RESEARCH ARTICLE **(Open Access)**

Effect of Seed Size on Yield and Some Other Agronomical and Productive Traits in Bread Wheat

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Abstract

The aim of study was to establish the influence of seed size on grain yield and its components of two bread wheat cultivars. A trial was set up using randomized complete block method with three replications in Botanical Garden of Agricultural University of Tirana. Seed was divided according to their thousand weight in three fractions: 39.76, 48.51 and 58.84 g for LVS cultivar and 31.93, 39.81 and 47.02 g for Progres cultivar. Analysis of variance data showed significant effect of seed size, cultivars, and their interaction on some agronomical and productive characteristics. So, effect of seed size on spikelet per spike, grain/spike, and grain yield was significant, and non significant for seed germination, spike length and 1000 grain weight. Cultivar had significant effect on heading time, spike length, , grains per spike, spike weight, 1000 seeds weight, and yield and no significant impact on seedling emergence. Only three traits (seed spike weight, 1000 grain weight and yield) had significant differences caused by interaction seed size x cultivar. This study suggested that large seed sizes were superior as compared to small seed size in some agronomical and productive traits, including yield. Both cultivars in study had similar performance regarding to the variation in seed sizes.

Keywords: Bread wheat; Emergence; Seedling; Seed size; Yield and yield components

1. Introduction

The size of the seed is an important physical trait and a clear indicator of the quality of the seed that influences on the vegetative growth and is often connected to the production, commerce and efficiency of the plant Many authors have studied this problem. Data obtained from them, must be said, are contradictory in regards of the achieved conclusions. Many researchers have concluded that within a genotype, the heavier or the bigger the grain, the higher the achieved production [6,9,12]. Spilde (1989) reports on additional characteristics in spring barley and in the production of wheat from large seeds, such as faster ripening, lower moisture content in the seed and higher hectoliter weight in the two species mentioned above [9]. . In wheat, seed size not only influence emergence and establishment but also affected yield components and ultimately grain yield [7,13].

On the other hand TeKrony et al. (1991) claim that the production and performance of soft wheat does not differ significantly from that obtained from seeds of different sizes [10]. Chastain et al (1995) [2], also did not find any consistent advantage achieved from large seeds of soft wheat and barley either in performance or in quality of production.

2. Materials and Methods

The experimental material consisted of two wheat cultivars (LVS and Progres). Three seed sizes of the two cultivars were tested for their effect on yield and some others agronomic and productive traits. The thousand kernel weight (TKW) of the seed sizes was as

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follows (from low to high seed size): LVS – **39.76, 48.51 and 58.84 g Progres 31.93, 39.81 and 47.02 g** The experimental design was a two-factorial (two cultivars, three different seed sizes). The crop was sown using randomized complete block design (RCBD) with three replications. A plot for each genotype was 1 m^2. Each plot consists of 5 rows 1 meter length, with a row to row distance of 20 cm. The seeding rate was adjusted for a density of 400 seeds m-2 for all seed size applications, according to standard practices. Laboratory analyzes of seed germination ability showed that in all fractions of seed used it was at 97% All cultural practices were performed same for all entries from sowing till the harvesting. Data were recorded on the following parameters on 5 randomly selected plants in each plot from each replication: 1.Emergence 2. Spike length 3. Spikelet/spike 4. Grain/spike 5. Grain weight/spike 6. 1000 grain weight, 7. grain yield/m^2

3. Results and Discussion

Analysis of variance (table 1) showed the significant impact of seed size, cultivars and their interaction , on grain yield and some other agronomic and productive characteristics

Tab.1. Analysis of variance of studied characteristics

	DF	**Emergence**	Spike/m^2	**Spike length**	**Spikelet/spike**	**Grain weight/spike**	**1000 grain weight**	**Grain yield**
Cultiv(C)	1	275405	15232.5**	0.23*	12.6*	8.9**	1907.2**	1733.4**
Seed size	2	6453	1.3 *	0.21	0.3*	0.6*	7.3	3.6*
CxS	2	2557	0.03*	0.40	1.3	0.8*	2.92*	3.9*
CV		13.3	16.8	5.8	18.7	9.23	2.97	8.45

3.1. Germination rate and emergence

Providing the optimum number of plants per unit area is an important element to ensure high yields. It depends on the internal factors of the seed and the environmental conditions [11]

Seed size easily affected germination rates in wheat, especially first days, but cultivars had no significant effect on seed germination rate. The eight first days, germination rate was reduced easily by increasing seed size. After 8 days till the end, the germination rate were higher in large seeds. The reason of this matter is probably because of large seed size needs water uptake more than small seed size and it is assumed that small seeds absorbed water more rapidly compared to large seeds, which resulted in increasing of germination rate. When seeds of any size absorb the necessary water, large seeds accelerate the rate of germination. When equal numbers of seeds per unit area were sown, the emergence of large seed tend greater than that of medium or small seed, but there was no significant differences, also non-significant (P>0.05) differences in germination percentage were observed due to cultivars and interaction between cultivars seed size (Tab 1 and 2) Other authors report that seed size had no significant impact on germination percentage, but it changes seedling emergence and grain yield, in this way the best category of seed size was related to >2.2-2.5 size, whereas emergence percentage and yield of seeds with 2-2.2 size was significantly less than other sizes [2, 10].

