# FORAGE PRODUCTION AND MORPHOGENIC COMPOSITION OF BLACK OATS (*Avena strigosa*) UNDER DOSES AND SOURCES OF NITROGEN FERTILIZATION

Felipe Dalpizzol[1], Juliano Cesar Dias[2], Henrique von Hertwig Bittencourt[3], André Luís Finkler da Silveira[4]

**ABSTRACT -** The objectives of this study were to evaluate the forage production and the morphological composition of black oat cultivated under different rates and sources of nitrogen fertilization. The experimental design used was randomized blocks, with five treatments and three replications. The treatments used were: 0, 50, 100 and 150 kg $ha^{-1}$ of nitrogen with urea (45% nitrogen) and 225 kg $ha^{-1}$ of nitrogen with commercial pelleted poultry bedding (2.0% N, 2.8% $P_2O_5$ and 2.6% $K_2O$). Dry matter (DM) production was influenced by nitrogen fertilization with urea, with an increase in DM production following the increase in N availability for black oats, reaching 2474.9 kg of DM $ha^{-1}$ with 150 kg $ha^{-1}$ of N ($Y = 1915.6165 + 1.0435*X + 0.0179*X^2$, adjusted $R^2 = 0.62$). The daily accumulation of DM was also influenced by nitrogen fertilization with urea, with a daily increase of 25 kg of DM $ha^{-1}$ in the fertilization with 150 kg $ha^{-1}$ of N ($Y = 16.917 - 0.0361*X + 0.0006* X^2$, adjusted $R^2 = 0.99$). Organic fertilization showed an effect ($p<0.05$) on the reproductive period of the pasture compared to the other treatments of N by urea, allowing the last cut to obtain a higher frequency of leaves, tillers and a higher leaf:stem ratio.

**Keywords:** dry matter, forage, nitrogen, organic fertilization, tillering

# PRODUÇÃO FORRAGEIRA E COMPOSIÇÃO MORFOGÊNICA DA AVEIA PRETA (*Avena strigosa)* SOB DOSES E FONTES DE ADUBAÇÃO NITROGENADA DE COBERTURA

**RESUMO -** Os objetivos deste estudo foram avaliar a produção forrageira e a composição morfológica da aveia preta cultivada sob diferentes doses e fontes de adubação nitrogenada de cobertura. O delineamento experimental utilizado foi o de blocos ao acaso, com cinco tratamentos e três repetições. Os tratamentos utilizados foram: 0, 50, 100 e 150 kg $ha^{-1}$ de nitrogênio com ureia (45% de nitrogênio) e 225 kg $ha^{-1}$ de nitrogênio com cama de aviário peletizada comercial (2,0% de N, 2,8% de $P_2O_5$ e 2,6% de $K_2O$). A produção de matéria seca (MS) foi influenciada pela adubação nitrogenada com ureia com aumento na produção de MS acompanhando o aumento na disponibilidade de N para a aveia preta, atingindo 2474,9 kg de MS $ha^{-1}$ com 150 kg $ha^{-1}$ de N ($Y = 1915,6165 + 1,0435*X + 0,0179*X^2$, $R^2$ ajustado = 0,62). O acúmulo diário de MS também foi influenciado pela adubação nitrogenada com ureia, com acréscimo diário de 25 kg de MS $ha^{-1}$ na adubação com 150 kg $ha^{-1}$ de N ($Y = 16,917 - 0,0361*X + 0,0006*X^2$, $R^2$ ajustado = 0,99). A adubação orgânica mostrou efeito ($p<0,05$) no período reprodutivo da pastagem em comparação aos demais tratamentos de N por ureia, permitindo que no último corte obtivesse maior frequência de folhas, perfilhos e maior relação folha:colmo.

