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# EFFECTS OF NITROGEN ON THE DEFOLIATION PROCESS IN RYEGRASS (*LOLIUM MULTIFLORUM* L.)

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**Resumo**

A cada ano que passa, cresce os estudos a respeito do azevém anual (*Lolium multiflorum* L.), devido a sua grande importância e contribuição no sistema de integração lavoura-pecuária em áreas de clima temperado. Diante do exposto, está revisão de literatura tem como objetivo descrever, ressaltar e avaliar a produção de forragem e sementes, capacidade de rebrote e uniformização de perfilhos em azevém anual, a importância das desfolha e da adubação nitrogenada. Podemos concluir com essa revisão que o azevém é uma forragem que apresenta uma série de dificuldades para a sua produção, porém é uma ótima alternativa de pastagem durante os meses de frio no sul do País, por conta da sua adaptabilidade a temperatura que faz durante o inverno, de sua tolerância com mais intensidade o pisoteio dos animais em relação a outras espécies forrageiras.

**Palavras-chaves:** produtividade; sementes; adubação; implementação.

# EFEITOS DO NITROGÊNIO NO PROCESSO DE DESFOLHA EM AZEVÉM (*LOLIUM MULTIFLORUM* L.)

**Abstract**

With each passing year, studies on annual ryegrass (*Lolium multiflorum* L.) have increased, due to its great importance and contribution to the crop-livestock integration system in temperate climate areas. Given the above, this literature review aims to describe, highlight and evaluate the production of forage and seeds, regrowth capacity and standardization of tillers in annual ryegrass, the importance of defoliation and nitrogen fertilization. We can conclude from this review that ryegrass is a forage that presents a series of difficulties for its production, but it is an excellent pasture alternative during the cold months in the south of the country, due to its adaptability to the temperature during the winter and its tolerance to animal trampling with greater intensity in relation to other forage species.

**Keywords:** productivity; seeds; fertilization; implementation.

## Introduction

The process of implementing forage seeds is recent in Brazil, and several points must be considered before carrying out this process because each area or place has a different soil type, edaphoclimatic conditions, so it is important to map the place of forage implementation first (Kunrath *et al.*, 2020).

As there are government incentives, and the demand for forage seeds has increased, especially grasses, it generates concern at the same time, due to the preservation of the genetic standard of the seed and the transfer, to producers, of the existing technology (Bohn *et al.*, 2020).

Because there is a rapid change in the organization of forage seeds in some states and the need of producers, especially in the southern region of Rio Grande do Sul, it is necessary to introduce winter species, as an alternative to face the forage void characteristic of this period (Pereira et al., 2022).

Ryegrass is a forage plant that, when well-managed, meets the immediate needs of forage deficit due to the complementarity it exerts (Malalgoda *et al.*, 2020). It is one of the most cultivated annual grasses in Rio Grande do Sul, due to its excellent adaptation to climatic conditions and offering great productive potential, and its propagation is done only via seed (Bohn *et al.*, 2020).

However, to acquire a quality ryegrass seed is essential, and for this you must consider some factors such as: physical, physiological, genetic and sanitary quality, these characteristics will directly influence the performance of the crop in the field (Malalgoda *et al.*, 2020). In addition, its production due to management is also important, when it is subjected to a greater or lesser frequency of defoliation and levels of nitrogen fertilization.

Because nitrogen (N) is one of the nutrients absorbed in large quantities and essential for plant growth and the continuity of defoliation causes two impacts, which are the reduction in leaf area by the removal of leaves and apical meristems, reduces the plant's nutrient reserve (Kunrath *et al.*, 2020). On the other hand, it generates benefits to plants by increasing the penetration of light within the canopy, changing the proportion of new leaves (Svečanjak *et al.*, 2020).

In view of the above, this literature review aims to describe the production of forage and seeds, regrowth capacity and uniformity of tillers in annual ryegrass, the importance of defoliation and nitrogen fertilization.

## Material and Methods

The study of this literature review was carried out last year, which includes the consultation of scientific publications that allow describing the importance of ryegrass cultivation, its origin, production, management and harvesting. Because when preparing a bibliographic review, the results of some discovery, experiment performed, description of a case, description of some phenomenon that occurred are being reported.

