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# The express manner of thousand grains weight in $F_1$ hybrids of winter barley

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**Abstract** Thousand grain weights is one of most important parameter of seed quality influenced by both genetic and environmental factors. The present studies were under taken to assess the level of thousand grains weight for 15 $F_1$ hybrids of six winter barley varieties, with different genetic and ecological origin, to identify valuable combination that can be use in future breeding programs.
The potency ratio showed that for most of the hybrids, the gene effects were associated with an increase in most cases, except for Metal x Plaisant and Metal x Turul where the dominance has very low influence on the genetic control of thousand grains weight. Also, in the case of five combinations this trait was controlled by partial dominance. The hybrids: Viktor x Lyric, Orizont x Lyric and Plaisant x Turul showed the highest values of mid and better parent heterosis and may be used as breeding material for increasing barley grains weight and productivity.

**Key words**

Winter barley, thousand grains weight, F1 hybrids.

The thousand grains weight as a final component of grain yield depends on many components that develop in the previous phases of ontogenesis [10]. Thousand grain weights is one of most important parameter of seed quality, who depends of embryo size and seed storages for germination and emergence. High thousand seeds weight will increase germination percent, seedling emergence, tillerring, density, spike yield and provide stronger competition against, weeds [2].

This trait is influenced by both genetic and environmental factors. Tillering capacity, number of grains per spike and 1000-grain weight are interrelated yield components. Grain weight, the latest determined yield component of barley, compensates for earlier stresses, if favourable conditions prevail during the grain filling period [6]. Grain density is another important factor that influences the thousand grains weight. In this way Güner (2007) has characterized barley as having the kernel density of 995± 7 kg/m3.

Genetic differences between parents and estimates of the mode of inheritance of major yield components and mode of gene action can help identify combinations in the hybrid material that will form the basis for selecting desirable genotypes or genes determining desirable traits [7].

According to Morgan et al. (1989), if parents show high yielding potential, heterosis for grain yield would be less because parents have already many beneficial genes in homozygous state. In addition, Fabrizius et al., (1998) reported that the more genetic differences among parents are, the more heterosis can be possible positively for grain yield in a hybrid.

The present studies were under taken to assess the level of thousand grains weight for 15 $F_1$ hybrids of six winter barley varieties, with different genetic and ecological origin, to identify valuable combination that can be use in future breeding programs.

## Material and Method

The biological material comprised of 15 hybrids resulting from a diallel cross between six winter barley varieties (Metal, Orizont, Plaisant, Viktor, Turul Lyric) with different ecological and genetic origin. The research was conducted based on a randomized complete block design with three replications.

The values of mid parent heterosis and better parent heterosis (heterobeltiosis) were estimated as formulated by Matzinger et al., (1962) and Fonseca & Patterson (1968). Heterosis % = ($F_1$-MP) x 100/ MP ; Heterobeltiosis = ($F_1$- BP) x 100/BP, where $F_1$, MP and BP denote the performance of hybrid, average performance of parents and performance of better parent, respectively.

Inheritance nature was evaluated based on dominance parameters. The potency ratio was computed by ratio of dominance parameters (*d/a*), where *d* is the difference between $F_1$ means and parent means, and *a* is the half difference of two parents for a

combination, according to the formula: $d/a = (F_1 - MP) / ½(P_1 - P_2)$.

To estimate significant differences among parents and $F_1$ hybrids, the data were subjected to statistical analysis by using the analysis of variance technique (Ciulca, 2006). Significant differences were further subjected to Multiple Range Test. The 't' test was manifested to determine whether $F_1$ hybrid means were statistically different from mid parent and better parent means (Wynne et al., 1970).

## Results and Discussions

The highest values of heterosis index were achieved by the hybrids Plaisant x Turul (16.50), Orizont x Viktor (3.25), Turul x Lyric (2.50), combinations where there was no large differences between the parental forms in terms of thousand grains weight. The lowest values of heterosis index correlated with low levels of this trait were registered at: Metal x Plaisant (-0.09); Metal x Turul (0.01) and Metal x Viktor (0.13).

