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INFLUENCE OF DIFFERENT FACTORS ON SOME BIOMETRICAL TRAITS AT TRITICALE

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Abstract

Triticale is a cereal species obtained by crossing the wheat with rye, and therefore it has specific traits between those of the parental species. There are two important factors in establishing the resistance to plant lodging: the plant height and thickness of straw. These two traits with importance upon the plant lodging are determined by the plant genetics and are influenced, between some limits, by the environmental and technological factors. In this respect, the aim of the paper is to present the results obtained at different triticale varieties under different technological and climatic conditions regarding the biometrical traits plant height and straw thickness. The experimental data were obtained in field experiments located in South Romania. In the agricultural year 2012-2013, ten triticale varieties were studied. In the agricultural year 2013-2014, two triticale varieties were studied under three technological conditions: two preceding crops (sunflower and maize); two soil tillage (ploughing and harrowing); six nitrogen application variants (respectively 0+0+0, 40+40+40, 40+80+0, 0+40+80, 0+80+40, and 0+120+0 kg.ha^{-1}). For each triticale variant and replication and in each experimental year, there were measured the plant height and stem diameter at soil level. The obtained results showed that the plant height and straw thickness do not correlate each other according to the triticale variety. But, for a given triticale variety, the plant height correlates negatively with the straw thickness, according to the plant water supply, preceding crop and soil tillage. However, nitrogen application determined the increasing of both studied plant traits, respectively the plant height and the straw thickness, the effect being different according to the split nitrogen applications.

Key words*: *environmental factors, plant height, straw thickness, technological factors, triticale, varieties

INTRODUCTION

Triticale (X *Triticosecale* Wittmack) is a new species obtained through crossing the wheat with rye. The first wheat and rye cross occurred in Scotland in 1875, but the first fertile crosses were realised in Germany in 1888, and the name triticale was first used in literature in Germany in 1935 [4].
This new species was designed to combine the good quality and high yielding capacity which is specific for wheat with the tolerance to abiotic and biotic stress factors which is specific for rye [7, 12]. As a result, triticale has specific traits between those of wheat and rye. For instance, an important feature of triticale is the resistance to some unfavourable biotic and abiotic environmental factors and the capacity to produce good yield in marginal regions [11, 13].
The interest in triticale increases due to its unique combination of a number of economic characteristics, such as: high grain yield, significant amount of the accumulated protein with a high content of essential amino acids, primarily lysine, as well as high degree of adaptive capacity [3].
In Romania, in 1971 it was initiated the breeding program for triticale species at National Agricultural Research and Development Institute (NARDI) Fundulea [5]. The first Romanian triticale cultivar created at Fundulea was TF2, which was registered in 1984 [10].
The specific growing conditions from South Romania are favourable for triticale crop [6], this being used both for producing grain and biomass yields.
The biometrical characteristics of the plants are specific traits to each variety, these being determined by the plant genetics and being influenced, between some limits, by the environmental and technological factors.
The plant height is very important in terms of resistance to lodging [4]. Also, an important factor in establishing the resistance to lodging

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is the thickness of straw, respectively the diameter of the stem.

In the NARDI Fundulea breeding programme, an important contribution in the yield improvement had the decrease of plant height from 128.8 cm to 114 cm (-0.871 cm/year), with favourable effects on the improvement of the lodging resistance [10]. The intensive triticale varieties with small plant height have better yielding performances than the extensive triticale varieties with high plant height [9].

Nitrogen fertiliser application at different plant stages has an essential effect on the height of stems [1]. Moreover, it is expected that also the other technological factors to have a certain influence on the biometric traits of the plant.

The aim of the paper is to present the results obtained at different triticale varieties under different technological and climatic conditions regarding the biometrical traits plant height and straw thickness.

MATERIALS AND METHODS

Researches were performed in the agricultural years 2012-2013 and 2013-2014, in field experiments located in South Romania, respectively in the specific conditions from Moara Domneasca Experimental Farm belonging to the University of Agronomic Sciences and Veterinary Medicine of Bucharest.

