IMPACT OF MINERAL FERTILISATION ON PLANT SIZE AND ON FALL IN WINTER WHEAT

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Abstract*. Plant size in winter wheat, a genetically-determined feature, is directly impacted by vegetation and technological factors such as fertiliser rate and particularly nitrogen fertiliser rates. Re-search carried out aimed at assessing the level of interdependence between fertilisation system and plant size in winter wheat as well as fall risks caused by the fertilisers. Fertilisation was done with nitrogen rates ranging between 0 and 200 kg of active substance per ha both alone and associated with phosphorus and potassium at rates between 0 and 150 kg of active substance per ha. In the stem, in the area of basal internodes, there is also accumulation of tension and, when the tissues have a poor mechanical resistance because of cell elongation, break risks increase in the stem. Another area of accumulation of tension in the stem is at soil level, in the roots, where there can also be mechanical actions of tissue damage. Plants responded to mineral fertilisers by different growth of the stem until kernel appearance and until maturity depending on the fertiliser rate and on the type of fertiliser applied. Plant size ranging between 74.6 cm in the control variant (not treated) and 88.90 cm in the variant treated with $N_{150}P_{150}K_{150}$ in the year 2009 and 85.76 cm in the control variant (not treated) and 99.53 cm in the variant treated with $N_{200}P_{100}K_{100}$ in the year 2010. Fall risk occurs in rates over 150 kg/ha of nitrogen when applied unilaterally and also under environmental conditions that enhance tensions generated in the stem and increase sensitivity to fall.*

Keywords*: mineral fertilizers, fertilization system, winter wheat stem, cereal fall, correlations*

INTRODUCTION

Winter wheat is a crop with moderate requirements in nutrients, but optimal fertilisation ensures plant growth and plant normal development, and high quality yield, SALA *et al.* 2007, SALA *et al.* 2009.

Plant size is genetically determined and directly influenced by vegetation and technological factors, mainly by fertiliser rates and particularly by nitrogen, a macro-element directly involved in the plants' vegetative growth. High rates of fertilisers determine winter wheat size increase while unbalanced or unilateral fertilisation with nitrogen results in stem elongation, weakening of mechanic tissues, and fall risk with bad impact on yield level, BINGRU et al. 1992, ZDENKA NATROVA 2006.

Winter wheat fall resistance is given by the tissues in the stem parenchyma and a poor development of the latter determines stem sensitivity and break and fall risk increase, HOGAN et HENDRIX 1986, JIAN ZHU JINMAO *et al*. 2006.

Within our research, we ensured a technological level for the proper maintenance of the crop to be able to observe the impact of a variable factor, i.e. fertilisation, on plant size and fall resistance.

MATERIAL AND METHOD

We monitored the growth and development of plants and particularly size and fall resistance under the impact of different assortments of simple mineral fertilisers containing basic macro-elements (N, P, K) applied at different rates and in different combinations.

The biological material was represented by the winter wheat cultivar Alex (*Triticum* *aestivum.* ssp. *vulgare*), adapted for the western part of the country and with good yield results.

The natural trial frame is characterised by the soil and climate conditions of the Didactic Station in Timisoara, representative for the Banat Plain. The soil is of the cambic phaesiom type (cambic chernozem), poorly gleyied and with neuter reaction (pH = 6.65-6.8), good supply in humus (H = 3.26), a nitrogen index NI = 3.12, a high base saturation degree (above 85-87%), poor supply in mobile phosphorus (P_{AL} = 17.81 ppm) and medium supply in potassium (K = 129.7 ppm).

The trials were of the bi-factorial type 4x5 set on subdivided plots:

Factor A: phosphorus and potassium fertilisation:	Factor B: nitrogen fertilisation
$a_1 - P_0K_0$ – control	$b_1 - N_0$
$a_2 - P_{50}K_{50}$	$b_2 - N_{50}$
$a_3 - P_{100}K_{100}$	$b_3 - N_{100}$
$a_4 - P_{150}K_{150}$	$b_4 - N_{150}$
	$b_5 - N_{200}$

Climate conditions can be characterised by multiannual average values of 603.3 mm rainfall and by temperatures of 10.9°C; the specificity during the trial period resulted in different valorisation of the fertilisers and in different response from the plants in size and fall risk.

RESULTS AND DISCUSSION

Assessing plant size was done through biometrical measurements, after complete kernel formation, during the vegetation phases 65-73 cod bbch. During this period, mechanical requirements from the stem are higher because of intrinsic forces, because of spike weight, and because of the multiplication of these forces under the action of some external factors (wind, rainfall etc.).

The weight centre as a result of the changes in kernel weight after the filling of the grains sets along the last internode. At the same time, there are new pressures on the stem because of some external factors, because of the movement of the air masses, and because of the rainfalls.

In the stem, in the area of basal internodes, there is also accumulation of tension and, when the tissues have a poor mechanical resistance because of cell elongation, break risks increase in the stem (Figure 1).

Another area of accumulation of tension in the stem is at soil level, in the roots, where there can also be mechanical actions of tissue damage.

Plants responded to mineral fertilisers by different growth of the stem until kernel appearance and until maturity depending on the fertiliser rate and on the type of fertiliser applied.

