II.8. Comparative description of trisomics of Hordeum spontaneum and H. vulgare cv. 'Shin Ebisu 16'.

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Trisomics of diploid plants like barley (Hordeum vulgare L.) are very useful for assigning new genes to chromosomes (i.e., linkage groups). Accordingly, we are presently engaged in an approach to localize the gene(s) for resistance to Barley Yellow Mosaic Virus (VaYMV) in various Asian and European barley cultivars, e.g., the German winter barley cvs. 'Birgit', 'Franka', 'Ogra', 'Diana', 'Gloria' and 'Sonate' (cf. Friedt and Foroughi-Wehr 1987).

Trisomic strains were provided by Drs. R. Takahashi and T. Konishi, Institute for Agricultural and Biological Sciences, Okayama University Japan, and by Dr. T. Tsuchiya, Department of Agronomy, Colorado State University, Fort Collins, USA. The former set of trisomics had been obtained from Hordeum spontaneum and the latter series was derived from 'Shin Ebisu 16'. Analogue trisomics of both series exhibit similar morphological characteristics in spite of their different origin. These characteristics have already been described in detail by Tsuchiya (1958, 1963, 1967, 1969). Due to their gross morphology, trisomics have been named as Bush (chromosome 1), Slender (chromosome 2), Pale (chromosome 3), Robust (chromosome 4), Pseudonormal (chromosome 5), Purple (chromosome 6) and Semierect (chromosome 7). In order to provide a more detailed description of the different trisomics for an easier recognition in applied genetic analyses we have taken additional measurements and observations of the H. spontaneum and 'Shin Ebisu 16' trisomics, as summarized in Table 1 and 2.

In general, the different trisomics from H. spontaneum are relatively similar to each other, whereas trisomics of 'Shin Ebisu 16' show clear morphological differences, just as described by Tsuchiya (1958). Therefore, it is possible to recognize the common origin of the different H. spontaneum trisomics, while this is not the case for the 'Shin Ebisu 16' trisomics. Each trisomic of 'Shin Ebisu' clearly deviates from the original phenotype. These deviations are obvious, not only regarding the growth pattern in general, but also the spike morphology. Spikes of the H. spontaneum trisomics are, in general, not as much differentiated as those of 'Shin Ebisu 16' trisomics. Whereas spikes of the H. spontaneum line are parallel and very narrow with brittle rachis, the spikes from the 'Shin Ebisu 16' series are very different from each other.

Table 1. Trisomics of Hordeum Spontaneum

	BUSH	SLENDER	PALE	ROBUST	PSEUDONORMAL	PURPLE	SEMIERECT
I. Seed Characteristics							
1) color	grey-black	grey-black	yellow-grey	grey-black	black	grey-black	grey-black
2) length	short	short	medium long	medium long	medium long	long	medium long
3) thickness	slim	slim	slim	slim	slim	full	full
4) tecture of glume	smooth	smooth	smooth	smooth	smooth	smooth	smooth
5) TGW	23.5 g	20.3 g	20.2 g	21.8 g	21.9 g	30.7 g	27.4 g
6) base-bristle	a-type	a-type	a-type	a-type	a-type	a-type	a-type
II. Spike Characteristics							
1) row number	two-rowed	two-rowed	two-rowed	two-rowed	two-rowed	two-rowed	two-rowed
2) sterile spikelet position	slightly V-shaped	slightly V-shaped	medium V-shaped	medium V-shaped	slightly V-shaped	medium V-shaped	medium V-shaped
3) shape of sterile spikelets	pointed	pointed	round	round	round	round	round
4) general shape	slightly pyramid-like	parallel	parallel	parallel	slightly pyramid-like	parallel	parallel
5) length	5.6 cm	8.6 cm	8.8 cm	10.5 cm	8.3 cm	8.4 cm	9.4 cm
6) width	0.6 cm	0.7 cm	0.8 cm	0.8 cm	0.7 cm	0.9 cm	0.8 cm
7) spikelets per 10 cm	22.0	22.0	24.0	26.0	26.0	25.3	21.6
8) arrangement of awns	accumbent	accumbent	accumbent	accumbent	accumbent	accumbent	accumbent
9) awn length	short	short	medium long	medium long	medium long	long	long
10) position of spike	erect	slightly inclined	erect	erect	erect	erect	erect
III. Leaf Characteristics							
1) length	16.1 cm	15.3 cm	12.7 cm	12.3 cm	12.9 cm	11.0 cm	11.8 cm
2) width	1.0 cm	0.9 cm	0.9 cm	1.5 cm	1.1 cm	1.1 cm	0.9 cm
3) rotation	dextrorotary	dextrorotary	dextrorotary	destrorotary	dextrorotary	dextrorotary	dextrorotary
4) position	erect	erect	erect	erect	erect	erect	erect
5) index (length/width)	16.1	17.0	14.1	8.2	11.7	10.0	13.1
IV. Culm Characteristics							
1) height	63.4 cm	84.2 cm	82.4 cm	93.6 cm	88.9 cm	109.9 cm	96.0 cm
2) surface wax	little	none	little	little	little	strong	mediocre
3) formof nodium	small quadratic	very small narrow	very small narrow	middle-sized narrow	middle-sized quadratic	large quadratic	middle-sized quadratic
V. Transmission % surviving plants	9.5%	17.4%	11.5%	12.1%	6.7%	36.0%	29.0%
VI. Special Characteristics	shortest strain		frequently infected by Erysiphe graminis	-	-	-	-

Table 2. Trisomics of Shin Ebisu 16'

