4. Characterization and mapping of *multiple shoot1*

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Primary growth of plant is achieved by two apical meristems: shoot apical meristem (SAM) and root apical meristem. Considering the importance of SAM in plant development, elucidating the mechanisms of SAM establishment and maintenance is of primary importance in understanding plant architecture. We isolated two mutants derived from cv. Taichung 65 (*odm87* and *odm54* Hong et al., 1995). These two mutants formed multiple shoots in one embryo, and their seedlings were bushy. Because these mutants were allelic, we named them *multiple shoot1-1* (*mps1-1*) and *mps1-2*, respectively.

The abnormality of these mutants first appeared in embryogenesis. Until 7 days after pollination (DAP), we could not discriminate *mps1* embryo from wild-type embryo (data not shown). At 13 DAP, about 25%, embryos developed fewer leaves and lacked root cap suggesting that development of the *mps1* embryo was retarded compared to the wild-type embryo (Fig. 1A, B). In the *mps1* embryos at this stage, the basal region was abnormally enlarged. In mature embryos, ectopic shoot and/or roots were formed in the basal region (Fig. 1C). In most of *mps1* embryos, one ectopic root was formed, resulting in two roots in total. The ectopic shoot was observed in about half of *mps1* embryos examined. Ectopic shoot was always underdeveloped. Thus, *mps1* could have defect in proper apical-basal patterning at the later stage, causing ectopic differentiation of shoot and root in the basal region.

The *mps1* plants were dwarf and bushy (Fig. 1D). The multiple shoot phenotype seemed to be caused by at least two reasons. One is the reduced dormancy of axillary buds: in contrast to the axillary bud of the wild-type first leaf that remained dormant, that of *mps1* frequently elongated to become a tiller (Fig. 1E). Another reason is the ectopic formation of shoots. In Fig. 1F, three shoots are outgrowing from one seed. Since the number of shoots in *mps1* embryo was never more than two, at least one of the three shoots was thought to be formed after germination. Leaves of *mps1* plant were short, and lacked collars, ligules and auricles, and blade-sheath boundary was unclear (Fig. 1G). The blade of the *mps1* leaves was underdeveloped. In some cases, the leaves seemed to comprise only sheath. The *mps1* plants did not enter the reproductive phase (data not shown). These results show that *mps1* has pleiotropic effects on the growth and patterning of leaves, tissue differentiation, adventitious bud formation, and bud dormancy.

To map the *MPS1* locus, we crossed *MPS1*/*mps1-1* heterozygous plant with cv. Kasalath, and the F2 population was used for mapping. Linkage analysis using 353 *mps1-1* homozygous segregants revealed that *MPS1* is located in 53.7-55.4 cM on chromosome 8 (Fig. 2).

Reference

Hong S.-K., T. Aoki, H. Kitano, H. Satoh, and Y. Nagato, 1995. Phenotypic diversity of 188 rice embryo mutants. Dev. Genet. 16: 298-310.

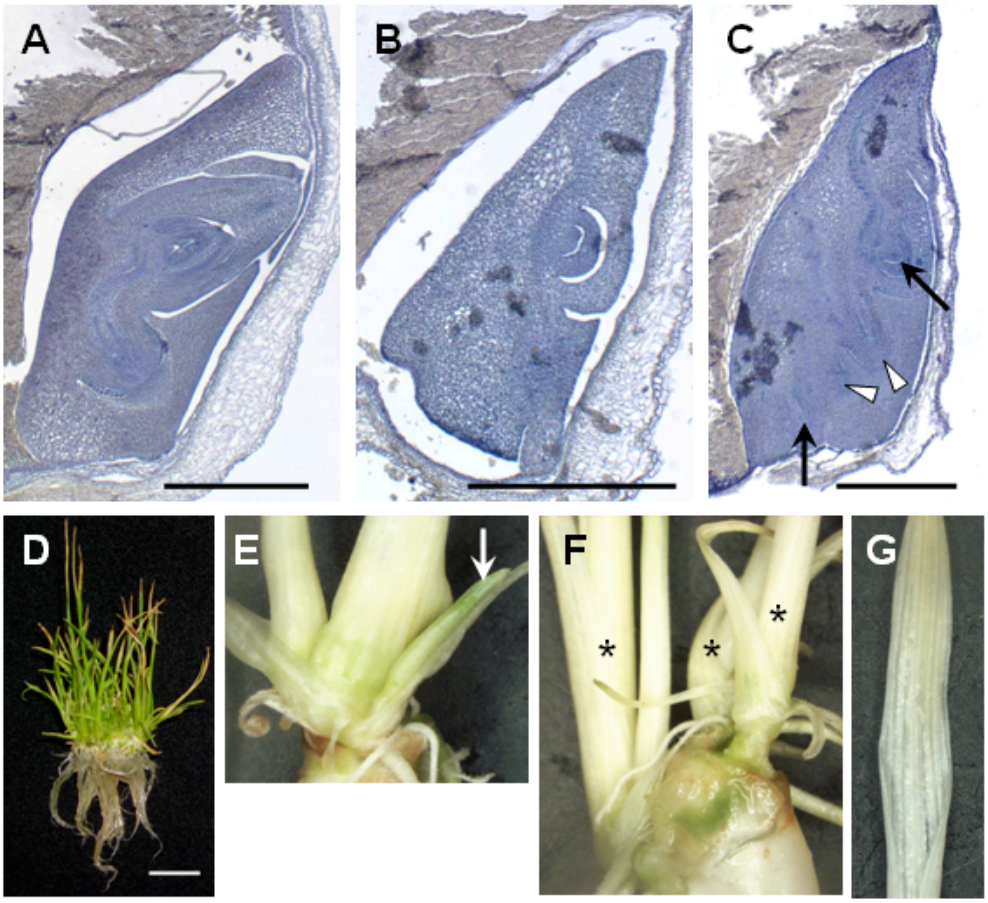

Fig. 1 Phenotype of *mps1*. (A) Wild type embryo at 13 DAP. Bar = 500 μm (B) *mps1-1* embryo at 13 DAP. Bar = 500 μm (C) Mature *mps1-1* embryo. Arrows and arrowheads indicate shoots and roots, respectively. Bar = 500 μm (D) 10-week-old *mps1-1* plant. Bar = 1 cm (E) 17-day-old *mps1-1* seedling. Arrow indicates tiller outgrowing from the axil of the first foliage leaf. (F) 17-day-old *mps1-1* seedling. Asterisks indicate shoots. (G) *mps1-1* leaf without ligule and auricle.

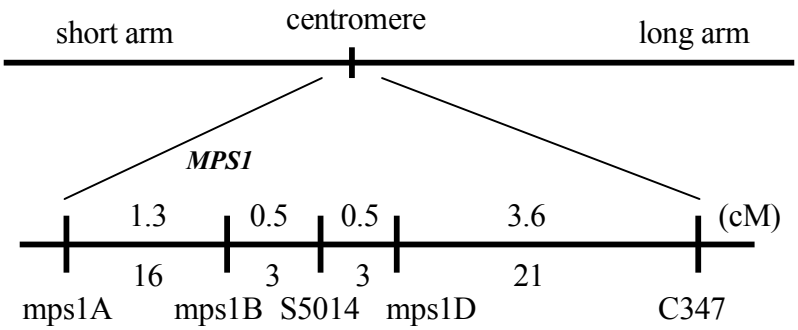

Fig. 2 Linkage map of the region near *MPS1* on the chromosome 8. We newly developed three genetic markers: a CAPS marker (mps1B) and two STS markers (mps1A and mps1D). The numbers of recombination among 706 chromosomes are shown below the horizontal line.