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Original paper

Grain Yield Seed Hybrids Maize per Different Way of Detasseling

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Abstract

The experiments were conducted in field conditions, comprising two maize hybrids and two methods of detasseling, in the period 2014-2016 in a randomised block design. The seed yield was 3.64 t/ha, as average for all the hybrids and the methods of detasseling. “Suanito“ yielded 2.88 t/ha while “MAS 26K“ yielded 4.41 t/ha. The highest yield was obtained in 2015 (3.81 t/ha), then in 2014 (3.47 t/ha), while the lowest yield was obtained in 2016 (3.12 t/ha). Manual detasseling resulted in the seed yield of 3.94 t/ha, whereas a significantly lower yield was achieved with mechanised detasseling (3.34 t/ha). There was a highly significant interaction found between the year and the hybrid, the year and the method of detasseling and the hybrid and the method of detasseling, whereas there was a significant interaction between the year, the hybrid and the method of detasseling.

Keywords

maize, hybrid, grain yield, seed, detasseling

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Introduction

Given that global demands for maize increases each year, the science has to address that challenge. One of the ways to do so is to introduce into production the seeding material that would be more productive, i.e. that would lead to higher and stable yields of satisfactory quality. People are creating hybrids with numerous advantages over cultivars; the first of all is the possibility to obtain higher yields (JOCKOVIĆ & al. [6]).

A shift to hybrid maize breeding and production has enabled us to generate considerable profits and at the same time to achieve astonishing improvement in the field of breeding and seed production, thus making maize seed production become a high-tech industry (DOKIĆ & al. [2], PAVLOV & al. [13], SEČANSKI & al. [15]).

Hybrid maize seed production is also important from the aspect of profits for seed companies, and therefore the bar has been set high in terms of quality, yields and benefits for growing areas so that we could maintain and increase our competitiveness on the world market. The quality and profitability of maize seed production will be ensured by good production management. Seeds must meet high genetic, physical and phyto-sanitary standards (MAC ROBERT & al. [12]).

Detasseling, apart from soil preparations, sowing and removing atypical plants, is one of the key stages in the overall process of seed production, significantly affecting the end result. Unless detasseling is well and timely done, one will not get results they want, which is quality and genetically uniform hybrid maize seeds (KNEŽEVIĆ [8]).

Detasseling has become a common method in production of maize seed. Detasseling either conducted manually or with equipment, always raise a question how much the yields decrease when one or more leaves are removed with the tassel. The aim of the research was to determine which method of detasseling in production of maize hybrid seed ("MAS 26K" and "Suanito") is more effective, manual or with equipment, from the aspect of seed yield per unit area.

Materials and Methods

The field experiment comprised two maize hybrids, Suanito, the product of the German seed company Saaten Union and MAS 26K, the product of the French seed company Maisadour Semences. Both hybrids are early vegetation (Suanito FAO group 230, MAS 26K FAO group 300). The experiment was conducted on the field owned by "AD Poljoprivreda" from Senta, in 2014, 2015 and 2016 in a randomised block design with three repetitions and two variants of detasseling (manual and with equipment). The size of a

basic plot was 1,000 m² (100 x 10 m). The soil type was chernozem on a loess terrace of a mildly alkaline reaction, with 2.5 % humus in the plough layer, fairly equipped with easily accessible phosphorus and well equipped with potassium. The preceding crop in all three years was barley, and a standard maize cropping practice in the Republic of Serbia was used (MARINKOVIĆ & al. [11], LATKOVIĆ & al. [10]). The both hybrids were sown following the 4:3 seeding scheme. "Mother plants" were sown in four rows, with 70 cm spacing between the rows of and at 55 cm distance from "father plants". "Father" plants were sown in three rows, with 15 cm spacing between the rows (Figure 1). Sowing was done with machinery in the second half of April. The plants were sown in the depth of 5 cm. Detasseling was conducted in the period from late June to early July. The detasseling was done with a high clearance "Frema" machine, type "Aiglon" and manually. After detasseling, three control were done in which the rest of the tassels were manually removed. "Fathers" were removed in early August. The plants were harvested at the moment when the grains contained 35% moisture, at the end of August, after which the seed yield was determined.

The data were statistically analysed by using the analysis of variance, with MSTAT - C software, Michigan State University, Version 1. The year, hybrid and the method of detasseling were taken as factors in the analysis. The results are shown as a three-year average.

Results and Discussions

Based on the trifactorial variance analysis, very significant differences ($P \leq 1\%$) for the grain yield of seed corn seed were determined, depending on the tested hybrids, the method of detasseling and years. Very significant differences were established for interactions: year x hybrid, year x treatment, hybrid x treatment while significant ($P \leq 5\%$) differences were established for interaction years x hybrid x treatment (Table 1).