**Palavras-chave:** adubação orgânica, forragem, matéria seca, nitrogênio, perfilhamento.

[1] Engenheiro Agrônomo. E-mail: dalpizzol_felipe@hotmail.com
[2] Universidade Federal da Fronteira Sul (UFFS), *campus* Laranjeiras do Sul, PR. E-mail: julianocdias@yahoo.com.br
[3] Universidade Federal da Fronteira Sul (UFFS), *campus* Laranjeiras do Sul, PR. E-mail: henrique.bittencourt@uffs.edu.br
[4] Instituto de Desenvolvimento Rural do Paraná (IDR - Paraná), Pato Branco, PR. E-mail: andrefinkler@idr.pr.gov.br

## INTRODUCTION

Black oat (*Avena strigosa*) is southern Brazil's most used winter annual forage, allowing earlier grazing than most winter cereals. The species is essential to the crop/livestock (summer/winter) integration systems with direct seeding. It can be used in rotational systems with barley, wheat, rye and triticale, as it reduces the population of some pathogens that affect these cereals (Primavesi et al., 2000).

Nitrogen (N) is the nutrient with the most significant effect on oat growth and may limit phytomass production. The availability of N stimulates growth and root activity, positively affecting the absorption of other nutrients and the amount of dry matter produced by oats (Amado et al., 2003). According to Mundstock & Bredemeier (2001), this is due to the increase in black oats tillers when fertilized with nitrogen.

Nitrogen fertilization in black oats can be an alternative to solve soil deficiency problems since this forage has a high N extraction and accumulation capacity (Derpsch et al., 1985). These characteristics give the species the potential to reduce the contamination risks of the water table with nitrate. At the same time, it can constitute a source of N due to the decomposition of residues for the cultures in succession (Santi et al., 2003).

Black oats are very efficient in nutrient cycling due to their high dry matter production capacity, and plant stand and aggressive root system. However, oat nutrient cycling can also be affected by N availability in the soil (Santi et al., 2003).

Silveira et al. (2020), evaluating N (0 to 90 kg $ha^{-1}$) fractioned applied to black oats, concluded that dry matter production increased linearly with the doses used.

In addition to fertilization with a synthetic fertilizer rich in N, such as urea, organic sources of N are commonly used in agriculture. The use of these organic residues significantly stimulates the beginning of the oat cycle, so there is adequate development of the shots regarding height and leaf area (Ramires et al., 2022).

Given the above, this work aims to evaluate the effects of different levels and sources of top-dressing nitrogen fertilization on forage production and the morphological development of black oats.

## MATERIAL AND METHODS

The experiment was conducted in the municipality of Laranjeiras do Sul, central-southern region of Paraná, Brazil (26º07'S latitude and 52º41'W longitude). The field is 700 meters above sea level and has a Cfa climate (subtropical), according to the Köppen classification.

The work was carried out in agricultural soil with a no-tillage system, with the experiment being implemented later in the soybean crop. Soil samples were collected at 0-20 cm depth for physical-chemical characterization (Table 1).

Table 1 - Soil analysis data from the experiment field

| Soil analysis report | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| pH | MO. | P | $Al^{3+}$ | H+AL | $K^{+}$ | $Ca^{2+}$ | $Mg^{2+}$ | SB | CTC | V% |
| $CaCl^2$ | g $dm^{-3}$ | mg $dm^{-3}$ | ***********cmol $dm^{-3}$************* | | | | | | | |
| 5.4 | 60.31 | 1.96 | 0 | 4.6 | 0.18 | 7.85 | 3.34 | 11.37 | 15.97 | 71.2 |

The experiment began by seeding the black oats cv. Embrapa 139 with direct sowing of 60 kg $ha^{-1}$. The spacing between rows was 15 cm, and no base fertilization was used during seeding.

The experimental design used was randomized blocks, with five treatments and three replications per treatment, totalling 15 plots. The treatments used were: 0, 50, 100 and 150 kg $ha^{-1}$ of nitrogen by fertilization with urea (45% nitrogen) and 225 kg $ha^{-1}$ of nitrogen by organic fertilization with commercial pelletized poultry bedding (2.0% of N; 2.8% of $P_2O_5$, and; 2.6% of $K_2O$). The dimensions of the plots were 3x2 m, totalling 6 $m^2$, and using 1 m of corridor between the plots. The total experimental area was 15x13 m (195 $m^2$).

