FOLIAR APPLICATION OF NPK + POLIHEXOSE IN THE CULTURE OF WHEAT

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ABSTRACT: This study aimed to evaluate the response of wheat to the application of NPK + POLIHEXOSE leaves. The experiment was conducted in the municipality of Maripá - PR, between the months of April and August 2008. The experimental design was randomized blocks with five replications. Treatments consisted of application of four doses (0, 2.5, 5.0 and 10.0 L ha\textsuperscript{-1}) of a foliar fertilizer containing 15\% nitrogen (N), 10\% Phosphorus (P) 15 \% potassium (K) and the presence of POLIHEXOSE. The foliar applications were divided into two phases, the first at the beginning of the tillering stage and the second in the early boot stage. And is performed with a backpack sprayer pressurized with CO\textsubscript{2}, and with a volume of 165 L ha\textsuperscript{-1}. The results obtained showed that the parameters plant height, stem diameter, peduncle length, spike length, insertion of the flag leaf, weight (PH), number of grains per spike, number of spikelets per spike and grain number per spikelet were not influenced significantly by foliar application of increasing doses of NPK + POLIHEXOSE. The foliar application of NPK + POLIHEXOSE provided linear increments about mass of spike, 1000 grain weight, grain weight per spike and yield of wheat.
The dose of 10 L ha\(^{-1}\) of solution containing NPK + POLIHEXOSE was not enough for obtained maximum productivity.

**Key-words:** *Triticum aestivum*, L.; gibberellins; macronutrients; foliar application.

**INTRODUCTION**

The wheat (*Triticum aestivum* L.) is considered a product of strategic importance for many countries, assuming an important role in the field, either as an option in crop rotation, as too in the generation and multiplication of income in other components of the productive chain as seed production, the industry of machinery and inputs, processing and services (COSTA, 2008).
Nutritionally, the wheat plants demand greater amount of macronutrients nitrogen (N) and potassium (K) (PAULETTI, 1998). Wendling et al. (2007) point out that the N per be absorbed in large quantities by wheat usually is not supplied in the required amount and the physiological state required.

Freitas et al. (2000) detach that the wheat grown in Brazil, when established in succession to other grasses, has in the deficiency of N the factor that most limiting grain yield, followed by P deficiency.

The K is essential for growth, development and maturation of grains and fruits of plants. According to Meurer (2006) this element has important function in the energy state of the plant, in translocation and storage of assimilates and in the maintenance of water in plant tissues.

In plants the P participates of several metabolic processes, such as energy transfer, synthesis of nucleic acids, glucose, respiration, synthesis and membrane stability, activation and deactivation of enzymes, redox reactions, carbohydrate metabolism and N\textsubscript{2} fixation (VANCE et al., 2003).

The foliar fertilization is a form of nutrition supplement to soil fertilization, adding also that there should be the concern in apply soil fertilizers that provide other nutrients beyond the NPK.

Among the advantages of foliar fertilization stand out the application of specific nutrient at the stage in that plant has greater demand, stimulates plant metabolism due to rapid absorption and utilization of nutrients, providing stimulus in formation of amino acids, proteins, chlorophyll, etc.

Aiming to increase the efficiency of foliar fertilization on the market currently, there are formulations of foliar fertilizer that has in its composition substances that act as catalysts for increasing the rate of absorption of nutrients by plant foliage, also increase the adhesive strength of fertilizer on the sheet by reducing losses by evaporation,
rain and other factors beyond the function of plant growth regulator, being that in its composition can be found plant hormones. As example of these substances can be cited POLIHEXOSE. Pompei (2007) reports that in plants that received foliar application of nutrients along with POLIHEXOSE the amount of nutrient increased from two to three times regarding of plants that received foliar application of nutrients, without POLIHEXOSE.

There is great product offering considered as multifunctional that acting simultaneously as fertilizers and plant protectors, being made up of nutrients, amino acids, activators of growth and/or antimicrobial substances. However, the rational use of these products still needs to criteria based on scientific research, because the agronomic efficiency of them often is not confirmed for different combinations of environments, cultures and management systems.

Based on the above, this study aims to evaluate the response of wheat to foliar application of NPK associated to POLIHEXOSE in western Paraná.

**MATERIAL AND METHODS**

The experiment was conducted at the Estância Zoz farm, municipality of Maripá, PR (53 ° 44'W, 24 ° 22'S and 380 m altitude), in an area of no-tillage system in force for 12 years. Before of the deployment of experiment the area was cultivated with succession soybeans and corn in crop year 2007/2008.

