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EFFECT OF SEED SIZE AND CULTIVATION METHOD IN THE GROWTH AND YIELD OF WHEAT (*TRITICUM AESTIVUM*)

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ABSTRACT

A field experiment was carried out in the agricultural fields belong to the Faculty of Agriculture – University of Kufa, during the 2016 growing season to study the effect of seed size (large, medium, small or unsorted mixture) and cultivation method (broadcasting or rows) on wheat growth and yield parameters including plant height, Spike length, number of tillers, number of spikes, grain per spike, 1000-grain weight and grain yield. The experiment was factorial based on Randomized Completely Block Design (RCBD) with three replicates. Plants grown from large seeds resulted in higher values of most parameters studied. Planting in rows method on the other hand positively affected most parameters under study. Except for plant height, grain per spike and 1000-grain weight, all the other parameter was affected by the treatment interaction between seed size and planting method.

***Keywords*:** Seed size, cultivation method, grain yield

Introduction

Wheat is one of the most important field crops in the world in terms of cultivated areas, production volume, and daily use of food tables or in the industry. It is a source of food for more than 35% of the world's population. The cultivation of homogenous seeds may be an important factor in optimizing the use of resources available for plant growth. The heterogeneity of the seeds may cause a marked disparity in plants growth among plants grown from different seed size. Plants with different sizes compete differently on light, nutrients and water. This, throughout time, will increase the disparity in growth and consequently reflect negative effects on yield quantity and quality (Ref). Nouri *et al.* (2007) reported that large seeds gave better results than small seeds resulting in higher percent germination, faster seedling elongation and shorter period of second leaf appearance in 50% of tested seedlings. The variation in plant sizes is actually observed in the wheat fields, especially in those cultivated with heterogeneous seeds. This can be inferred from increasing the number of shoots at the expense of fruit branches. Large seeds probably give larger and better growing seeds (Khafaji, 2009). Yenish *et al.* (2004) found significant differences in grain yield and the biological yield in wheat plants grown from large seeds.

In a study by Mian *et al.* (1994) on the effect of seed size and water stress in germination and seedling growth of two varieties of red winter wheat (Auburn and Howell) in a water medium showed that germination rate was not affected by seed size but was negatively affected with water stress increase (in mannitol solutions). It was found that wheat plants grown from large seeds were faster to germinate and emerge, larger leaf area, higher number of branches and much higher yield of straw and grains than plants grown from small seeds (Grieve *et al.,* 1992). Similarly Lafoond *et al.* (1986) found that larger seeds of spring wheat resulted in more rapid growth rate (21%) and higher dry weight of vegetative growths (28%) than plants of small-sized seeds. It is also reported that the number of fertile branches is significantly increased in wheat growing from larger seeds (Peteson *et al.,* 1989). Planting method on the other hand is an important factor in the growth and yield of wheat. Studies indicated that planting wheat in rows method in most cases was significantly better than broadcasting method. The later resulted in lower average of grain yield than the first (Krezel *et al.,* 1996). Khan and others (6) found that the planting method has a significant effect on the balance and availability of water, nitrogen and phosphorus in the plants rhizosphere.

AL-ansari (1981) confirmed that cultivating wheat by rows is the best for even seed distribution and also indicated that plant spacing affect the amount of light and temperature available to the plants. Naresh *et al.* (2014) found that cultivation wheat by dens broadcasting and transplanted them in plates resulted in higher spike number m^{-2} than broadcasting or rows methods. It was also mentioned by Naresh *et al.* (2014) that the highest mean of grain yield was 4581 and 4247 kg. 0 dunum where using rows and broadcasting planting methods, respectively. Thus the aim of this research is to determine the effect of seed size and planting methods in growth and yield of wheat.

Materials and Methods

The experiment was conducted in the experimental fields of the Faculty of Agriculture - University of Kufa during winter growing season of 2016. The experiment was factorial based on RCBD with three replicates. The experimental factors were seed size (small, medium, large and unsorted) and two planting methods (broadcasting and rows). Seeds were sorted depends on their size into three items using standard sieves. Seeds were considered large where collected on a 7 mesh (2.83 mm) sieve. While seeds that passed through the same sieve were rated medium and small seeds were collected on an 8 mesh (2.36 mm) sieve. Regular mix of seeds was unsorted and served as control (Nouri *et al*., 2013). Experimental units were 3x2 (6 m^2) and space between units was 50 cm. For the rows method, units were sown with 10 rows 3m each with 20 cm spacing between lines. While for the broadcasting method, units were sown at rate of 160 kg h^{-1}.