The seed yield per unit area in this three-year research amounted to 3.64 t/ha, regardless of the hybrids and the

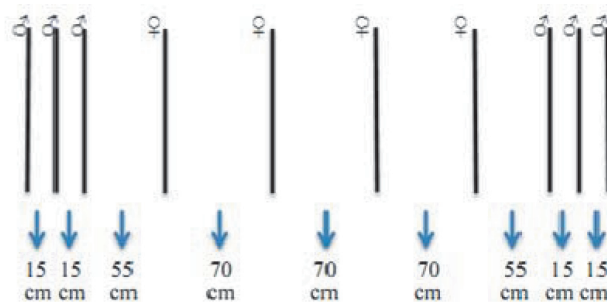


Figure 1. Seed production of maize

Table 1. Analysis of variance for grain yield of maize seed

Source	Df	Sum of Squares	Mean Squares	F	
				Value	Significance
Repetition	2	0.002	0.001	0.70	
Year (Y)	2	2.850	1.425	1330.46	**
Hybrid (H)	1	19.010	19.010	17750.06	**
YxH	2	0.134	0.067	62.33	**
Treatment(T)	1	2.970	2.970	2773.10	**
YxT	2	0.022	0.011	10.36	**
HxT	1	4.416	1.416	1322.27	**
YxHxT	2	0.008	0.004	3.94	*
Error	22	0.024	0.001		
Total	35				

method of detasseling. In the three-year average, when observed the hybrids and detasseling, the yield of “Suanito” was 2.88 t/ha and the yield of “MAS 26K” was 4.41 t/ha. This difference is highly significant (Tables 2, 1, Graphs 1 and 2).

Observed by year, it was shown that the highest seed yield was achieved in 2015 (3.81 t/ha), and then in 2014 (3.47 t/ha), while the lowest yield was achieved in 2016 (3.12 t/ha). The analysis showed a highly significant difference between the years, which often occurs in the agro-ecological conditions of the Republic of Serbia (Tables 1 and 2) (Graphs 1 and 2). The manual detasseling resulted in the

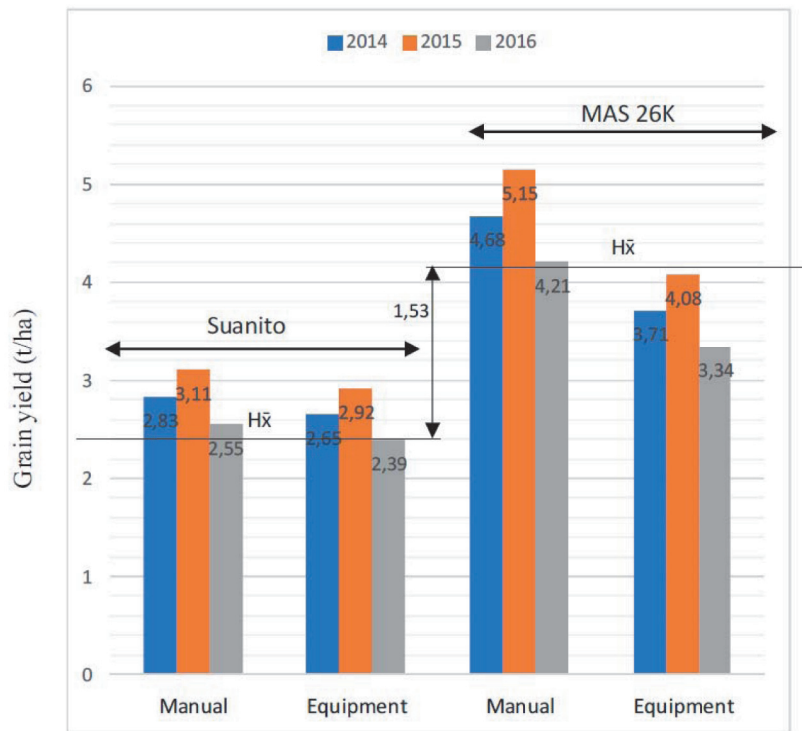
seed yield of 3.94 t/ha, while the detasseling with equipment had a significant lower yield of 3.34 t/ha (Tables 1 and 2) (Graphs 1 and 2).

A highly significant interaction was found between the years and the hybrids, between the year and the method of detasseling as well as between the hybrid and the method of detasseling, whereas there was a significant difference between the year, the hybrid and the method of detasselling (Table 1).

