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EVALUATION OF DIFFERENT SOURCES OF NITROGEN IN COVERAGE IN CORN SECOND CROP

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ABSTRACT

The cultivation of off-season corn in Brazil is expressive, mainly because the cultivation of soybeans in the first crop has been traditionalized and conditioning rotation with corn in the second crop. Nitrogen (N) is one of the most required and important nutrients for good maize crop development. Nitrogen fertilization is, without a doubt, one of the fundamental management operations for success and yields. This work was carried out aiming to evaluate the effect of different N sources in the off-season corn crop. The experiment was carried out on a farm in the city of Paraguaçu, Minas Gerais, in the off-season of the agricultural year 2020/2021. The treatments constituted different sources of N, being they: the control (without addition of N). T2 930g Polyblen 30-00-11 (0.279 kg/N), T3 607g 46% N urea (0.280 kg/N), T41.330g 21% N ammonium sulfate (0.279 kg/N), T5 850g of ammonium nitrate 33% N (0.280 kg/N, and T61.400g of polyblen 20-00-11 (0.279 kg/N). The experimental delineation was in randomized blocks with six treatments and four replications. corn was harvested manually as soon as it reached the maturation stage, then dry mass and green mass of the aerial part were evaluated. control without any addition of N provided the best results, it is noteworthy that during the period of execution of the research, the climatic conditions in the region were quite adverse, with irregular rainfall and high temperatures;

Keywords: Safrinha, Grains, Nitrogen, Fertilization.

1. INTRODUCTION

Corn (*Zea mays* L.) is among the main cereals produced in Brazil and in the world, with a prominent position from a social and economic point of view.

The corn crop needs favorable climatic conditions to reach its maximum production, in addition to an adequate balance of soil nutrients. Among the main nutrients required by the plant, nitrogen (N) is extremely important for its good development and production excellence, and is greatly influenced by environmental conditions and management practices.

In fertilizer supply, the N element in the crop does not fully absorb the applied N, a situation attributed to the various loss processes that occur in the soil-plant-atmosphere system, such as leaching, volatilization and denitrification.

The efficiency of these fertilizers in reducing N losses, as well as their agronomic efficiency and their impact on corn grain yield, is highly dependent on soil and climate conditions and management practices.

Specifically in the off-season, we emphasize that one of the most limiting aspects to the productivity of the corn crop is the water deficit, which can occur in up to half of the lost productivity.

A ureia é a fonte de fertilizante a base de N mais utilizada na agricultura, porém, principalmente por ser uma fonte concentrada, porém sujeita a perdas por a volatilização na forma de amônia.

Broadly, an attenuated knowledge about the sources and release of N provided by nitrogen fertilizers allows for a reduction in applied doses and greater efficiency in the use of the nutrient, minimizing environmental impacts, reducing losses due to leaching and volatilization, and increasing productivity , since the plant will have the element available to the extent of its need. The use of N sources that allow the best use has been the subject of numerous researches, aiming at improving productivity and minimizing environmental impacts

For this purpose, this work aimed to evaluate the effect of different nitrogen sources applied to corn second crop coverage.

2. MATERIALS AND METHODS

The research was carried out from February to June 2021 at Sitio Rabicho, located in the city of Paraguaçu, in the south of the State of Minas Gerais. Located at 810 meters of altitude, with

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latitude: 21° 33' 22" South, and longitude: 45° 44' 22" West. It has a warm and temperate climate and in winter there is much less rainfall than in summer. According to Köppen and Geiger, the climate classification is Cwa, that is, climate with summer rain and hot summer (EXPOSTI, 2013). The average annual temperature in the municipality is 20.5 °C, and average annual rainfall is 1461 mm (CLIMATE, 2021).

Being the month with the driest characteristic, July, which presents an average of 25 mm of precipitation. According to data from Clima Tempo, most of the precipitation occurs in the month of December, with an average of 270 mm (CLIMATE, 2021).

January is the hottest month of the year, with an average temperature of 23.3 °C, while the average temperature in June is 16.6 °C, being the lowest average of the year (table 1). (CLIMATE, 2021).