The soil of the experiment was fertilized twice with nitrogen (urea) at a rate of 100 kg h^{-1}. The first was incorporated with the soil at planting and the second was applied one month after planting. Tri-super phosphate (P 2.5) was also applied at a rate of 100 kg h^{-1} as recommended (AL-kubaisi *et al.,* 2000). The experimental units were irrigated and weeded as needed. Seed germination was preliminarily tested which was found to be 90%. The experiment started on 18/11/2016 and ended at harvest on 5/5/2016.

Measurements and parameters under study:

1. Plant height (cm): measured from the ground up to the end of very top beard on the main stem.
2. Spike length (cm): according to the average of ten random plants from each unit, measured from the base of the spike up to the end of the spikelet on the main stem (7).
3. Number of branches per square meter; calculated from 1 m^2 at branching time.
4. Number of spikes m^{-2} according to the average number of spikes per a randomly selected square meter from each unit.
5. Number of grains per spike: calculated to be an average of ten random plants from each experimental unit.
6. Weight of 1000 grain (g): yield of each unit was thoroughly mixed and 1000 grain was pulled and counted, then weighted using a sensitive electronic balance.
7. Grain yield (tons h^{-1}); after spikes were air dried, grain yield of randomly selected square meter from each unit was weighted and converted to tons per hectare.

Data analysis

Data collected from all experimental units were subjected to analysis of variance using Genstate Discovery the 3rd Edition. The least significant difference (LSD) was performed for comparing between treatments means ($P \leq 0.05$).

Table 1 : Physical and chemical characteristics of the experiment field soil

Soil texture	K (ppm)	P (ppm)	NO_3 (ppm)	EC ground water (dSm^{-1})	pH ground water	EC soil (dSm^{-1})	pH soil
Silt-clay	9.44	143.8	32.3	2.87	7.10	3.74	8.4

Table 2 : Effect of seed size and methods of agriculture in studied traits

Seed size	Planting method	Plant height (cm)	Spike length (cm)	Branches $plant^{-1}$	No. of spikes m^{-2}	Grain $spike^{-1}$	1000-grain weight (g)	Grain yield t ha^{-1}
Mix	Broad.	95.0	8.9	251.7	253.0	51.1	31.3	3.4
	Rows	97.0	9.0	255.7	261.6	50.0	32.6	4.1
Small	Broad.	100.0	8.3	303.7	243.6	53.0	33.3	4.1
	Rows	105.3	9.3	324.7	257.3	51.0	36.0	4.2
Middle	Broad.	114.0	9.0	406.0	273.3	60.6	41.6	4.8
	Rows	117.6	12.0	440.7	291.3	58.6	43.6	5.0
Large	Broad.	121.0	9.2	410.3	284.3	58.0	39.3	4.5
	Rows	122.0	12.0	432.0	294.0	56.3	40.3	4.8
Seed size treatments mean	Mix	96.0	8.9	253.7	257.3	59.6	32.6	3.7
	Small	102.6	8.8	314.2	250.5	52.0	34.6	4.1
	Middle	115.8	10.5	423.3	282.3	50.5	42.6	4.9
	Large	121.5	10.6	421.2	289.1	57.1	39.8	4.6
Planting methods mean	Broad.	110.5	8.8	342.9	263.5	55.6	36.4	4.2
	Rows	107.5	10.5	363.2	276.0	54.0	38.1	4.5
Seed size		2.8	1.0	16.1	2.8	1.4	0.9	0.1
Planting method		2.0	0.7	11.4	2.0	0.9	0.6	0.1
Interaction		N.S	1.4	22.8	4.0	N.S	N.S	0.1

Results and Discussion

Plant height

The results as shown in Table (2) indicated that plants grown from large seeds were significantly higher plant height with the highest average of 121.5 cm compared to the mixed (unsorted) seeds which resulted in lowest plant height that averaged of 96.0 cm. This result is logically expected as large seeds will germinate faster and so extending the period of growing longer compared to the period available for late germinated plants. Planting in rows resulted in shorter plants (107.5 cm) than plants of broadcasting methods which had higher plants height (110.5 cm). This might be due the number of seeds grown in the area unit. In the broadcasting method number of plants will be much higher than plants number of the other method. The high population density will increase competition among plants for light decreasing oxygen metabolism and resulting in more elongation in plant body. As shown in table 2, interaction of seed size and planting method was not significant.