The specific soil in the studied area is reddish preluvosoil, with a humus content between 2.2 and 2.8%, a clay loam texture, and a pH between 6.2 and 6.6.

In the period September 2012 - June 2013, the average temperature was of 9.3^{o}C, and the sum of rainfall was of 225 mm. In the period September 2013 - June 2014, the average temperature was of 9.5^{o}C, and the sum of rainfall was of 572 mm.

In the agricultural year 2012-2013, ten triticale varieties were studied, respectively: Negoiu, Mezin, Cascador, Haiduc, Stil, Gorun 1, Polego, Tulus, Titan, and Oda. The sowing was performed on 16th of October 2012, at 12.5 cm row spacing, and at a density of 500 germinal seeds per square meter. The preceding crop was rapeseed and the soil tillage was ploughing. Fertilization was performed with 86 kg ha^{-1} of nitrogen and 40 kg ha^{-1} of phosphorus.

In the agricultural year 2013-2014, two triticale varieties were studied (Tulus and Gorun 1) under the following technological conditions: two preceding crops, respectively sunflower and maize; two soil tillage, respectively ploughing and harrowing; six nitrogen application variants, respectively 0+0+0 kg.ha^{-1}, 40+40+40 kg.ha^{-1}, 40+80+0 kg.ha^{-1}, 0+40+80 kg.ha^{-1}, 0+80+40 kg.ha^{-1}, and 0+120+0 kg.ha^{-1} (figures means the amount of nitrogen at first application + amount of nitrogen at second application + amount of nitrogen at third application). For the experimental variants with ploughing, the ploughing work was performed on 26th of September 2013, at a depth of 18 cm, after one harrowing work, and with one harrowing work after ploughing. For the experimental variants with harrowing, two harrowing works were performed on 26th of September 2013, at a depth of 12 cm. Seedbed preparation was performed on 29th of October 2013, and the sowing was performed in the same day, at 12.5 cm row spacing and at a density of 600 germinal seeds per square meter. Split nitrogen applications were the following: first application in the autumn, before seed bed preparation (on 29th of October, 2013); second application in the spring, in the tillering growing stage (on 14th of March, 2014); third application in the spring, in the two nodes growing stage (on 26th of April, 2014).

In both experimental years, the weed control was performed by using herbicides.

The plant height and stem diameter at soil level were measured at ten stems for each triticale variant and replication and in each experimental year. The experimental data were statistically processed by analyses of variance (ANOVA).

RESULTS AND DISCUSSIONS

Under the specific climatic conditions of the year 2013 and according to triticale variety, the plant height varied between 76.9 and 97.5 cm, with an average value for the ten studied varieties of 86.9 cm, and the diameter at the base of the stem varied between 4.33 and 5.07 mm, with an average value for the ten studied varieties of 4.68 mm [8]. The values for the plant height registered in 2013 are lower than those reported by other authors in Romania because of the low rainfall recorded this year. Thus, Draghici [5] found for twelve triticale varieties tasted in the period 2009-2011 on sandy soils conditions from Dabuleni, in South Romania, a variation of the plant height from 86.3 to 106 cm, with an average value for the studied varieties of 93 cm. Pochişcanu et al. [14] found for six triticale varieties tasted in the period 2007-2012 on a cambic chernozem located at A.R.D.S. Secuieni, Neamţ county from Romania, a variation of the plant height from 89 to 110 cm, with an average value for the studied varieties of 104.8 cm.

Analysing the experimental data at the ten studied triticale varieties in 2013, it was found that plant height and diameter at the base of the stem do not correlate each other (Fig. 1). That means there are some triticale varieties with tall plant and thick straw, but also there are triticale varieties with tall plant and thin straw, and vice versa.

