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Morphological and yield components of wheat due to the splitting and sources nitrogen

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ABSTRACT

Background: The parceling of nitrogen fertilization seeks increase nitrogen absorption efficiency in wheat crop, which reflects directly on the morphological components and grain yield. **Objective:** This study aims was to determine the effect of parceling and nitrogen sources applied in coverage in morphological components and yield, in wheat genotypes grown in two crop years. **Methods:** The assay was conducted in the experimental field of the Plant Breeding Laboratory and Plant Production in crop years 2012 and 2013. The experimental design was split plot, six parceling of nitrogen applied in top dressing three nitrogen sources and five wheat genotypes. The variables evaluated were: spike insertion height, plant height, spike length, grain mass of spike of main stem. **Results:** The parceling involving fractionation of nitrogen applied to coverage the tillering and stem extension stages result in major increases in plant height. The parceling and nitrogen sources mutually influence each other spike length and grain mass of spike of main stem, thus, the effects of nitrogen parceling applications at different plant growth stages vary with the intrinsic characteristics of nitrogen source used. The ammonia nitrate applied in parceling in stem extension and flowering stages influenced positively in the grain mass of main stem.The traits spike length and the grain mass of spike of main stem were significantly influenced by the used genotypes and crop years. To the spike insertion height, the nitrogen parceling coverage including managements parceled in tillering stage are equivalent to application single dose of nitrogen in tillering, however, the parceling that does not include applications in the tillering stage resulted in lower increase of this trait. The absence of interaction between nitrogen parceling and genotypes for spike insertion height and plant height indicated that the response of genotypes front of the parceling occurs in a similar way, with this, the tested genotypes showed similar direction in response, but different magnitudes for the traits, the as it changes the nitrogen parceling. **Conclusions:** The nitrogen parceling in the tillering and stem extension stages are more efficient to increase the plant height, spike length and spike insertion height, yet parceling in stem extension and flowering stages result in increase in the grain mass of spike of main stem. The ammonia nitrate stands out as an alternative to replace the urea nitrogen applications in coverage in the wheat crop.

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INTRODUCTION

The wheat (*Triticumaestivum* L.) is a grass belonging to the family of Poaceae, characterized by the annual cycle and cultivation in winter and spring (Brum and Heck, 2005). Because of the high demand for its products, in which it highlights the various types of flours. Wheat is the second cereal longer produced in world agricultural context (Pinnow *et al*., 2013).In the year 2015, Brazil grew about 2.75 million hectares of this cereal, and the South Region held the largest area cultivated (Conab, 2015). However, cultivation is expanding to the Midwest region of the country, from the development of new genotypes for specific climatic conditions of the region, with increasing trends of the area sown with cereal in the country.

As an alternative to increasing crop yield, it has searched more productive genotypes, with tolerance to biotic and abiotic factors, efficient in the use of light and nutrients, and exhibit favorable traits for industrialization (Freo *et al*., 2011). However, along with the breeding culture is necessary to improve the growth environment and the handling techniques used in such a way that both factors simultaneously improved, resulting in increase in productivity and technological quality of grain.

Among the management techniques that need to be improved, it highlights the mineral nutrition of plants, due to the wheat crop demand large amounts of nutrients in order to obtain high yields and technological quality of grain. Among the greater demand for nutrients by culture, nitrogen is considered the most important because it is the precursor of biochemical processes, structural constituent of proteins, enzymes, nucleic acid, and chlorophyll molecules, responsible for promoting the growth and development of plants, protein content and grain yield (Jan *et al*., 2011; Kong*et al*., 2013).

The nitrogen applications in coverage require precautions depending on the climatic factors the cropping system, the dose and sources used, as the nitrogen cycle in the soil is distinct from other nutrients (Cantarella, 2007; Wiethölter, 2011). Thus, the use of managements aimed at increasing efficiency is needed, reduce losses and improve the availability of nitrogen in stadiums that have greater demand for the nutrient.

