イネ科草の穎のパピラ

誌名	日本草地学会誌
ISSN	04475933
著者名	広田,秀憲 小林,正義
発行元	日本草地学会
巻/号	33巻3号
掲載ページ	p. 282-288
発行年月	1987年12月

農林水産省 農林水産技術会議事務局筑波産学連携支援センター
Tsukuba Business-Academia Cooperation Support Center, Agriculture, Forestry and Fisheries Research Council Secretariat

J. Japan. Grassl. Sci., 33 (3) : 282—288 (1987)

— Short Report —

Papillae on the Surface of Glumes in Some Gramineous Plants

Hidenori HIROTA* and Masayoshi KOBAYASHI**

Higher plants have cuticular structure on the surface of aboveground organs[2,5]. The structure penetrates light onto the photosynthetic tissues, but it is waterproof with wax-like substances. By this structure, plants are protected from wind, frost damage and exposure of solar radiation and increase tolerance against insect-damages and infections by fungous diseases[4].

In the course of the authors' research work on fine surface structures of seed coats of forage crops and wild grasses[1], glumes were found to have protruding architectures on the cuticular wax. Fine surface structures of the glumes using thirteen species belonging to Gramineae were further examined to compare their shapes and some chemical characters by scanning electron microscope.

Key words : Papilla, Ocellus, Glume, Gramineae

Materials and Methods

Most seed samples for the examination were collected in the field and roadside in the campus of Niigata University. Both of chemically treated and untreated seeds of *Zoysia japonica* were kindly supplied by Prof. M. MATSUMURA, Gifu University. The treated seeds were firstly soaked in 0.5%NaOH, followed by dipping in mixed solution of 50 ppm GA_3 and 0.1%KNO_3 for 12 h under 35°C and continuous light. Unhulled seeds were immersed in acetone for half an hour to remove dust from the glumes and were kept dry in vial as reported elsewhere[7].

Following thirteen species were examined ;

Agrostis alba L.
Agropyron tsukushiense (Honda) Ohwi var. *transiens* (Hack.) Ohwi
Avena sativa L.
Chloris gayana Kunth.
Cynodon dactylon (L.) Pers.
Digitaria adscendens (H.B.K.) Henry
Miscanthus sinensis Anderss.
Panicum coloratum L.
Paspalum notatum Flügge
Pennisetum alopeculoides (L.) Spreng.
Poa pratensis L.
Setaria viridis (L.) Beav.
Zoysia japonica Steud.

Glumes of the seeds were coated with 200–500 Å C–Au under a vacuum evaporator, examined and photographed with an electron probe X-ray micro-analyzer (Shimazu EMX-SM) in accelerating voltage of 10–25 kV. Samples were analyzed for the presence and/or absence of silicon and its distribution patterns were investigated in dot-mat.