Table 1: Average, minimum and maximum temperature in the municipality of Paraguaçu/MG in 2020 [2]

	Janeiro	Fevereiro	Março	Abril	Maio	Junho	Julho	Agosto	Setembro	Outubro	Novembro	Dezembro
Temperatura média (°C)	23.3	23.2	21.7	20.3	17.5	16.6	17.3	19.2	20.7	21.8	22.3	21.8
Temperatura mínima (°C)	17.6	17.4	15.6	14.1	10.3	9	9.5	11.4	13.8	15.6	16.7	15.9
Temperatura máxima (°C)	29.1	29	27.9	26.5	24.8	24.3	25.2	27	27.7	28.1	28	27.7
Chuva (mm)	255	199	164	69	47	29	25	26	67	132	178	270

The soil in the experiment area has a dark red color and is classified as clayey with 35% clay, being a red-yellow oxisol. The soil analysis carried out to implement the research showed the following chemical characteristics in the 0-0.20 m layer: pH (H2O): 5.89; Al+3, Ca+2 and Mg+2 2.81 and 0.96 cmol dm-3, respectively; P(Mehlich-1) and K+ (Mehlich-1): 11.0 and 70.0 mg dm-3, respectively; organic matter (Walkley Black): 1.87 dag kg-1; CTC (pH 7.0) (T): 6.89 cmol dm-3; V: 58.9%. The experimental area had a history of 4 years of cultivation of maize on maize, before the installation of the experiment the soil preparation was carried out in a conventional way through a heavy harrow and a light harrow. The fertilization was carried out based on the parameters of the 5th approximation, being calculated according to the characteristics presented by the soil analysis (0-0.20 m), the application of fertilizers was done in the sowing furrow 300 kg ha-1 of the formula 08-24-12+ Zn.

Sowing was carried out on February 28, 2021, with a Jumil model 2680PD planter with 4 rows spacing 70 cm between rows and 4.2 seeds per meter, totaling 60 thousand plants ha-1, the genetic material used was the Feroz hybrid vip 3 Syngenta.

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The experiment was installed in a randomized block design with 6 (six) treatments and 4 (four) repetitions, totaling 24 (twenty four) experimental plots. Five different sources of nitrogen (N) applied in topdressing were used, in addition to 1 control distributed as follows:

T1 = Control (without adding N),

T2 = 333 kg/ha^{-1} of Polyblen 30-00-11,

T3= 217 kg/ha^{-1} Urea 46% N,

T4= 476 kg/ha^{-1} Ammonium Sulfate 21% N,

T5= 303 kg/ha^{-1} Ammonium Nitrate 33% N,

T6= 500 kg/ha^{-1} Polyblen 20-00-11

Following the standardized dosages of 100 kg ha-^{1} of N in coverage for each source.

The application was performed 20 days after the emergency (DAE) and the other elements were adjusted so that they were all provided equally in all treatments, only varying the source in relation to N.

With 134 DAE from the plants, the material was manually harvested for evaluation, due to the water deficit faced during the experiment; the collection of samples had to be anticipated. Twenty central plants were collected from each plot; they were stored in bags identified with each treatment and repetition. The process to crush this material was used in a 3 knives ensiladery with a 3hp electric motor and soon after this material was weighed and separated 300 grams where it was taken to a microwave oven to carry out the water loss of the material.

According to Oliveira et al. (2015) dry matter can be measured using a microwave oven, a technique that was used in this experiment. The plant sample was placed in the microwave together with a glass of water, after 3 minutes at full power it was removed and after cooling the sample was mixed and placed again in the microwave for 2 minutes, and this process was repeated with 1 minute and then with 30 seconds of oven, and the repetition was necessary with the last time until the sample weight was the same for three consecutive weighings. The final value was given as the result of the formula: Dry matter (%) = (100 x Final Weight) ÷ Initial Weight.

The following variables were evaluated: green mass weight (ton ha-1) and dry mass weight of the aerial part (ton ha-1).

The results were subjected to analysis of variance and comparison of means made by the Scott-Knott test, at 5% probability, both using the SISVAR ® software (FERREIRA, 2014).

3. RESULTS AND DISCUSSION

After manually harvesting the corn plants, in June/2021 they were subjected to evaluation of green mass weight and dry mass, as shown in table 2.

Table 2: Green and dry mass weight of the aerial part of the maize (ton/ha-1), submitted to different sources of N coverage

Green Mass Dry Mass Treatment	Green Mass Dry Mass Treatment	Green Mass Dry Mass Treatment
1 -Control	3.870 A	2.805 A
2 - Polyblen 30-00-10	3.153 B	2.370 B
3 – Ureia 46%	3.890 A	2.868 A
4 – Sulfato de Amônio21%	3.465 B	2.420 B
5 – Nitrato de Amônio 33%	3.063 B	2.280 B
6 – Polyblen 20-00-11	3.920 A	2.772 A
CV (%)	6.03	6.03

*Means followed by different letters in the column differ statistically by the Knott Scoot test at 5% probability

Treatments 1, 3 and 6 showed statistical differences from the other treatments in the production of green mass and dry mass.