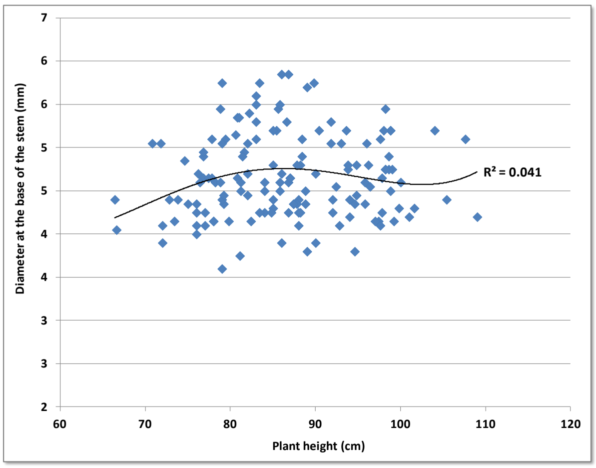

Fig. 1. Correlation between plant height (cm) and diameter at the base of the stem (mm) at the studied triticale varieties (2013)
Source: Own determinations

However, it is interesting to notice that there is a slight tendency for the plants with the height between 80 and 90 cm to have thicker straw. This means that in practice, these triticale varieties could have a higher resistance at the plant lodging process. These findings need to have further evaluations through testing an assortment of triticale varieties in different climatic and soil conditions.

The better climatic conditions of 2014 compared to 2013, especially concerning the much better water supply from rainfall, determined a significant increase in the plant height at both triticale varieties, respectively Gorun 1 and Tulus (Fig. 2). But, the increasing in plant height was associated with a decrease of the diameter at the base of the stem for both studied varieties of triticale. These findings lead to the conclusion that, for a given triticale variety, the plant height correlates negatively with the thickness of straw according to the plant water supply.

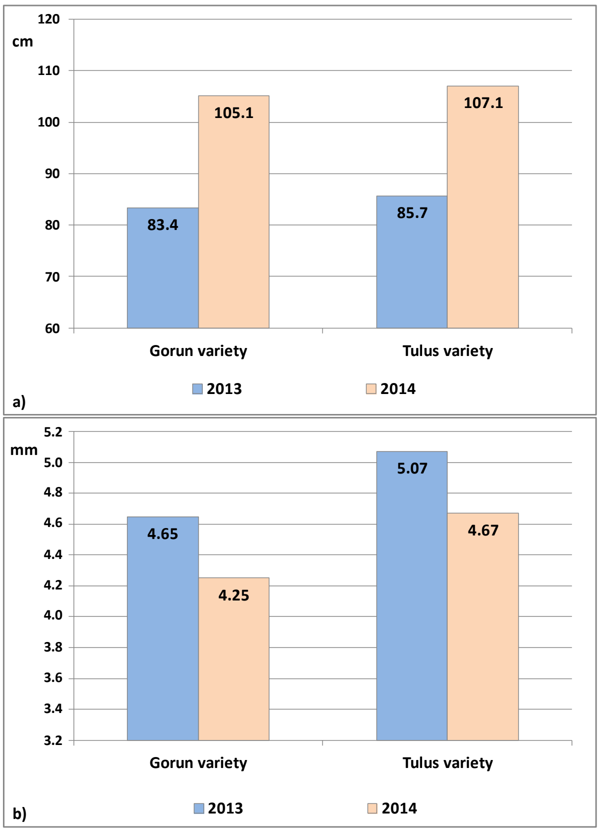

Fig. 2. Biometrical determinations at two triticale varieties under the different climatic conditions of 2013 and 2014: a) plant height; b) diameter at the base of the stem
Source: Own determinations

Nitrogen application has as consequence the increasing of the plant height and the diameter at the base of the plant (Fig. 3). So, both plant traits, respectively plant height and straw thickness, correlate positively with nitrogen application. Nevertheless, the effect is different according to the split nitrogen applications.

