

# INTRODUCTION OF SHORT STRAW GENES IN ROMANIAN TRITICALE GERMPLASM

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## ABSTRACT

The paper presents the first, recently registered, two short straw triticale cultivars, Gorun and Haiduc, with improved earliness, carriers of semidwarf dominant rye gene *Hl*. Averaged on 35 trials (2003-2005), Gorun and Haiduc performed better than the average of the *Rht1* carriers cultivars Titan and Tril by 500 and 660 kg/ha respectively, were shorter than these cultivars with 9-10 cm and had higher harvest index. The relationships between plant height and yield showed that for each centimeter reduction of plant height by breeding, the yield increased by 23.8 kg/ha under intensive and by 10.5 kg/ha under low input crop management. Genetic progress for yield, estimated in three years and 12 locations, in yield trials involving cultivars registered in the last 22 years, was 60.0 kg/ha/year. Current semidwarf cultivars with *Hl* gene, are high yielding, and have improved earliness. Further improvement of preharvest sprouting resistance in this germplasm is needed in the next step of breeding.

**Key words:** triticale, yield, plant height, short straw genes .

## INTRODUCTION

Introduction of major genes for plant height reduction (*Rht1* and *Hl*) in triticale is important in order to improve yield and yield stability, through increased lodging resistance and uniformity of plant height and spike size of the tillers (Zillinsky, 1974; Wolski et al., 1996; Shevchenko and Goncharov, 1998). All Romanian triticale cultivars are carriers of semi-dominant gene *Rht1* for short straw (Ittu et al., 2001 and 2004). Introduction of dominant short straw gene *Hl*, in Romanian triticale germplasm, was done directly from the radiation mutant EM1 or from the Polish cultivar Debo. In this paper we present the first high yielding triticale cultivars, (among them being the recently registered Gorun and Haiduc), carriers of *Hl* gene, and having suitable earliness for Romanian environment.

## MATERIAL AND METHODS

Agronomic performance of short straw triticale germplasm was tested during three years (2003-2005) in 12 locations, under two rates of nitrogen fertilizations (N 100 kg/ha and N0). Yield data and other agronomic traits (plant height, TKW, TW, resistance to several diseases and abiotic stress) were statistically analyzed and compared with the average of the most widely grown triticale cultivars, Titan and Tril. Correlations between earliness, plant height and earliness and yield among the short straw genotypes carriers of *Rht1* and *Hl* genes were estimated. Also, genetic progress for yield, involving cultivars registered in the last 22 years, was estimated.

## RESULTS AND DISCUSSION

The first, recently registered cultivars (Gorun and Haiduc), with improved earliness, carriers of semidwarf dominant rye gene *Hl*, averaged on 35 trials (2003-2005), yielded significantly better than the average of the *Rht1* carriers Titan and Tril, by 500 and 660 kg/ha respectively.

The yield trials were performed in a high diversity of environmental conditions, proved by the large variation of yields (Figures 1 and 2).

Gorun yielded from 1258 kg/ha, under severe drought in 2003 at NARDI Fundulea, to 11297 kg/ha under irrigation at ARDS Braila in 2004. In the same conditions Haiduc yielded from 1532 to 10825 kg/ha.

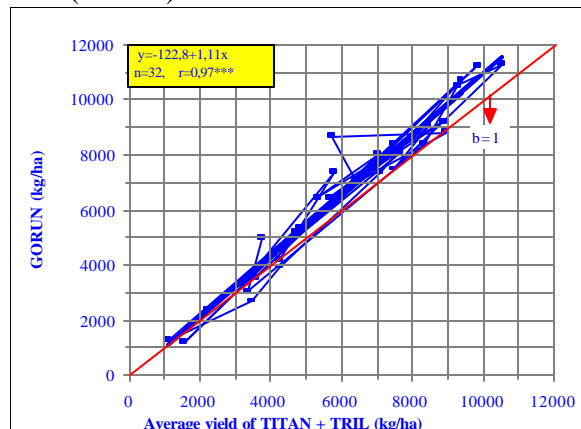
Regression slopes of the yield of new cultivars (Gorun and Haiduc), against the average yield of two controls across 35 environments, was close to 1, suggesting that both new cultivars performed better than controls both in poor and favorable environmental conditions.

Both two cultivars were shorter than *Rht1* controls with 9-10 cm and had higher TKW and harvest index (Table 1).

The two new cultivars (Gorun and Haiduc), carriers of the short straw gene *Hl*, have the same

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earliness as *Rht1* control cultivars and are superior compared to these for winterhardness and FHB resistance. They are medium resistant to *Septoria* and a little bit better for aluminum tolerance (Table 2).