The soil of the area is classified as Oxisol of very clayey texture. Before of deployment of the experiment, were quantified chemical and textural characteristics of soil, that are presented in Tables 1 and 2.
Table 1. Chemical analysis\(^{(1)}\) of the Oxisol in layers of 0-20 and 20-40 cm before the deployment of the experiment. Maripá - PR, 2008

<table>
<thead>
<tr>
<th>Layer</th>
<th>Ca</th>
<th>Mg</th>
<th>K</th>
<th>Al</th>
<th>H+Al</th>
<th>SB</th>
<th>CTC</th>
<th>MO</th>
<th>V</th>
<th>Al</th>
<th>P</th>
<th>pH CaCl₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>cm</td>
<td>cmol c dm⁻³</td>
<td>g dm⁻³</td>
<td>%</td>
<td>mg dm⁻³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-20</td>
<td>7,01</td>
<td>1,17</td>
<td>0,71</td>
<td>0,00</td>
<td>4,96</td>
<td>8,89</td>
<td>13,85</td>
<td>31,97</td>
<td>64,19</td>
<td>0,00</td>
<td>21,29</td>
<td>5,10</td>
</tr>
<tr>
<td>20-40</td>
<td>7,10</td>
<td>1,93</td>
<td>0,75</td>
<td>0,00</td>
<td>5,76</td>
<td>9,78</td>
<td>15,54</td>
<td>25,49</td>
<td>62,93</td>
<td>0,00</td>
<td>10,40</td>
<td>4,90</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Methodology adopted by IAPAR (Pavan et al., 1992).

Table 2. Granulometric analysis\(^{(1)}\) of the Oxisol in layer of 0-20 cm, before the deployment of the experiment. Maripá - PR, 2008

<table>
<thead>
<tr>
<th></th>
<th>Sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>g kg⁻¹</td>
<td>103</td>
<td>123,4</td>
<td>773,6</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Determined by the method of pipette as EMBRAPA (1997).

The climate of region, according to the classification of Köppen, is the type Cfa, subtropical humid (mesothermal), hot summers with a trend of concentration of rainfall (average temperature above 22 °C), winters with infrequent frosts (average temperature below 18 °C), without definite season. The data of pluviometric precipitation during the experiment are shown in Figure 1. During the conduct of experiment, the total precipitation was 533 mm.
The experimental design used was randomized block with 5 replications. The treatments consisted of applying four doses (0, 2.5, 5.0, 10.0 L ha⁻¹) of a ionized solution with density of 1.40 g mL⁻¹, containing 15% nitrogen (N), 10% phosphorus (P), 15% potassium (K) + POLIHEXOSE, registered commercially as Ubyfol L-15®. The applications were divided into two phases, the first in stage of tillering and the second in the beginning booting stage, being performed with a backpack sprayer pressurized with CO₂, with spray volume of 165 L ha⁻¹.

The plots consisted of 10 rows with 6 m long, totaling an area of 9 m². For the evaluation we used the six central rows disregarding one meter at each end of the plot.

The sowing was realized on 26/04/08. The row spacing used was 15 cm, with population density of 300 seeds per square meter. The seeds were treated with insecticide and fungicide. The basic fertilization was performed by applying 500 kg ha⁻¹ of formulation 04-20-20, to provide 20 kg ha⁻¹ of N, 100 kg ha⁻¹ of P₂O₅ and 100 kg ha⁻¹ of K₂O respectively. According to chemical analysis of soil was not needed liming.
During the conduct of experiment was done two preventive applications of fungicide and two applications for insect control with the combination of an insecticide contact and a systemic.

The topdressing fertilization was performed in the beginning of tillering stage, applying 80 kg ha\(^{-1}\) of N under form of urea.

The wheat cultivar used was CD 104 which has the following characteristics: average cycle, average height of 81 cm, improved wheat, average gluten strength (W) of 360, moderately sensitive to aluminum, demanding soil of medium to high fertility.

Were collected 10 spikes randomly within each plot to make assessments of: mass of spike, grain mass per spike, number of grains per spike, number of spikelets per spike and number of grains per spikelet.

Also were selected 10 plants at random within the area useful for making assessments of: plant height (the distance between the neck of the plant to apex of the spike), height of insertion of the flag leaf (distance between the neck of the plant until the sheath the flag leaf), spike length (distance between the base and apex of the spike), peduncle length (distance between the flag leaf sheath and base of the spike), stem diameter (measured at the middle third of the first internode with a digital caliper), number of spikes per m\(^2\), (marked two linear meters of each parcel, and proceeding to count spikes and converted to spikes per m\(^2\) ). The remaining plants of useful area each parcel were cut and after of the track, cleaning and weighing of grain, the data were corrected to 13% moisture and converted to yield in kg ha\(^{-1}\). To obtain the mass of 1000 grains were collected eight samples of 100 grains of each plot, and weighed with a precision scale.

The data were submitted to analysis of variance, and the medium adjusted to the regression equations. For data
processing we used the statistical software SISVAR version 4.0 (FERREIRA, 2000).

RESULTS AND DISCUSSION

The parameters plant height, stem diameter, stem length, spike length, insertion of the flag leaf, test weight, number of grains per spike, number of spikelets per spike and number of grains per spike were not affected significantly by foliar application of increasing doses of NPK + POLIHEXOSE.

Zagonel (2002) evaluating the interaction between nitrogen levels, population densities and growth regulators in wheat, also found no significant difference in plant height and stem diameter regarding to nitrogen levels.

