between the length of mesocotyl and the ratio of horizontal crown root growth using cultivars known to vary in crown root growth direction⁴⁾. Secondly, a hormone treatment was given to seeds of Sekiyama, which have little mesocotyl length and downward crown root growth.

Materials and Methods

We used 24 cultivars varying in crown root growth direction⁴⁾. These were cultured in darkness and the direction of crown root growth was measured by the method of Ueno et al.⁴⁾ Five plants were used from each cultivar and four crown roots were measured from each plant. For each cultivar the number of crown roots which grew within 20 degrees of the agar surface was divided by the total crown root number (namely 20 roots). This value was then used as the ratio of horizontal crown root growth.

For evaluation of the mesocotyl length, seeds were sown on 4 ml of 0.4% agar, which

had been injected into tubes (18×180 mm). The tubes were then cultured in darkness at 28°C. After ten days, the length of each mesocotyl was measured. Ten seedlings were measured from each cultivar and the average used for evaluation.

We used GA₃ 10⁻⁵ mol and ABA 10⁻⁴ mol for the treatment by hormones known to increase mesocotyl length²⁾. In preliminary experiments these concentrations were found to be the most effective for elongation of mesocotyl length. Treatment with water was also used as a control. Sterilized seeds were treated with hormones of the above concentrations or with water. Germinated seeds were cultured in darkness and the direction of crown root growth was measured by the method of Ueno et al.⁴⁾.

Results and Discussion

Fig. 1 shows the correlation of mesocotyl length and the ratio of horizontal crown root growth in 24 cultivars. This correlation coefficient was shown to be significant at 1% (r=0.64). This suggests that cultivars with elongated mesocotyls, namely *aman* and *boro*, have horizontal crown root growth (Fig. 1).

Table 1 shows the crown root growth directions of Sekiyama treated with hormones and with water. All of the crown roots treated with water grew more than 20 degrees downward from the horizontal. Of those seeds treated with GA₃ and ABA, 75% and 66.7% of the respective crown roots grew within 20 degrees of the horizontal. This suggests that while cultivars with little mesocotyl length show downward crown root growth, cultivars with increased mesocotyl length show horizontal

Table 1. Direction of crown root growth of Sekiyama with and without hormone treatment.

	Direction of crown root growth* (%)					Total
	-90°~-60°	-60°~-20°	-20°~20°	20°~60°	60°~90°	
Water	0.0	0.0	0.0	40.7	59.3	100
GA ₃	0.0	0.0	75.0	8.0	17.0	100
ABA	0.0	0.0	66.7	0.0	34.3	100

*The minus means growth direction above the agar surface.

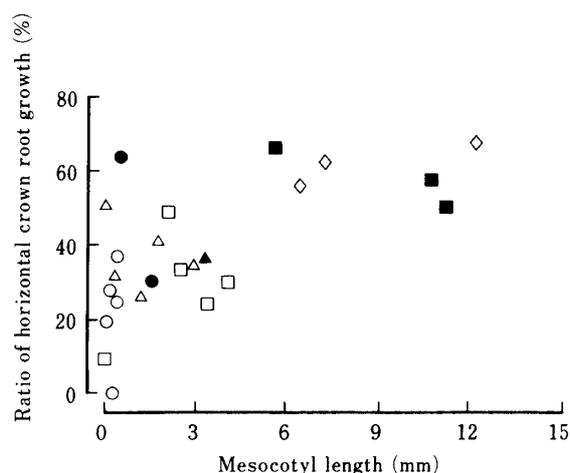


Fig. 1. Relationship between mesocotyl length and horizontal crown root growth.
 □ : *aus*, ■ : *aman*, ◇ : *boro* (Indian ecotypes)
 △ : *bulu*, ▲ : *tjereh* (Indonesian ecotypes)
 ○ : Japanese lowland rice ● : Japanese upland rice

crown root growth.

Downward growth crown roots show greater response to geotropic stimuli than horizontal

growth crown roots⁵⁾. Thus, increased mesocotyl length may effect the geotropic response of crown roots.

In illuminated conditions, rice crown roots grow downward⁵⁾ and mesocotyls show no elongation. The crown roots of Japanese rice grow downward in early stages but horizontally at the internodal elongation stage¹⁾. This data, combined with our results, suggests that horizontal crown root growth relates to the internodal elongation of rice.

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