Nitrogenous Fertilizers and Planting Densities to Corn Variety Isanão-VF1 at winter

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RESUMO – O objetivo da pesquisa foi verificar o efeito de fertilizantes nitrogenados e densidades de semeadura nas características agronômicas da variedade de milho Isanão-VF1. O delineamento experimental foi em blocos casualizados no esquema fatorial 2x4 com quatro repetições. Os tratamentos originaram-se da combinação entre dois fertilizantes nitrogenados (uréia e sulfato de amônio) com quatro densidades de semeadura (55.000, 70.000, 85.000 e 100.000 plantas ha^{-1}). O nitrogênio foi aplicado de forma parcelada em cobertura na dose de 160 kg ha^{-1} sendo metade da dose em V_4 e o restante em V_6, juntamente com a primeira adubação nitrogenada aplicou-se 70 kg ha^{-1} de K_2O utilizando como fonte o cloreto de potássio. No presente trabalho foram realizadas as seguintes avaliações: diâmetro de espiga, comprimento de espiga, número de fileiras e de grãos por fileira, número de grãos na espiga, massa de 1.000 grãos e produtividade. O sulfato de amônio reduziu a massa de mil grãos na população de 55000 plantas ha^{-1}. O aumento da população de plantas até proporcionou crescimento da produtividade de grãos utilizando sulfato de amônio em cobertura.

Palavras-chave: *Zea mays* L., população, adubação.

Introduction

Corn is one the most important cereal around the world. It's use have great importance in pharmaceutics, biofuel and food, so animal as human. Conab (2012) reported in Brazil this crop have a increase of planted area in first and second season. However, grain yield, growth relation to before crop at first season but the same didn't happen at second season.

Among cultural practices that looked increase corn yield, the choice of row spacing and plants densities have great importance because determinate take of environmental to express grains yield potential. Planting densities demand care because several interactions between maize plants and environment that influence plant canopy, architecture changing the standard of growth and development and carbohydrate production (SANGOI et al., 2005).

Suboptimal populations increase the period to cover space between rows and decrease solar interception because low morphologic and phonologic available to adjust leaf area index (SILVA et al., 2006). There are many researches of corn response to plants population and results has been showed different among hybrids. Sangoi et al. (2010) reported that grains yield changes from 10.750 to 13.740 kg ha^{-1} and increase in square mathematic model with increase of plantig density. Dourado Neto et al. (2003) looked that increase of population from 60.000 to 90.000 plants ha^{-1} had a different tendence because of leaf architecture.

The hybrid, rainfall and soil fertility have great influence to corn yield. Among nutrients, nitrogen is that most demanded by corn and Gross et al. (2006) mentioned the nitrogen is one of nutrients that have more expressive effects to increase grains yield of corn. According them, constituted proteins, enzymes, co-enzymes, nucleic acids and cytocroms and is one of component of chlorophyll molecule. To increase of nitrogen fertilization it's important combine a adequate nitrogen fertilizer and planting density looking for decrease loss of this nutrient. The urea, ammonium sulfate and ammonium nitrate are one of fertilizers used to corn fertilization. Cantarella (2007) said that study of nitrogen fertilizers had a great importance to corn because of loss of nitrogen because it behavior when applied on the soil. Urea can provide little efficiency because loses of amoniacal nitrogen, but ammonium sulfate have great efficiency relation to little loses o that nitrogen form.

This research looking for nitrogenous fertilizers and planting densities effect at agronomical characters of corn variety Isanão-VF1.

Material and Methods

This research was carried out at field in experimental area of Universidade Estadual Paulista "Júlio de Mesquita Filho" in Selvíria, Mato Grosso do Sul State. Geographical coordinates were 51º 22'West and 20º 22' South with elevation of 335 m above sea level. Soil type is a Clayed Eutrophic Red-Oxisol (EMBRAPA, 2006). The average of annual temperature is 23.5ºC, with rainfall of 1.370mm and air humidity ranges from 70 to 80% (HERNANDEZ et al., 1995).

Therebefore plantig, soil was tillage by harrow plow and leveling harrow. Corn variety Isanão-VF1 was planted at 16th July. Planting fertilization was used 450 kg ha-1 of 04-30-10 + 0,3% de Zn. Seeds were coated with 45 g of carbendazim + 150 g of thiram in each 100 kg. Weeds control was used 1.500 g of atrazine ha^{-1} at 2nd expanded leaf, 60 g of nicosulfuron ha^{-1} at 4th and 100,8 g of tembotrione ha^{-1} at 6th. Plagues control were sprayed 129 g of metomil + 24 g of triflumuron ha^{-1}.

