Research Journal of Agricultural Science, 50 (4), 2018

NITROGEN FERTILIZATION EFFECT ON ABOVEGROUND BIOMASS PRODUCTION IN *TRITICUM AESTIVUM*

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Abstract. *The aim of this study was to assess the interdependency level between the fertilization system and wheat, Triticum aestivum ssp. vulgare, Ciprian cv, aboveground biomass production. The use of fertilizing substances or complexes has a major importance for crops, application being realized in a wide range of systems depending on the climatic and pedological conditions, but also on the economic status of the farm. Thus, the biomass production, but also other physiological, yield or quality indices can be predicted for different quantities of fertilizers. N is the most used fertilizer due to the fact that it has a high impact on crop development and quality, but also on grain production. N is commonly used alone because is it cheaper, but it is also the base for other complexes, like NPK. Nitrogen utilization efficiency is dependent on the N efficiency of biomass formation, remobilization of N from the senescent tissues, the N influence on carbohydrate partitioning and nitrate reduction efficiency. The field experiment was carried out in the Didactic Station of BUASVM Timişoara, Romania, where a slightly gleized cambic chernozem, specific for Banat region is found. The plants were fertilized with ammonium azotate in five variants (0, 50, 100, 150 and 200 kg active substance ha^{-1}). This research was conducted on fresh and dried samples, representing aerial parts of wheat plants. The probes were sampled in May 2018. Biomass production was estimated using linear regression analysis. Only the aboveground parts of the wheat plant were studied, because the belowground biomass production on wheat is harder to estimate due to the morphology of the radicular system. Fresh and dry aboveground biomass increased proportionally with the amount of nitrogen used. The lowest fresh biomass was obtained for N 0 probes. The highest fresh biomass was obtained for N 200 samples. Regarding dry biomass production, similar tendencies were observed.*

Keywords: *fresh biomass, wheat, nitrogen fertilization, dry biomass*

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the third most cultivated plant worldwide after maize and rice, more than six millions tones being produced annually (ASSENG et al., 2011). It is nutritious, easy to store and transport and can be processed into various types of food (KUMAR et al., 2011). Wheat is considered a good source of protein, minerals, B-group vitamins and dietary fibers (SHEWRY, 2007). It is also known that grain yield is considered a quantitative character of high complexity, due to the fact that is influenced by several genes and involves a combination of numerous components, making difficult the direct selection of genotypes by low heritability that it presents (RIGATTI et al., 2018).

Regarding wheat fertilization, there is an absolute requirement for N for plant growth, crop yields and quality depending upon substantial N inputs (HAWKESFORD, 2014). A common agronomic practice to increase grain quality indices is the use of N fertilization in relation to plant nutrition status (WATERS et al., 2009; SALA, 2011). MOLL et al. (1982) defined Nitrogen use efficiency as grain dry matter yield per unit of N available (from the soil and/or fertilizer) and divided it into two components: N-uptake efficiency (crop N uptake/N available; UPE) and N-utilization efficiency (grain dry matter yield / crop N uptake; UTE). N-utilization efficiency is dependent on the N efficiency of biomass formation, nitrate reduction efficiency, the effect of N on carbohydrate partitioning and remobilization of N from senescent tissues as well as storage functions (GOOD et al., 2004; HIREL et al., 2007; LEA AND AZEVEDO, 2007). The N-efficiency in wheat is also strongly influenced by the level of soil PK and especially PK fertilization rate (SALA et al., 2016). The minimum N% in the biomass or grain at harvest will largely determine how much biomass or grain can be produced per unit of absorbed N (HAWKESFORD, 2014). Under high N supply, several global studies concluded that wheat breeding did not result in consistent improvements of nitrogen-uptake efficiency but in improved nitrogen-utilization efficiency associated with higher harvest index, for example in Argentina (CALDERINI et al., 1995) or in other countries (FEIL, 1992). In contrast, studies made in the UK (FOULKES et al., 1998), Mexico (ORTIZ-MONASTERIO et al., 1997) and Finland (MUURINEN et al., 2006) found that increases in nitrogen use efficiency were explained approximately equally by nitrogen-uptake efficiency and nitrogen-utilization efficiency (FOULKES et al., 2009). The N application rate (kg ha $^{-1}$ yr $^{-1}$) showed a curvilinear time trend, with a 50-year average of 52 for wheat (LADHA et al., 2016). More sustainable practices are needed in order to minimize the environmental impact of agricultural production and land use (LUDWIG et al., 2011).

The increase of nitrogen fertilization determines bigger nitrogen and gliadins amounts in grains and higher gluten and total protein contents (GODFREY et al., 2010). A substantial percentage of the N in wheat grain is supplied by amino acids remobilized from vegetative tissue (GREGERSEN et al., 2008). Much of this N content is derived from proteins that are disassembled and recycled during the leaf senescence stage of development (HOPKINS et al., 2007). A major focus of wheat breeders has been grain protein concentration as it affects bread- and pasta-making quality, micronutrient improvement receiving less attention (WATERS et al., 2009).

The aim of this study was to determine the aboveground biomass production for fresh and dry samples of wheat depending on N dose.

MATERIALS AND METHODS

The biological material to be analyzed was represented by samples belonging to the *Triticum aestivum* (L.) ssp *vulgare*, Ciprian cultivar. Wheat was cultivated in the Didactic Station of BUASVM Timișoara, Romania, where the soil can be characterized as a slightly gleized cambic chernozem (PÂSLEA AND SALA, 2012).

The experimental treatments consisted of five nitrogen fertilizer rates: 0, 50, 100, 150 and 200 kg active substance ha^{-1}.