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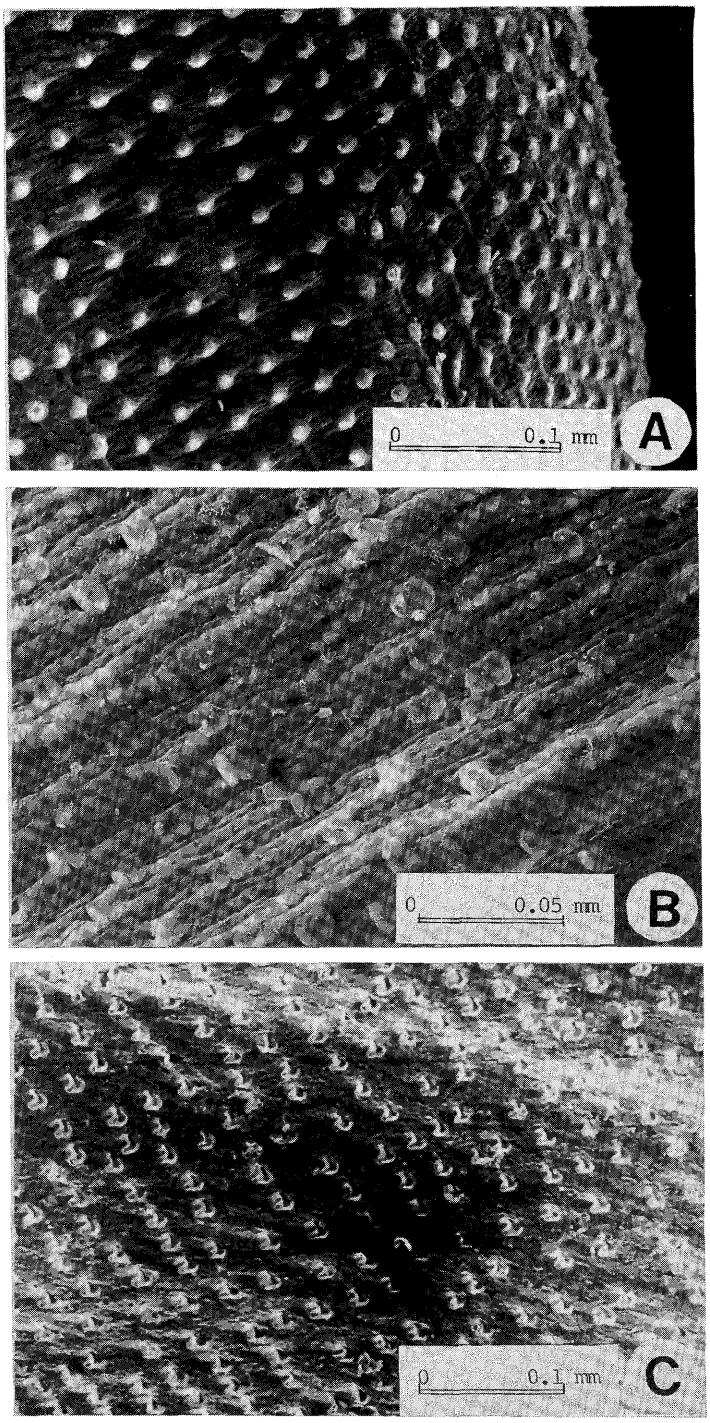
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A
0 0.05 mm
B
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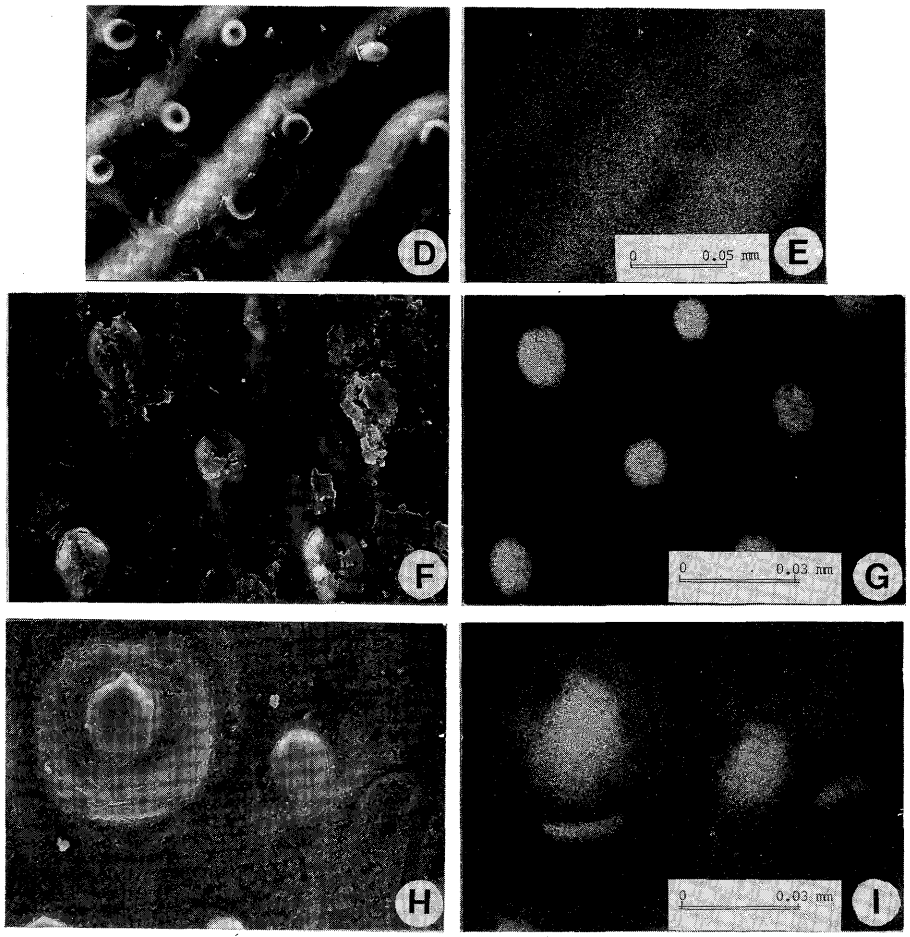
C



Explanation for Figures

A—C Three types of papillae on the glume
A : *Digitaria adscendens* lemma, × 220
B : *Pennisetum alopeculoides* lemma, × 375
C : *Chloris gayana* lemma, × 188
D—O SEM photographs of papillae on the glumes of six grass species. Pictures on the right are silicon-dot maps corresponding to the left.
D—E : *Setaria viridis* lemma, × 375
F—G : *Cynodon dactylon* lemma, × 750
H—I : *Agropyron tsukushiense* lemma, × 750
J—K : *Miscanthus sinensis* lemma, × 750
L—M : *Pennisetum alopeculoides* lemma, × 750
N—O : *Digitaria adscendens* lemma, × 750
P—R SEM photographs of lemma of *Z. japonica* after chemical treatment to improve germination.
P : Whole shape of glumes, × 22
Q : Distribution of holes where papillae had been attached until chemical treatment. × 187
R : Enlarged photograph of a hole. × 3,000