Experimental design was in randomized blocks in factorial scheme with four replications. Treatments were two nitrogen fertilizers (urea and ammonium sulfate) and four planting densities (55.000, 70.000, 85.000 and 100.000 plants ha^{-1}). Nitrogen was sidedressed two times at rate 160 kg ha^{-1}, a half at 4^{th} expanded leaf and the other at 6^{th}. Potassium was sidedressed with first nitrogen fertilization and rate used was 70 kg ha^{-1} of K_2O using as K source the potassium chloride. Plots had four plants lines with 0.45 row spacing.

Follow evaluations were made at two center lines of each plot: cobs m^{-2} – were counted the number of cobs in each plot and results were converted to square meter; ear diameter – with a caliper were made reading at center of five cobs chosen randomized in each plot; cob length – was measured cob length from plots with results expressed in cm; rows in cob and grains in row – was gotten by count of number of rows in cob and grains in row; grains in cob – were multiplied the number of rows in com and grains in row; weight of one thousand grains – were chosen two subsamples of one thousand grains and data were adjusted to 13% moisture; grain yield – after harvest of plots, grains were separated from cobs and weighted with moisture correct to 13%.

Statistic evaluations of results were made by Tukey test at 1 and 5% of probably. Regressions were fit when looked significative effect of planting densities or interaction between planting densities and nitrogenous fertilizers and was chosen mathematic model that showed biggest R^2 value.

Results and Discussion

The averages of cobs number in square meter, cob diameter, cob lenght and rows in cob to corn as function nitrogenous fertilizers and planting densities at winter are presented in Table 1.

In relation cobs number in square meter was looked that treatments were not significant and even as interaction among them. Unfold of significative interaction referred variance analysis of cob diameter to corn as function nitrogenous fertilizers and planting densities is in Table 2. Comparing nitrogenous fertilizers inside planting densities looked that urea was superior to ammonium sulfate at 55.000 plants ha^{-1} and planting densities inside nitrogenous fertilizers wasn't gotten a mathematic model that represented cobs diameter as function planting densities.

Cob diameter have not effect of nitrogenous fertilizers, planting densities and interaction nitrogenous fertilizers x planting densities wasn't significative.

The cobs length didn't presented signifcative effect of treatments used and the interaction among them hadn't significance.

Number of rows in cob have not effect of treatments and interaction among them wasn't significative. Casagrande e Fornasieri Filho (2002) didn't look nitrogen rates effect (0, 30, 60 e 90 kg ha^{-1} de N), using urea as nitrogenous fertilizer. Kappes (2010) reported a interaction between hybrids and planting densities to rows in cob. According him, a bigger number of rows in con was gotten at 55.000 plants ha^{-1} with hybrids AG9010 and XB6012.

The grains in row didn't presented signifcative effect of treatments used and the interaction among them hadn't significance.

In relation to grains in cob have not effect of treatments and interaction among them wasn't significative. Penariol et al. (2003) reported that smallest values were gotten with increase of planting density to hybrid AG9020. This can be relationed to intra-specific competition in row planting that increase resources as fertilizers, light and water per plant decreasing grains in cob. For nitrogen, Souza et al. (2011) studying corn hybrid AG5020 didn't find difference among nitrogenous fertilizers (urea, ammonium sulfate and ammonium sulfonitrate) to this evaluation.

Weight of one thousand grains have showed significative effect of nitrogenous fertilizers, planting densities and interaction among them was significative too. Unfold of significative interaction referred variance analysis of one thousand weight to corn as function nitrogenous fertilizers and planting densities at winter are presented in Table 4. Comparing nitrogenous fertilizers inside planting densities was looked that ammonium sulfate was superior to urea at 100.000 plants ha^{-1} and planting densities inside nitrogenous fertilizers was looked that at both fertilizer didn't show mathematic adjust as function planting densities. Santos et al. (2011) looked the biggest grains weight was gotten using calcium nitrate at 4^{th} expanded leaf. Souza et al. (2011) didn't find difference to weight of grains using ammonium sulfate, urea and ammonium sulfonitrate.

Grains yield presented significative effect of planting density and nitrogenous fertilizers an interaction among them was significative too. Unfold of significative interaction referred to variance analysis of grains yield to corn as function nitrogenous fertilizers and planting densities at winter are in Table 5. Comparing nitrogenous fertilizers inside planting densities was looked that urea was superior to ammonium sulfate at 55.000 and 70.000 plants ha^{-1} and planting densities inside nitrogenous fertilizers was looked that grains yield increase in a linear tendence. Sangoi et al. (2007) looked that hybrids AG303 and Speed had a

quadratic model as function of planting density and for the second the best plants population was 107.416 plants ha^{-1} to Speed and 81.016 plants ha^{-1} to AG303.