Among managements, parceling of nitrogen applied to coverage the wheat crop provides increased efficiency because of the low initial demand, high probability losses through lixiviation and / or volatilization, denitrification and salinity level of fertilizers in order to reduce damage to the environment and to maximize plant uptake (Teixeira Filho *et al*., 2010). Consequently, the fragmentation of nitrogen fertilization, favors the performance of grain yield components (Costa *et al*., 2013).

Morphological and yield components of wheat, such as plant height, spike insertion height, spike length and grain mass of spikes are highly responsive to nitrogen application in coverage, and these have direct and indirect effects on yield grains. Studies done by Pires *et al*. (2011), Teixeira Filho *et al*. (2011), Costa *et al*. (2013) and Orso *et al*. (2014) point out that the parceling of nitrogen applied in coverage is a strategy to increase the morphological and grain yield traits in wheat. However, the same authors diverge in relation stages of plant in which to carry out the parceling of nitrogen and the number of parcelins, considering the answer modified to measure that change soil and climatic conditions, the nitrogen sources used and cultivated genotypes.

Among the nitrogen sources, urea ($(NH_2)_2CO$) stands out as the main source used for application in coverage for wheat, because it has a high concentration of nitrogen (45%), high solubility, less corrosivity, less soil acidification and ease of manufacture (Yano *et al*., 2005). However, the use of this fertilizer on the surface can lead to high losses by volatilization, enhanced by the lack of humidity and in areas with higher amount of straw (Cantarella *et al*., 2008).

In this way, we have sought other nitrogen sources to substitute the use of urea in applications for coverage, aiming to reduce losses of nitrogen through volatilization and lixiviation, and balance the nutrient availability, come to attend nutritional requirements of the plant. Faced with the alternatives with potential for use, stand out from the ammonia nitrate (NH_4NO_3), composed of ammonia nitrogen with longer availability, low salinity level, and nitric nitrogen readily available (Viera, 2009) and liquid nitrogen applied foliar however, the efficiency of these sources is still often questioned.

In this way, this study aimed to determine the influence of parceling and nitrogen sources applied in coverage, in plant height and spike insertion height, spike length and mass of grains of spike of main stem in cultivated wheat genotypes in two crop year.

MATERIAL AND METHODS

The assay was conducted in the experimental field of the Plant Breeding and Plant Production Laboratory, Federal University of Santa Maria, Campus Frederico Westphalen - RS, located in the geographic coordinates 27º 23 '26 "S; 53 25'43 "O, 461.3 meters above sea level. The soil is classified as Dystrophic Red Latosol (Santos*et al*., 2006) and the climate characterized by Köppen as Cfa, with an average annual temperature of 20,5ºC and average annual rainfall of 1,280 mm (Maluf, 2000).

The experiment was carried out a randomized block design in a split plot arranged in three repetitions, being: two crop year x five wheat genotypes x three nitrogen sources x six parceling nitrogen applied in coverage. The two crop years were 2012 and 2013. The wheat genotypes were: Fundacep 52, TBIO Mestre, TBIO Itaipu, TBIO Iguaçu and Quartzo. The nitrogen sources used were: Urea (45% nitrogen), ammonia nitrate (AN: 33.5% nitrogen) and Liquid Nitrogen (32% nitrogen). The parceling of nitrogen fertilization were: I: absence of nitrogen, II: tillering, III: tillering and stem extension, IV: tillering and flowering, V: stem extension and flowering, and VI: tillering, extension and flowering. The growth stages of wheat development were defined according to scale of development of the Feekes-Large (Large, 1954) and dose of nitrogen applied to all subdivisions and sources was 115 kg ha^{-1}.

The experimental units related to the plot of effect were composed of 12 lines of 63 m length spaced 0.17 m, a total area of 128.52 m². The subplots were composed of 12 lines with 3.5 m length, spaced by 0.17 m, with an area of 7.14 m². The sowing was under no-tillage system with the set tractor-seeder, and the sowing dates for processed crop years on May 25th, 2012 and June 10th, 2013, respectively. The base fertilizer used for both years was 200 kg ha^{-1} in NPK formulation (08-24-12). Cultural practices related to the control of weeds, insect pests and diseases were carried out preventively according to crop needs.

