ADVANCES IN TRITICALE BREEDING PROGRAMME FROM R.I.C.I.C. FUNDULEA

Gheorghe Ittu, Nicolae N. Săulescu, Mariana Ittu, Pompiliu Mustăţea *)

ABSTRACT

The objective of the paper was to evaluate the genetic gain for yield and other agronomic characteristics in the Fundulea triticale breeding programme, on the basis of two years of yield trials (1997-1998) at ten locations and the performance of two current commercial cultivars, Plai and Titan, in comparison with the main cultivated varieties of wheat, barley and rye under Romanian environmental conditions, using the data obtained, during three years (1997–1999), in regional yield trials. Based on these data, the genetic progress estimated for yield was 96.03 kg^{-1} year^{-1}. This resulted from increased number of grain/spike, increased grain weight/spike, improved test weight, reduction of plant height and improved of lodging resistance. Yield results showed that triticale cultivars outyielded wheat by 916 kg/ha in 27 trials, barley by 1,695 kg/ha in 21 trials and rye cultivars by 2,007 kg/ha in 12 trials. The trend was more or less the same when the average yield of five top entries from the triticale trials was compared with the average of five top entries from wheat, barley and rye trials. In this case triticale still performed better than wheat with 762 kg/ha, 1,475 kg/ha than barley, 1,821 kg/ha than rye, respectively. At both levels of comparison the slope of the regression line was less than one, suggesting that triticale frequently produced higher yield under poor conditions than other small grain species, but in no testing location involved in this study, average yield of triticale genotypes was lower than those of wheat, barley and rye.

Key words: breeding programme, cultivar, triticale, yield.

INTRODUCTION

Triticale has the ability to realize increased grains and biomass yields under various pedoclimatic conditions with limited resources. The characteristic of this species to perform better than other crops with low input technologies, has determined its quite rapid extent in production in the last decennia, both in developed and developing countries. In some European countries like Poland, Germany, Hungary, triticale has already become a major crop (Varugese, 1996; Wolsky et al., 1998).

In Romania, triticale started to be cultivated, on a small scale, twenty years ago, approximately. The first Romanian triticale cultivar, TF2, was registered in 1984 and was cultivated in 1987, in hilly regions with acid soils, on over 25,000 ha (Ittu et al., 1986). TF2 cultivar was replaced in 1992 and 1993 by Plai and Colina cultivars, which were more productive and represented a progress for test weight, spike fertility, winter hardiness and lodging resistance in comparison wth TF2 (Ittu et al., 1995; Ittu and Săulescu, 1996). Also, the registration in 1998 of the first Romanian intensive cultivar, Titan, has determined an increasing seed demand from this species in the last years (Ittu et al., 1999).

The objective of this paper was to evaluate the genetic progress achieved in the breeding programme from R.I.C.I.C. Fundulea for grain yield and some important agronomic characteristics as well as to make an estimation of yield performances obtained in triticale breeding in comparison with wheat, barley and rye.

MATERIALS AND METHODS

The genetic progress for grain yield, grain number/spike, grain weight/spike, test weight, plant height and resistance to lodging have been estimated on the basis of data obtained in 20 trials, ten locations, during two years (1997–1998) with the main Romanian triticale cultivars: TF2, Plai, Colina and Titan, registered from 1984 till 1998.

The production data for the comparison of performances achieved by triticale cultivars and lines with those of other small grains, were obtained from ecological yield trials performed during 1997–1999. The yield trials of triticale and wheat were performed under the same environmental conditions in nine location, from which three on fertile soils and six in hilly regions with poor soils, and for the comparison with barley, the trials were performed in seven locations, two on fertile soils and five in hilly regions. Also, for the comparison between triticale and rye cultivars, the data were obtained from the yield trials performed in four locations placed in a hilly region with podzolic soils.

*) Research Institute for Cereals and Industrial Crops, 8264 Fundulea, Calarasi County, Romania

The yields realized by the triticale cultivars in comparison with those of wheat, barley and rye were analysed on the basis of data obtained in contiguous comparative trials in each testing location. The comparisons were made at two levels: on one hand, between the average yields obtained by the most spread triticale cultivars (Plai and Titan) with those of wheat (Flamura 85, Dropia, Fundulea 4, Apullum and Arieºan), barley (Dana, Adi, Mãdãlin and Orizont), rye (Suceveana, Gloria and Dan-kovskie Zlote) and, on the other hand, between the average yield of the best five genotypes classified in the yield trials.

RESULTS AND DISCUSSION

The genetic progress for grain yield were evaluated by the calculation of linear regression between the average yields obtained under the same environmental conditions (two years and ten locations) by the cultivars released by the breeding programme from R.I.C.I.C. Fundulea and the registration years. On the basis of these data, the genetic progress estimated for yield was 96.03 kg/ha/year (Figure 1). This level of genetic progress for yield is very close to that registered in the most important two triticale breeding programmes in the world: CIMMYT spring triticale programme and winter triticale breeding programme from Poland (Varugese, 1996; Wolsky, 1992).