Spike length (cm)

The spike length was affected by seed size and planting method (table 2). The growing plants of the large seeds significantly had longer spikes with average of 10.6 cm compared to 8.9 cm spike length from plants of unsorted seeds. Like in plants of large seeds, plants grown in rows gave spikes of 10.5 cm long compared to much lower spike length (8.8 cm) from plants of broadcasting planting method. This may be due to even seeds distribution in rows method which resulted in uniform of plant density and consequently reduced competition for water and nutrients, and thus increasing the length of the spike. Interaction of seed size and planting method had significant effect on spike length.

Number of tillers per square meter

The growing plants of medium-sized seeds significantly had higher number of branches recording highest average of 423.3 m^{-2} compared to the lowest mean average of 253.7 m^{-2} from plants of mix seeds. This may be due to the early growth of middle and large seeds and their higher amounts of stored nutrient available for germination and rapid growing. This early rapid growing resulted in higher number of branching. Planting in rows again resulted in significantly higher branches number (363.2 m^{-2}) than broadcasting method which gave the lowest average (342.9 m^{-2}). Plants uniformity and even distribution reduced competition among plants grown in rows and so resulted in higher number of branches. It was observed that plant branches number was affected by interaction of seed size and planting method.

Number of spikes per square meter

Results in table (2) also showed that spikes numbers were affected by seed size. Plants of larger seeds had significantly higher number of spikes that of 289.1 spike m^{-2}, while number of spikes from plants of small seeds average 250.5 spike m^{-2}. This is normal as plants of large seeds had much higher branches numbers and so this was reflected on spikes numbers. The method of planting the lines (rows) gave the highest average number of spikes (276.0 spike m^{-2}) compared to lowest average (263.5 spike m^{-2}) from the broadcasting method. Uniformity and homogenization of plants in the rows method reduced competition between plants gave an opportunity to produce larger number of spikes. The higher numbers of branches were also reflected in the increase of spikes numbers. This is consistent with former studies confirming that interaction of seed size and planting method has significant effect of spikes number per plant.

Grain per spike

Number of grain per spike differed among treatments (table 2)The results of Table (2). Number of seeds per spike in plants of mixed seeds increased significantly and gave the highest average of 59.6 seed $spike^{-1}$ compared to lowest number (50.5 seed $spike^{-1}$) form plants of middle size seeds. Increase in spikes number per plant may the amount of carbonate metabolism product that available to each spike and consequently reduces number of seeds per spike. Broadcasting method had the highest average of (55.6 seed $spike^{-1}$) while the rows planting method had less average of (54.0 seed $spike^{-1}$). The lower number of seeds in the rows method may due to the higher number of spikes which were receiving fewer amounts of carbonate metabolism products and resulted in lower number of seeds per spike. Interaction between seeds size and planting method was not significant.

1000-Grain weight

As shown in Table (2), plants of middle-size seeds had significantly higher 1000-grain weight (42.6 g) than that resulted from plants of mixed seeds (34.6 g). This may be due to the early growth and the low number of grain per spike of middle size seeds plants. This may provide more nutrients and reduce competition resulted in higher weight of grains. Using the rows planting method again resulted in higher weight of 1000 grain than the broadcasting planting method. Plants uniformity and less competition for carbonate products in the rows method increased nutrient available to seeds increasing the grain weight. However, the results showed a lack of significant effect in interaction between seed size and planting method.

Grain yield

Grain yield was also affected by treatments (Table 2). Plants of large seeds resulted in significantly higher grain yield (4.6 tons h^{-1}) than grain yield from mixed seeds plants (3.7 6 tons h^{-1}). Seed size influenced germination and growth. Plants of large seeds germinated faster and grown more rapid than those of small and mix seeds. Larger seed produced stronger and fast growing plant due to higher efficiency of photosynthesis and thus producing seeds with large size and density. The rows planting method again had higher grain yield (4.5 6 tons h^{-1}) than the broadcasting which yielded 4.2 6 tons h^{-1}. This may because the rows method had much higher number of spikes and 1000-grain weight. Interaction between planting method and seed size had significant effect on grain yield.

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