A rain gauge was installed to record rainfall during the experiment period. It registered an accumulation of 492 mm, and approximately 82.3% of this total (405 mm) occurred up to the 2nd cut.

Nitrogen fertilization was carried out by dividing the urea dose into two applications, at the beginning of tillering and after the oat's 2nd cut. Organic fertilization was done in a single dose at the beginning of oat tillering.

The oat's dry mass (DM) production was esteemed with plant shot samples of 0.5 $m^2$ per plot. Plants shots were cut 10 cm above the soil surface and taken to the laboratory to dry in an oven with forced air circulation at 65º for approximately 72 hours. The cuts were made with manual scissors and simulated grazing when the forage was between 25 and 30 cm tall (Aguinaga et al., 2008).

Another 0.25 m² sample was used for manual separation of the morphological components of the plant (stem + sheath, leaf blade, senescent material and inflorescence), with subsequent drying in an oven with forced air circulation at 65º for approximately 72 hours. This sample allowed estimation of the participation of each component in the structure of the forage canopy. The plant population and the number of tillers per plant were counted before cutting, using the counting method in a 0.5 m line (Nakagawa et al., 2000).

The daily dry matter accumulation rate in the different treatments resulted from dividing the total produced between the three cuts by the number of days in the period.

Data were subjected to analysis of variance (ANOVA) to verify the differences between treatments. Variables with $p<0.05$ were submitted to regression analysis or had means compared by Tukey's test ($p<0.05$).

## RESULTS AND DISCUSSION

The N dose influenced the cutting heights ($p<0.05$), which averaged 25.80 ± 0.15; 26.20 ± 0.15; 26.20 ± 0.15; 27.40 ± 0.15 and 27.10 ± 0.15 for 0, 50, 100, 150 and 225 kg N $ha^{-1}$. The treatments with 150 kg $ha^{-1}$ of N with urea and 225 kg $ha^{-1}$ of N with organic fertilizer showed higher cutting heights than the other treatments, but they did not differ from each other.

This difference in height between treatments was because the cuttings were made when the forage reached an average height of 25 to 30 cm. This fact was not verified by Lupatini et al. (2013), who established a grazing height for black oat intercropped with ryegrass at 20 cm, and by Flaresso et al. (2001), who established a cutting height of 30 cm with black oats.

The N dose influenced the total production of oat shoot dry mass (Table 2). Applying 150 kg $ha^{-1}$ of N with urea resulted in total shoot DM production higher than the control. The results are similar to those of Ben et al. (1998), who evaluated the black oat dry matter yield by applying nitrogen doses by chemical fertilization 27 days after plant emergence and found an increase in DM production as a function of nitrogen fertilization.

Table 2 - Dry mass production of black oat grown under different rates and sources of nitrogen fertilization (mean ± standard error)

| Nitrogen Source | Dose (kg N $ha^{-1}$) | Dry mass production (kg $ha^{-1}$) | | | |
|---|---|---|---|---|---|
| | | 1st cut | 2nd cut | 3rd cut | Total |
| Control | 0 | 882.73 ± 47.35 | 463.00 ± 41.81 | 533.73 ± 20.15 | 1879.47 ± 81.30$^{b}$ |
| Urea | 50 | 906.53 ± 76.96 | 502.20 ± 41.55 | 712.27 ± 189.31 | 2121.00 ± 224.95$^{ab}$ |
| Urea | 100 | 929.13 ± 66.58 | 482.93 ± 55.37 | 678.53 ± 42.55 | 2090.60 ± 161.21$^{ab}$ |
| Urea | 150 | 1051.53 ± 32.39 | 572.87 ± 43.18 | 886.80 ± 45.31 | 2511.20 ± 72.33$^{a}$ |
| Poultry bedding | 225 | 876.67 ± 10.03 | 529.87 ± 28.33 | 892.47 ± 31.91 | 2299.00 ± 32.97$^{ab}$ |

Different letters in the same column differ by Tukey's test ($p<0.05$). N: nitrogen.