The variables were determined after physiological maturation of plants, and randomly selected 10 representative plants of each subplot and calculating the average per plant. The variables measured were: spike insertion height (SIH), by measuring the distance between the ground level and about insertion of spike, results in centimeters (cm); plant height (PH), measured the distance between the base of the plant to the spike apex disregarding the edges, results in cm; spike length (SL), obtained by measuring the spike insertion stitch length to the height of spike excluding the edges, resulting in cm; grain mass of spike of main stem (GMSMS) obtained from the track each spike, with subsequent measurement of the grain mass of spike of main stem, using digital scales and moisture corrected 13%, results expressed in grams (g).

The data obtained were submitted to analysis of variance by F test at $p < 0.05$ level of probability. Noting significant interaction among the factors of treatment were dismembered the simple effects, and the averages compared by Tukey test to $p < 0.05$ probability. Analyses were performer using the statistical software Genes (Cruz, 2013).

RESULTSAND DISCUSSIONS

Analysis of variance showed a significant interaction ($p < 0.05$) between nitrogen parceling x crop years x nitrogen sources for the variables of spike insertion height and plant height. There was significant interaction between nitrogen parceling x nitrogen sources and crop years x wheat genotypes for variables, spike length and grain mass of spike of main stem. That way, if dismembered them simple effects, and the derivations of the inferences made for one of the variation factors. The occurrence of significant interaction between nitrogen parceling and other of variation factors, evidenced that as changes genotypes, the nitrogen sources and weather conditions relating to crop years, tend to modify the nitrogen parceling efficiency applied in coverage, which refers to improving the agronomic traits and consequently the productivity of wheat grains.

According to Zagonel and Fernandes (2007), the increase in plant height is related to the greater number of nodes of the stem, length of internodes and spike peduncle thereby the parceling and nitrogen sources that gave superiority to the trait height plant were more efficient in providing a balanced manner the nitrogen to the plants, thus supplying their nutritional requirements throughout the crop cycle. Thus, in the crop year 2012, the liquid nitrogen source with the parceling II, V and I, had the highest increases in plant height, differing from the VI parceling (Table 1). In contrast, for the ammonia nitrate source the parceling II showed superiority to parceling I and IV. The parceling do not differentiate when using the urea.

In the crop year 2013, the parceling to the liquid source revealed no significant differences, therefore, fractioning of nitrogen applied via the leaves does not lead to increased plant height. The ammonia nitrate when parceling in the tillering and stem extension stages (III) and tillering, stem extension and flowering (VI) had the highest values of this trait, differing up of parceling I and V. The split application of urea in the tillering and stem extension stages (III) resulted in the largest increase in plant height. The parceling involving fractionation of nitrogen applied to coverage the tillering and stem extension stages result in major increases in plant height because improve nutrient availability in periods of increased nutritional requirements of the plant.

According Peruzzo*et al*. (1994), the parceling application of nitrogen results in greater uptake by plants compared to application only in seeding. These results contrast with those obtained by Teixeira Filho*et al*. (2010) and Theago*et al*. (2014), because the cerrado conditions the authors found that early nitrogen application in seeding increases plant height, in relation to application only in stem extension stage.

Table 1: Averages for interaction between the parceling of the nitrogen applied in coverage (I: absence of nitrogen, II: tillering, III: tillering and stem extension, IV: tillering and flowering, V: stem extension and flowering, and VI: tillering, stem extension and flowering) x nitrogen source (liquid, ammonia nitrate(Ammo N) and urea) x crop year (2012 and 2013), for the variable plant height (cm).