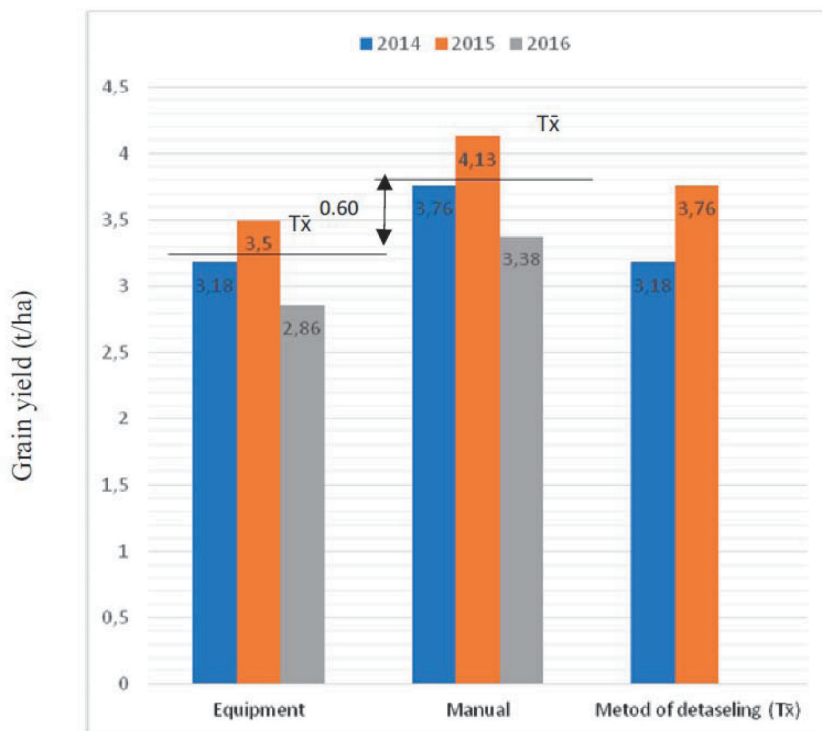
KRIZMANIĆ & al. [9] in their research point out that maize yields significantly vary depending on the method of detasseling but also on hybrids. The highest seed yield was

Table 2. Yield of seeds (t/ha) of different maize hybrids at different detasseling methods (2014-2016)

Years	Method of detasseling	Hybrid (H)					
		(T)	Suanito	MAS 26K			
YT \bar{X}							
Y \bar{X}							
(Y)		(T)	Suanito	MAS 26K			
2014	Manual		2.83	4.68	3.76		
	Equipment		2.65	3.71	3.18	3.47	
YH \bar{X}							
2015	Manual		3.11	5.15	4.13		
	Equipment		2.92	4.08	3.50	3.81	
YH \bar{X}							
2016	Manual		2.55	4.21	3.38		
	Equipment		2.39	3.34	2.86	3.12	
YH \bar{X}							
	Manual		2.47	3.78	T \bar{X}		
	Equipment		2.97	4.91	3.94		
TH \bar{X}							
	Equipment		2.78	3.90	3.34	3.64	
H \bar{X}							
			2.88	4.41			
Level of significance							
	H	Y	T	YH	HT	YT	YHT
LSD 0.05	0.082	0.027	0.040	0.038	0.031	0.038	0.053
0.01	0.095	0.036	0.048	0.051	0.042	0.051	0.073



Graph 1. Grain yield of seed maize by year, hybrid and method of detasseling



Graph 2. Interaction between the years (y) and the methods of detasseling (T)

obtained when detasseling was done manually, and a significantly lower yield when it was done mechanically.

Yield decreasing is directly related to decreasing of the leaf area and it is expressed as a decrease in absolute grain mass and the number of grains per row. When two leaves were removed with the tassel, yield decreased an average of 22–31%, while when plants were cut above the main ear, seed yield decreased an average of 31–66 % (GHEŢE & al. [3]). When it comes to the variants with the second leaf removed and certain maize lines, the yield was not significantly reduced, while in some others the yield was reduced at 5% significance level. By cutting off the leaves at the height of the first tassel the yield will decrease from 11% to 14%. The difference amounts to 7% when the first leaf is removed, 12% when the second leaf is removed, 16% for the third and 21% for the fourth leaf (ĆIROVIĆ & JOCIĆ [1]). Differences in a yield reduction grow with the increase in the number of removed leaves.

Removing the second, third and fourth leaf with the tassel decreases the average yield of seven inbred lines by 11.7, 21.8 and 27.9%, while the average decrease in four individual crossings was 7.1, 8.6 and 19.4% when compared to the decrease without leaf removal (PUCARIĆ & GOTLIN [14]).

A loss of a certain amount of the leaf area was coupled with detasseling, whether manual or mechanised. Studies done by KIESELBACH [7], HUNTER & al. [4], HUNTER & al. [5], PUCARIĆ & GOTLIN [14], GHEŢE & al. [3] shows that the removal of the tips had different effects, depending on the properties of the studied maize lines. Thus, the number of leaves removed has a varying influence on seed yield. Large differences in yield decrease caused by leaf removal were found among inbred lines and among individual crossbreds. These differences were mostly in the amount of decrease in leaf area per plant.

Conclusions

In three-year research, the maize seed yield of 3.64 t/ha per unit area was recorded, regardless on the tested hybrids and methods of detasseling. The researchers recorded the seed yield of 2.88 t/ha in “Suanito” and 4.41 t/ha in “MAS 26K”. The difference is highly significant.

The highest seed yield was recorded in 2015 (3.81 t/ha) and then in 2014 (3.47 t/ha) while the lowest yield was recorded in 2016 (3.12 t/ha). The analysis shows a highly significant difference among the years in which the experiment was conducted.

Manual detasseling resulted in the seed yield of 3.94 t/ha, and mechanised detasseling resulted in a significantly lower yield of 3.34 t/ha.

A highly significant interaction was found between the years and the hybrids, between the year and the method of detasseling as well as between the hybrid and the method of detasseling, whereas there was a significant difference between the year, the hybrid and the method of detasseling.

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