SHORT COMMUNICATIONS

VASCULAR TISSUE AND TRANSFER CELL DISTRIBUTION IN THE RICE SPIKELET*

By S.-Y. Zee†

Recently Zee and O'Brien (1971*a*, 1971*b*) have described the distribution of the vascular tissue and transfer cell in the nodes of the spikelet axis of wheat and millet. From those reports it was clear that the distribution of the vascular system and its associated transfer cells could be quite variable. In this communication another variation found in the nodal region of the spikelet of the rice plant will be described.

Experimental

Samples of half-matured spikelets of rice (*Oryza sativa* L. cv. IR8) (at milk stage of development) with a small portion of the pedicel still attached were removed from the parent plants grown under paddy field conditions and fixed in 2% glutaraldehyde, dehydrated, and then embedded in glycol methacrylate. Serial longitudinal and transverse sections, 1–2 μm in thickness, were cut using glass knives and examined by light microscopy.

Results and Discussion

The spikelet of rice consists of a minute axis (rachilla) on which a single floret is borne. Each floret has four bracts, two outer sterile glumes and two fertile bracts (lemma and palea).

Figure 1 is a diagram of a sagittal section of the spikelet and shows the distribution of the vascular tissue and transfer cell in the organs of the spikelet. One should note that xylem and phloem from the pedicel and rachilla are continuous with the vascular bundle in the pericarp (see also Fig. 3). In order to confirm further this observation, experiments were done by tracing the flow of a 1% solution of acid fuchsin which was introduced into the xylem by severing the culm immersed in the dye solution. Within minutes, the dye solution could be detected in the vascular bundles of the rachilla, glumes, lemmas, and paleas. But no dye was detected in the tracheary elements of the pericarp bundles unless the caryopses were exposed by carefully separating the lemma and palea of the spikelet and the plant allowed to transpire in the dye solution for 3–5 hr. Under these conditions dye solution was detected in the xylem of the pericarp bundle next to the pigment strand indicating that there is xylem continuity between the vascular bundles of the pericarp and the pedicel.

The situation in rice therefore differs from that found in wheat where the tracheary elements do not cross from the xylem of the rachilla to that of the pericarp.

* Manuscript received 13 August 1971.

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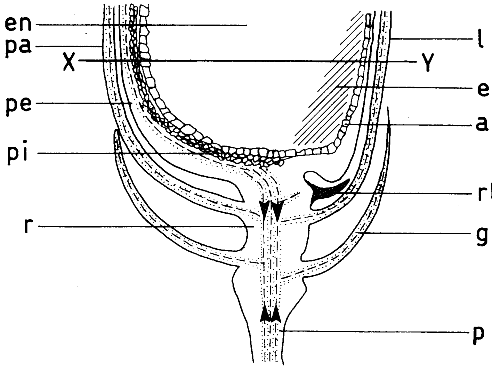
In other words, in rice the continuity of the xylem between the pericarp of the caryopsis and the rachilla is not interrupted by a core of modified tracheary elements, as is the case in wheat (Zee and O'Brien 1970). Moreover, rice differs from wheat in another respect, for only xylem transfer cells are present and there are no phloem transfer cells in the organs of the nodal tissue of the spikelet. In rice, xylem transfer cells are restricted to the region of the rachilla and the pedicel (Figs. 1, 3, and 4);



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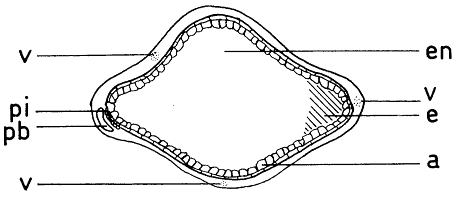

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Fig. 1.—A sagittal section of a spikelet of rice (at milk stage of development) showing in detail the distribution of the various tissues. *a*, aleurone cell; *e*, embryo; *en*, endosperm; *g*, glume; *l*, lemma; *p*, pedicel; *pa*, palea; *pe*, pericarp; *pi*, pigment strand; *r*, rachilla; *rl*, remnant of lodicule; ⋮⋮⋮ phloem; – – – xylem. The region marked by the arrowheads shows the area where xylem transfer cells occur. X–Y, level at which Figure 2 was taken.