Regression models were adjusted to the relation between nitrogen fertilization with urea and DM production and daily DM accumulation. There was an increase in the production of dry mass with the increase in the dose of N applied in the form of urea, with the highest production of the dry mass of shoots (2475 kg $ha^{-1}$) obtained with the dose of 150 kg N $ha^{-1}$ (Figure 1).

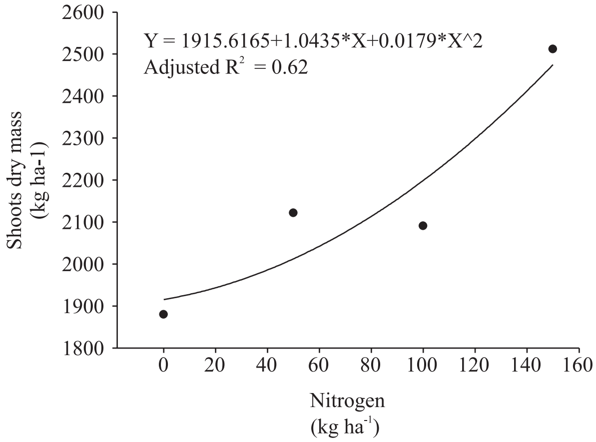



Figure 1 - Regression of black oats dry mass production as a function of the amount of nitrogen fertilization by urea.

According to Bratti (2013), the development of oats depends on nutrient availability in soil, with nitrogen and phosphorus playing essential roles. Nitrogen fertilization increases forage production and increases pasture support capacity and animal productivity.

In addition to being the nutrient required in greater quantity by plants, nitrogen is an element that constitutes several of its cellular components. Therefore, its deficiency quickly compromises plant growth (Taiz et al., 2017). Plant productivity is compromised by reduced photosynthesis, leaf area and leaf longevity (Mu & Chen, 2021).

The treatment of 225 kg $ha^{-1}$ of N with organic fertilizer did not differ from the other treatments with urea, despite the higher concentration of N available. It is speculated that the fact that organic fertilizers need to be mineralized for subsequent absorption by plants (Bratti, 2013) has reduced nitrogen availability. Not differing from the treatment with 150 kg $ha^{-1}$ of N with urea and having the potential to contribute to the increase of organic matter in the soil (source of N by mineralization) constitutes a positive result towards organic fertilizer use when deciding on the source of N.

For Amado et al. (2003), biotic and abiotic factors determine the speed of the organic matter decomposition process and define the persistence of these residues on the soil surface. Several edaphoclimatic factors and organic material characteristics influence nutrient mineralization (Fioreze et al., 2012). Together they can delay nutrient availability to plants compared to readily soluble fertilizers (Bratti, 2013).

Nitrogen fertilization influenced the daily accumulation of black oats DM, with the dose of 150 kg $ha^{-1}$ with urea being higher than the doses of 0, 50 and 100 kg $ha^{-1}$ and similar to the dose of 225 kg $ha^{-1}$ with poultry bedding. The results indicate that nitrogen availability directly influences daily DM production (Table 3).

Table 3 - Daily accumulation of dry mass of black oat grown under different doses and sources of nitrogen fertilization (mean ± standard error)

| Nitrogen source | Dose (kg N $ha^{-1}$) | Daily accumulation of dry mass (kg $ha^{-1}$) | | |
|---|---|---|---|---|
| | | $1^{st}$ to $2^{nd}$ cut | $2^{nd}$ to $3^{rd}$ cut | $1^{st}$ to $3^{rd}$ cut |
| Control | 0 | 21.05 ± 1.90 | 14.43 ± 0,54 | 16.89 ± 0.83$^{c}$ |
| Urea | 50 | 22.83 ± 1.89 | 19.25 ± 5,12 | 20.58 ± 3.80$^{bc}$ |
| Urea | 100 | 21.95 ± 2.52 | 18.34 ± 1,15 | 19.69 ± 1.61$^{c}$ |
| Urea | 150 | 26.04 ± 1.96 | 26.08 ± 1,33 | 26.07 ± 1.57$^{a}$ |
| Poultry bedding | 225 | 24.08 ± 1.29 | 26.25 ± 0,94 | 25.40 ± 0.41$^{ab}$ |

Different letters in the same column differ by Tukey's test ($p<0.05$). N: nitrogen.