	Yield. (t/ha)	Dif. (%)
Gorun	6.4	109*
Titan + Tril	5.9	100

Figure 1. Relationship between yield of Gorun cultivar against the average yield of Tril and Titan, over 35 trials

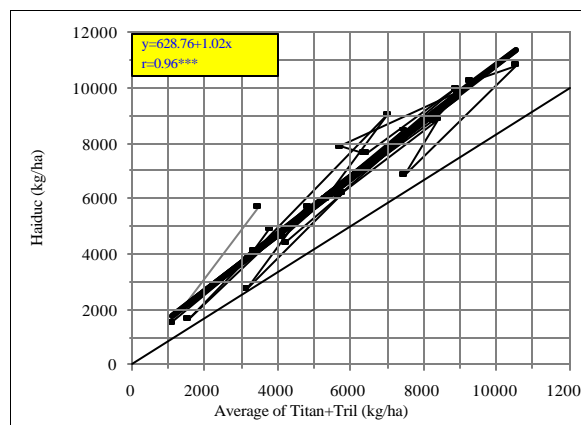
Table 1. Agronomic characteristics of the new short straw carriers of *H1* gene, in comparison to *Rht1* carriers

Cultivar	Plant height (cm)	Number of plants/m <sup>2</sup>	Number of heads/m <sup>2</sup>	Number of kernels/spike	TKW (g)	TW (kg/hl)	HI
<i>No of trials</i>	43.0	40.0	40.0	27.0	31.0	31.0	6.0
Plai	118.3	374.0	524.7	37.5	45.0	73.7	0.44
Titan	112.2	362.3	485.7	42.5	46.4	73.4	0.42
Tril	109.9	391.3	503.3	33.1	55.8	70.9	0.42
Stil	109.8	397.3	508.7	41.3	46.4	74.0	0.43
<b>Gorun</b>	<b>102.2</b>	<b>396.0</b>	<b>485.7</b>	<b>37.3</b>	<b>51.0</b>	<b>73.3</b>	<b>0.46</b>
<b>Haiduc</b>	<b>104.4</b>	<b>386.0</b>	<b>459.7</b>	<b>39.0</b>	<b>51.0</b>	<b>72.3</b>	<b>0.46</b>
<b>Gigant</b>	<b>86.3</b>	<b>391.7</b>	<b>497.3</b>	<b>39.7</b>	<b>49.3</b>	<b>70.3</b>	<b>0.46</b>
TF2	125.4	378.7	496.3	34.5	51.5	70.6	0.38
Average	108.6	384.7	495.2	38.1	49.6	72.3	0.43
<b>LSD 5%</b>	<b>9.7</b>	<b>25.9</b>	<b>37.6</b>	<b>4.1</b>	<b>4.8</b>	<b>3.7</b>	<b>0.07</b>

Table 2. Physiological characteristics of the new short straw carriers of *H1* gene, in comparison to *Rht1* carriers

Cultivar	Heading time	Resistance to low temperatures	Resistance to FHB		Resistance to <i>Septoria</i>	Resistance to leaf rust	Aluminum tolerance
	Days from Jan. 1 <sup>st</sup>	(1-9)	AUDPC	(1-9)	(1-9)	Cobb. modified	Length of seedling roots (cm)
<i>No of trials</i>	27.0	4.0	4.0	4.0	5.0	2	4.0
Plai	136.0	5.5	262.5	4.0	4.0	50MS-S	2.2
Titan	136.0	4.0	114.5	3.0	4.0	0R	2.9
Tril	134.5	3.9	295.0	6.5	2.0	40MS	2.6
Stil	134.5	3.0	72.5	4.5	3.0	10MR	2.9
Gorun	135.0	3.7	70.8	2.0	5.0	20MR	3.1

(2003-2005)



	Yield. (t/ha)	Dif. (%)
Haiduc	6.61	113*
Titan + Tril	5.87	100

Figure 2. Relationship between yield of Haiduc cultivar against the average yield of Tril and Titan, over 35 trials (2003-2005)

GHEORGHE ITTU ET AL.: INTRODUCTION OF SHORT STRAW GENES  
IN ROMANIAN TRITICALE GERmplasm

Haiduc	136.5	2.8	163.0	3.5	5.0	trMR	3.1
Gigant	138.5	4.8	224.0	5.0	4.0	20MS	2.4
TF2	136.5	5.9	446.0	7.0	5.0	trMR	2.2
Average	135.9	4.2	206.0	4.4	4.0	-	2.7
<b>LSD 5%</b>	1.5	1.2	-	-	-	-	0.29