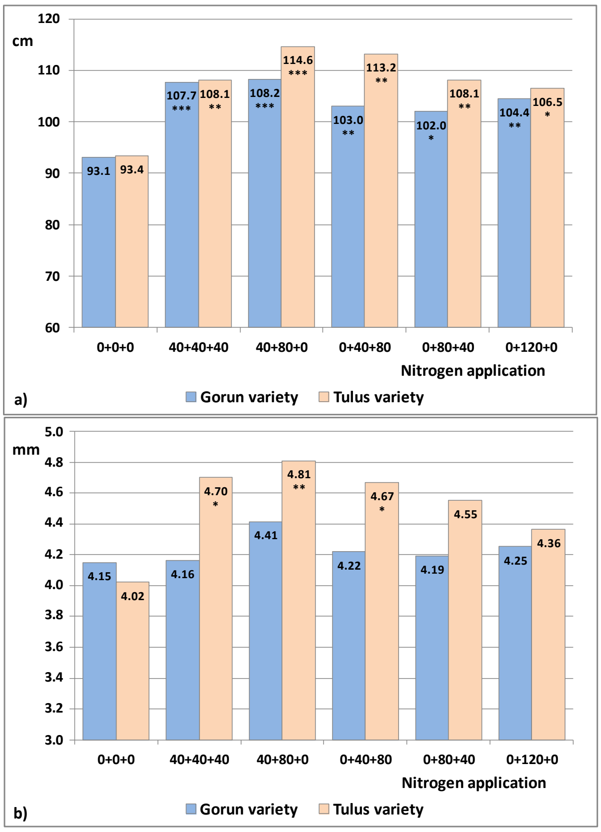

Fig. 3. Biometrical determinations at two triticale varieties under different nitrogen split applications (2014): a) plant height; b) diameter at the base of the stem

Source: Own determinations

The highest value of the plant height and the highest value of the diameter at the base of the plant were registered at the nitrogen split 40+80+0, respectively 40 kg.ha^{-1} of nitrogen applied in autumn before seedbed preparation, 80 kg.ha^{-1} of nitrogen applied in spring in the tillering growing stage, and 0 kg.ha^{-1} of nitrogen applied in spring in the two nodes growing stage.

It has to be emphasized that the nitrogen application, but also the split nitrogen applications has a similar effect both on the plant height and the diameter at the base of the plant. However, compared to the unfertilised variant (0+0+0), all the split applications of nitrogen determined differences statistically significant for the plant height. As concerning the diameter at the base of the plant, only the split applications 40+40+40, 40+80+0 and 0+40+80 determined differences statistically significant and only at Tulus variety. Given these results, it can be concluded that the split nitrogen applications have a more significant effect upon the plant height than upon the thickness of straw.

The two triticale variety reacted differently at nitrogen application and at the split applications.

Among the two studied preceding crops, sunflower determined higher triticale plant heights but thinner straw, while maize determined smaller triticale plant heights but thicker straw (Fig. 4). It is interesting to notice that, according to preceding crop, the plant height correlate negatively with the diameter at the base of the stem.