Wheat plants were collected on May 2018. All the probes were intact and healthy. No visible damages were observed. The samples representing aerial parts of wheat plants, from a 30 cm row for each variant, were harvest and taken to the plant physiology laboratory. The probes were weighted using a Kern analytical balance, FW – fresh weight being obtained. The probes were then placed into an oven at 85 ^{o}C for 24 h. A reweighting after drying process conducted to dry weights – DW values. Data were processed using MS Excel 2013. Statistical analysis were performed using PAST software v3 (HAMMER et al., 2001). Linear regression was performed. Values lower than 0.05 were considered significant.

RESULTS AND DISCUSSION

This research aimed to determine the values of fresh biomass parameter for the local cultivar Ciprian. Fresh aboveground biomass increased proportionally with the increase of N dose (R^2 = 0.988) (Figure 1). The lowest value was recorded for N 0 probes (6016.0800 kg ha^{-}

^{1}). The highest value was obtained for N 200 probes (31533.4933 kg ha^{-1}). The variation of fresh biomass depending on the controlled dosage of N is best described by (1), statistical accuracy being assured (p= 0.00053, R^2=0.988, F=255.98).

It is a known fact that N availability is an important determinant of crop growth and productivity (VAN KEULEN et al., 1989). Under nonlimiting water supply, the N status of a crop is the major factor controlling the rate of biomass accumulation (JENSEN et al., 1990), and, at any given time, there is a strong relationship between N and biomass.

$$FB = 127.1x + 5763 \qquad (1)$$

x – N doses

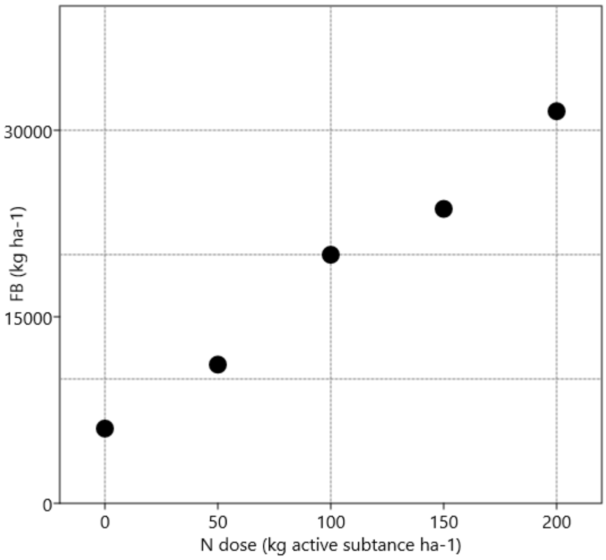

Figure 1. N dose (kg active substance ha^{-1}) influence on fresh aboveground biomass production

Dry aboveground biomass presented also an increase when the amount of ammonium azotate was supplemented (r^2 = 0.982) (Figure 2). The variation of dry biomass depending on the controlled dosage of N is described by (2), statistical accuracy being assured (p= 0.00053, R^2=0.988, F=255.98).

$$DB = 33.11x + 1523 \qquad (2)$$

x – N doses

The lowest values of this parameter were recorded for N 0 probes (1634.7467 kg / ha) and the highest value was noticed on N 200 samples (8435.1200 kg / ha). In addition, globally about 850 Tg of wheat residues are annually produced (TALEBNIA et al., 2010). The aboveground biomass is important because is the base of wheat straw which can be utilized in industry. Use of wheat straw for single production of bioethanol, biogas and biohydrogen has been demonstrated successfully (FAN et al., 2006; LINDE et al., 2007). Wheat straw like any other biomass of lignocellulosic composition is a complex mixture of cellulose, hemicellulose and lignin, as three main components, and a small amount of soluble substrates and ash (TALEBNIA et al., 2010). Sugars released from wheat straw by hydrothermal pretreatment were used for biofuels (bioethanol, biohydrogen and biogas) production based biorefinery successfully (KAPARAJU et al., 2009). Thus, biomass production studies are related to other uses of the wheat.

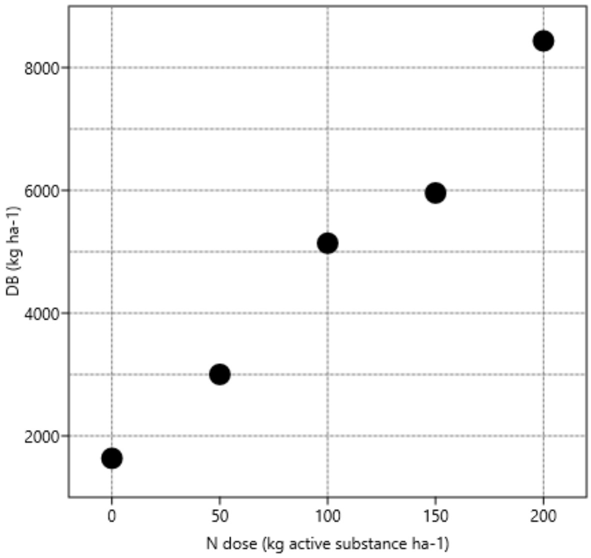

Figure 2. N dose (kg active substance ha^{-1}) on dry aboveground biomass production

CONCLUSIONS

The research was realized to determine the influence of ammonium azotate fertilization doses on the production of fresh and dry aboveground biomass.

Regarding the fresh biomass, a really clear trend was noticed. Thus, there is a strong interdependency between the N dose and the aerial mass of the wheat plant.

Moreover, this trend can also be noticed when the water is removed, after the drying process, organic and mineral substances increasing proportionally with the increase of active substance ha^{-1}.

ACKNOWLEDGEMENTS

The authors wish to thank Didactic Station of BUASVM Timișoara for providing equipment and support.

We also thank SCDA Lovrin for the wheat seed and West University of Timișoara, Faculty of Chemistry, Biology and Geography for research equipment and tools.

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