Conclusion

Ammonium sulfate increase one thousand weight at 55000 plants ha^{-1} planting density.

The increase of plant population provided grains yield growth using ammonium sulfate at sidedressing.

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Tables

Table 1. Averages of cobs number in square meter (CSM), cob diameter (CD), cob lenght (CL) and rows in cob (RIC) to corn as function nitrogenous fertilizers and planting densities at winter. Selvíria, MS, 2011.

Treatments		CSM	CD (mm)	CL (cm)	RIC
Nitrogenous fertilizer	Urea	7.35	43.33	16.40	14.12
	Ammonium sulfate	6.87	42.71	16.26	14.05
Planting density (plants.ha^{-1})	55.000	6.95	43.28	15.57	13.95
	70.000	6.60	43.33	16.62	14.51
	85.000	8.30	42.39	16.07	14.05
	100.000	6.61	43.06	17.06	13.85
F Test	NF	0.58^{ns}	1.66^{ns}	0.14^{ns}	0.05^{ns}
	PD	1.64^{ns}	0.86^{ns}	2.84^{ns}	1.03^{ns}
	NF x PD	0.87^{ns}	3.06*	3.00^{ns}	0.25^{ns}
VC (%)		25.00	3.12	6.65	5.79

^{ns} – not significative. * and ** significative at 5 and 1% by Tukey test.

Tabela 2. Unfold of significative interaction referred variance analysis of cob diameter to corn as function nitrogenous fertilizers and planting densities at winter. Selvíria, MS, 2011.

Treatments (plants.ha^{-1})	Urea	Ammonium sulfate	F test
55.000	44.73a	41.83b	9.39**
70.000	43.73a	42.98a	0.61^{ns}
85.000	42.13a	42.65a	0.29^{ns}
100.000	42.71a	43.41a	0.53^{ns}
-	2.92^{ns}	0.99^{ns}	-

^{ns} – not significative. * and ** significative at 5 and 1% by Tukey test. For comparison of nitrogenous fertilizers inside populations considered letters in the horizontal sense.

Table 3. Averages of grains in row (GIR), grains in cob (GIC), grains one thousand weight (OTW) and grains yield to corn as function nitrogenous fertilizers and planting densities at winter. Selvíria, MS, 2011.

Treatments		GIR	GIC	OTW (g)	Yield (kg ha^{-1})
Nitrogenous fertilizer	Urea	33.48	473.15	161.85b	8.723,32a
	Ammonium sulfate	32.92	463.84	162.31a	7.620,50b

Planting density (plants.ha^{-1})	55.000	32.68	456.61	158.94	7.006,26
	70.000	34.24	498.10	182.67	8.567,53
	85.000	32.83	461.65	155.43	8.110,85
	100.000	33.04	457.63	121.27	9.002,99
F Test	NF	0.92^{ns}	0.37^{ns}	8.12**	9.54**
	PD	1.45^{ns}	1.70^{ns}	11.44**	5.78**
	NF x PD	0.05^{ns}	0.19^{ns}	7.14**	3.10*
VC (%)		4.99	9.17	6.21	12.35

^{ns} – not significative. * and ** significative at 5 and 1% by Tukey test.

Table 4. Unfold of significative interaction referred variance analysis of one thousand weight to corn as function nitrogenous fertilizers and planting densities at winter. Selvíria, MS, 2011.

Treatments (plants.ha^{-1})	Urea	Ammonium sulfate	F test
55.000	163.17a	154.71a	1.32^{ns}
70.000	177.58a	187.76a	1.94^{ns}
85.000	154.15a	156.71a	0.12^{ns}
100.000	152.50b	190,05a	26.17**
-	1,27^{ns}	0,68^{ns}	-

^{ns} – not significative. * and ** significative at 5 and 1% by Tukey test. For comparison of nitrogenous fertilizers inside populations considered letters in the horizontal sense.

Table 5. Unfold of significative interaction referred to variance analysis of grains yield to corn as function nitrogenous fertilizers and planting densities at winter. Selvíria, MS, 2011.

Treatments (plants.ha^{-1})	Urea	Ammonium sulfate	F test
55.000	8.284.31a	5.728.21b	12.81**
70.000	9.438.45a	7.696.62b	5.95*
85.000	8.206.46a	8.015.25a	0.07^{ns}
100.000	8.964.05a	9.041.94a	0.01^{ns}
-	1.34^{ns}	7.53**	-

^{ns} – not significative. * and ** significative at 5 and 1% by Tukey test. For comparison of nitrogenous fertilizers inside populations considered letters in the horizontal sense. Y = 0,07x+2319,59; R^2=0.91.

(Nas duas menores densidades de plantio avaliadas.a uréia promoveu maior produtividade de grãos do que o sulfato de amônio)