Parcel.	Crop Year 2012			Crop Year 2013		
	Nitrogen Sources					
	Liquid	Ammo. N	Urea	Liquid	Ammo. N	Urea
I	83.75 a Aβ	82.37 b A β	82.97 a Aα	86.12 a Aα	86.59 b A α	84.93 d A α
II	84.00 a Aβ	85.10 aA β	83.12 aA β	87.43 a B α	88.30 ab AB α	90.15 ab A α
III	82.74 ab A β	83.92 ab A β	84.46 aA β	86.37 a B α	89.62 aA α	90.46 aA α
IV	82.59 ab A β	81.74 b A β	83.71 aA β	88.22 aA α	88.14 ab A α	88.16 bc A α
V	81.95 aA β	83.71 ab A β	82.52 aA β	86.97 aA α	86.50 b A α	87.28 c A α
VI	81.42 b B β	83.81 ab A β	84.31 aA β	87.69 aA α	89.72 aA α	88.70 abc A α
CV (%)	3.60					

* Means followed by the same lowercase letter (a) column for strategy of nitrogen application coverage, uppercase (A) on the line to nitrogen sources, and greek letters (α) for crop year, did not differ statistically the Tukey p> 0.05 probability.

In both crop years, the ammonia nitrate and urea showed the highest magnitude, and in 2012 were greater than liquid source for the parceling VI in 2013 differed from the liquid source in the parceling III. Studies by Orso*et al*. (2014), in order to assess the nitrogen sources urea, ammonium sulfate, ammonium nitrate and FH Nitro Mais® with coverage application at the beginning and end of tillering, did not show significant differences between nitrogen sources for the trait plant height of the wheat, being at odds with the results found in this study, because significant differences were observed in this study.

Among the crop years it is evident that the environmental conditions that occurred in 2013 were more favorable than in 2012, thus bringing greater plant height irrespective source or nitrogen installment. According Wiethölter (2011), environmental factors such as temperature, humidity and solar radiation directly influence the transformation processes and nutrient dynamics, and can be obtained differential behavior for sources that alter nutrient availability.

The parceling and nitrogen sources mutually influence each other spike length and grain mass of spike of main stem, thus, the effects of nitrogen parceling applications at different plant growth stages vary with the intrinsic characteristics of nitrogen source used. Being that nitrogen parceling coming from liquid source does not have efficient to increase the trait spike length, on the other hand, parceling of ammonia nitrate in the stages of tillering and stem extension resulted in the increase of this trait (Table 2). Whereas the parceled urea nitrogen source revealed that treatment with no nitrogen was lower and differed from the other parceling, with it, the urea applications as a single dose at tillering or parceled increment the spike length.

Applications of nitrogen at appropriate times can increase the efficiency of this nutrient for wheat, increasing the number of grains per spike and the number of spikes per unit area (Sangoi*et al*., 2007). These results are consistent with those obtained by Bredemeier and Mundstock (2001), where characterizing the critical time for supplementation of nitrogen in coverage in the wheat crop, they concluded that nitrogen applications at the beginning of the cycle, stimulate the increase in the number of spikelets and the dimensions of the spike.

Among the nitrogen sources, ammonia nitrate and urea are show greater than liquid source in parceling III and VI, for the others parceling differences were not observed between nitrogen sources (Table 2). Thus, the applications of liquid nitrogen may show lowest efficiency with increased dose fractionation over the cycle. In contrast, ammonia nitrate and urea are equivalent in respect to availability of nitrogen to plants, thus being possible to use ammonia nitrate in the nitrogen applications in coverage at wheat crop. The results corroborate Orso*et al*. (2014) who studied the wheat crop behavior under effect of sources and doses of nitrogen did not show differences between ammonia nitrate and urea sources for the variables studied.

Table 2: Averages for interaction between the parceling of the nitrogen applied in coverage (I: absence of nitrogen, II: tillering, III: tillering and stem extension, IV: tillering and flowering, V: stem extension and flowering, and VI: tillering, stem extension and flowering) x nitrogen source (liquid, ammonia nitrate(Ammo N) and urea), for the variable, spike length (SL) and grain mass of spike of main stem (GMSMS).