In the breeding programme from Fundulea, the major contribution in yield improvement resulted mainly from the increase of the number of grains/spike (0.4 grains/year), grain weight/spike (0.0164 g/year) and test weight (0.337 kg/hl/year). Also, an important contribution had the decrease of plant height from 128.8 cm to 114 cm (-0.871 cm/year), with favourable effects on the improvement of the lodging resistance (Figure 1).

The comparison between the average yields of the two triticale cultivars (Plai and Titan), obtained during the three years of testing (1997–1999), showed that triticale achieved greater yields than wheat, barley and rye in all testing locations (Table 1).

On an average, the triticale cultivars overyielded the wheat cultivars by 916 kg/ha in 27 trials, barley by 1,695 kg/ha in 21 trials and rye by 2,007 kg/ha in 12 trials. The trend was more or less the same when the average yields of the best five entries of the triticale yield trial were compared whit those of wheat, barley and rye. In this case, triticale realized higher average yields than wheat with 762 kg/ha, barley with 1,475 kg/ha and rye with 1,821 kg/ha.

The linear regression was used to analyse the adaptability to the testing environmental conditions of triticale cultivars in comparison with those of wheat, barley and rye.

Table 1. Comparison of triticale mean yields obtained under R.I.C.I.C. Fundulea ecological network with those of wheat, barley and rye (1997–1999)

Species	No of exp.	Yield kg/ha	Diff. kg/ha	Relative yield %	Probability	Regression coefficient b	Correlation coefficient r
Cultivars							
Triticale (2)	27	7,145	916	115	P<0.05	0.43	-
Wheat (5)	27	6,283	-	100	-	-	-
Triticale (2)	21	7,031	1,695	132	P<0.001	0.14	0.15
Barley (4)	21	5,336	-	100	-	-	-
Triticale (2)	12	7,309	2,007	138	P<0.001	0.87	0.80**
Rye (3)	12	5,302	-	100			
The five top entries from experiments							
Triticale	27	7,645	762	111	P<0.05	0.64	0.68**
Wheat	27	6,883	-	100	-	-	-
Triticale	21	7,514	1,475	124	0.01>P<0.00	0.28	0.32
Barley	21	6,057	-	100	1	-	-
Triticale	12	7,574	1,821	132	-	0.73	0.79**
Rye	12	5,753	-	100	P<0.001		

