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Grain Yield And Yield Components Of Two-Row Winter Barley Cultivars And Lines

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Abstract: A comparative study on the grain yield and yield components of six winter barley cultivars and lines was conducted at an experimental farm of the Small Grains Research Centre in Kragujevac over a three-year period. The analysis included stem height, spike number per m^2, kernel number per spike and grain yield.

The smallest and greatest plant heights were found with the K-10-85 line and cv. NS-293, respectively, regardless of the year of observation. A considerably lower stem height, as compared to the standard cultivar, was observed in genotypes NS-331, K-10-85 and ZA-88.

Plant height and grain yield were substantially affected by environmental conditions during the observation period. These traits were also considerably affected by the genotype-year interaction.

Spike number per m^2 and kernel number per spike were significantly affected by year, the differences between the cultivars and lines observed in this study were not significant, and moreover, no important effects of the genotype-year interaction were registered. There were significant differences in grain yield between the genotypes studied, the highest and lowest being obtained by K-10-85 and KG-8/4, respectively.

Key words: barley, stem height, plant number, kernel number and grain yield

Introduction

Grain yield and kernel quality of barley are the most important traits of a barley genotype. The expression of these traits represents a synthesis of individual traits and environmental conditions under which plants develop. The basic components of yield, grain being its main economic product, include plant number per unit area, kernel number per plant and 1000 kernel weight. Maximum productivity is a result of the most favourable balance achieved between the yield components.

An annual yield increase in two-row barley is 1.1 %, yield increase being generally due to an increase in some yield components such as kernel weight and kernel number per spike, an increase in total biomass or improvements of harvest index (Pržulj *et al*. 2000, Madić *et. al*. 2006, 2007, Paunović *et. al*. 2006, Paunović *et. al*. 2007).

The issue of optimum plant height of malting barley has not been defined precisely. Barley stem has a poor-quality mechanical tissue due to which barley breeding tendencies are aimed at developing short-stem cultivars to eliminate lodging problems. Stem height is dependent primarily on the genetic composition of the cultivar, the production methods and practices used and climate conditions. Likewise, spike length is affected by breeding aimed at reducing or increasing plant height in barley. Dwarf genotypes of barley are highly susceptible to stem breakage and diseases and produce low-quality malt (Pržulj *et al*. 2000, Hellewell *et al*. 2000).

Apart from high yields, optimum stem height, 1000 kernel weight and good biological and non-biological stress resistance, malting barley cultivars should have low chaff and protein contents, but a high content of starch. In order to realize the full genetic potential for yield and quality, particularly in malting barley, the production practices and methods used should be strictly followed (Malešević and Starčević 1992, Pržulj and Momčilović 2002, Paunović *et. al*. 2008).

Material and Method

Five winter cultivars and lines of two-row barley, i.e. KG-8/4, Jagodinac, K-10-85, NS-331 and ZA-88, were analyzed for yield and yield components and compared to the NS-293 standard.

The comparative study of the cultivars was conducted at an experimental field of the Small Grains Centre in Kragujevac over a three-year period (1993-1995). The experiment was set up as a randomized block design in 5 replications. The size of the elementary plot was $5m^2$. Common cultural practices were used in the experiment.

Plant height, spike number per m^2 and kernel number per spike were analyzed using a sample of 50 plants per replication. Grain yield was determined on each elementary plot and calculated as grain yield in t/ha at 14% moisture.

The obtained data were subjected to a two-factor analysis of variance and the significance of differences between the individual means and the standard were assessed by Dannet's test.

Results and Discussion

Plant height in malting barley is dependent primarily on the genetic composition of the cultivar grown, production methods used and climate conditions.

The analysis of variance for plant height showed that the cultivars and lines observed in this study differed considerably, that the environmental conditions had a considerable effect on the traits examined and that there were important interactive effects between the genotypes and years of observation. Irrespective of the year of observation, plant height was lowest in K-10-85 and greatest in cv. NS-293. As compared to the standard cultivar, a considerably shorter stem was produced by the NS-331, K-10-85 and ZA-88 genotypes.

The analysis of the interactive effects between the genotypes and the year of observation showed that all genotypes except ZA-88 exhibited an identical tendency in terms of their response to environmental conditions as compared to the standard. ZA-88 deviated from the tendency in that it produced a smaller plant height in the first year, and its mean in the following years conformed to the average value, irrespective of the year (Table 1).

Spike number per m^2 is a direct yield component, indirectly affecting the kernel number per spike and 1000 kernel weight, though. A high number of spikes per m^2 can also induce the development of kernels of non-uniform size, being an unfavourable trait of malting barley (Maksimović *et al*. 2001).

The analysis of variance of the spike number per m^2 showed that the spike number was significantly affected by year, whereas the differences between the genotypes were not significant and there were no significant interactive effects between the cultivar and year of observation.

Kernel number per spike is a direct yield component, being dependent on spike length and spike density as well as on the row number per spike. Kernel number is a highly variable trait, resulting from the number of spikelets and number of flowers per spikelet, on the one hand, and from the success of fertilization and grain setting in the flowers, on the other. The analysis of variance suggested significant differences between the genotypes, a considerable effect of year of observation and no significant effect of the genotype-year interaction. The number of kernels per spike was lowest in NS-331 and highest in NS-293. NS-331 gave a considerably lower number of kernels as compared to the standard, whereas no significant differences were observed between the other genotypes and the standard. All genotypes showed similar tendencies during the years of observation, suggesting that the kernel number per spike is a cultivar characteristic that can be considerably affected by environmental factors (Table 1).