## Results and Discussion

Annual ryegrass (*Lolium multiflorum* L.) is a grass, of not well-defined origin, but probably originated in northern Italy (Bohn *et al.*, 2020), and in Brazil it was introduced by Italian colonizers in 1875 in the state of Rio Grande do Sul and its expressive forage production contributes to the performance of areas that support a crop-livestock integration system (Kunrath *et al.*, 2020).

This system of Crop-Livestock Integration (ICL) is nothing more than an alternation of animal production and grains in the same production area, markedly developed in corn and soybean production areas in the Plateau of Rio Grande do Sul to the State of Paraná and much more intensified in the rice-producing areas of the southern region of Rio Grande do Sul, because they prioritize summer crops, they use cold-season forage species in the off-season periods to feed cattle managed in the ICL system (Malalgoda *et al.*, 2020).

Because common ryegrass has a photosynthetic metabolism of the C3 cycle, with slow growth at low temperatures, especially in the months of June and July and despite being a cold climate plant, it increases its dry matter production at higher temperatures in spring (Bazzo *et al.*, 2021). The optimum temperature for its production is between 20 and 25 °C, with maximum production of around 22 °C (Bohn *et al.*, 2020).

However, some producers have already been using new varieties of common ryegrass as an example, tetraploid cultivars, which have some differences in ploidy levels (2n or 4n), which determine genotypic and phenotypic characteristics, such as the duration of the vegetative cycle. Because of chromosomal duplication, tetraploid plant cells are larger with a higher cell content versus cell wall ratio, increasing the content of soluble carbohydrates, proteins, and lipids (Brown *et al.*, 2020).

## Morphological structure of ryegrass

The annual ryegrass of the winter cycle has a habit of cespitous growth, being able to form clumps from 0.50 m to 1.20 m, its leaves are thin and laminated in dark green color, and its inflorescence is in the shape of a spike of the couplet type, erect, 15 to 25 cm long, with spikelets, where the flowers originate, with two glumes, a lemma and a palea that surround the caryope and have three yellow or purple anthers (Pereira et al., 2022).

This species is adapted to lower temperatures, not resisting the summer heat of tropical climates, developing from autumn to spring (Kunrath *et al.*, 2020). It is a crop that is easy to implement and flexible to exploit, with high productive potential and has great resistance to grazing and excess moisture, with good natural reseeding capacity and is little affected by pests and diseases (Kunrath *et al.*, 2020).

**Figure 1.** It represents a pasture containing only ryegrass.

Source: (Google, 2024).

**Ryegrass production**

Ryegrass production begins after its formation and development, physiological maturation occurs, and when not harvested, it falls to the ground, remaining dormant there until the end of summer, when germination begins (Svečanjak *et al.*, 2020).

The seeds are compact, medium-sized for a forage grass. One thousand grains weigh from 2 to 2.5 g in diploid varieties and 3 to 4.5 g in tetraploid varieties. The coating structures (lemma and palea) are adhered to caryopsis, facilitating soaking (Bazzo *et al.*, 2021).

The planting recommendation is from March to May, with a sowing depth of no more than 2 cm, with 15 kg to 18 kg of seeds per hectare, with viable pure seeds in row sowing and 20 kg/ha by sowing in a throw. According to studies by (Kunrath *et al.*, 2020), the ryegrass cycle, when naturalized, goes from March to December, when it blooms and dies. Although it is grass that has an annual cycle, due to its natural reseeding, it can present a perennial behavior, as they remain in the area through seed accumulation, elongating the internodes, leading to inflorescence and end up improving seed dispersal in the area (Bazzo *et al.*, 2021).

**Type of soil for ryegrass production**

As for the type of soil, it develops well in many soils, but prefers low, slightly moist and medium-textured soils, with moderate fertility, despite tolerating humidity, it does not show good growth where accumulated water is found (Kunrath *et al.*, 2020).

