Registration of TS1, TS10 and TS41, Three High Biomass Production Tetraploid Triticale Germplasm Lines

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TS1 (Reg. No. GP-18, PI-643454), TS10 (Reg. No. GP-19, PI-643455), and TS41 (Reg. No. GP-20, PI-643456) are tetraploid triticales (×*Triticosecale* Wittm.) developed and released by the Institute for Sustainable Agriculture (CSIC) in Córdoba, Spain, for use in research and crop improvement programs. Tetraploid triticales were first achieved by Krolow (1973), crossing hexaploid triticale with diploid rye (*Secale cereale* L.) followed by selfing the F_1 hybrid. Amphiploids between *Aegilops tauschii* Coss. and rye have been obtained from callus induced on immature inflorescences of the hybrid between *A. tauschii* and *S. cereale* L. (Fedak, 1984), by colchycine treatment of the hybrid (Bernard and Bernard, 1987) and crossing the tetraploid plants for each parent (Kawakubo and Taira, 1992).

TS1, TS10, and TS41 are three tetraploid triticale germplasm lines with high non-grain biomass production. TS1 was derived from the cross T6/Huescar as reported by Cabrera et al. (1996), T6 being an autotetraploid *A. tauschii* ($2n = 4x = 28$, DDDD) originally from the former Plant Breeding Institute (Cambridge, UK). Huescar is a spontaneous autotetraploid *S. cereale* collected at the Huescar hills, Spain ($2n = 2x = 28$, RRRR). TS10 and TS41 were obtained by chromosome doubling of the hybrid using colchicine treatment. They were derived from the crosses T4/Centeio do Alto and Sando 208/Grand Crouelle, respectively. T4 and Sando 208 (CIae 51) are diploid *A. tauschii* lines ($2n = 2x = 14$, DD). T4 was developed by Gordon Kimber. Centeio do Alto (PI 321643) and Grand Crouelle (PI 235536) are diploid rye accessions ($2n = 2x = 14$, RR).

Somatic chromosome counts revealed that the plants had the expected chromosome number of 28. The difference in chromosome size between the two parental species clearly proved that the plants were true amphiploids. For somatic chromosome counting, root tips were treated for 4 h with a 0.05% colchicine-aqueous solution, fixed in 3:1 ethanol–acetic and stained by the conventional Feulgen technique.

These lines did not show susceptibility against the common diseases of the area, including stripe rust [caused by *Puccinia striiformis* West. (syn. *P. glumarum* Eriks & Henn.)], leaf rust [caused by *P. triticina* Eriks (syn. *P. recondita* Rob. ex Desm. f. sp. *tritici*)], stem rust (caused by *P. graminis* Pers.: Pers. f. sp. *tritici* Eriks. & E. Henn.), and powdery mildew [caused by *Blumeria graminis* (DC) E.O. Speer f. sp. *tritici* Em. Marchal (syn. *Erysiphe graminis* DC f. sp. *tritici* Marchal)].

TS1, TS10, and TS41 are characterized by a high non-grain biomass production. In 2 yr of Guadalquivir River Valley trials (37° 85´N, –4° 85´W) with three replications, tetraploid triticale lines TS1, TS10, and TS41 were compared with *Triticum aestivum* 'Cartaya', a normal tester used in the area for field trials due to its adaptation to the local conditions. During the first year three irrigations were applied to avoid water deficit. No irrigation was needed during the second year because rainfall was adequately distributed during the crop season.

TS1, TS10, and TS41 are characterized by excessive height leading to lodging, late flowering, and low grain yield (Table 1). These lines have very long spikes (2.5 to 3 times longer than wheat), with low density of spikelets per spike, low fertility, free threshing, and hard glume (Table 1). Seeds are long and small, causing a low thousand kernel weight. In addition, they show very long and narrow leaves. All three lines maintained the green area during a longer period than wheat, although this trait was not quantified.

The high potential for non-grain biomass production of these lines was explained by a high tillering ability during winter and a low leaf senescence rate during booting. TS10, TS41, and TS1 yielded more non-grain biomass than Cartaya (Table 1).

The high non-grain biomass production of these lines makes them an interesting option as forage or bioenergy crop. However, all these lines show very low grain yield and fertility. Therefore, improvement of both traits is needed for the uses described above.

TS1, TS10, and TS41 will be maintained by the Institute for Sustainable Agriculture–CSIC in Córdoba, Spain. Small samples of seed for research purposes may be obtained on request from the corresponding author. In the USA, small quantities of seed may be obtained from the National Plant Germplasm System (NPGS).

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Table 1. Agronomic characteristics of TS1, TS10, and TS41 compared with common wheat Cartaya.[†]

	Flowering	Height	Spike length	Spikelets/ spike	Grains/ spike	Grains/ spikelet	1000-kernel weight	Hectolitric weight	Yield (kg/ ha)	Harvest index	Non-grain biomass
	d after sowing	cm	cm				g	kg	kg ha^{-1}	%	kg ha^{-1}
TS10	139 b	165 a	20 c	28 b	26 c	1.05 b	26.9 c	63.4 b	1585 b	9.16 b	15860 a
TS41	142 a	160 b	27 a	30 a	34 b	1.10 b	27.2 c	63.7 b	793 c	5.04 c	15282 a
TS1	128 c	160 b	22 b	24 c	26 c	1.04 b	31.7 b	63.9 b	1537 b	9.96 b	13988 b
Cartaya	116 d	93 c	11 d	20 d	53 a	2.40 a	39.7 a	76.1 a	6350 a	38.80 a	10227 c

[†]Means within a column followed by the same letter are not significantly different ($\alpha = 0.05$).

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