Barley yield is a highly complex trait resulting from the effect of genotype and environment throughout the life cycle of the plant. The analysis of variance of the average yield showed significant differences between the genotypes. The highest yield was produced by K-10-85 and the lowest by KG-8/4. Grain yield was considerably affected by environmental conditions (year) as well as by the genotype-year interaction. There were no significant differences in grain yield between the genotypes and the standard cultivar.

Tab. 1. Plant height, spike number per m^2, kernel number per spike and grain yield in winter barley cultivars and lines over a three-year period

		Plant height (cm)	Spike number per m^2	Kernel number per spike	Grain yield tha^{-1}
Cultivars and lines (A)	KG-8/4	87.1*	738.8 ns	20.2 ns	6.83 ns
	Jagodinac	87.7ns	692.3 ns	20.4 ns	6.83 ns
	K-10-85	76.3**	650.7 ns	19.6 ns	7.00 ns
	NS-331	82.1**	703.3 ns	18.1 ns	6.28 ns
	ZA-88	87.8 ns	622.3 ns	20.3 ns	6.82 ns
	NS-293	91.4	676.3	20.8	6.57
Years (B)	1993	88.1 b	640.2 b	20.3 a	5.58 a
	1994	94.8 a	844.7 a	20.1 a	6.96 b
	1995	73.3 c	556.9 b	19.3 b	7.64 c
KG-8/4	1993	92.6 e	776.2	20.8	5.18 g
	1994	96.4 cd	860.6	20.2	7.11 cde
	1995	72.2 j	579.6	19.7	8.20a
Jagodinac	1993	92.7 de	601.0	20.2	5.66 g
	1994	98.8 bc	883.2	20.9	6.93 cde
	1995	72.6 j	592.8	20.2	7.88 ab
K-10-85	1993	80.0 ghi	511.6	20.1	5.52 g
	1994	81.1 gh	957.4	19.6	7.17 b-e
	1995	68.0 k	483.2	19.1	8.32 a
NS-331	1993	83.5 fg	620.8	18.4	5.57 g
	1994	90.7 e	917.2	18.1	6.48 ef
	1995	72.0 j	571.8	17.8	6.78cde
ZA-88	1993	85.8 f	776.4	20.9	5.80 fg
	1994	100.9 ab	658.4	20.7	7.44 bcd
	1995	76.8 i	442.2	19.2	7.20 bcd
NS-293	1993	93.9 de	565.0	21.4	5.62 g
	1994	102.2 a	791.6	21.3	6.64 de
	1995	78.1 hi	672.2	19.7	7.4 bc
Anova	Cultivar(A)	**	ns	**	**
	Year (B)	**	**	**	**
	AxB	**	ns	ns	**

*;**; significant at 95 or 99% for cultivars as compared to the standard (NS-293) following Dannet's test and ANOVA (F-test), respectively

The mean values across columns for years and cultivar-year interaction marked with an identical small letter do not differ significantly at 95 % according to LSD-test.

The analysis of the interactive effects between the genotypes and year showed that Jagodinac, K-10-85, NS-331 and NS-293 exhibited similar tendencies with respect to their response to environmental conditions, with the exception of KG-8/4 and ZA-88, considerably deviating from this (Table 1).

Conclusion

A study on grain yield and yield components was conducted at an experimental field of the Small Grains Research Centre in Kragujevac over a three-year period.

Irrespective of the year of observation, plant height was lowest in K-10-85 and highest in cv. NS-293. A considerably smaller stem height, as compared to the standard cultivar, was produced by the NS-331, K-10-85 and ZA-88 genotypes.

Plant height was considerably affected by environmental conditions during the years of observation. The analysis of the interactive effects between the genotypes and the year of observation showed that all genotypes, with the exception of Za-88, exhibited identical tendencies in terms of their response to environmental conditions, as compared to the standard.

Spike number per m^2 and kernel number per spike were considerably affected by year of observation. The observed differences between the genotypes were not significant and there were no significant effects by the genotype-year interaction.

The genotypes differed significantly in grain yield, which was highest in K-10-85 and lowest in KG-8/4. Grain yield was considerably affected by environmental conditions (year) as well as by the genotype-year interaction.

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PRINOS ZRNA I KOMPONENTE PRINOSA SORTI I LINIJA OZIMOG DVOREDOG JEČMA

- originalni naučni rad -

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Rezime

U trogodišnjem periodu obavljena su uporedna sortna ispitivanja komponenti prinosa i prinosa zrna šest ozimih sorti i linija ječma na imanju Centra za strna žita u Kragujevcu. Analizirana je visina stabla, broj klasova po m^2, broj zrna po klasu i prinos zrna.

Bez obzira na godinu ispitivanja najmanju visinu biljke imala je linija K-10-85, a najveću sorta NS-293. Značajno nižu visinu stabla u odnosu na sortu standard imali su genotipovi NS-331, K-10-85 i ZA-88.

Uslovi uspevanja u posmatranim godinama imali su značajan uticaj na visinu biljke i visinu prinosa. Za data svojstva javio se i značajan interakcijski efekat između genotipa i godine.

Na broj klasova po m^2 i broj zrna po klasu značajno je uticala godina, a razlike između sorti i linija nisu značajne i nije bilo značajnih efelkata u interakciji genotip-godina. Genotipovi su se značajno razlikovali u visini prinosa, tako da je najveći prinos imala linija K-10-85, a najmanji KG-8/4.