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MINERAL COMPOSITION OF CORN LEAVES CULTIVATED IN INTERCROPPING WITH FORAGE SPECIES

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ABSTRACT
The study objective was to evaluate the corn nutrition through macronutrients levels in leaves of corn intercropped with forage species. The trial was conducted in second crop season in 2020, in Rio Verde city, GO, Brazil. The treatments were: corn (single), corn intercropped with *Urochloa ruziziensis* (*Syn. Brachiaria ruziziensis*), corn intercropped with *Megathyrsus maximum* (*Syn. Panicum maximum*) cv. BRS Tamani, corn intercropped with *M. maximum* cv. BRS Quênia and corn intercropped with *M. maximum* cv. BRS Zuri. The experimental design was in randomized blocks with four repetitions. For analysis of macronutrients content, it was collected five leaves of corn in flowering stage. The data was submitted to analysis of variance and compared by Tukey test at 5% of probability using SISVAR software. There was no difference in N, P, K, Ca, Mg and S content in corn leaves between intercropping systems. It indicates no interspecific competition for nutrients between corn and forage species intercropped. The forage species intercropping did not affect the macronutrients absorption of corn.
Key words: crop-livestock integrated system; nutrients; fertilization

INTRODUCTION

Under Brazilian tropical conditions, the corn intercropping with perennial *Urochloa* grasses is an option to cash crop production coupled with a cover crop establishment (PARIZ et al., 2016; ALMEIDA et al., 2017). The introduction of forage species in production systems may proportionate high biomass production, nutrient recycling efficiency, and improving of soil physical conditions due the aggressive root system, which can reach up to two meters deep (CRUSCIOL et al., 2012).

Nitrogen (N) is one of the main nutrients related to corn yield, as it is part of proteins and affects directly the photosynthetic process (ANDRADE et al., 2003). According to ARNON (1975), corn demand for N increase according to growth, reaching the maximum at the flowering stage and begining of grain formation. Potassium (K) is the second most demanded nutrient by corn, and had several peaks of absorption during crop cycle, reach up mean absorption higher than N at initial phases of corn (BORGES, 2006). Phosphorus (P) absorption occurs during all corn growth cycle, with the peak at reproductive phase, close to 80 days after sowing (ANDRADE et al., 1975; BÜLL, 1993). Calcium (Ca), Magnessium (Mg) and Sulfur (S) are extracted in small amounts by corn plants. There is a high demand for Ca at flowering and physiological maturity and for Mg at the end of corn cycle (VON PINHO et al., 2009).

Some authors (PORTES et al., 2000; JAKELAITIS et al., 2005) stated that viability of corn-palisadegrass intercropping is related to different initial growth rate and by different nutritional

demand peaks. It becomes possible to meet the demands of two species without exceed the maximum nutrient rate that environment could supply. Therefore, the present study aimed to evaluate the macronutrients levels in leaves of corn intercropped with grass species.

MATERIAL AND METHODS

The trial was conducted during the agricultural year of 2020 in Rio Verde city, Goiás State (17º 47' 53" latitude and 50º 55' 41" longitude, 715 m of height), in experimental field of GAPES (Grupo Associado de Pesquisa do Sudoeste Goiano). The experimental field was cultivated with soybean and corn was sown in second crop. Corn was cultivated in monoculture and intercropped with (treatments): *Urochloa ruziziensis* (*Syn. Brachiaria ruziziensis*), *Megathyrsus maximum* (*Syn. Panicum maximum*) cv. BRS Tamani, *M. maximum* cv. BRS Quênia and *M. maximum* cv. BRS Zuri.

The experimental design was in randomized blocks with four repetitions and each experimental unit had 60 m^2. Corn (Pionner hybrid 3898) was sown with seed drill at 0.5 m spaced rows at 60,000 seeds per hectare. Sowing was realized in February 25th of 2020 with the forage species spread superficially at seeding rate of four quilograms of pure viable seeds per hectare. It was realized cover fertilization with nitrogen (N) at 28 days after the crop seeding at rate of 90 kg ha^{-1} of N using cover urea (SuperN®) as N source.

In order to evaluate the nutritional analysis of the corn, it was collected five leaves of corn at flowering stages at central points of the plot. The collected leaves were the leave immediately below and opposite to the corn ear. After sampling, the midrib, tip and ends were removed, using the central part of the leaf to further analyses. The samples were place ta forced air oven (55 °C) during 72 hours. Then, macronutrients composition (N, P, K, Ca, Mg and S) were measured (MALAVOLTA et al., 1997).