Results and Discussions

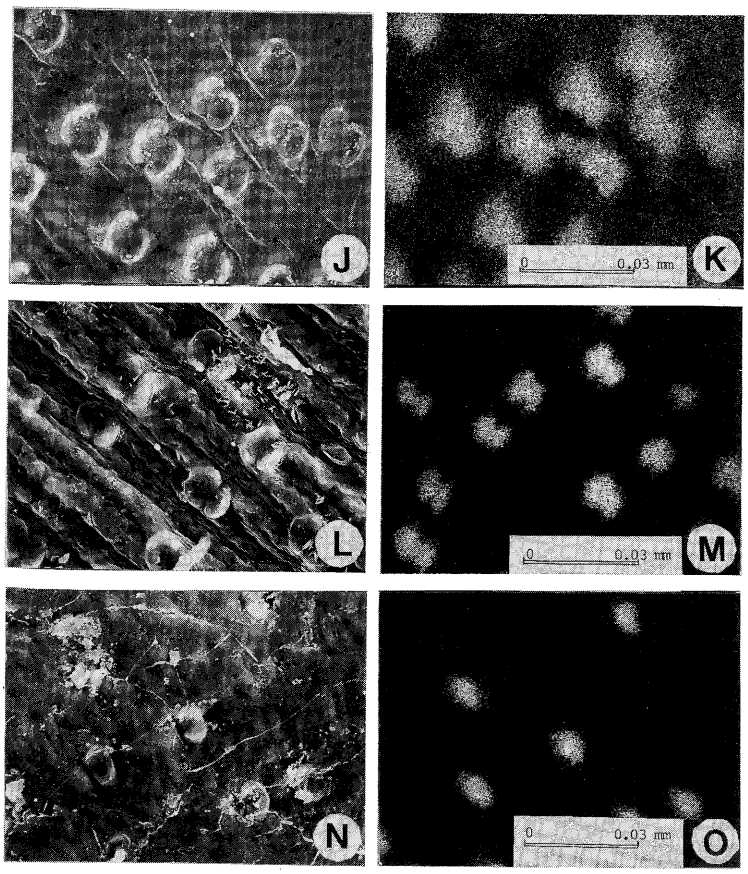
Typical photographs are shown in figures A–R. As seen in the figures A–C, there are three types in the surface architectures of the glumes with papillae and one type of glume which has no papillae, i.e. they are divided into four groups as shown in Table 1.

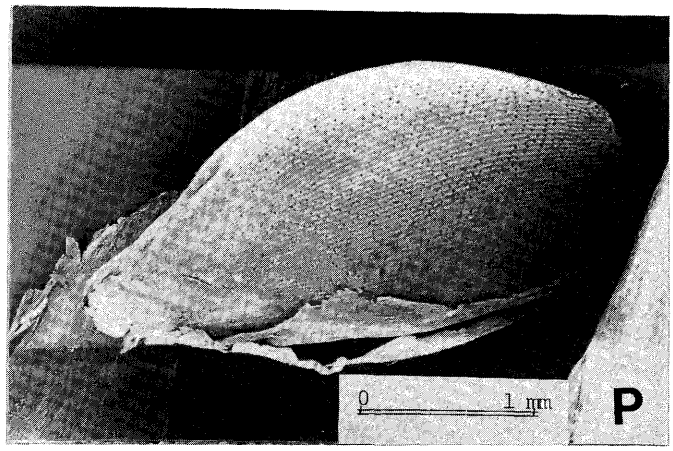
In group (2), arrangement of the single domes on the surface of the glumes differes with the species examined. In *Setaria viridis*, the papillae are located orderly on the hills of the cuticular structures and the hills are connected with each other. In *Agropyron tsukushiense*, different sizes of papillae are mixed and some domes are sharper. Some papillae look like lids put on the holes and other look to be complete structures protruding from the cuticular surfaces as shown in Fig. H.

In group (3), the structures look like gourds or wings of butterfly and their shapes differ widely with species.

In group (4), the shapes of the papillae differ from other types and have incomplete domes accompanied by small holes ; they resemble human ears. Species of this type look to be comparatively rare.