Higher nitrogen application (150 kg N $ha^{-1}$ with urea and 225 kg N $ha^{-1}$ with poultry bedding) resulted in more stability in daily DM accumulation. It is hypothesized that the more significant root development in black oat submitted to greater nitrogen availability was responsible for the production stability between cuts.

Piazzetta et al. (2014), working with black oat and ryegrass pasture fertilized with 150 kg N $ha^{-1}$, did not observe a paralysis in the growth of plants subjected to water stress. This result suggests that a good supply of N keeps the root system active even in water-stress situations. In a situation of low N availability, the meristematic activity of shots is reduced, with the plants allocating more significant amounts of photoassimilates for the growth of the root system.

Under water deficit conditions, the root system is stimulated towards more profound soil zones, with root expansion stimulated by surface drying (Sampaio et al., 2007). At the same time, there is a reduction in the growth and development of the aerial part of the crops, with frequency and intensity being the most important factors limiting production (Santos & Carlesso, 1998). During the plants' development, the roots' length increases until the beginning of flowering, subsequently decreasing with the decrease in water absorption efficiency (Sampaio et al. 2007). The occurrence of water deficit affects the growth and development of crops, and the frequency and intensity are the most important factors limiting production (Santos & Carlesso, 1998).

The daily accumulation of DM was influenced by nitrogen fertilization, with an increase in the daily accumulation of DM in oat shoots from 30 kg N $ha^{-1}$ with urea (Figure 2).

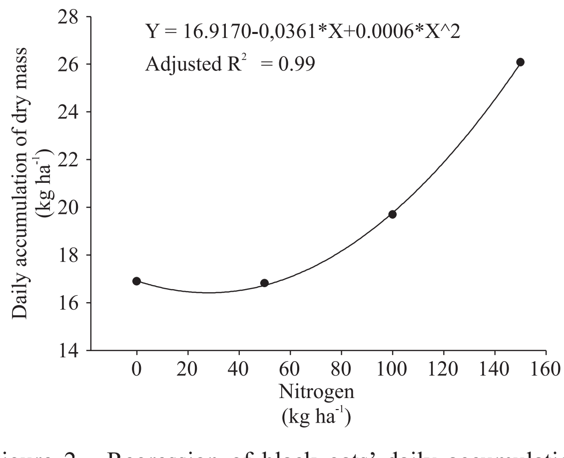
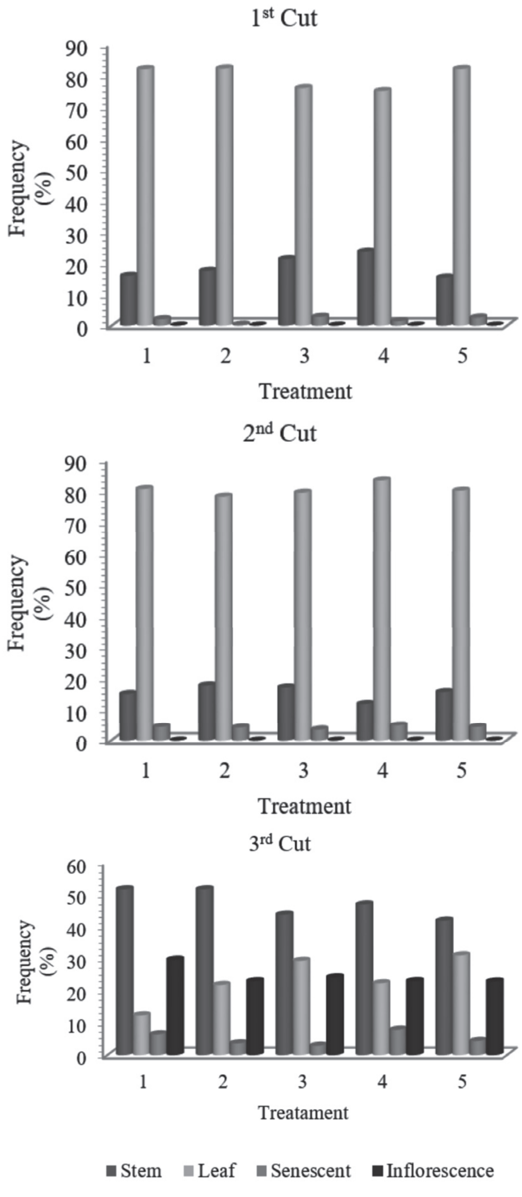