Regarding the values of potency ratio for this trait it is noted that the gene effects were associated with an increase in most cases, except for Metal x Plaisant and Metal x Turul where the dominance has very low influence on the genetic control of thousand grains weight. The over dominance plays an important role for combinations: Plasiant x Turul; Orizont x Viktor; Turul x Lyric; Orizont x Lyric; Viktor x Lyric. In the case of Metal x Orizont; Metal x Lyric; Orizont x Plaisant; Orizont x Turul; Plaisant x Viktor the inheritance of this trait was controlled by partial dominance effects. At Viktor x Turul the inheritance of this trait was controlled by full dominance.

Table 1

**Potency ratio for thousand grains weight in $F_1$ hybrids**

| Genitori | Metal | Orizont | Plaisant | Viktor | Turul | Lyric |
|---|---|---|---|---|---|---|
| Metal | - | 0.67cd | -0.09d | 0.13d | 0.01d | 0.29d |
| Orizont | | - | 0.50cd | 3.25b | 0.57cd | 1.75bcd |
| Plaisant | | | - | 0.66cd | 16.50a | 1.17bcd |
| Viktor | | | | - | 1.06cd | 1.56bcd |
| Turul | | | | | - | 2.50bc |
| Lyric | | | | | | - |

The values marked with different letters are significant at p 0.05

The values of this trait in the hybrid combinations registered a medium variability ($s_{\%}$ =7.02 %) and a variation amplitude of 8.45 g, with values ranging between 39.07 g in Plaisant x Lyric and 47.52 g for Orizont x Lyric. Approximately 47% of hybrid combinations showed values of this trait between 40 and 45 g, while 40% of the hybrid recorded a thousand grains weight over 45 g. Only for 13% of the hybrids values below 40 g were observed.

In the case of 67% of the hybrids combinations the values of this trait were significantly higher than the parents mean. Compared with the best parent, 40% of the combinations showed significant differences, so that the highest values of heterobeltiosis (14.79 % ) were also observed in Plaisant x Turul combination.

Considering the data from Table 2, it is found that the hybrids have achieved higher or intermediate values to parental forms. Compared to the mid parent the majority of hybrid combinations excepting (Metal x Plaisant) showed higher values of this trait, in this sense the highest values of heterosis (19.76 %) were recorded by Viktor x Lyric.

Table 2

**Thousand grains weight of $F_1$ hybrids compared to parents**

| Total hybrids number | Number and % of $F_1$ hybrids | | | | Range towards parents mean(%) | Mean heterosis (%) | |
|---|---|---|---|---|---|---|---|
| | Higher to both parents | Between parents | | Lower to both parents | | "MP" | "BP" |
| | | Upper mean | Under mean | | | | |
| 15 | 11 (73.34%) | 2 (13.33 %) | 2 (13.33 %) | - | 98.64 – 119.76 | 107.99 | 105.82 |

In terms of the express manner of thousand grains weight, 73 % of the hybrids, were superior to both parents, and the rest were intermediate to the parents, so that hybrids with values of this trait lower to both parents have not been observed. In comparison with the parents mean the hybrids from this generation showed a low amplitude (21.12 %), while the average values of "mid parents" heterosis were 7.99% and 5.82 5 for heterobeltiosis, respectively.

Variance analysis presented in Table 3 shows that there are real differences between studied hybrid combinations in terms of thousand grains weight. The low heterogeneity of experimental conditions between repetitions does not significantly influence the achieved results regarding the manifestation of this trait at hybrid combinations.

