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VARIATION OF GRAIN NUMBER - EAR^{-1} AND -PLANT^{-1} TRAITS UNDER THE INFLUENCE OF TWO TREATMENTS OF WINTER WHEAT (*TRITICUM AESTIVUM* L.) VARIETIES

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ABSTRACT

This study was carried out to investigate the variation of traits; grain number ear^{-1} and plant^{-1} in three winter varieties namely Batko, Diya and Krasnodarskaya 99 under the influence of the growth regulator, Furolan and mineral fertilizer. The grain quantity ear^{-1} and grain quantity plant^{-1}are some of the basic traits which account for plant yield. For Deya's variety the grain number ear^{-1} varied from 37.4 pieces (control) to 38.2 pieces (the fertilized variant). The difference between the fertilized variant and control was 0.8 grains. This was a significant difference in grain number ear^{-1}. The interaction of factors A and B on grain number ear^{-1} in Krasnodarskaya 99 variety varied from 37.6 pieces (control) to 39.1 pieces (the fertilized variant). The difference between these variants of Krasnodarskaya 99 in grain number ear^{-1} was 1.5 pieces. By application of only growth regulator the grain number plant^{-1} obtained was 68.2 pieces i.e. about 4.8 pieces more than the control. of By combined application of mineral fertilizer and growth regulator the grain number plant^{-1} obtained was 78.8 pieces which was 15.4 pieces more than control. All this increase in grain number plant^{-1} in all the variants was statistically significant.

KEYWORDS: Wheat varieties; mineral fertilizer; Furolan; Grain Quantity- Ear^{-1} and -Plant^{-1}.

1.0 INTRODUCTION

The number of grains on each ear depends on the number of fertile spikelets on the central stem of the ear. In barley, each spikelet contains only one floret, while wheat spikelets contain two to five fertile florets. In two-row barley, spikelets form in threes. However, only the floret in the central spikelet is fertile. In six-row barley, florets in all three spikelets are fertile. Once the terminal spikelet is formed, stem elongation starts and the spike begins to grow. Spike growth occurs from the appearance of the leaf prior to the flag leaf (penultimate leaf) up to ten days past anthesis (Kirby and Appleyard, 1984). Spike growth, slow in its early stages, increases greatly about the time the ligule of the flag leaf becomes visible (Krumm *et al*., 1990).

The wheat spike contains only one spikelet per rachis node. Each spikelet has between three and six potentially fertile florets (Kirby and Appleyard, 1984), which are self-pollinated in 96 percent of the cases (Martin *et al*., 1976; Malaker and Mian, 2009).

Crop management, particularly nutrition, can significantly influence grains/ear and ears/m^2. Together these determine the number of grains/m^2. Grains/m^2 and the size of individual grains determines the total storage capacity during the grain filling period (Protich et al., 2007; Protich et al., 2011). In winter barley, grain yield is most strongly related to grain number; therefore, early management decisions to optimize tiller production and survival are particularly important.

The grain number is itself a function of the number of fertile shoots per unit area and the number of grains per head. The grower therefore needs to consider the nutrients that can have an impact on the grain numbers/ear (spike) which are mainly nitrogen, potassium, copper, zinc, boron and manganese.

Nitrogen will affect the number of grains that are set on individual ears/spikes. A high yielding crop of wheat will have approximately 45-50 grains/ear, however if nitrogen supply is limiting this will be reduced. The timing of the applied nitrogen is important as grain numbers are determined early from double ridge to floret initiation. By using the nitrogen to create the correct leaf canopy and therefore final grain site numbers, the result is more grains/ear at harvest (Barbara et al., 2009; Protich et al., 2011).

Boron is well documented at having an effect on pollen viability and therefore deficiency can lead to a reduction

in the number of grain sites per spike. A measurement used to observe the effect of boron is Grain Set Index and normally expressed as a %. A high Grain Set Index is the target as this will lead to more grains per ear/spike. Care needs to be taken with boron as if applied at the incorrect timing and rate, yield reduction through decreased tillers can result.

These very large differences/effects show how important boron is as an essential plant nutrient.