	BUSH	SLENDER	PALE	ROBUST	PSEUDONORMAL	PURPLE	SEMIERECT
I. Seed Characteristics							
1) color	golden-yellow	gray-yellow	golden-yellow	whitish-yellow	whitish-yellow	golden-yellow	golden-yellow
2) length	medium long	medium long	medium long	medium long	medium long	long	medium long
3) thickness	full	full	bulgy	full	bulgy	bulgy	full
4) tecture of glume	medium rough	medium rough	medium fine	medium rough	medium rough	medium rough	medium fine
5) TGW	33.4 g	31.0 g	42.4 g	46.6 g	40.8 g	53.4 g	50.5 g
6) base-bristle	c-type	a-type	a-type	a-type	a-type	c-type	a-type
II. Spike Characteristics							
1) row number	intermediate	two-rowed	two-rowed	two-rowed	two-rowed	two-rowed	two-rowed
2) sterile spikelet position	medium V-shaped	extremely V-shaped	straight-lined	slightly V-shaped	slightly V-shaped	very V-shaped	medium V-shaped
3) shape of sterile spikelets	pointed	round	round	round	round	round	round
4) general shape	parallel	slightly pyramid-like	slightly pyramid-like	pyramid-like	parallel	pyramid-like	parallel
5) length	7.4 cm	5.1 cm	6.1 cm	8.4 cm	7.4 cm	8.1 cm	7.0 cm
6) width	1.0 cm	1.4 cm	1.4 cm	1.2 cm	1.0 cm	1.4 cm	1.2 cm
7) spikelets per 10 cm	79.5	72.3	57.0	39.4	36.6	36.4	32.6
8) arrangement of awns	slightly extended	slightly extended	very extended	very extended	very extended	very extended	slightly extended
9) awn length	long	long	medium long	very long	medium long	long	medium long
10) position of spike	erect	erect/ slightly hanging	erect	erect	erect	erect	erect
III. Leaf Characteristics							
1) length	18.2 cm	18.8 cm	12.3 cm	21.9 cm	15.8 cm	23.8 cm	15.3 cm
2) width	1.4 cm	1.2 cm	1.1 cm	2.0 cm	1.6 cm	1.9 cm	1.1 cm
3) rotation	dextrorotary	dextrorotary	dextrorotary	dextrorotary	dextrorotary	dextrorotary	straight
4) position	erect	hanging	bent above 1/3	tip slightly bent	horizontal, top 1/3 erect	erect	tilted in 45° angle
5) index (length/width)	13.0	15.6	11.2	11.0	9.9	12.5	13.9
IV. Culm Characteristics							
1) height	59.2 cm	58.6 cm	69.6 cm	62.8 cm	54.5 cm	80.6 cm	60.2 cm
2) surface wax	very strong	strong	med. strong	very strong	very strong	very strong	very strong
3) form of nodium	-	-	-	-	-	-	-
V. Transmission (% surviving plants	27.0%	30.0%	30.3%	35.5%	34.7%	25.0%	45.0%
VI. Special Characteristics	extensive development of adventive-roots	compact growth in flowering phase(strong foliage)	reddish node - parallel culm-position	-	-	stiff growth habit	frequently infect. *Pseudocercosporella herpotrichoides*

The following peculiar spike morphology of the latter series of trisomics can be distinguished (cf. Fig. 1).

(1) Bush
- the ear spindle appears step-like;
- the spikelets are comparatively loose;
- the spikes often remain in the leaf-sheath;
- the spikes incidently contain very compact spikelets;
- the awns often look wavy.

(2) Slender
- the awns are bundled at both sides on top of the spike-body;
- the spike looks very compact because the main spikelets are thick and spread apart and the sterile spikelets are bushy;
- there is a sharp incision between the left and right row of sterile spikelets;
- the awns often remain in the leaf-sheath and, as a result, the spike emerges in a spreaded position.

(3) Pale
- the sterile spikelets are arranged in a straight line;
- there is a sharp incision between the rows of spikelets;
- numerous sterile spikelets are grouped at the tip of the spike;
- low pollen-fertility that was found by Tsuchiya (1963) leads to sterile florets.

(4) Robust
- spikes are compact;
- lemma and upper palea are tightly connected with each other;
- sterile anthers are frequently observed;
- there are occasionally additional glumes between the closed spikelets;
- the exceptional repeated appearance of branched spikes is remarkable.

(5) Pseudonormal
- branched spikes occur in Pseudonormal as well as Robust, but in mature plants only in Robust;
- glumes are positioned between the closed spikelets;
- sterile spikelets occasionally occur in main spike rows;
- slenderness of the spike is noteworthy.

(6) Purple
- spikes are very thick;
- glumes are tightly linked.

(7) Semierect
- lemmas are doubled; second lemmas are empty and very large;
- spikelets are occasionally doubled;
- an accumulation of sterile spikelets can occasionally be observed at the spike base;
- the lower spikelets occasionally contain 5 or 6 anthers.

Such a detailed description of characters of barley trisomics gives some indication for localization of relevant genes on the respective triplo-chromosome. Furthermore, the detailed knowledge of characters of trisomics can be very helpful in practically using trisomics for genetic analyses of important agronomic characters, e.g., disease resistances like mildew- or BaYMV-resistance. Obvious phenotypic differences between trisomic and diploid individuals can help to identify trisomics without cytological examination and, consequently, larger numbers of segregating progenies can be tested in a given time interval.

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Legend

Figure 1. Spike morphology of trisomics derived from Hordeum vulgare cv. 'Shin Ebisu 16' ('S.E.') . Page 1: 'S.E.' (top left), triplo 1 (top right), triplo 2 (bottom left), triplo 3 (bottom right). Page 2: triplo 4 (top left), triplo 5 (top right), triplo 6 (bottom left), triplo 7 (bottom right).