It is importantly detach that the stem diameter is related to lodging, being that the largest diameter of the stem gives the plant more resistance to lodging.

The height of insertion of the flag leaf is directly linked to plant height, so as to plant height not presented significantly difference, expected to repeat the same with the height of insertion of the flag leaf, which in fact occurred.

The flag leaf is essentially important for wheat, Rawson et al. (1983), and Rawson et al. (2004), report that the flag leaf of wheat is the main source of assimilates to the grain.

In Figure 2a it can be seen that the number of spikes per square meter decreased (p <0.05) regarding of foliar application of increasing doses of NPK + POLIHEXOSE, being that for each liter of fertilizer applied there was a reduction of 11, 45 spikes per m². This variable is directly related to the number of viable tillers per plant, thus it can be seen that there was lower production of tillers per plant.
Figure 2. Number of spikes per square meter (a) mass of 1000 grains (b) mass of spike (c) and mass grains per spike (d) of wheat regarding to the leaf application of NPK + POLIHEXOSE. Maripá - PR, 2008. (** significant at 1% by Tukey test, C.V. = coefficient of variation).

This reduction in the number of tillers is probably not related to the application of NPK of the product, but with the hormone present in POLIHEXOSE. The POLIHEXOSE contains in its formulation components that will likely affected the hormonal balance of wheat that reduced the number of tillers.

It is important to emphasize that the POLIHEXOSE has in its composition the hormone gibberellin. According to Taiz and Zeiger (2009) some types of gibberellin, as the GA3 regulate the transition from juvenile phase to the reproductive phase, the gibberellin may have accelerated the transition from juvenile phase to the reproductive phase as was observed by Taiz and Zeiger (2009) in some conifers, and thus shortened the period of tillering of wheat, and consequently reducing the number of spikes per square meter.

In Figure 2b can be seen that the mass of 1000 grains increased linearly with increasing the dose NPK + POLIHEXOSE. There was an increase in mass of 15.18% in the treatment with
application of 10 L ha⁻¹ compared with treatment without applied of NPK + POLIHEXOSE.

Nitrogen fertilization increases the mass of 1000 grains, but second Borrell and Hammer (2000) the nitrogen absorbed of the soil is unable to sustain the demand of N by grains, then occurs acceleration the process of senescence, with increase the remobilization of N leaves and to lesser extent, of the stem.

Del Molino (1992) observed in wheat that, after anthesis the grains are the main drain of N from the leaves, therefore the leaf senescence that occurs during the grain filling is very important for grain yield and protein content. And considering that the number of tillers was lower, decreased the number of drains the which possibly increased the mass of 1000 grains.

Barneix and Guitman (1993) also observed that the biosynthesis of protein in wheat grains is dependent on the amount of amino acids in leaves and that the increased levels of amino acids present in leaves could increase the export of amino acids to the grain.

Based on this assumption the nitrogen present in the formulation of NPK + POLIHEXOSE applied, was probably translocated to the grains in order to meet the demand of grains and consequently increasing the mass of 1000 grains.

The mass of spikes (Figure 2c) and the mass of grains per spikes (Figure 2d) increased linearly regarding increasing doses of NPK + POLIHEXOSE. This can be explained by the decrease in the number of viable tillers, due to source-sink relationship of plant. The spike is a physiological drain, with the decrease in the number of drains (spikes per m²) which can be verified in Figure 2, the plant concentrates assimilates, and consequently increases the mass of each drain (spike).
There was increase (p < 0.05) in the productivity of wheat with application of increasing doses of NPK + POLIHEXOSE (Figure 3), probably due to increased mass of spike, grain mass per spike and 1000 grain mass, since the number of plants per square meter decreased with increasing dose of fertilizer.

Figure 3. Wheat yield regarding to the leaf application of NPK + POLIHEXOSE. Maripá - PR, 2008. (** significant at 1% by Tukey test, C.V. = coefficient of variation).

Zagonel et al. (2002) also observed increase in productivity with nitrogen application on wheat, but in this work the number of plants per square meter was responsible for the increase in production due to the fact that for the mass of 1000 grains did not show significant difference. Freitas et al. (1994) worked with three wheat genotypes and observed increase in productivity with the application of increasing doses of N in the soil.

Carvalho et al. (2001) evaluated the foliar application of nitrogen and potassium in addition to sowing fertilization on cotton, and found that the N promoted increase in yield, but the same was not observed for the K.

Camargo (1984) also found significant difference in wheat yield for different levels of P in nutrient solution. Rezende et al. (2005) evaluated the effect of leaf application of P at different stages of soybeans, and found significant increase.
of up to 16% yield with leaf application of phosphorus compared to the control.

CONCLUSION

The foliar application of NPK + POLIHEXOSE promotes increased wheat yield and the dose 10 L ha−1 of solution containing NPK + POLIHEXOSE was not enough for obtained maximum productivity.

REFERENCES