Figure 2 - Regression of black oats' daily accumulation of dry mass as a function of urea nitrogen fertilization.

Fertilization with N influenced the proportions of the morphological components in the different cuts (Figure 3); however, there were no differences (p>0.05) between treatments and cuts in the distribution of stem, senescent material and inflorescence.




OBS.: 1 = 0 kg $ha^{-1}$ of nitrogen (urea), 2 = 50 kg $ha^{-1}$ of nitrogen (urea), 3 = 100 kg $ha^{-1}$ of nitrogen (urea), 4 = 150 kg $ha^{-1}$ of nitrogen (urea), 5 = 225 kg $ha^{-1}$ of nitrogen (poultry bedding)

Figure 3 - Morphological components in black oat forage structure under doses and sources of nitrogen fertilization.

More leaves were in the forage canopy in 1st and 2nd than in the 3rd cut (Table 4). The participation of stem in the forage structure in the 3rd cut was higher than in the first two. This characteristic is observed in forage species since plants allocate their production to different organs and tissues throughout their phenological development (Taiz et al., 2017).

Forage structure changed according to the phenological stage during the vegetative cycle. A higher proportion of leaves was observed at the beginning, and a more significant proportion of stems at the end of the oat life cycle (flowering period).

The third cut was the only one that showed inflorescence in the canopy structure, but it did not differ between treatments (p>0.05).

The percentage of leaves in the black oat forage structure was influenced by the interaction of the different doses and sources of top-dressing nitrogen fertilization with the cutting (Table 4).

Table 4 - Percentage of black oat leaves cultivated under different rates and sources of nitrogen fertilization (mean ± standard error)

| Nitrogen source | Dose (kg N $ha^{-1}$) | Leaves (%) | | |
|---|---|---|---|---|
| | | 1st cut | 2nd cut | 3rd cut |
| Control | 0 | 81.98 ± 2.79$^{a}$ | 80.59 ± 5.53$^{a}$ | 12.34 ± 2.83$^{bB}$ |
| Urea | 50 | 82.17 ± 2.30$^{a}$ | 78.12 ± 4.33$^{a}$ | 21.80 ± 2.39$^{bAB}$ |
| Urea | 100 | 75.92 ± 1.61$^{a}$ | 79.38 ± 4.80$^{a}$ | 29.28 ± 4.51$^{bAB}$ |
| Urea | 150 | 74.94 ± 2.13$^{a}$ | 83.29 ± 2.18$^{a}$ | 22.30 ± 3.04$^{bAB}$ |
| Poultry bedding | 225 | 82.03 ± 2.02$^{a}$ | 80.00 ± 4.23$^{a}$ | 31.00 ± 0.49$^{bA}$ |

Different uppercase letters in the same column and lowercase letters in the same row differ by Tukey's test (p<0.05). N: nitrogen.

The participation of leaves in the structure of oats changed over time. The 1st and 2nd cuts had more leaves than the 3rd (p<0.05) in all treatments. The high participation of leaves in the oat structure, observed in the 1st and 2nd cuts, indicates the better nutritional quality of this forage in the initial stages of plant development. This hypothesis comes from the fact that the pasture's quality is usually related to the amount of leaves available for grazing. The results obtained meet the findings by Fiorin et al. (2015), who suggest that nitrogen plays a fundamental role in producing more tissues for use as fodder.