Approximately 40% of the studied combinations have achieved higher values of this trait than the experience mean, but statistically ensured differences were recorded only in case of combinations: Viktor x Lyric (5.07***); Orizont x Lyric (3.19*); Orizont x Viktor (3.18*); Viktor x Turul (2.99*); Metal x Orizont (2.75*). Values of the thousand grains weight below the experience mean have been recorded by combinations: Plaisant x Lyric ($-5{,}26^{000}$); Turul x Lyric ($-4.78^{000}$); Metal x Plaisant ($-2.98^{0}$).

Table 3

**a) Variance analysis of thousand grains weight in $F_1$ hybrids**

| Variability source | SS | DF | MS | F |
|---|---|---|---|---|
| Total | 485.01 | 47 | | |
| Replications | 2.64 | 2 | 1.32 | 0.52 |
| Hybrids | 406.69 | 15 | 27.11 | 10.75** |
| Erorr | 75.68 | 30 | 2.52 | |

**b) Estimative values and the significance of differences between $F_1$ hybrids concerning thousand grains weight**

| No | Hybrids | TGW (g) | | Relative value (%) | Difference Signifficance |
|---|---|---|---|---|---|
| | | $\bar{x} \pm s_{\bar{x}}$ | s % | | |
| 1 | Experience mean | 44.33 ± 0.17 | 0.65 | 100.00 | Control |
| 2 | Metal x Orizont | 47.08 ± 0.63 abc | 2.30 | 106.20 | 2.75* |
| 3 | Metal x Plaisant | 41.35 ± 1.08 fgh | 4.52 | 93.29 | $-2.98^{0}$ |
| 4 | Metal x Viktor | 45.64 ± 1.07 bcd | 4.07 | 102.95 | 1.31 |
| 5 | Metal x Turul | 42.06 ± 1.08 fg | 4.45 | 94.87 | -2.27 |
| 6 | Metal x Lyric | 44.98 ± 1.14 bcde | 4.38 | 101.47 | 0.65 |
| 7 | Orizont x Plaisant | 42.53 ± 0.98 ef | 4.00 | 95.94 | -1.80 |
| 8 | Orizont x Viktor | 47.51 ± 0.36 ab | 1.33 | 107.18 | 3.18* |
| 9 | Orizont x Turul | 42.93 ± 1.01 ef | 4.06 | 96.84 | -1.40 |
| 10 | Orizont x Lyric | 47.52 ± 1.23 ab | 4.50 | 107.20 | 3.19* |
| 11 | Plaisant x Viktor | 44.69 ± 0.79 cdef | 3.04 | 100.82 | 0.36 |
| 12 | Plaisant x Turul | 43.31 ± 0.93 def | 3.71 | 97.69 | -1.02 |
| 13 | Plaisant x Lyric | 39.07 ± 1.07 h | 4.75 | 88.14 | $-5.26^{000}$ |
| 14 | Viktor x Turul | 47.32 ± 0.87 abc | 3.17 | 106.75 | 2.99* |
| 15 | Viktor x Lyric | 49.40 ± 0.40 a | 1.41 | 111.43 | 5.07*** |
| 16 | Turul x Lyric | 39.55 ± 0.84 gh | 3.66 | 89.22 | $-4.78^{000}$ |

$LSD_{5\%}$ = 2.65 g $LSD_{1\%}$ = 3.57 g $LSD_{0.1\%}$ = 4.73 g

Based on the multiple comparisons of the 15 hybrids it is notes that the combination Viktor x Lyric achieved significantly higher values of the thousand grains weight compared to 71% of the other hybrids. Also, in case of combinations Orizont x Lyric and Orizont x Plaisant was significantly higher than 62% of the studied combinations.