In wheat, the number of eventual grains per spike (ear) varies from season to season and is affected by a number of factors including:

- Varietal choice
- Disease control during flowering
- Weather conditions during flowering
- Temperature and day length before terminal spikelet (Zadoks GS 30).

This variability enables high yields to be achieved through two ways:

1. Low shoot numbers and high grain numbers/spike.
2. High shoot numbers and low grain numbers/spike.

The aim of this study is to determine the variation pattern of grain quantity ear^{-1} and plant^{-1} traits in three winter varieties. The findings of this research will help in breeding programme aimed at increasing yield in this crop.

2.0 MATERIALS AND METHODS

The investigation was carried out at the All-Russian Rice Research Institute, Belozerny, Krasnodar, Russia between the period 2007-2009.

Winter wheat varieties were sown according to the fertilizer variants at the end of September. The experimental plot was 3 m x 8 m = 24 m^2 in three replicates. The plots were completely randomized. The seeds were sown at 5 million grains per hectare. The precursor plant was winter barley.

The grain quantity/ear is one of the basic traits characterizing the yield of a variety. This quantity depends on conditions which occur during pollination of flowers, fertilization of egg-cells and grain formation. Theoretically, if per ear 17 cones were generated, and in each cone there were six flowers, then the product of quantity of cones and flowers is the grain number ear^{-1}. It means, theoretically 102 grains will be fastened in each ear. However, in practice the number was always less. The fastening of grains in each ear is influenced by ecological factors: high temperature, low humidity of soil and air, fertility of soil, fertility of pollen grains, ability of pollen grains to sprout in the flower stigma, effect of selectivity and gametophytic factors, heterosterility etc. The grain quantity plant^{-1} could be evaluated by counting all the ears of quality sheaf in each plant. The second method – is to multiply the quantity of grain quantity ear^{-1} by productive bushiness. In both cases their values would be statistically significant.

3.0 RESULTS AND DISCUSSION

In each variant and replicate of the multi-factorial experiment, the number of grains fastened in each ear of winter wheat varieties was determined. The grain quantity ear^{-1} determined in Bat'ko variety varied on the average from 38.7 pieces to 40.3 pieces. Differences between extreme variants were statistically significant (LSD_{05}-variant = 0.17). With increase in fertility of the soil the grain quantity ear^{-1} increased. The same trend was observed in other winter wheat varieties (Table 1).

Table 1: Data on variation of grain quantity ear^{-1} in winter wheat varieties under the influence of different doses of mineral fertilizers and growth regulator, pieces (2007-2009).

Variety (factor A)	Dose of Mineral fertilizers, kg added per hectare (factor B)	Growth regulator (factor C)	Average for:						
			Variants	A	B	C	AB	AC	BC
Bat'ko	Control	control	38.7		37.9		38.8		37.7
		Furolan	38.8					39.3	38.2
	$N_{50}P_{90}K_{40}$ + N_{60} in the spring + N_{30} at spike formation	control	39.8	39.1	39.1		40.1		38.8
		Furolan	40.3					39.6	39.3
Deya	Control	control	37.0				37.4		
		Furolan	37.8					37.5	
	$N_{50}P_{90}K_{40}$ + N_{60} in the spring+ N_{30} at spike formation	control	38.0	37.8			38.2		
		Furolan	38.3					38.1	
Krasnodar-skaya 99	Control	control	37.3				37.6		
		Furolan	37.9			38.3		38.0	
	$N_{50}P_{90}K_{40}$ + N_{60} in the spring+ N_{30} at spike formation	control	38.7	38.3			39.1		
		Furolan	39.4			38.8		38.7	
LSD_{05}			**0.17**	**0.09**	**0.07**	**0.07**	**0.12**	**0.12**	**0.10**

For factor A (variety) the grain number ear^{-1} varied in the following sequence: 37.8 pieces (Deya); 38.7 (Krasnodarskaya 99) and 39.4 grains (Bat'ko). These differences in grain quantity ear^{-1} in the various varieties were statistically significant (LSD_{05}-factor A = 0.09).