Although corn is one of the options for cultivation in the second crop in the region and in the country, it has even been showing a growing increase in cultivated area in recent years, however, we cannot forget the risks arising from adverse weather conditions quite common at this time.

Among the existing climatic factors, the ones that stand out in the corn crop are: solar radiation, temperature and precipitation. These factors are directly related to plant growth and development, and their action varies with the plant's phenological stage, so each stage has different tolerable levels (MALDANER, et al., 2014).

According to CONAB data, (YEAR) the second crop corn planting has been occupying areas larger than those destined for summer corn cultivation, its production and planted area is twice the size when compared to the summer crop.

It can be observed that the results obtained in this experiment were not as satisfactory, due to adverse climatic conditions during cultivation, such as high temperatures and lack of rain, which negatively influenced the development of the crop, as shown in tables 3 and 4.

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Table 3: Weather data from February to July/2021 in Paraguaçu MG

	February	March	April	May	June	July
2021	261 mm	103 mm	27 mm	38 mm	52 mm	1 mm

Table 4: Meteorological and historical data on rainfall distribution in the city of Alfenas/MG (COOXUPÉ)

	February	March	April	May	June	July
2020	165 mm	121,4 mm	21,4 mm	8 mm	21,6 mm	0 mm
2019	167,4 mm	153,4mm	111,4 mm	92,2 mm	4,4 mm	7 mm

Source: http://sismet.cooxupe.com.br:9000/

According to meteorological records, rainfall distribution during the growing season was below average.

Compared to previous years, although February and June/2021 had more rainfall, the months of March, April and July were much lower compared to 2019, as shown in table 4.

According to Conab, rains were below the historical average, causing losses in the corn second crop, still associated with the delay in planting and harvesting soybeans, which also affected the second crop planting window (CONAB, 2021).

Normally, the water deficit is more accentuated the later the corn sowing date, since the lack of moisture in the soil hinders the absorption of nutrients by the plant (SIMÃO et al., 2018).

Simão and collaborators (2018) concluded that sowing in January favors productivity by reconciling better rainfall distribution at the end of the vegetative and reproductive phases.

Andrade (2020) explains that the lack of water can compromise three stages of maize development, namely the beginning of flowering, the pollination period and grain filling.

Some sources point out that maize maximum productivity occurs when water consumption throughout the cycle is between 500 and 800mm, however, the crop requires a minimum of 350 to 500mm for it to produce without the need for irrigation. (ANDRADE, 2020).

According to Magalhães and Durães (2006), the water consumption of corn is around 600 mm, and it can be cultivated in a range between 300 and 5,000 mm.

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The main factor influencing the success of the crop is solar radiation, which is why the climate can favor or hinder the producer. The off-season, target of this work, was affected by high temperatures, especially in February and March, exceeding 30ºC. Compared to the last two years, there is a noticeable increase in temperature during the planting months

Fancelli & Dourado Neto (2000), in a study on corn production, shows that temperatures below 10ºC and above 40ºC: can reduce the percentage of germination; between 25ºC and 30ºC would be the ideal temperature; above 26ºC: accelerate flowering; below 15.5°C: delay flowering; and above 21ºC (within 60 days after sowing): each degree can accelerate flowering (maximum advance of three days).

Rehagro (2018), in its blog, corroborating the data, published that the ideal temperature conditions for corn in the germination phase would be between 25 and 30º, in the emergency phase, flowering, from 24 to 30º, and the temperature daily average of 21º leads to a higher grain yield. Bringing information also that the occurrence of cloudy period, water deficit, reduction of leaf area due to pests and diseases and nutritional imbalance, will considerably reduce the dry matter accumulation rate in the grains, reducing their weight and productivity.

Solar radiation is totally linked to direct mass production in maize, so the ratio of accumulated dry matter mass and the radiation intercepted by the plant over a period of time, gives the efficiency in mass production of the plant (MALDANER, et al. ., 2014).

The positive result of corn second crop is related to the sowing time. For this reason, in an article published by MyFarm (2021) it is recommended to plant earlier, after harvesting the summer crop, as it increases the chances of obtaining a good off-season corn crop. Thus, the risks caused by reduced air temperature in winter and availability of water in the ground are reduced.

4. CONCLUSION

It is concluded that the sources of N, Urea 46% , Polyblen 20-00-11, and the control (without any addition of N) were the most efficient in covering in the off-season corn crop, under the conditions of the experiment that had unforeseen environmental such as water deficit and high temperatures.

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