Parcel.	SL (cm)			GMSMS (g)		
	Nitrogen Sources					
	Liquid	Ammo. N.	Urea	Liquid	Ammo. N	Urea
I	7.64 a A	7.20 c B	7.13 b B	1.030 a A	0.955 b AB	0.919 c B
II	7.46 ab A	7.73 ab A	7.74 a A	1.015 a B	1.031 ab B	1.167 aA
III	7.34 abc B	7.97 aA	7.82 aA	0.999 aA	1.029 ab A	1.055 b A
IV	7.36 abc A	7.56 b A	7.58 aA	0.976 aA	1.026 ab A	1.019 bc A
V	7.28 bc A	7.46 bc A	7.52 aA	0.961 a B	1.069 aA	1.078 ab A
VI	7.11 c B	7.70 ab A	7.82 aA	0.959 a B	1.054 ab AB	1.081 ab A
CV (%)	8.93			20.78		

* Means followed by the same lowercase letter (a) column for strategy of the nitrogen application coverage, and uppercase (A) on the line to nitrogen sources, did not differ statistically the Tukey p> 0.05 probability.

The grain mass of spike of main stem is characterized as a major component of yield of wheat grain, since the main stem is responsible for contributing an average of 70% of total grains mass of the plant at ideal plant stand for each genotype (Almeida*et al*., 2002). In this way, the ammonia nitrate applied in parceling in stem extension and flowering stages influenced positively in the grain mass of main stem obtaining greater magnitude, however, differed only the parceling with no nitrogen (Table 2). According Didonet*et al*. (2000) the greater availability of nitrogen in the flowering stage and beginning grain filling results in increased grains mass of spike.

Urea applied in a single dose at tillering stage resulted in greater magnitude trait, but did not differ from parceling in stem extension and flowering stages (V), tillering, stem extension and flowering (VI). The application of urea in parceling to coverage these stages, does not reduce grain yield per plant and according Pires*et al*.(2011), can allow an increase in industrial grain quality. In this way, parceling of nitrogen could increase the protein proportions and the technological properties of the grains.

Among the nitrogen sources, urea was superior to ammonia nitrate in the parceling II and more than a source of liquid nitrogen in parceling II, V and VI, the remaining parceling no significant differences (Table 2). The ammonia nitrate was greater than liquid source in parceling application in stages of stem extension and flowering. The ammonia nitrate is presented as an alternative to replacement of urea coverage nitrogen applications because it meets the nitrogen requirements required by wheat and also increases grain mass of spike of main stem. Research Lara Cabezas*et al*. (1997), says the ammonia nitrate and ammonium sulphate as alternatives to reduce losses of nitrogen through volatilization and increase efficiency in the production dynamics of plants in applications where surface.

The traits spike length and the grain mass of spike of main stem were significantly influenced by the used genotypes and crop years, this way, changes in environmental conditions resulting from the crop years, tend to alter the response of genotypes, and these behave if differently when subjected to the same environmental conditions. For the trait spike length was observed that the Quartzo genotype was higher than the other genotypes in 2012 year, being 14.61% and 15.33% higher than the TBIO Itaipu and TBIO Mestre genotypes, respectively (Table 3).

In the crop year 2013, the superior genotypes were Quartzo, Fundacep 52 and TBIO Itaipu, which differed from TBIO Iguaçu and TBIO Mestre genotypes. Thus, there is the spike length of the Quartzo genotype, for the two crop years remained among genotypes. The results found by Nardino*et al*. (2013) corroborate those obtained in this work, in which the Quartzo genotype expressed superiority to spike size, grain mass per spike, and therefore larger number of grains per spike.

Among crop years, environmental conditions occurred in 2012 contributed to an increase in the size of spikes for Quartzo and TBIO Iguaçu genotypes. In 2013 positive influences for this trait were pointed out to genotypes TBIO Itaipu and Fundacep 52. Only TBIO Mestre genotype remained stable against the environmental conditions during the crop years, without abrupt changes to the spike length. Among the environmental factors that most influenced the morphological traits and grains yield in wheat, can be highlighted photoperiod, temperature, rainfall and solar radiation (Wal, 1998).