For factor B (mineral fertilizers) the grain quantity ear^{-1} in the fertilized variants of experiment varied from 37.9 pieces (control) to 39.1 grains (the fertilized variant). The difference between these two variants on the average was 1.2 grains (LSD_{05}-factor B = 0.07). It means that with increase in quantity of the mineral fertilizer applied on the winter wheat varieties the number of grains ear^{-1} increased significantly.

For factor C (growth regulator) the grain quantity ear^{-1} of winter wheat varieties in experimental variants on the average varied from 38.3 pieces to 38.8 pieces. In these variants there was no statistical difference in grain number ear^{-1}. It means that the growth regulator, Furolan weakly influenced the process of fertilization and grain formation ear^{-1}.

During the study of interaction of factors A and B, the grain quantity ear^{-1} determined in Batko variety varied from 38.8 pieces (control) to 40.1 grains (the fertilized variant). Among these variants there were significant differences in grain number ear^{-1} (LSD_{05}-interaction AB = 0.12).

For Deya's variety the grain number ear^{-1} varied from 37.4 pieces (control) to 38.2 pieces (the fertilized variant). The difference between the fertilized variant and control was 0.8 grains. This was a significant difference in grain number ear^{-1}.

In the interaction of factors A and B in Krasnodarskaya 99 the grain number ear^{-1} varied from 37.6 pieces (control) to 39.1 pieces (the fertilized variant). The difference in grain number ear^{-1} in Krasnodarskaya 99 variants was 1.5 pieces.

Analyzing results of interaction of factors A and B, one could draw the following conclusion that: mineral fertilizers significantly increased the grain number ear^{-1} in all the varieties studied. Thus, the top dressing of N_{60} dose at spring bushing-out and N_{30} - at ear-formation phases respectively increased considerably the grain quantity ear^{-1} in comparison with control.

By the analysis of results of interaction of factors A and C it was noted that in Bat'ko variety with application of growth regulator, Furolan the grain number ear^{-1} varied from 39.3 pieces (without treatment) to 39.6 grains (treated with growth regulator). The difference between these variants was 0.3 grains (LSD_{05}-interaction AC = 0.12).There was significant increase in grain number ear^{-1} in Bat'ko variety with application of Furolan.

With the interaction of factors A and C it was observed that in Deya's variety there was notable variation of grain number ear^{-1} from 37.5 pieces (without treatment) to 38.1 grains (variant treated with Furolan). The difference between these variants in grain number ear^{-1} in Deya's variety was 0.6 pieces (LSD_{05}-interaction AC = 0.12).

In Krasnodarskaya 99, during the interaction of factors A and C the grain quantity ear^{-1} varied from 38.0 pieces to 38.7 pieces (LSD_{05}-interaction AC = 0.12). Meaning that during the interaction of factors A and C the grain number ear^{-1} recorded significant differences with the application of growth regulators by increasing the grain number ear^{-1}.

Thus, the application of fertilizers and growth regulator, Furolan showed significant increase in grain number ear^{-1} in all varieties of winter wheat which were investigated in the multi-factorial experiment.

By means of the three-factorial dispersion analysis it was established that the effect (influence) of the general variation on the formation of grain number ear^{-1} was 35.6%. On the other hand, the effect of experimental variants on the formation of grain quantity ear^{-1} was 32.3% while effect of the factor A (variety) in the formation of grain number ear^{-1} was 16.4%. All the same, the genotypes of varieties significantly influenced the trait - grain number ear^{-1}.

The effect of the factor B (mineral fertilizers) on grain number ear^{-1} was 12.3%. Thus there was a strong effect of mineral fertilizers in the mainfestation of the trait - grain number ear^{-1} in all the wheat varieties. The effect of the factor C (growth regulator) on the formation of grain number ear^{-1} was 3.3%. Furolan alone had a weak influence on fastening of grains externally on each ear. But, during the interaction of factors AC and BC substantial growth of grain number ear^{-1} was observed.