The data obtained were submitted to analysis of variance (ANOVA) and means were compared by Tukey test at 5% of probability, using the software SISVAR (FERREIRA, 2008).

RESULTS AND DISCUSSIONS

There was no difference in mineral composition (N, P, K, Ca, Mg and S) between the treatments. The intercropping systems did not affect the macronutrient absorption (Table 1).

Management mistakes of the corn-grasses intercropping can led to interspecific competition between the plants. Situations that promote higher light availability to the grass favors the forage growth, which led to higher nutrient absorption by the grass specie and may decrease the corn yield. Corn intercropped with *U. ruziziensis* can affect the nutritional status of the corn, and, consequently, corn yield (JAKELAITIS et al., 2005). According to Silva et al. (2007), the intensity of the competition varies according to soil and climatic conditions, cultivars and management. In the conditions of this study, corn grow without limitations and was able to dusk the grass, preventing any competition by nutrients, similar to observed by Borghi & Crusciol (2007).

There was no competition by nitrogen, even though both species have a high N demand when cultivated in monoculture. Almeida et al. (2018) observed that palisadegrass shaded by corn intercropping, in well managed intercropped system, absorbed up to 1.4% of N-fertilizer applied on the system, without impairing the amount of N absorbed by corn.

Table 1. Corn leaf chemical composition N (nitrogen), P (phosphorus), K (potassium), Ca (calcium), Mg (magnessium) e S (sulfur) at flowering stages in different intercropping systems.

Treatment	N	P	K	Ca	Mg	S
			g kg^{-1}			
Corn[1]	31.11 a	2.96 a	38.69 a	2.75 a	0.86 a	1.60 a
Corn + *U. ruziziensis*[2]	30.27 a	2.73 a	36.26 a	3.39 a	1.15 a	1.59 a
Corn + *M.* cv. BRS Tamani[3]	26.04 a	2.76 a	39.81 a	3.02 a	1.00 a	1.66 a
Corn + *M.* cv. BRS Quênia[4]	27.33 a	2.47 a	32.58 a	2.54 a	0.92 a	1.78 a
Corn + *M.* cv. BRS Zuri[5]	33.42 a	2.46 a	32.02 a	2.37 a	0.84 a	1.64 a
MSD*	8.98	1.19	17.72	1.63	0.40	0.26
CV**	13.44	19.81	21.91	25.68	18.71	6.85

a: there was no difference between means in the same column by Tukey test at 5% of probability. *MSD: minimal significant difference. **CV: coefficient of variation.
[1]Corn in monoculture; [2]Corn + *U. ruziziensis* – Corn intercropped with *U. ruziziensis*; [3]Corn + *M.* cv. BRS Tamani - Corn intercropped with *M. maximum* cv. BRS Tamani; [4]Corn + *M.* cv. BRS Quênia - Corn intercropped with *M. maximum* cv. BRS Quênia; [5]Corn + *M.* cv. BRS Zuri - Corn intercropped with *M. maximum* cv. BRS Zuri.

CONCLUSIONS

The grass species intercropped with corn did not impair the macronutrients absorption by corn, demonstrating there was no competition between intercropped crops. The forage species evaluated in this study are able to grow in intercropping system without negatively impact the corn crop.

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REFERENCES

ALMEIDA, R. E. M. de; FAVARIN, J. L.; OTTO, R.; PIEROZAN JUNIOR, C.; OLIVEIRA, S. M. de; TEZOTTO, T.; LAGO, B. C. Effects of nitrogen fertilization on yield components in a corn-palisadegrass intercropping system. **Australian Journal of Crop Science**, v. 11, n. 3, p. 352-360, 2017.

ALMEIDA. R. E. M. de, FAVARIN, J. L.; OTTO, R.; FRANCO, H.; REIS, A. F. B.; MOREIRA, L. A.; TRIVELIN, P. C. O. Nitrogen recovery efficiency for corn intercropped with palisade grass. **Bragantia**, v. 77, n.4, p. 557-566, 2018.

ANDRADE, A. G. et al. Acumulação diferencial de nutrientes por cinco cultivares de milho (Zea mays L.): I-acumulação de macronutrientes. **Anais da Escola Superior de Agricultura Luiz de Queiroz**, v.32, p.115-149, 1975.