Table 4

**The significance of differences between groups of $F_1$ hybrids with the same recurrent parent regarding thousand grains weight**

| Recurrent parent | $\bar{x} \pm s_{\bar{x}}$ | s% | Orizont 45.51 | Plaisant 42.19 | Viktor 46.91 | Turul 43.03 | Lyric 44.10 |
|---|---|---|---|---|---|---|---|
| Metal | 44,22±1,09 | 5,50 | -1,29 | 2,03 | -2,69 | 1,19 | 0,12 |
| Orizont | 45,51±1,14 | 5,61 | | 3,32 | -1,40 | 2,48 | 1,41 |
| Plaisant | 42,19±0,95 | 5,04 | | | $-4{,}72^{0}$ | -0,84 | -1,91 |
| Viktor | 46,91±0,81 | 3,88 | | | | 3,88* | 2,81 |
| Turul | 43,03±1,26 | 5,43 | | | | | -1,07 |
| Lyric | 44,10±2,01 | 10,55 | | | | | |

| $LSD_{5\%}$ | $LSD_{1\%}$ | $LSD_{0,1\%}$ |
|---|---|---|
| 3.76 g | 5.10 g | 6.82 g |

Regarding to the groups of hybrids with the same recurrent parent (Table 4) it is noted that the lowest value of this trait was carried out by the hybrids of Plaisant variety, while the hybrids of Viktor variety showed the highest value of thousand grains weight associated with significant increases compared to the hybrids of Plaisant and Turul varieties. On the background of low variability between the hybrids groups, the variability within the groups was generally rather small with the limits between 3.88 % for Viktor and 10.55 % for Lyric.

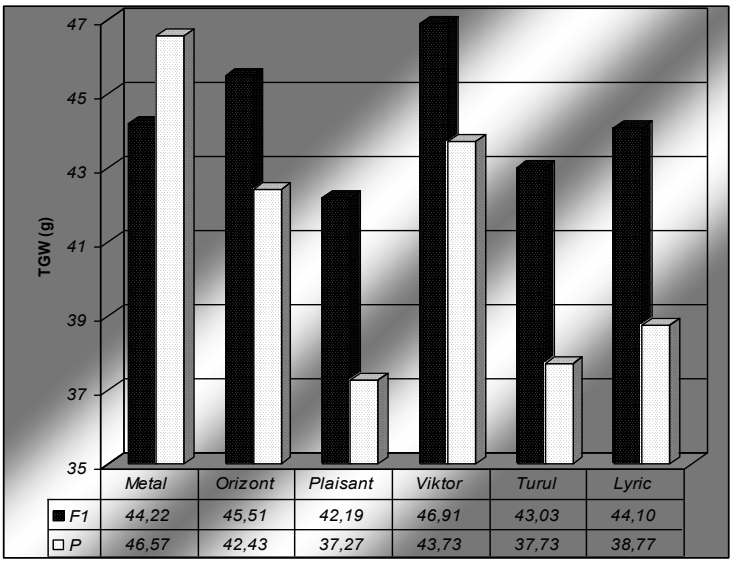


**Fig. 1 Thousand grains weight for groups of $F_1$ hybrids with the same recurrent parent**

As shown in Figure. 1, it is observed that in most cases the hybrids have achieved higher values of thousand grains weight to the recurrent parent, with increases ranging from 7% for the hybrids of Viktor and 14 % for the group of Turul variety. For Metal variety which showed the highest value of this trait, the hybrids showed a 5% reduction of thousand grains weight. The biggest differences are seen in the groups of hybrids where the recurrent parents submit two limits of variation, except for Metal variety.

## Conclusions

The potency ratio showed that for most of the hybrids, the gene effects were associated with an increase in most cases, except for Metal x Plaisant and Metal x Turul where the dominance has very low influence on the genetic control of thousand grains weight. Also, in the case of five combinations this trait was controlled by partial dominance.

The hybrids: Viktor x Lyric, Orizont x Lyric and Plaisant x Turul showed the highest values of mid and better parent heterosis and may be used as breeding material for increasing barley grains weight and productivity.

To utilize non-additive gene effects which were predominant in the inheritance of this trait at the studied hybrids, breeding methods involving recurrent selection or biparental mating were suggested for further improvement.

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