There was also a treatment effect (p<0.05) on the morphological composition of black oats, with poultry bedding showing a higher percentage of leaves than the control in the third cut (Table 4). This greater participation of leaves may be due to slower N release by the organic fertilizer. The organic fertilizer probably also increased other nutrients' availability and promoted soil physical characteristics (Lupatini et al., 2013; Dias-Filho, 2014).

The results demonstrate the possibility of obtaining black oat pastures fertilized with organic fertilizer similar to black oat pastures submitted to conventional nitrogen fertilization. Similar results were reported by Aguinaga et al. (2008), who described that black oat presents excellent DM production in the first cuts, influenced by the cycle of use, cultivar and sowing time. This result indicates that the later the planting, the lower the vegetative growth.

Different doses and sources of nitrogen fertilization did not influence the following morphological components of black oat: plants $m^{-2}$, stems $m^{-2}$, leaves $m^{-2}$, senescent material $m^{-2}$ and inflorescence $m^{-2}$.

Regardless of the dosage or source of nitrogen used, there was no increase in the number of plants and forage structure components. Thus, it is hypothesized that the increases in DM production and the daily accumulation of DM (Figures 1 and 2) occurred due to the greater development capacity and not to the increase in the percentage of morphological components formed.

Nakagawa et al. (2000) verified a difference in the final population of black oat plants submitted to different doses of N (0 to 60 kg $ha^{-1}$) applied in tillering, contrary to the results obtained in this study.

Results obtained by Santos et al. (2013) evaluating the dynamics of N use in black oats for soil cover in no-tillage differ from the results of this work. The authors found linear responses in the number of leaves with increased N doses between 0 to 184 kg $ha^{-1}$.

When evaluating the number of tillers per plant, there was an effect between cuttings but no treatment effect on this characteristic (Table 5).

Table 5 - Number of black oat tillers per plant grown under different doses and sources of nitrogen fertilization (means ± standard errors)

| Nitrogen source | Dose (kg N ha$^{-1}$) | Tillers plant $^{-1}$ | | |
|---|---|---|---|---|
| | | 1st cut | 2nd cut | 3rd cut |
| Control | 0 | 4.01 ± 0.20$^{aA}$ | 4.02 ± 0.36$^{aA}$ | 3.26 ± 0.09$^{aA}$ |
| Urea | 50 | 3.77 ± 0.31$^{aA}$ | 5.06 ± 0.60$^{aA}$ | 3.66 ± 0.27$^{aA}$ |
| Urea | 100 | 4.50 ±0.31$^{aA}$ | 4.17 ± 0.11$^{aA}$ | 3.18 ± 0.13$^{aA}$ |
| Urea | 150 | 3.68 ± 0.38$^{aA}$ | 4.63 ± 0.36$^{aA}$ | 4.22 ± 0.90$^{aA}$ |
| Poultry bedding | 225 | 2.74 ± 0.13$^{bA}$ | 5.74 ± 0.05$^{aA}$ | 4.52 ± 0.81$^{abA}$ |

Different uppercase letters in the same column and lowercase letters in the same row differ by Tukey's test ($p<0.05$). N: nitrogen.

It was observed that the 2nd cut with poultry bedding showed a higher production of tillers per plant compared to the 1st ($p<0.05$), not differing from the 3rd cut ($p>0.05$). This variation observed in the number of tillers between 1st and 2nd cuts in the poultry bedding, can be explained by the secondary effects of organic fertilization. Lupatini et al. (2013) state that the response of forage grasses to nitrogen fertilization depends mainly on the species used, period of use of the pasture, type and content of soil organic matter and climatic conditions. No significant differences were observed in the other treatments and cuts ($p>0.05$).

The results are similar to those of Nakagawa et al. (2000), who, working with black oats under different doses of top-dressing nitrogen fertilization at the end of tillering, verified that the number of tillers per plant is not influenced by the N doses applied.