Table 3: Averages for interaction between crop year (2012 e 2013) and genotypes (TBIO Itaipu, Quartzo, TBIO Iguaçu, Fundacep 52 e TBIO Mestre) for the variable, spike length (SL) and grain mass of spike of main stem (GMSMS).

Genotype	SL (cm)		GSMS (g)	
	Crop Year		Crop Year	
	2012	2013	2012	2013
TBIO Itaipú	7.07 d B	7.70 aA	1.140 b A	0.839 c B
Quartzo	8.28 aA	7.93 a B	1.150 b A	0.937 a B
TBIO Iguaçu	7.84 b A	7.24 b B	1.104 c A	0.918 abc B
Fundacep 52	7.39 c B	7.72 aA	1.254 aA	0.934 ab B
TBIO Mestre	7.01 d A	7.05 b A	1.022 d A	0.877 bc B
CV (%)	8.93		20.78	

*Means followed by the same lowercase letter (a) column for genotype and uppercase (A) on the line to crop year, did not differ statistically the Tukey p> 0.05 probability.

The grain mass of spike of main stem and the number of grains are directly related to grain yield, where studies by Kavalco*et al*. (2014), had significant and positive correlations between the mass of grains per spike and grain yield. Thus, the increase in grain mass of spike results in increased grain yield of the genotypes. In the agricultural year 2012, the Fundacep 52 genotype differed from the other genotypes, higher than 18.5% of TBIO Mestre genotype, which obtained the smallest magnitude (Table 3). For the year 2013, it showed that the Quartzo genotype had the highest magnitude, and the genotypes differed TBIO Itaipu and TBIO Mestre (Table 3). For the crop year, it was observed that in 2012 there was a greater grain mass of spike of main stem 2013.

The spike insertion height showed that the crop year 2012, for both sources nitrogen application the single dose in tillering showed the highest magnitudes (Table 4). In the crop year 2013, it was observed that for the urea source, the parceling II and III showed the highest magnitude, differing up of parceling I and V. For ammonia nitrate the parceling III and VI showed up higher than parceling I and V, on the other hand, the liquid source revealed that the parceling IV had the highest magnitude, differing parceling I. Thus, the nitrogen parceling coverage including managements parceled in tillering stage are equivalent to application single dose of nitrogen in tillering, however, the parceling that does not include applications in the tillering stage resulted in lower increase of this trait.

The greatest nitrogen demand is observed in the initial stages of culture, being determining to set the number of nodes of the stem and the elongation of internodes, furthermore, not supplying nitrogen coverage affects the growth of plants, resulting in lower plant height and compromising crop productivity. Bredemeier and Mundstock (2001) determined that in the initial stages are defined the number of spikelets per spike and number of grains per spike, with that nitrogen is needed in these periods. Yano *et al*. (2005) pointed out that the period of greatest need for nitrogen is between emergency until the issuance of the seventh leaf in wheat.

Table 4: Averages for interaction between the parceling of the nitrogen applied in coverage (I: absence of nitrogen, II: tillering, III: tillering and stem extension, IV: tillering and flowering, V: stem extension and flowering, and VI: tillering, stem extension and flowering) x nitrogen source (liquid, ammonia nitrate(Ammo N) and urea) x crop year (2012 e 2013) for the variable spike insertion height (cm).