Fig. 2.—Transverse section (X–Y, Fig. 1) of the rice grain at milk stage of development showing the arrangement of the various tissues. *a*, aleurone cell; *e*, embryo; *en*, endosperm; *pb*, pericarp bundle; *pi*, pigment strand; *v*, vestigial vascular bundles of the ovary.

they are absent from the traces that supply the glume, palea, and lemma. Furthermore, the wall ingrowths of the xylem transfer cells in rice (Fig. 4) are not as well developed as those found in wheat but are similar to those found in millet (Zee and O'Brien 1971*b*). As recently pointed out by Gunning, Pate, and Green (1970), since no two species are likely to have identical transport systems, one would expect

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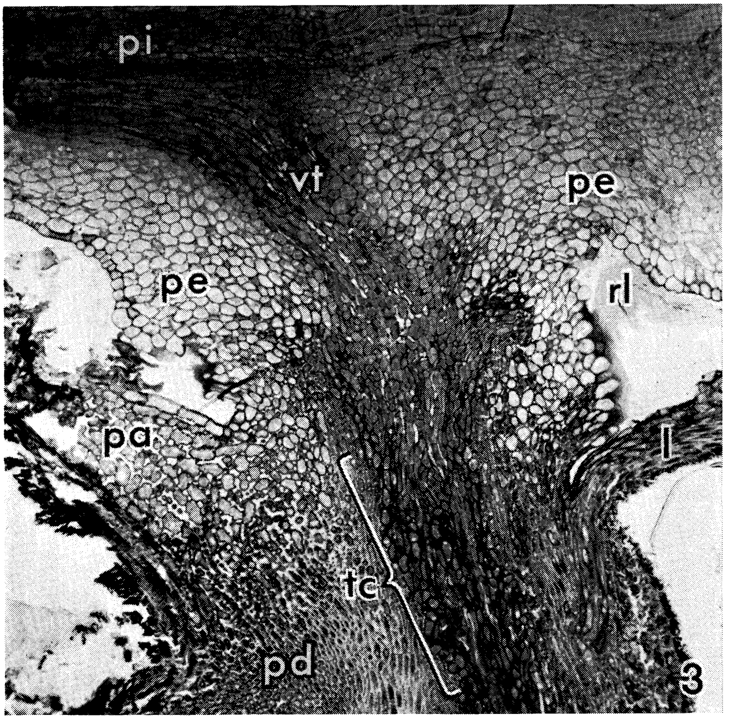
Fig. 3.—A low magnification view of the region between the grain and the pedicel (*pd*) seen in longitudinal section. *l*, lemma; *pa*, palea; *pe*, pericarp; *pi*, pigment strand; *tc*, region where xylem transfer cells occur; *rl*, remnant of lodicule; *vt*, vascular tissue. ×95.

Fig. 4.—A high magnification view of the xylem transfer cells (*tc*) in the pedicel seen in oblique longitudinal section. *te*, tracheary element. ×380.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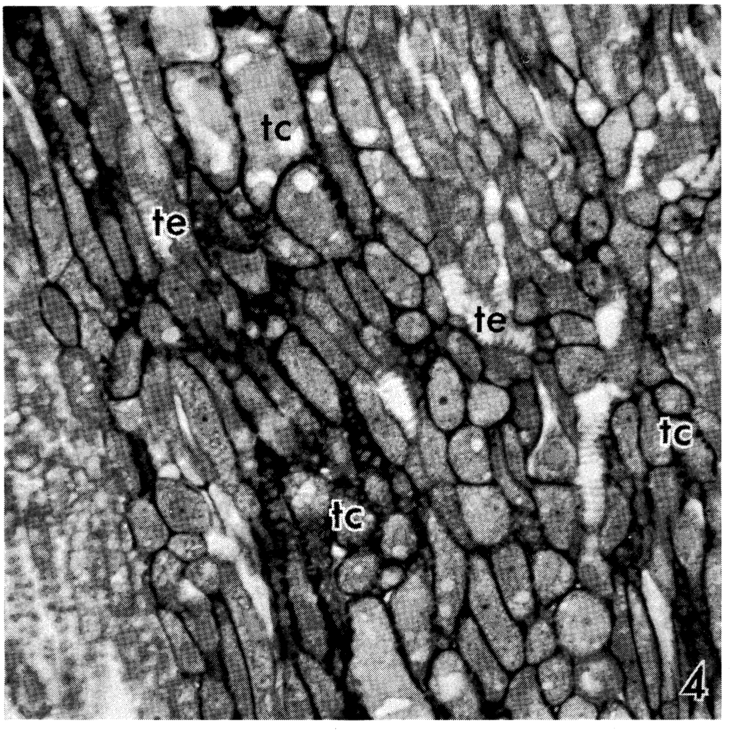
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a great variation in the extent and frequency of the development of the transfer cells in different species.

In wheat, Zee and O'Brien (1970) have provided evidence which suggests that the xylem discontinuity in the nodal region of the spikelet axis may restrict the flow of material from the xylem in the rachilla to that of the pericarp, thus aiding the solute transfer from the tracheary elements to the sieve tubes. In rice a device such as this is absent in the nodal tissue of the spikelet. Does this mean that rice is less efficient in solute transfer and grain filling than wheat or is it vice versa? Or perhaps there is no difference between the two. Only a full analysis of the rate of nutrient supply to the developing grain of wheat and rice can give us the answer.

Acknowledgment

This work is supported by grants from the University of Hong Kong.

References

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