In the year 2009, average winter wheat plant size oscillated between 74.6 cm in the control variant (not fertilised) and 88.90 cm in the variant treated with $N_{150}P_{150}K_{150}$ (Figure 2). Though, under normal conditions, plant size in the winter wheat cultivar Alex is higher (95-110 cm), the agricultural year 2008-2009, a year that lacked rainfall in April-May, resulted in a lower increase of plant size. There was no plant fall whatsoever.

In the year 2010, the rich rainfall during the spring ensured better conditions for the valorisation of fertilisers in general and for plant growth in particular, the latter having a higher size than in the previous year, with differences between the variants as a result of fertiliser rates.

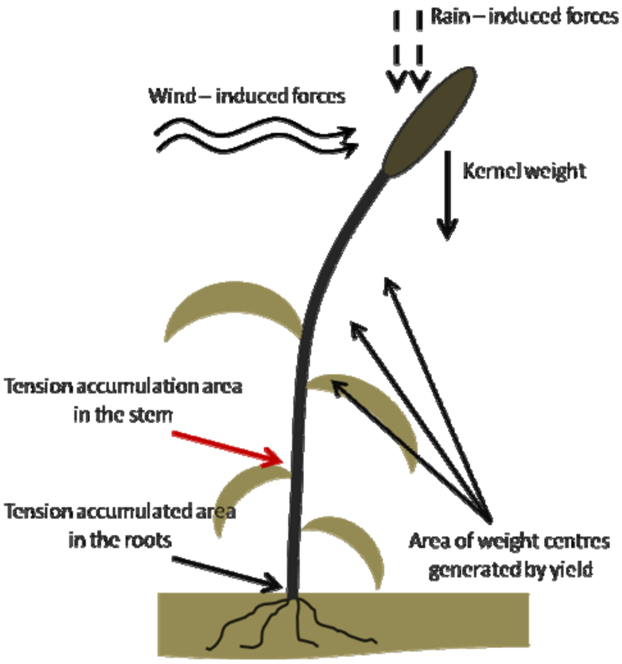

Fig. 1. Areas where tension and breaking sensitivity in winter wheat stem cumulate.

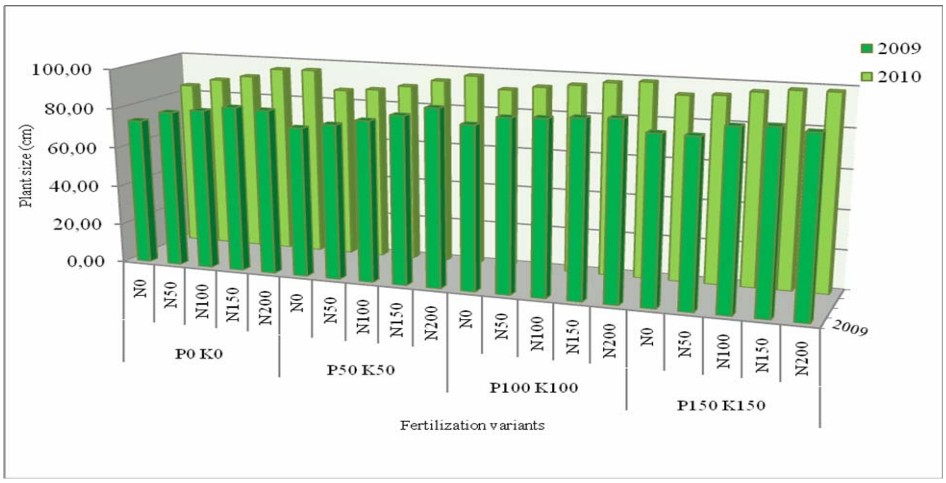

Fig. 2. Graph of plant size in the winter wheat cultivar *Alex* under the impact of fertiliser rates at the Didactic Station in Timisoara (2009-2010)

Thus, average winter wheat plant size oscillated between 85.76 cm in the control variant (not treated) and 99.53 cm in the variant treated with $N_{200}P_{100}K_{100}$.

Plant size increase as a result of increased nitrogen fertiliser rates also resulted in a weakening of the stem structure of resistance, which led to plant fall.

This phenomenon was also in the trials including high rates of nitrogen fertiliser (150-200 kg/ha) applied unilaterally (Figure 3).

Fig. 3. Plant fall in the winter wheat cultivar Alex, under the impact of high rates of nitrogen fertiliser applied unilaterally ($N_{200}P_0K_0$).

CONCLUSIONS

Research carried out pointed out the different impacts of fertiliser assortments and rates applied in different combinations to fertilise winter wheat under the soil and climate conditions of the Didactic Station in Timisoara.

Winter wheat plant stems cumulate a series of forces and tensions as a result of the changing of kernel weight and of the action of external forces given by the movement of the air masses and by the rainfalls.

High rates of fertiliser results in an increase in plant size ranging between 74.6 cm in the control variant (not treated) and 88.90 cm in the variant treated with $N_{150}P_{150}K_{150}$ in the year 2009 and 85.76 cm in the control variant (not treated) and 99.53 cm in the variant treated with $N_{200}P_{100}K_{100}$ in the year 2010.

In unilateral nitrogen fertilisation, the stem is both longer and it has a weaker structure of resistance which results in fall risk, a phenomenon noticed in 2010.

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