ANDRADE, A. C. et al. Adubação nitrogenada e potássica em capim-elefante (*Pennisetum purpureum* Schum. cv. Napier). **Ciência e Agrotecnologia**, p.1643- 1651, 2003.

ARNON, I. **Mineral nutrition of mayze**. Bern: International Potash Institute, 1975. 452 p.

BORGES, I. D. **Marcha de absorção de nutrientes e acúmulo de matéria seca em cultivares de milho**. 2006. 115p. Tese (Doutorado), Universidade Federal de Lavras. Lavras, MG, 2006.

BORGHI, E.; CRUSCIOL, C.A.C. Produtividade de milho, espaçamento e modalidade de consorciação com Brachiaria brizantha em sistema plantio direto. **Pesquisa Agropecuária Brasileira**, v.42, n.2, p.163-171, 2007. DOI: 10.1590/S0100-204X2007000200004.

BÜLL, L. T. Nutrição mineral do milho. In: BÜLL, L. T., CANTARELLA, H. **Cultura do milho**: fatores que afetam a produtividade. Piracicaba. 1993. p.63-145.

COBUCCI, T.; WRUCK, F. J.; KLUTHCOUSKI, J; CAVALCANTE, L. M.; MARTHA JUNIOR, G. B.; CARNEVALLI, R.A.; TEIXEIRA, S. R.; POLINARIA, A.; TEIXEIRA, M. Opções de integração lavoura pecuária e alguns de seus aspectos econômicos. **Informe Agropecuário**, v.28, p.64-79, 2007.

CRUSCIOL, C. A. C.; MATEUS, G. P.; NASCENTE, A. S.; MARTINS, P. O.; BORGHI, E.; PARIZ, C. M. An innovative crop-forage intercrop system: early cycle soybean cultivars and palisadegrass. **Agronomy Journal**, v. 104, p. 1085-1095, 2012.

FERREIRA, D. F. SISVAR: um programa para análise e ensino de estatística. **Revista Symposium**, v. 6, p. 36-41, 2008.

FREITAS, M. A. M. **Impacto do consórcio milho-braquiária no crescimento, características nutricionais e fisiológicas do milho e na atividade da microbiota do solo**. 2013. 49f. Tese (Doutorado em Fitotecnia) - Curso de Pós-graduação em Fitotecnia, Universidade Federal de Viçosa, MG. 2013.

JAKELAITIS, A. et al. Efeitos do nitrogênio sobre o milho cultivado em consórcio com *Brachiaria* brizantha. **Acta Scientiarum. Agronomy**, v.27, n.1, p.39-46, 2005.

MALAVOLTA, E; VITTI, G. C.; OLIVEIRA, S. A. **Avaliação do estado nutricional das plantas**: princípios e aplicações. 2.ed. Piracicaba: POTAFOS, 1997. 319p.

NASCIMENTO, F. M. et al. Diagnose foliar em plantas de milho em sistema de semeadura direta em função de doses e épocas de aplicação de nitrogênio. **Revista Brasileira de Tecnologia Aplicada nas Ciências Agrárias**, v.5, n.1, p.67-86, 2012. DOI: 10.5777/PAeT.V5.N1.04.

PARIZ, C. M.; COSTA, C.; CRUSCIOL, C. A. C.; MEIRELLES, P. R. L.; CASTILHOS, A. M.; ANDREOTTI, M.; COSTA, N. R.; MARTELLO, J. M.; SOUZA, D. M.; SARTO, J. R. W.; FRANZLUEBBERS, A. J. Production and soil responses to intercropping of forage grasses with corn and soybean silage. **Agronomy Journal**, v. 108, n. 6, p. 2541-2553, 2016.

PORTES, T. A. et al. Análise do crescimento de uma cultivar de braquiária em cultivo solteiro e consorciado com cereais. **Pesquisa Agropecuária Brasileira**, v.35, n.7, p.1349-1358, 2000. DOI: 10.1590/S0100- 204X2000000700009.

SILVA, A. A. et al. Herbicidas: classificação e mecanismo de ação. In: SILVA, A.A.; SILVA, J.F. (Eds.). **Tópicos em manejo de plantas daninhas**. Viçosa, MG: Universidade Federal de Viçosa, 2007. p.83-148.

VON PINHO, R. G. et al. Marcha de absorção de macronutrientes e acúmulo de matéria seca em milho. **Revista Brasileira de Milho e Sorgo**, v.8, n.2, 2009.