KASAHARA[3] has examined the structures of seed surfaces of 408 herbaceous species

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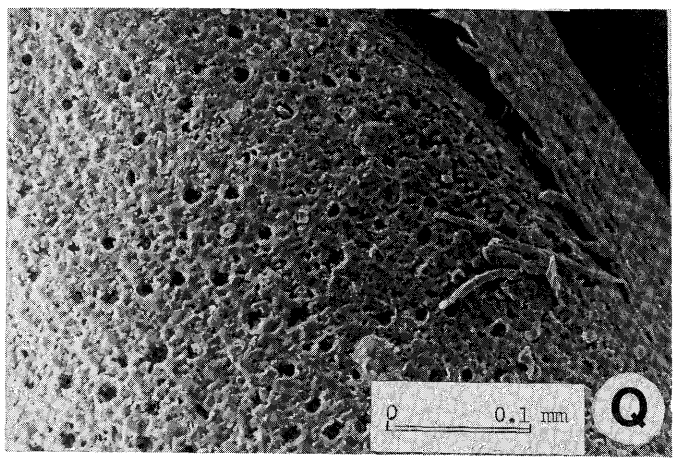
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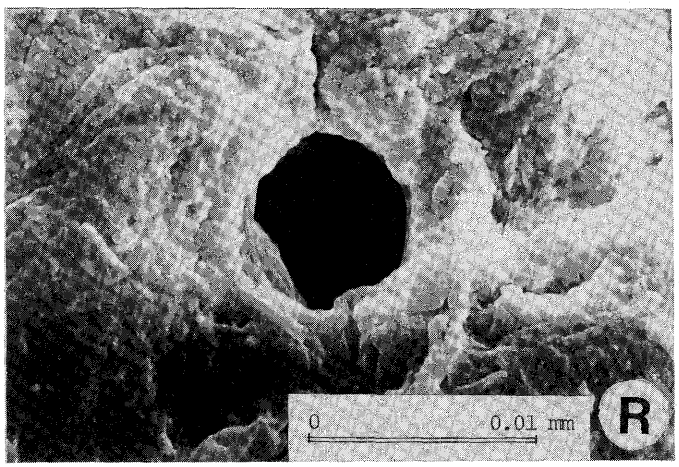
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R

Table 1. Types of papillae on the glumes of gramineous plants.

Without papillae	With papillae		
(1)	(2) Single dome	(3) Gourd-shaped	(4) Incomplete dome beside a hole
A. sativa	*A. alba*	*M. sinensis*	*C. dactylon*
	A. tsukushiense	*D. adscendens*(palea)	*C. gayana*
	D. adscendens (lemma)	*P. alopeculoides*	
	P. coloratum		
	P. notatum		
	P. pratensis		
	S. viridis		
	Z. japonica		

belonging to 219 genera and 57 families including Gramineae and classified them into 40 types in relation to their shapes. And the structures on the glumes such as papillae, trichomes and holes were grouped into 12 types by the same author.

By inspecting the pictures of his research works, the following species were picked up and grouped into the categories of this experiment as shown in Table 1.

2) Single Dome

Digitaria adscendens (H.B.K.) Henry (lemma)
Digitaria timorensis (Kunth) Balansa
Paspalum dilatatum Poir.
Poa annua L.
Setaria viridis (L.) Beauv.

3) Gourd-Shaped

Digitaria adscendens (H.B.K.) Henry (palea)
Echinochloa colonum Link.
Echinochloa crus-galli (L.) Beauv.
Echinochloa orizicola Vasing.
Hymenachne indica Büse *forma oryzetorum* T. Koyama

As far as the species used are concerned, there are not much differences in the surface structure of the glumes between wild- and cultivated species, nor between winter- and summer growers.

As shown in the figures D-O, presence of papillae on the surface of the glumes corresponds to the distribution of silicon-dots except in *Setaria viridis*, where silicon spread evenly irrespective of the distribution of the papillae.

Low germinability of Japanese lawngrass, *Zoysia japonica*, has been improved by chemical treatment[6]. Figures P and Q show that deep holes can be seen after the silica cells were dropped off by the chemical treatment. It suggests that stomata or their remains are hidden in the holes. But it is doubtful whether the removal of the silica cells by the chemical treatment be directly related to the improvement of the low germination.

Juniper *et al*[2]. mentioned this kind of dome cells protruding on the leaf surface of *Discorea quinqueloba* and *Fittonia verschafeltii* and named it ocelli, explaining that they can detect light intensity, similar to those of human eyes and suggested that phytochrome is likely to be involved at an early stage of leaf growth. Silicon involved in the dome cells seem to facilitate this function. More informations are needed concerning the developmental processes of the papillae on the glumes of gramineous plants and their physiological functions on

photoreaction.

Acknowledgements

Thanks are due to Prof. M. MATSUMURA, Gifu University for sharing seeds of *Zoysia japonica* and Dr. E. MAEDA, Nagoya University for valuable informations and advices.

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(Received on May 29, 1987)