3.2 Grain Quantity Plant^{-1}

The grain quantity plant^{-1} is one of the basic traits included in the list determining plant yield. In our multi-factorial experiment in variants of Bat'ko variety the grain quantity plant^{-1} varied from 61.8 pieces (control) to 68.6 pieces (variants with combined treatment). By application of only growth regulator, Furolan the grain quantity plant^{-1}formed was 63.9 pieces. The difference between control and the treated variant amounted to 2.1 grains (LSD_{05}-variant = 0.16). By application of only mineral fertilizers the grain number plant^{-1} formed was 67.6 pieces which was 5.8 pieces more than the control (Table 2).

In Deya's variety the grain quantity plant^{-1} varied from 55.6 pieces (control) to 68.9 grains (mineral fertilizers). In the variant where growth regulator, Furolan was used, the grain quantity plant^{-1} formed was 60.5 pieces which was 4.9 pieces more than the control.

In the fertilized variant, the grain number plant^{-1} formed was 64.6 pieces which was 9.0 pieces more than the control (LSD_{05}-variant = 1.63). By application of only growth regulator 60.5 grains was obtained which was 4.9 pieces more than the untreated variant. In the variant of combined application of mineral fertilizers plus growth regulator the grain quantity plant^{-1} formed was 68.9 pieces which was 13.3 pieces more than the control (LSD_{05}-variant = 1.63).

Table 2: Data on variation of grain quantity plant^{-1} of winter wheat varieties under the influence of doses of mineral fertilizers and growth regulator, pieces/plant (2007-2009).

Variety (factor A)	Dose of Mineral fertilizers, kg added per hectare (factor B)	Growth regulator (factor C)	Average for:						
			Variants	A	B	C	AB	AC	BC
Bat'ko	Control	control	61.8		62.2		62.9		60.3
		Furolan	63.9					64.8	64.2
	$N_{50}P_{90}K_{40}$ + N_{60} in the spring + N_{30} in spike formation	control	67.6	65.5	70.3		68.1		68.6
		Furolan	68.6					66.3	72.1
Deya	Control	control	55.6				58.1		
		Furolan	60.5					60.1	
	$N_{50}P_{90}K_{40}$ + N_{60} in the spring+ N_{30} in spike formation	control	64.6	62.4			66.8		
		Furolan	68.9					64.7	
Krasnodar-skaya 99	Control	control	63.4				65.8		
		Furolan	68.2			64.4		68.5	
	$N_{50}P_{90}K_{40}$ + N_{60} in the spring+ N_{30} in spike formation	control	73.5	71.0			76.1		
		Furolan	78.8			68.2		73.5	
LSD_{05}			**1.63**	**0.81**	**0.76**	**0.76**	**1.13**	**1.13**	**0.43**

In the control of Krasnodarskaya 99 variety, without application of mineral fertilizers, the grain quantity plant^{-1} was 63.4 pieces. Application of mineral fertilizers in full according to the scheme of experiment the grain number plant^{-1} formed was 73.5 pieces which was 10.1 more than the control (LSD_{05}-variant = 1.63).

Application of only growth regulator grain number plant^{-1} was shown to be 68.2 pieces which was 4.8 pieces more than the control without treatment.

Application of combined mineral fertilizer and growth regulator the grain number plant^{-1} obtained was 78.8 pieces which was 15.4 pieces more than control. All these increases of grain number plant^{-1} by all the variants were statistically significant.

In factor A (variety) genotypes the grain number plant^{-1} varied in the following sequence: 62.4 pieces (Deya); 65.5 (Bat'ko) and 71.0 grains (Krasnodarskaya 99). All varieties investigated statistically differed significantly among themselves in grain quantity plant^{-1} (LSD_{05}-factor A = 0.81).

For factor B (mineral fertilizers) on the fertilized variants of experiment the grain number plant^{-1} on the average obtained was 70.3 pieces which was 8.1 pieces more than control (LSD_{05}-factor B = 0.76). The mineral fertilizers introduced according to the scheme of experiment, significantly increased the grain number plant^{-1} in relation to control.

For factor C (growth regulator) the grain number plant^{-1} in variants with Furolan varied from 64.4 pieces (without treatment) to 68.2 pieces (with growth regulator), (LSD_{05}-factor C = 0.76). The growth regulator, Furolan statistically increased significantly the grain number plant^{-1}.