It has shallow roots (5 to 15 cm), which makes it more sensitive to drought, where the optimal temperature for growth is between 18 and 20 °C, where it paralyzes growth at low temperatures. As it is a species considered aggressive in relation to tillering, it ends up helping to protect the soil, has a high nutritional value, is more rustic, tolerates animal trampling and cold more intensely (Pereira et al., 2022). An important characteristic of the use of ryegrass in the south of the country is due to its natural reseeding capacity, which favors the producer, as it is not necessary to acquire seeds every year (Bazzo *et al.*, 2021).

**Sowing Density**

Sowing density in forages is a factor of great importance in production, as it is a cultivation technique that aims to maximize the yield potential of the species and the final population of plants and consequently the greater amount of pod produced (Bazzo *et al.*, 2021).

Despite being a simple technique, sowing density can increase competition between plants, and it is necessary to adjust it to improve the use of certain productive parameters such as: water, light and nutrients, so that there is no reduction in product quality and yield (Svečanjak *et al.*, 2020).

**The importance of defoliation**

Defoliation management can be defined as the removal of plant material, due to the intensity, frequency, and time of occurrence (Franz *et al.*, 2020). The intensity of defoliation reflects the proportion of forage removed by cutting or grazing and is usually measured by the residual values of forage mass, height or leaf area index. The frequency of defoliation refers to the interval between successive cuts or grazing (Viencz *et al.*, 2021).

The use of forage can be analyzed in terms of the balance between its growth and consumption; and in terms of absolute amounts of forage consumed by grazing herbivores. Thus, optimizing pasture utilization efficiency requires knowledge of the life span of leaves, which together with height, serve to define pasture rest days and understanding the factors that influence defoliation severity (Pereira et al., 2022).

The rapid recovery of pastures after a cut is conditioned by the morphophysiological characteristics of each species that make them more or less adapted to grazing (Cardoso *et al.*, 2021). Frequent defoliation can result in slower pasture growth, as they effectively reduce the opportunity for full reestablishment of the original levels of organic reserves of the forage plant (Franz *et al.*, 2020).

Also, according to Franz *et al.* (2020) this author, the stimulus to the formation of vegetative tillers per m 2 by the cuts, reduces the proportion of fertile tillers in relation to the total tillers and, consequently, the potential yield of seeds. However, highlight availability at the base of pastures maintained at low leaf area index (LAI) values, associated with the increase in the proportion of new leaves in relation to old ones, results in an increase in photosynthetic efficiency per unit of leaf area (Bazzo *et al.*, 2021). The quality of light provides the beginning of the formation of new structures, especially leaves, ensuring the production of dry mass, either by tiller or by area (Viencz *et al.*, 2021).

**Nitrogen fertilization**

In general, the factor that most influences pasture productivity is nitrogen fertilization, as N is the most limiting nutrient for plant growth (Svečanjak *et al.*, 2020). N plays an important role in plant morphogenesis due to the differential action on morphogenic variables that determine pasture structure and may provide plants with conditions to increase leaf expansion and tillering rates, with a slight effect on the leaf appearance rate (Pereira et al., 2022).

In addition, N is a nutrient that affects both the morphophysiological characteristics of forage plants, as well as has a direct effect on tissue flow and can influence the height at which the canopy intercepts 95% of incident light, since it accelerates the processes of growth and senescence (Ramos *et al.*, 2021). N interferes with the morphogenesis of grasses, when not well managed, especially the rate of leaf expansion and tillering, as it modifies tiller density and vertical distribution of forage (Bohn *et al.*, 2020).

On the other hand, when the pasture is not managed correctly, without fertilization and with an excessive stocking rate, animal trampling can cause soil compaction that decreases the growth of plant roots, also reducing the growth of the aerial part (Svečanjak *et al.*, 2020). This situation can be further harmed by the depletion of plant reserves due to intensive grazing. In this condition, the plant tends to direct the flow of root reserves to regrowth of leaves and tillers, thus recovering its photosynthetic capacity, impairing root growth (Viencz *et al.*, 2021).