Tab. 2. Means for seven agronomic traits for different seed sizes

Seed size	**Emergence %**	**Spike/m^2**	**Spike length cm**	**Spikelet/spike**	**Spike weight g**	**1000 grain weight g**	**Yield/m^2 g**
Large	97.6	1061a	10.9a	17.9a	0.74a	46.3a	584a
Medium	96.9	944a	10.8a	16.8ab	0.70b	45.9	532b
Small	96.4	790b	10.2a	16.3b	0.66c	45.8	527b
D.0.05	N.S	132.4	N.S	1.1	0.35	N.S	3.7

3.2. Number of spikes/m²

The data obtained show significant differences. Plants derived from large seeds had higher tillering ability, affecting a higher number of spikes/m². So, in the variants planted with larger, medium and small seeds result respectively 1061, 944 and 790 spikes / m² (Tab 2). Although the differences between the first and second group are not statistically proven, that differences between them in the number of spikes formed is not so small. The number of spikes, in addition to the effect of seed size, also the effect of the cultivar was significant. The LVS cultivar, biologically has a higher tillering ability (614 spikes / m2) than the Progress cultivar (524 spikes / m2). This difference between them, is confirmed for the level of 0.01 probability (Tab1, and 2).

3.3. Spike length

Spike morphological architecture, including its length, is an important element that influence the yield of wheat. However, this trait is not always correlated with high yield, because often a long spike is not associated with high numbers of spikelets and grain number/spike Spike length is a trait that is controlled by genetic and environmental factors [5,6] . The spike length of wheat varieties LVS and Progres as affected by seed size is presented in Table 1 and 2. The analysis of variance indicated that the differences in the spike length due to seed size and interaction seed size x cultivars were statistically non significant (P<0.05) and significant (P>0.05) due to cultivars effect. It is evident from the results that the spike length was higher (11.7 cm) in Progres cultivar than LVS cultivar (9.68 cm), and differences between these values were statistically different, suggesting that Progres is genetically superior than LVS for spike length (Tab1, 2 and Fig 1, 2).

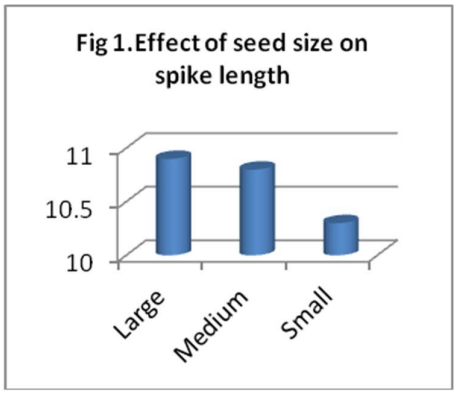

Fig. 1. Effect of seed size on spike length

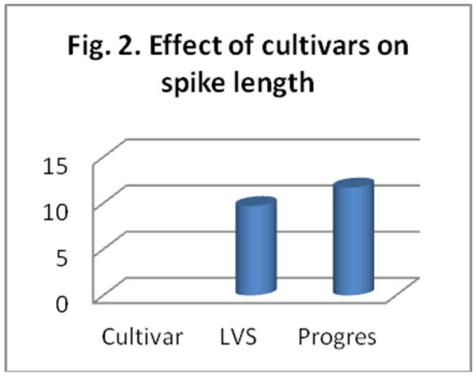

Fig. 2. Effect of cultivars on spike length

3.4. Number of spikelet/spike

The number of spikelet/spike is a major yield determining component of wheat and contributes more towards seed yield. Highly significant differences were recorded for number of spikelet/spike among wheat cultivars. The parameter was in the range of 15.7 to 18.4 spikelet/spike. The average number of spikelets/spike was 17.0. Maximum number was recorded for LVS cultivar, 18.4 spikelets/spike, and lowest one recorded for Progres 15.7. The maximum number of spikelet/spike was shown by the large seed size, while the minimum number was shown by the smaller seed size. (Tab 1, 2 and Fig. 3, 4).