These findings reinforce that the difference observed between 1st and 2nd cuts in the treatment with 225 kg ha$^{-1}$ N with poultry bedding can be explained by the secondary effects of organic fertilization. The lack of difference observed between the 3rd and 1st, and 2nd cuts can be explained by the water deficit that occurred in this period and by the fact that during the reproductive stage of the plant, the appearance of new tillers ceases, and the accumulation of forage mass is dependent on of the growth of existing tillers (Duchini et al., 2014). The authors also describe the importance of this characteristic in forage development, indicating that the number of tillers is the main factor determining the accumulation of forage during the vegetative stage.

When comparing the leaf:stem ratio, characteristics of great importance due to their direct relationship with the quality of forage for grazing, there was an effect ($p<0.05$) of treatment and cutting (treatment/cutting interaction) on the characteristic (Table 6). It was observed that the leaf:stem ratio changed with the development of the black oat vegetative cycle, with the 1st and 2nd cuts showing a higher ratio than the 3rd cut ($p<0.05$) in control.

Table 6 - Means and standard errors of the leaf:stem ratio in black oat grown under different doses and sources of nitrogen fertilization

| Nitrogen source | Dose (kg N ha$^{-1}$) | Leaf:stem ratio | | |
|---|---|---|---|---|
| | | 1st cut | 2nd cut | 3rd cut |
| Control | 0 | 3.04 ± 0.02$^{a}$ | 3.32 ± 0.19$^{a}$ | 1.50 ± 0.23$^{bB}$ |
| Urea | 50 | 3.06 ± 0.06 | 2.71 ± 0.10 | 2.31 ± 0.07$^{AB}$ |
| Urea | 100 | 3.01 ± 0.04 | 2.82 ± 0.10 | 2.67 ± 0.34$^{A}$ |
| Urea | 150 | 3.05 ± 0.01 | 2.88 ± 0.26 | 2.35 ± 0.39$^{AB}$ |
| Poultry bedding | 225 | 3.14 ± 0.01 | 3.22 ± 0.14 | 2.80 ± 0.09$^{A}$ |

Different uppercase letters in the same column and lowercase letters in the same row differ by Tukey's test ($p<0.05$). N: nitrogen.

This finding reinforces the importance of nitrogen fertilization in maintaining forage characteristics for a more extended period of the cycle, with a probable influence on pasture quality. Cecato et al. (2001) add that nitrogen fertilization increases leaf production, improving forage structure and pasture quality.

The reduction in the leaf:stem ratio observed between the control cuts is an expected characteristic due to the vegetative period of the forage. When passing through the reproductive period, a reduction in the number of leaves is observed, a fact also observed by Aguinaga et al. (2008).

There was also a difference ($p<0.05$) in the leaf:stem ratio between treatments, with 100 kg N ha$^{-1}$ with urea and 225 kg N ha$^{-1}$ with poultry bedding, showing a higher ratio than the control in the 3rd cut. According to Cassol et al. (2011), nitrogen increases the production of biomass and tillers per plant, as well as improving pasture quality by increasing the number of leaves, which is the most palatable component and best digestible for animals.

The leaf:stem ratio is a critical variable in animal nutrition and forage plant management, being associated with grazing quality (selectivity), where a reduction in leaf production would imply a decrease in forage quality (Rizato et al., 2019).

## CONCLUSIONS

The production and daily accumulation of dry matter in black oats showed no difference between conventional nitrogen fertilization with urea, at a dose of up to 150 kg $ha^{-1}$ of nitrogen, and nitrogen fertilization with organic fertilizer, at a dose of 225 kg $ha^{-1}$ of nitrogen. The production and the daily accumulation of dry matter in black oats increase with the top-dressing nitrogen fertilization up to 150 kg $ha^{-1}$ of nitrogen. Nitrogen fertilization by organic fertilizer improves stability in the morphological components of black oats, with higher frequencies of leaves and tillers and a higher leaf:stem ratio in the final stages of the vegetative forage cycle.

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