2528-9705

Örgütsel Davranış Araştırmaları Dergisi
Journal Of Organizational Behavior Research
Cilt / Vol.: 7, Sayı / Is.: S, Yıl/Year: 2022, Kod/ID: 22S0-879

Examining the Quantitative properties of Durum Wheat

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ABSTRACT

The current study aims to examine the quantitative properties of durum wheat. The experiment was carried out on a plot of land with an area of 1600 square meters. After the initial land preparation and implementing the land plan, furrows were made in the land by a groove maker. The length of grooves was 60 cm and they made along the land perpendicular on irrigation direction and then, test plan was prepared. The plot inside each replicate was equal to the number of treatments which is 20. Each plot consisted of 6 planting lines with a distance of 30 cm and dimensions of 1.5 × 6 m. Data were analyzed by ANOVA and mean of treatments compared using Duncan's multiple range test method. Calculations were performed using MSTATC and SAS software and graphs were drawn using EXCEL software. The results showed that the number of ears per square meter had a significant effect in the plan. Moreover, there was a significant difference ($p < 0.01$) between the studied genotypes in terms of plant height. There was no statistical difference in the number of tillers between the studied cultivars and genotypes. Moreover, a significant difference was observed between the average 1000-seed weight of cultivars and genotypes at the statistical level of 0.01. There was a statistically significant difference between the means of leaf area index measured for the studied genotypes at the statistical level of 0.01. According to the results, there was a significant difference between the mean grain yield of the studied cultivars at the statistical level of 0.01.

Keywords: *Durum wheat, quantitative properties of wheat, number of ears, plant height, number of tillers*

INTRODUCTION

Durum wheat production and trade increased during the second half of the 1980s and early 1990s with regard to the increase in populations and further demand. According to the FAO report in 1985, the total area under wheat cultivation was about 240 million hectares, only about 8% of which (21 million hectares) was dedicated to durum wheat cultivation. As with bread wheat, durum wheat, can be grown in all regions. Durum wheat has better adaptation to drought and has more crop production in marginal areas. Under favorable conditions, durum grain yield of more than 10 tons per hectare has also been reported in improved wheat [54]. Durum wheat, with about 21 million hectares of cultivated area, ranks eighth among the cereals grown in the world, followed by bread, rice, corn, sorghum, millet, barley and oats.

Joppa et al (1983) studied the effect of gliadins on pasta quality. The results showed the chromosome B1 of the Edmore variety with strong gluten, and the γ^{-45} band in the PAGE test, and the Langdon variety with weak gluten and the γ^{-45} band, which indicates strong gluten. When semolina of these varieties were analyzed for qualitative properties, both Langdon and Edmore showed strong mixograms and high SDS sediment volumes, while the initial Langdon

was weak. Other studies have been conducted by Mc Ritchie (1984 and 1980) and Pomeranze (1980) on the properties of gluten proteins by dissolution-based separation method. Filet (1984 and 1980) stated after doing extensive research that the baking quality of pasta as well as the baking quality of wheat flour depend heavily on gluten protein.

Properelya and Suzinov (1980) and Rigley et al. (1981) confirmed the relationship between certain gliadin bands and the quality of baking in bread wheat. Dexter and Matsuo by examining the effect of undesirable wheat grains on semolina and pasta quality showed that by increasing the grain starchy kernel ratio, the semolina husks become softer and the flour ratio produced during the milling process increases. Seibel and Filet (1977) used the Disk Method to produce pasta flakes and to examine the qualitative properties of pasta, including the cooking time of the flakes.

Along with the development of the electrophoresis method, Damidaux et al. (1978) discovered a specific polypeptide of gliadins that correlates with the consistency and quality of gluten in durum wheat (gamma gliadin 45) as well as another polypeptide in the same locus with poor correlation (gamma gliadin 42), and the presence of these polypeptides can be used as a quality characteristic of durum wheat. Dexter and Matsuo (1978) examined the effects of protein content on some quality parameters of Canadian durum wheat and concluded that the amount of yellow pigment in semolina increases as the amount of protein increases. Wasick (1978) in his study on the effect of durum wheat protein compositions on pasta quality found that a simple correlation between a number of pasta quality parameters and the ratio of each protein composition indicates the direct effect of insoluble protein on the properties of raw gluten.

Payne et al (1983) for the first time categorized the individual correlation between glutenins and wheat grain proteins weight based on their solubility. Irwin and Adeston (1953) in a study on 7 cultivars of durum wheat, concluded that the pigment diversity in semolina and lipoxidase is more affected by the cultivar than environmental conditions. Moreover, the determinants of pasta color are the pigments in semolina and the amount of lipoxidase activity. Semolina with high gluten content is preferred in the pasta industry. The maximum expected amount of gluten in semolina is 13%. Measuring gluten by wet method is very expensive, so it is possible to use a measure of protein which is both inexpensive and simple, because it estimates the quality and quantity of gluten. According to the above, the current study aims to examine the quantitative properties of durum wheat.

Materials and Methods

The experiment was carried out in autumn 2008 and spring 2009 in Baluchistan Agricultural Research Station in Bampur subregion (Iranshahr city) located at 60° 29′ E and 27° and 11′ N with an altitude of 525 m above sea level. Iranshahr has a hot and dry climate. In this region, the average annual rainfall is 100 ml and the maximum and minimum annual temperatures are 38.7 and 12.2 °C, respectively.