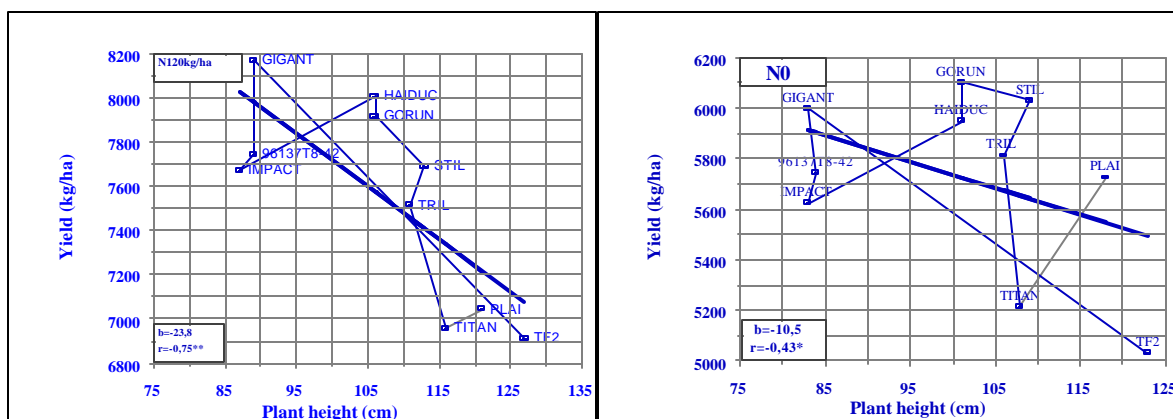


Figure 3. Relationships between yield and plant height under intensive and low input crop management (average of 12 yield trials)

The correlations between plant height and yield were significant in the set of triticale cultivars released during the last years, both with and without nitrogen fertilization ( $r = 0.75^{**}$  and  $r = 0.43$ , respectively) (Figure 3).

This relationship suggests that for each centimeter reduction of plant height, the yield increased by 23.8 kg/ha under intensive and by 10.5 kg/ha under low input crop management.

The new lines selected from crosses between *Rht1* and *Hl* parents were significantly shorter than both parents, suggesting that epistatic effect of *Hl* on *Rht1* does not exist (as was postulated by Shevchenko and Goncharov, 1998) or it depends on background. Short lines tended to have a later heading date, but the association was not very strong (Figure 4).

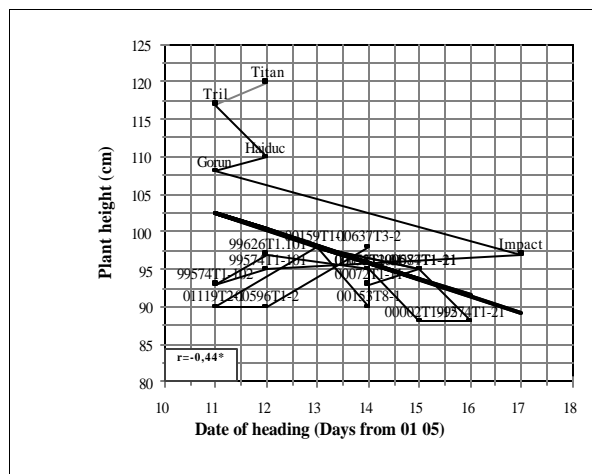


Figure 4. Relationship between plant height and earliness in new lines, carriers of *Hl* and *Rht1* reduced plant height genes

Genetic progress for yield, estimated during three years in 12 locations, in yield trials involving cultivars registered in the last 22 years, was 60.0 kg/ha/year (1.06 %/year). This genetic gain is similar to that estimated in important breeding program like the ones in Poland and CIMMYT Mexico (Ittu et al., 2001) (Figure 5).

Current semidwarf cultivars with *Hl* gene are high-yielding and have improved earliness. Further improvement of preharvest sprouting resistance in

this germplasm is needed, in the next step of breeding.

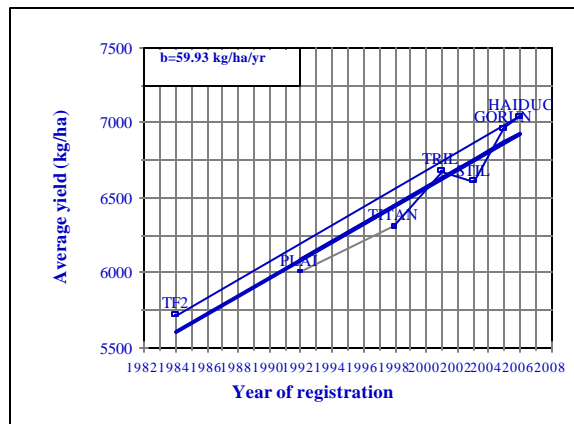


Figure 5. Genetic progress for yield in the Romanian triticale breeding program (Data of 32 trials, 2003-2005)

## CONCLUSIONS

Introduction of the dominant reduced height gene *H1* in the new triticale cultivars Gorun and Haiduc, improved lodging resistance and yielding potential.

The association between the dominant short straw gene *H1* and lateness seems not to be very strong.

Further research it is necessary to study the effects of recombining the short straw genes *Rth1* and *H1*.

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