The analysis of interaction of factors A and B showed that in each variety an increase in grain number plant^{-1} was determined during the application of mineral fertilizers. Interaction of factors A and C showed significant increase in grain number plant^{-1} after application of Furolan. In each variety grain number plant^{-1} increased respectively as follows: Batko variety recorded an increase of 1.5 grains in relation to control; in Deya by 4.6 pieces and Krasnodarskaya 99 by 5.0 grains. It means that the growth regulator, Furolan significantly influenced the increase in grain number plant^{-1} in all the winter wheat varieties investigated.

In the interaction of factors B and C only that of Furolan increased the grain number plant^{-1} by 3.9 pieces in comparison with control. Influence of only mineral fertilizers on grain number plant^{-1} increased on the average by 4.4 pieces. Combined influence of mineral fertilizers and Furolan showed an increase in grain number plant^{-1} by 3.5 pieces. Thus, the effects of interaction of mineral fertilizers and growth regulator led to significant increase in the grain number plant^{-1}. This indicated both biological and technological factors were involved.

The three-factorial dispersion analysis showed that the influence of the general variation on grain number plant^{-1} was 33.4%. The effect of experimental variants was 33.3 % while the effect of factor A (variety) was 12.9%. This was the average value of genotypes of varieties studied on grain number plant^{-1}. The effect of the factor A (mineral fertilizers) on the formation of grains plant^{-1} was 16.9%. This was a significant influence on formation of grain number plant^{-1}. Possibly the non-root top dressing carried out at the ear-formation phase with N_{30} dose, had considerable impact on the formation of grain plant^{-1} of winter wheat varieties. The effect of factor C (growth regulator) on the formation of grains plant^{-1} was 3.4%.

Thus, the overall influence of the variable factors namely: variants, number of replicates, factors A, B & C on the formation of grain number plant^{-1} was 66.8%. This was more than the influence of non-variable factors.

4.0 CONCLUSION

It was generally observed that mineral fertilizer and growth regulator, Furolan significantly influenced grain quantity ear^{-1} and plant^{-1} traits in the three winter wheat (*Triticum aestivum* L.) varieties investigated in this study. According to the data obtained from this study, it could be concluded that grain quantity ear^{-1} and grain quantity plant^{-1} are important traits that could be improved to increase plant yield.

5.0 REFERENCES

1. Barbara, C. D., Andrzej K. and Jarosław, B. Effect of selected agrotechnical factors on winter durum wheat yielding. Electronic Journal of Polish Agricultural, 2009; 12: 3: 02.
2. Kirby, E.J.M. and Appleyard, M. Cereal development guide. Stoneleigh, Kenilworth, UK, NAC Arable Unit., 1984; 95.
3. Krumm, M., Moazami, V. & Martin, P. Influence of potassium nutrition on concentrations of water soluble carbohyd-rates, potassium, calcium and magnesium and the osmotic potential in sap extracted from wheat (Triticum aestivum) ears during pre-anthesis development. Plant Soil, 1990; 124: 281-285.
4. Malaker, P. K. and I. H. Mian, Effect of seed treatment and foliar spray with fungicides in controlling black point disease of wheat. Bangladesh J. Agril. Res., 2009; 34(3): 425-434.
5. Martin, J.H., Leonard, W.H. and Stamp, D.L. Principles of field crop production. New York, NY, USA, Macmillan., 1976; 1118.
6. Protich, R., Markovich, M. and Protich, N. Effects of different ways of seed protection on some yield components grain yield winter wheat. Roumanian Biotechnological Letters, 2007; 12(5): 3435-3440.
7. Protich, R., Todorovich, G. and Protich, N. Effects of Winter Wheat Seed Protection against Tilletia tritici on Grain Yield. Bulgarian Journal of Agricultural Science, 2011a; 17(5): 435-439.
8. Protich, R., Todorovich, G. and Protich, N. Mass of 1000 grains in the case of several winter wheat genotypes using different ways of seed protection. Romanian Agricultural Research, 2011b; 28: 243-248.