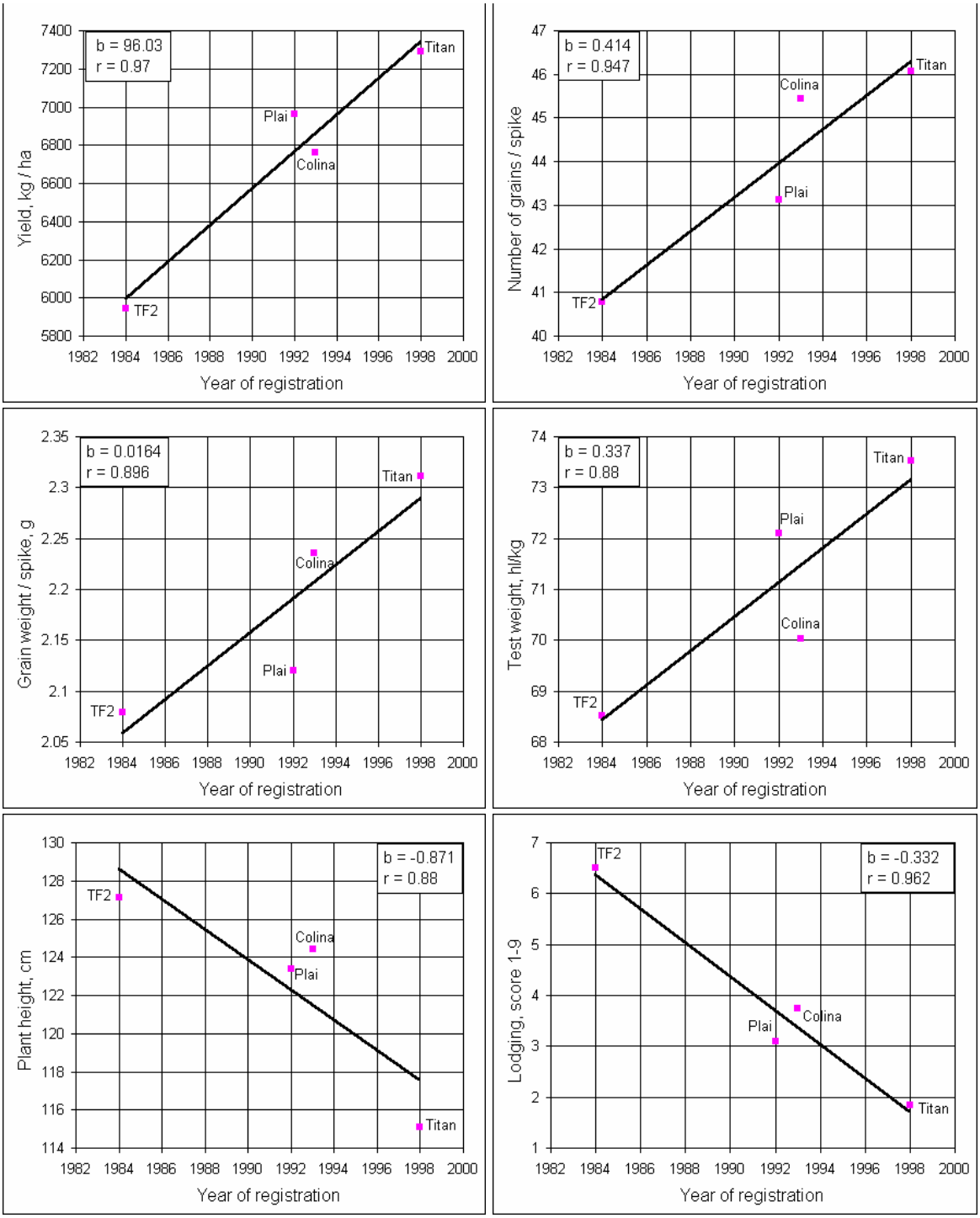


Figure 1. Genetic progress for yield, grain number/spike, grain weight/spike, test weight, plant height and resistance to lodging in the Romanian triticale breeding programme

At both levels of comparison, the slope of the regression line was less than one, suggesting that triticale frequently produced higher yields under unfavourable environmental conditions than other small grain species, but in no testing locations involved in the study, the average yields of triticale genotypes were lower than those of wheat, barley and rye.

The correlation coefficients between the average yields of triticale genotypes and those of wheat, barley and rye, showed that the reaction to the environmental conditions of triticale cultivars and lines was more similar to that of wheat and rye cultivars and lines then to that of barley.

Data suggested that a better tolerance to aluminium toxicity, as well as the high level of resistance to powdery-mildew (*Erysiphae graminis)*, rust (*Puccinia* spp.) and *Septoria tritici*, are important in conferring yield superiority of triticale over barley and wheat, while better lodging resistance and uniformity of tillers could explain the advantage over the rye. The triticale cultivars proved to be more adapted than other small grain cultivars in areas with acid soils from hilly region, but the yield results obtained with the new early triticale cultivar with short height, Titan, showed that this cultivar can be successfully cultivated, even in plain area with fertile soils.

REFERENCES

Ittu, Gh., Săulescu, N.N., Þapu, C., Ceapoiu, N., 1986. Soiul de triticale TF2 (x *Triticosecale* Wittmack). An. I.C.C.P.T. Fundulea, LIV: 43–55.

Ittu, Gh., Săulescu, N.N., Ittu, M., Verzea, M., Mustãþea, P., 1995. Soiul de triticale Plai (*Triticosecale* Witt.). An. I.C.C.P.T. Fundulea, LXII: 29-33.

Ittu, Gh., Săulescu, N.N., 1996. Triticale breeding in Fundulea - Romania. H. Guedes - Pinto, N. Darvey and V. P. Carnide (eds), Triticale: Today and Tomorrow. 663-668. Kluwer Academic Publishers, Nederlands.

Ittu, Gh., Săulescu, N.N., 1998. Advances in triticale breeding in Romania. Proc. of the 4th International Triticale Symposium, 65-70. Red Deer, Alberta, Canada.

Ittu, Gh., Săulescu, N.N., Ittu, M., Mustãþea, P., 1999. Titan – primul soi intensiv de triticale românesc. An. I.C.C.P.T. Fundulea, LXVI: 33–41.

Varugese, G., 1996. Triticale: Status and challenges ahead. In: H. Guedes - Pinto, N. Darvey and V.P. Carnide (eds), Triticale: Today and Tomorrow. 13-31. Kluwer Academic Publishers, Nederlands.

Wolsky, T., 1992. Progrès de l'amélioration du triticale d'hiver en Pologne. C.A.Acad. Agric. Fr. 78: 7–14.

Wolsky, I., Szolkowski, A., Gryka, J., Pojmaj, M., 1998. Current status of winter triticale breeding in Danko. Buletyn Institutu Hodowli I Aklimatyzacji Roslin, 205/206: 287–289.