Parcel.	Crop Year 2012			Crop Year 2013		
	Nitrogen Sources					
	Liquid	Ammo. N.	Urea	Liquid	Ammo. N	Urea
I	76.24 ab A α	75.25 ab A β	75.68 a Aβ	78.34 b A α	79.30 b A α	77.96 c A α
II	76.69 aAβ	77.35 aA β	75.54 aA β	79.83 ab B α	80.69 ab AB α	82.25 aA α
III	75.29 ab A β	75.65 ab A β	76.63 aA β	79.13 ab B α	81.95 aA α	82.65 aA α
IV	75.34 ab A β	74.11 b A β	76.11 aA β	80.75 aA α	80.66 ab A α	80.59 ab A α
V	74.81 ab A β	76.20 ab A β	74.99 aA β	79.56 ab A α	79.10 b A α	79.76 bc A α
VI	74.50 b A β	76.14 ab A β	76.44 aA β	80.39 ab A α	81.98 aA α	80.92 ab A α
CV(%)	3.79					

* Means followed by the same lowercase letter (a) column for strategy of nitrogen application coverage, uppercase (A) on the line to nitrogen sources, and greek letters (α) for crop year, did not differ statistically the Tukey p> 0.05 probability.

The spike insertion height revealed that the crop year 2012 did not provide differentiation among nitrogen sources, in 2013 the ammonia nitrate and urea were greater compared to liquid source in parceling II and III. In the remaining parceling of the nitrogen sources did not differ (Table 4). Thus, liquid applications of foliar nitrogen in tillering and/or parceled in the initial stages of culture, resulting in reduced availability of nitrogen and assimilation of nutrients by plants.

Among the crop years, in 2013 showed the best environmental conditions and were checked most of spike insertion height, when compared to 2012 in both parceling and nitrogen sources.

For the spike insertion height and plant height it showed that the genotypes showed similar and can highlight these traits are closely related (Table 5). In this way, Quartzo and TBIO Iguaçu genotypes showed themselves superior and differed from the other genotypes. Smaller magnitudes for these traits were obtained in TBIO Mestre genotype and Fundacep 52. Studies by Felício*et al*. (1988) and Salomon *et al*. (2003), with genotypes of semi-dwarf wheat, they reported that the plant height correlated strongly and positively to productivity, where higher yields of grain are linked with greater stature genotypes.

Table 5: Average results between genotypes (TBIO Itaipu, Quartzo, TBIO Iguaçu, Fundacep 52 e TBIO Mestre), for the variables, spike insertion height (SIH), plant height (PH).

Genotypes	SIH (cm)	PH (cm)
TBIO Itaipu	77.95 b	85.33 b
Quartzo	81.32 a	89.43 a
TBIO Iguaçu	82.28 a	89.82 a
Fundacep 52	73.46 c	81.01 c
TBIO Mestre	75.04 c	82.07 c
CV (%)	3.79	3.60

* Means followed by the same lowercase letter (a) column for genotype did not differ statistically the Tukey p> 0.05 probability.

The absence of interaction between nitrogen parceling and genotypes for these variables indicated that the response of genotypes front of the parceling occurs in a similar way, with this, the tested genotypes showed similar direction in response, but different magnitudes for the traits, the as it changes the nitrogen parceling. Studies of Costa *et al*. (2013), revealed the presence of interaction between wheat genotypes and nitrogen parceling coverage for the trait plant height.

The present study brought important contribution to the scientific community revealing strategies to increase the efficiency of nitrogen utilization applied to coverage in wheat plants, considering the high losses by volatilization and leaching of this nutrient, which result in increased production costs for the producer and environmental problems. Thus, the study evidenced effective strategies for nitrogen application in covering wheat crop and revealed that urea and ammonium nitrate are the best nitrogen sources in order to increment morphological components of wheat.

Conclusions:

The parceling of nitrogen in coverage in tillering and stem extension stages (III) increment plant height, spike length and spike insertion height.

The parceling in stages of stem extension and flowering increases grain mass of spike of main stem in approximately 7 % for both nitrogen sources.

The Quartzo genotype is superior 9,89 % for grain mass of main stem, and 15 % for spike length compared to TBIO Mestre genotype. For the variables spike insertion height and plant height, the genotypes Quartzo and TBIO Iguaçu were superior to the others.

The ammonia nitrate stands out as an alternative to replace the urea nitrogen applications in coverage of wheat grown because it reveals similar behavior of wheat morphological components when compared to urea.

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