**Seed quality**

To be successful in any agricultural enterprise that uses vegetable crops, it is important to require the use of high-quality seeds, with the potential to produce vigorous and productive plants, uniformly and in the shortest possible time (Cardoso *et al.*, 2021).

Gains in seed performance are accompanied by increases in their cost to farmers, raising the level of demand for product quality, which highlights the strategic importance of quality control programs for seed producing companies (Cirino *et al.*, 2022).

However, when it comes to quality seeds, in addition to everything mentioned above, we must also consider the physiological, genetic, sanitary and physical attributes. Because one of the major problems in obtaining high yields in forages is the quality of seeds used in the implementation of the crop, where they often did not go through physiological quality evaluation processes (Cunha *et al.*, 2022).

**Main analysis of seeds**

Seed analyses consist of the technical procedures used to assess the identity and quality of the representative sample of a seed lot, with quality being understood as the set of physical, physiological, genetic, and sanitary analysis attributes in seeds (Cardoso *et al.*, 2021). Among the main tests and analyses, which are carried out in laboratories, we can mention:

Purity analysis: Aims to determine the percentage composition by weight and the identity of the different seed species and the inert material of the sample and by inference that of the seed lot. All seeds and/or dispersal units belonging to the species under examination, declared by the applicant, or as being the predominant one in the sample and must include all botanical varieties and cultivars of the species, are considered pure. In addition to the whole, mature and undamaged seeds of the species, seeds should be included as pure seeds (Cirino *et al.*, 2022).

The purity standard is found in IN 45, in Law No. 10,711, of August 5, 2003, for the largest seed of *Brachiaria* species it is 60%, for *Panicum* 40%, and the rest of the crops the purity should be around 98% to 99%.

Determination of other seeds by number: Performed from a working sample, where the number of seeds of other species present in the working sample is verified, considering as seeds of other species those not belonging to the sample under examination, including seeds of another cultivated species (others and Vigna unguiculata), wild seed, tolerated harmful and prohibited harmful (Brasil, 2020).

Germination: Determine the maximum germination potential of a seed lot, which can be used to compare the quality of different lots and estimate the value for field sowing. Performing this test under field conditions is generally not satisfactory, because, given the variation in environmental conditions, the results cannot always be faithfully reproduced (Brasil, 2020).

Methods of laboratory analysis, carried out under controlled conditions, of some or all external factors, have been studied and developed to allow a more regular, rapid and complete germination of seed samples of a given species. These conditions, considered optimal, are standardized so that the results of the germination tests can be reproduced and compared, within the limits tolerated by the RAS (Brasil, 2020).

For the germination test according to Law No. 10,711, of August 5, 2003, the germination percentage for forage seeds is around 70%. In addition to these analyses, which are the main ones described in the RAS and performed in the seed laboratory, we can also perform the tetrazolium test in the case of ryegrass.

Tetrazolium test: A biochemical test that can be used when seeds need to be sown soon after harvest, when they are dormant, or to solve problems found in the germination test, such as the presence of many abnormal seedlings. It can also be used to evaluate vigor, determine the viability of seeds after pre-germination treatments, drying, insect and moisture damage, as well as to detect mechanical damage from harvesting and/or processing (Brasil, 2020).

In pre-harvest, this tetrazolium test is very important because producers collect soybean pods daily at random in the field, five to seven days before harvest. The pods are manually threshed, and the seeds are evaluated for physiological quality, by the tetrazolium test in soybean seeds, as it provides an estimate of the damage caused by stink bugs and deterioration by moisture in the seeds (Cirino *et al*., 2022).

According to IN 44, November 22, 2016, forage seeds of the species L. *multifloreum* L., annual ryegrass may be marketed based on the feasibility results obtained through the tetrazolium test, according to methodologies established by the Ministry of Agriculture, Livestock and Supply (MAPA).

## Conclusion

According to what has been described, we can conclude that ryegrass is a forage that presents a series of difficulties for its production, but it is a great alternative for pasture during the cold months in the south of the country. Because of its adaptability to temperature during the winter, due to its tolerance with more intensity to the trampling of animals in relation to other forage species, natural reseeding capacity, soil cover and for promoting the crop-livestock integration system.

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