This can be explained by the fact, that large seeds have a noticeable impact during the period of embryogenesis, when the wheat is in development stage often known as virage (spike 1 cm), a stage during the size of the spike, in particular the number of spikelets and flowers, were determined [3,5].

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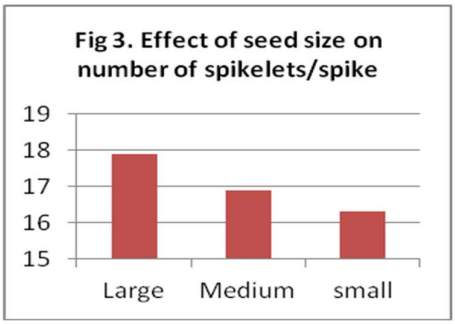

Fig. 3. Effect of seed size on number of spikelets/spike

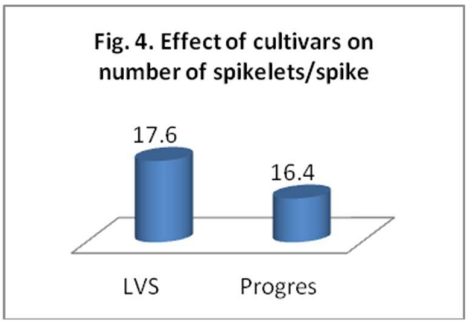

Fig. 4. Effect of cultivars on number of spikelets/spike

3.5. Spike weight

The weight of the spike, clearly appears to be strongly influenced by both the size of the seed and the cultivar. The data of the analysis of variance and the data from the respective tables (Tab1, 2), also show that the differences that exist between the different variants are significant. The larger the seed used for sowing, the greater the weight of the spike. In the variants where a large seed is used, we have spikes with a weight of 0.74 gram, in those where a medium seed is used, the weight of a spike 0.7 gram, while in the smaller variants this weight is only 0.66 gram. Regarding the effect of cultivar on spike weight, it is noticed that between two cultivars there are proven significant differences. So, in the LVS cultivar the weight of the spike (0.79 gr) is higher than in the Progress cultivar (0.63) This is explained by the changes in the architecture of the spike structure, where the Progress cultivar, despite having a longer spike, has fewer spikelets in the spike, so fewer grains, because it is a rarer spike than that of the LVS cultivar (Fig. 5, 6).

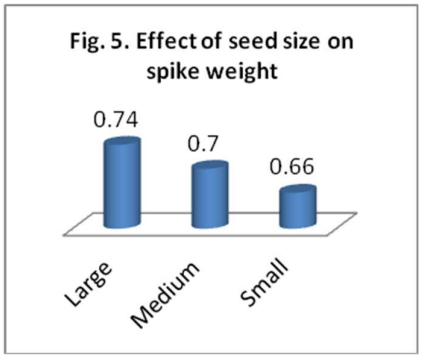

Fig. 5. Effect of seed size on spike weight

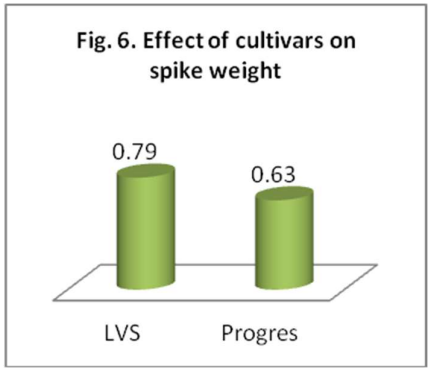

Fig. 5. Effect of cultivars on spike weight

3.6. Yield

Large seeds have also yielded higher than smaller ones. This is evident for both cultivars tested. Large seeds, on average, produced 8.9% more than medium seeds and about 9% more than small seeds. This feature is statistically proven for both seed size and cultivars. The LVS cultivar has yielded a significantly higher yield than the progress cultivar. Similar results have been reported by other authors. Thus Luo X et al. Wood D.W et al, report that large seeds have provided a yield higher then small seeds. [6,8,12].

4. Conclusions

The influence of seed size on grain yield is not accidental, but the result of all plant performance, starting from developmental stages, the number of productive tillers to components of the spike, which ultimately determine and expected grain yield.

Based on the results obtained in this study , we reach the following conclusions:

- Among the different variants that represent different seed sizes, there are proven differences for some studied traits and not differences for some others.

- There are no confirmed differences in the germination rate and the number of plants provided after full germination, in the weight of 1000 grains, and spike length
- There are proven statistically differences of seed size on the coefficient of productive tillers. The larger seed variants have a larger number of productive spikes than in the smaller one.
- The size of the seed has a significant impact on some important features, which are decisive on the realized production, especially on the weight of spike and the yield\ m^2 realized.

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