Table 1. Influence of aluminum ions, in reaction mixture, on the level of saccharasic activity in a reddish-brown soil fertilized with compost with different quantities (glucose+fructose-mg/100 g soil dw/24 hours)

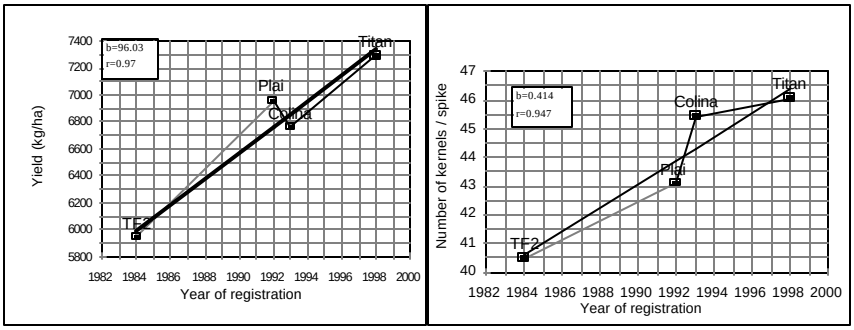
A- Factor	B – Factor – COMPOST (t/ha)								Average (A)	
	b1-0	%	b2-0	%	b3-0	%	b4-0	%		%
a1–without Al^{3+}	b 3287	100	b 4028	100	b 2579	100	b 3472	100	b 3341	100
a2- with Al^{3+}	a 4228	129	a 5019	125	a 3472	135	a 4528	130	a 4312	129
Average (B)	3757 c		4523 a		3025 d		4000 b			

LD P	5%	1%	0,1%
A	291	673*	2143
B	101	142	201*
AB	302	628*	1799
BA	144*	201	284

Table 2. Influence of aluminum ions, in reaction mixture, on the level of saccharasic activity in a chernozem mineral fertilized or manured with farmyard compost (glucose+fructose-mg/100 g soil dw/24 hours)

A- Factor	B – Factor – COMPOST (t/ha)										Average (A)	
	b1-0	%	b2-$N_{32}P_{32}$	%	b3-$N_{94}P_{96}$	%	b4-$N_{128}P_{128}$	%	b5 compost	%		%
a1–without Al^{3+}	b 1564	100	b 1496	100	b 1459	100	b 1401	100	b 1732	100	b 1530	100
a2- with Al^{3+}	a 1686	108	a 1581	106	a 1684	115	a 1589	113	a 1864	108	a 1681	110
Average (B)	1625 b		1538 d		1571 c		1495 e		1798 a			

LD P	5%	1%	0,1%
A	7	17	54*
B	14	20	27*
AB	19	28	45*
BA	20*	28	39



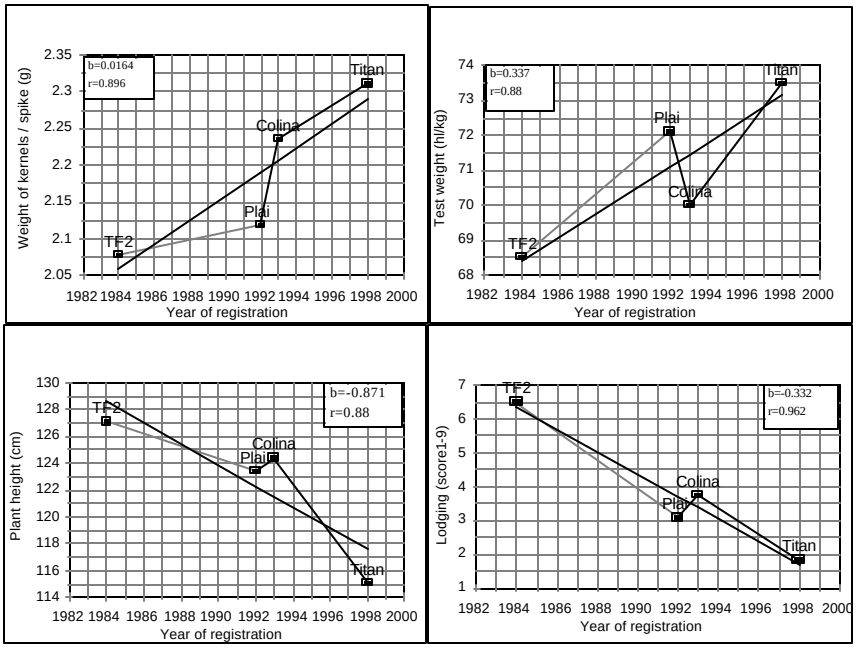


Figure 1. Genetic progress for yield, kernel number/spike, grain weight/spike, test weight, plant height and
resistance to lodging in the Romanian triticale breeding programme