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TECHNOLOGICAL INNOVATION FOR A SUSTAINABLE TROPICAL AGRICULTURE

PROCEEDINGS

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PROCEEDINGS

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FERTILIZER USE EFFICIENCY BY MAIZE GENOTYPES UNDER HIGH OR MEDIUM TECHNOLOGICAL INVESTMENT

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Introduction

Brazilian agriculture has continuously evolved over the past decades, contributing for a significant portion of the country's exports. However, the maintenance of the achieved grain production is largely dependent on the importation of fertilizer required by crops. Thus, it is essential to seek strategies to maximize the efficient use of nutrients in agricultural systems.

The maize is characterized by high nutrient demand and presents genotypic differences for nutrient use efficiency. Plant breeding has generated cultivars with high productivity and responsiveness to the improvement of soil fertility. This has been one of the most important factors for increasing the use efficiency of fertilizers applied in modern agriculture. But interaction with the environment is expected to occur. Therefore, genotypes can express different patterns of nutritional efficiency when grown under varying conditions of nutrient availability and other factors that affect the productivity.

This study aimed to compare maize genotypes regarding their capability in utilization of N, P_2O_5 and K_2O applied under two levels of technological investment in fertilization and other agronomic management practices.

Methods

The experiment was carried out under supplementary irrigation in the 2112/2013 season, at Embrapa Maize and Sorghum, located in Sete Lagoas - MG, Brazil. The soil is classified as clayey Oxisol and had been cultivated with crop rotation under no-tillage in a soybean/maize/soybean sequence in 2009/2010, 2010/2011 and 2011/2012, respectively. Two environments with different levels of initial soil fertility were established prior to the study with maize genotypes (Table 1). Subsequently, these environments continued to be managed in order to characterize different conditions of technological investment, with high (HI) or medium (MI) inputs. Thus, the sowing and sidedress fertilization, foliar spraying of nutrients, as well as the seed treatment and the use of chemicals to control diseases were differentiated between environments. This provided contrasting yield potentials.

We evaluated the performance of ten maize cultivars, being five experimental single cross hybrids and a commercial hybrid from the Embrapa's breeding program, plus four commercial single cross transgenic hybrids from private companies (Table 2).

Fertilization at sowing was done with 260 and 500 kg ha^{-1} of 08-28-16 NPK in the environments of medium and high investment, respectively. The hybrids were sown spaced of 0.5 m between rows, in density equivalent to 75000 seeds ha^{-1}. Sidedress fertilization in the MI environment was done with 90 kg ha^{-1} of N, while the HI environment received a total of 200 kg ha^{-1} of N and 70 kg ha^{-1} of K_2O, splitted in three sidedress applications.

For each environment, the experimental design was a randomized complete block with four replications. Each plot consisted of eight rows six meters long. Three of the central rows were harvested, leaving a meter in ends as borders. The use efficiency of N, P_2O_5 and K_2O by the genotypes was calculated dividing grain yield by total amounts of the respective nutrients applied in each growing environment. Data were subjected to analysis of variance and the treatment means were compared by the Scott-Knott test at 5% probability using the SISVAR program (Ferreira, 2011).

Results and discussion

Grain yield ranged from 10632 to 15187 kg ha^{-1} according to the genotype and level of technological investment for maize production (Table 2). Although some statistical differences among genotypes, the most and least productive groups of hybrids were the same at both levels of investment. This also made the ranking of genotypes for nutrient use efficiency remain the same between the two contrasting environments.

As productivity gains were not proportional to the increase in the amounts of fertilizer applied in the environment of high technological input, the use efficiency of N, P_2O_5 or K_2O was significantly lower in that condition.

The fact that the most productive hybrids were the same, regardless of high or medium investment, demonstrates a great stability of the modern genotypes compared in this study. In this case, it can be stated that the choice of the most productive hybrids will lead to higher use efficiency of fertilizers. On the average of nutrients and investment levels, the hybrids 1I 873, 8088 AG and P 30F53 were about 20% more efficient than the least productive genotype. However, the increased grain yields achieved under higher levels of technological investment normally involve some reduction in plant efficiency for using the nutrients supplied by fertilization. The challenge is to identify the level of technological input that harmonizes the response of genotypes to fertilization with an efficient use of fertilizers and a greater profitability of grain yield, in order to better position the cultivars delivered to farmers.

Conclusions

Differences around 20% in fertilizer use efficiency were found among genotypes.

The more productive and efficient genotypes were the same in both environments with medium or high technological investment for maize crop.

Keywords: Nutrient use efficiency, high yield corn, corn breeding.

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References

FERREIRA, D.F. Sisvar: a computer statistical analysis system. **Ciência e Agrotecnologia**, v.35, n.6, p.1039-1042, 2011.

Table 1. Soil fertility conditions at the 0-20 cm and 20-40 cm depth layers in the high and medium technological environments before establishing the experiment in 2012/2013

Soil attribute	Technological Input			
	High	**Medium**	**High**	**Medium**
	0-20 cm depth		20-40 cm depth	
Organic matter (dag kg^{-1})	4,7	4,6	3,8	3,8
pH_{water}	6,6	6,6	6,0	6,2
$P_{Mehlich\ 1}$ (mg dm^{-3})	21	17	8	6
K “	147	109	80	71
H+Al ($cmol_c$ cm^{-3})	2,2	2,7	3,2	3,4
Ca “	5,6	5,3	4,0	4,1
Mg “	1,4	1,2	0,8	0,8
CEC “	9,5	9,5	8,2	8,5
Base saturation (%)	77	71	61	60
Cu (mg dm^{-3})	0,9	0,8	0,9	0,9
Fe “	29	28	29	31
Mn “	59	56	37	43
Zn “	8,4	5,4	3,7	3,3

Table 2. Grain yield (kg ha^{-1}) and use efficiency (kg kg^{-1}) of applied N, P_2O_5 and K_2O by maize genotypes under high (HI) or medium (MI) technological input.

Genotype	Grain yield		N		P_2O_5		K_2O		Relative nutrient use efficiency by genotypes (%)*
	HI	MI	HI	MI	HI	MI	HI	MI	
1I 862	14100 b	12310 a	59 a	111 a	101 a	169 a	94 a	293 a	114
1I 873	15078 a	12720 a	63 a	115 a	108 a	174 a	101 a	303 a	120
1I 923	13575 b	11253 b	57 a	101 b	97 a	154 b	90 a	268 b	107
1I 931	13823 b	11766 a	58 a	106 a	99 a	161 a	92 a	280 a	110
1I 953	13160 b	11096 b	55 a	100 b	94 a	152 b	88 a	264 b	104
BRS 1055	12777 b	10632 b	53 a	96 b	91 a	146 b	85 a	253 b	100
AG 8088 YH	15125 a	12868 a	63 a	116 a	108 a	176 a	101 a	306 a	120
DKB 390 Pro	13603 b	12089 a	57 a	109 a	97 a	166 a	91 a	288 a	111
P 3646 H	13826 b	12241 a	58 a	110 a	99 a	168 a	92 a	291 a	112
P 30F53 YH	15187 a	12695 a	63 a	114 a	108 a	174 a	101 a	302 a	119
Average	14025 A	11967 B	58 B	108 A	100 B	164 A	94 B	285 A	
CV (%)	6.5		7.8		7.6		8.8		

*Considering the less efficient genotype as 100% on average of the three nutrients.