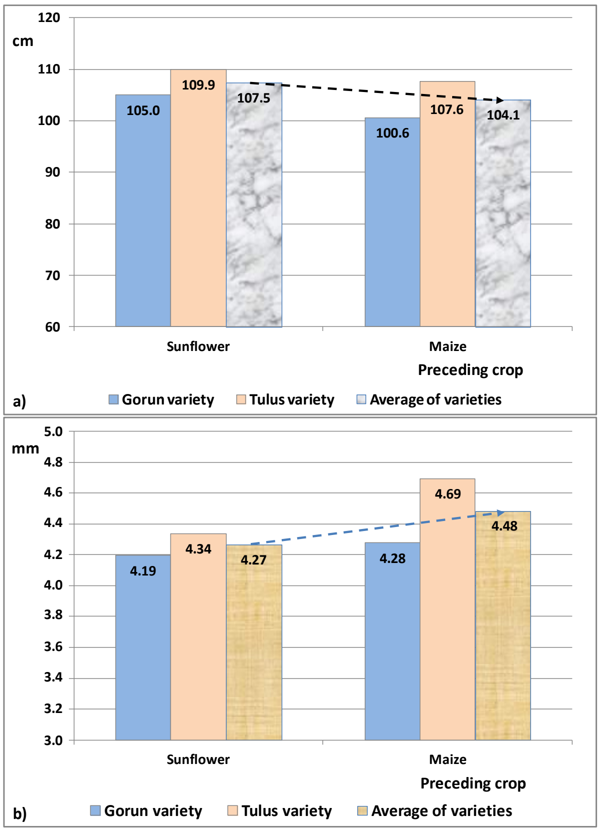

Fig. 4. Biometrical determinations at two triticale varieties under different preceding crop conditions (2014): a) plant height; b) diameter at the base of the stem

Source: Own determinations

Among the two studied soil tillage, harrowing determined higher triticale plant heights but thinner straw, while ploughing determined smaller triticale plant heights but thicker straw (Fig. 5). As in the case of the preceding crop, it is interesting to notice that, according to soil tillage, the plant height correlate negatively with the diameter at the base of the stem.

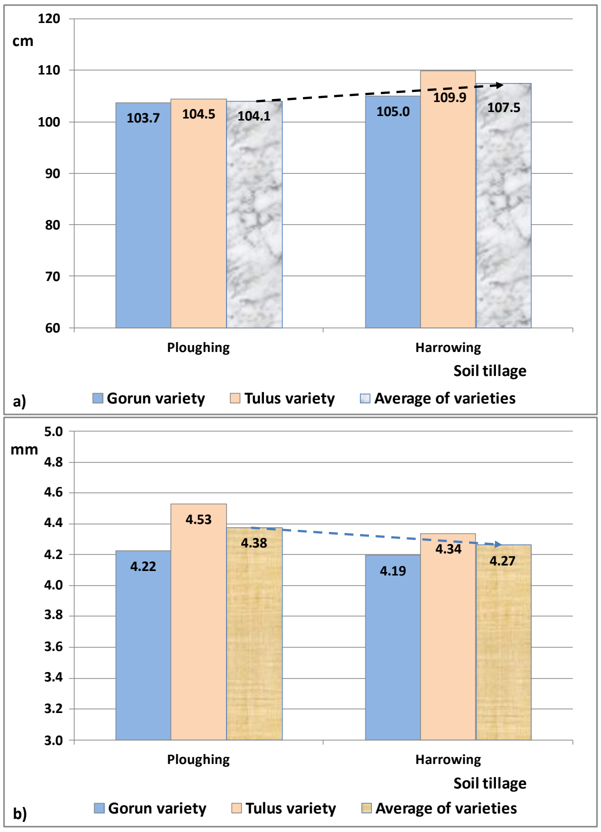

Fig. 5. Biometrical determinations at two triticale varieties under different soil tillage conditions (2014): a) plant height; b) diameter at the base of the stem
Source: Own determinations

CONCLUSIONS

The plant height and straw thickness do not correlate each other according to the triticale variety.

For a given triticale variety, the plant height correlates negatively with the straw thickness, according to the plant water supply.

Nitrogen application determined the increasing of both studied plant traits, respectively the plant height and the straw thickness. However, the effect is different according to the split nitrogen applications. In our study, the highest values were registered at the nitrogen split 40+80, respectively 40 kg.ha^{-1} of nitrogen applied in autumn before seedbed preparation and 80 kg.ha^{-1} of nitrogen applied in spring in the tillering growing stage.

The split nitrogen applications determined a more significant effect upon the plant height than upon the thickness of straw.

The preceding crop and the soil tillage determined specific biometrical characteristics of the triticale plants. According to preceding crop and soil tillage, the plant height correlate negatively with the straw thickness.

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