Table 1: Precipitation (ml) in 2008

April	May	June	July	August	September	October	November
15.9	9.2	0.4	0	0	0	0	9.2

Table 2. Mean temperature (°C) in 2008

April	May	June	July	August	September	October	November

17.13	21.18	27.27	29.24	25.13	22	20.27	12.48

Results of the mechanical and chemical analyses of the soil are shown in Table 3. With regard to mechanical analysis and the percent of each element of soil, Soil texture was determined to be loamy.

Soil properties	Soil texture	Electrical conductivity (EC) $ds.m^{-2}$	pH	Carbon (%)	Zn	Fe	Cu	Mn	Absorbable K	Absorbable P	Absorbable N
					mg/kg						Percent
Test result	Sand loamy	3.18	7.7	1.75	0.37	8	1	5	98	8.0	0.2

Table 3: result of soil analysis.

The experiment was carried out on a land with an area of 1600 square meters. After the initial preparation of the land and after implementing the plan, the land was made into a ridge by a groove maker. The length of grooves was 60 cm and they made along the land perpendicular on irrigation direction and then, test plan was prepared. The plot inside each replicate was equal to the number of treatments which is 20. Each plot consisted of 6 planting lines with a distance of 30 cm and dimensions of 1.5 × 6 m.

The amount of nutrients required included N2, P2O5 and K2O with formulas 135, 90 and 46 kg per hectare, respectively. All fertilizers except nitrogen fertilizer were applied to the soil at the time of soil preparation and nitrogen fertilizer was spread evenly on the field at the beginning of stem development, ear emergence and granulation.

Data were analyzed by ANOVA and mean of treatments using Duncan's multiple range test method. Calculations were performed using MSTATC and SAS software and graphs were drawn using EXCEL software.

Findings

analysis of variance for quantitative parameters of the fisrt experiment

harvest indext	biologic performance	seed performance	leaf surface index	number of tillers	1000-seed weight	plant height	number of seed in ear	number of ear at each surface unit	degree of freedom	source of variation
62.562 n.s	0.868 n.s	0.125 *	0.073 *	0.002 n.s	0.631 n.s	0.538 n.s	10.117n.s	9.450n.s	2	iteration
19.020 *	2.922 **	1.416 **	0.383 **	0.358 **	1.106 *	72.951 **	30.066 **	4184.874 **	19	cultivar
2.733	0.031	0.032	0.018	0.013	0.512	3.717	1.924	683.100	38	experiment eror
14.3	13.4	16.8	9	9	9.6	12.3	16.4	12.4	-	variation coefficient percent

n.s there is no significant difference among mean of examined parameters

* there is significant difference among mean of examined parameters at 0.05

** there is significant difference among mean of examined parameters at 0.01

Table 4: ANOVA for quantitative parameters

1.The effect of wheatear at square meter

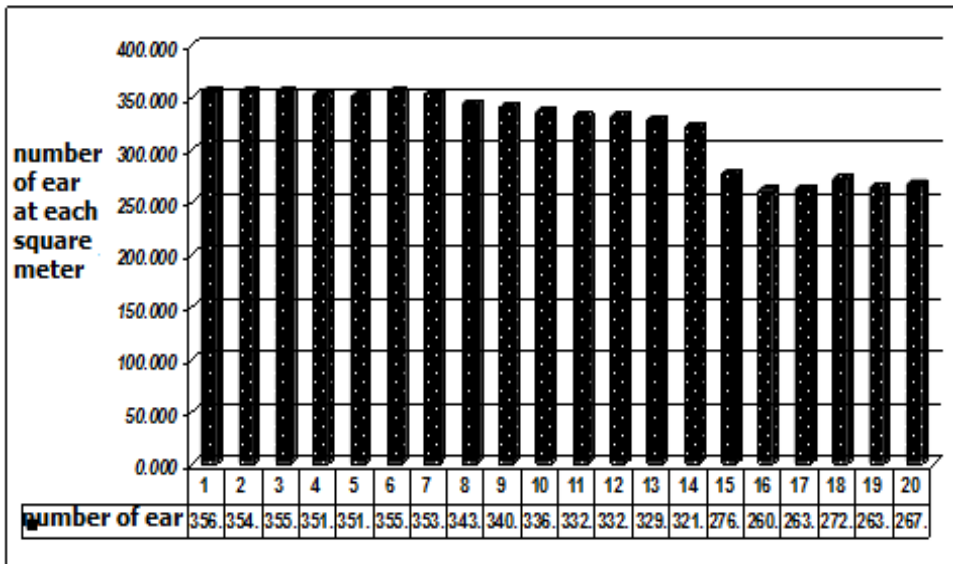

Figure 1: comparison of mean number of ear at square meter for cultivars of durum wheat in the first experiment

According to Table (4), the number of ears per square meter has shown a very significant effect in the plan, so that the highest number of ears per square meter of the cultivars 1, 6, 3, 2, 7, 4,

and 5 obtained in the range of 350-356 that according to the mean comparison test performed on this property, there is no statistical difference between these cultivars in terms of ear production per square meter and they are all in the same statistical class. On the other hand, the lowest number of ears obtained from cultivars 16, 17, 19 and 20 with a value between 260-267 ears per square meter which no statistical difference can be observed among them, and the number of ears per square meter of the other cultivars examined had a performance between these two groups. Since the number of ears per square meter along with other quality parameters is one of the important and influential factors in economic performance, it seems that these cultivars should have a higher yield than other cultivars, which was confirmed by ANOVA done on this property. It is important to note that the two control cultivars (cultivars 1 and 2) are both in the same group and have the maximum number of ears per square meter, and cultivars competing with these two, cultivars 6 and 3, 7, 4 and 5, are in the same class.

2.Plant height

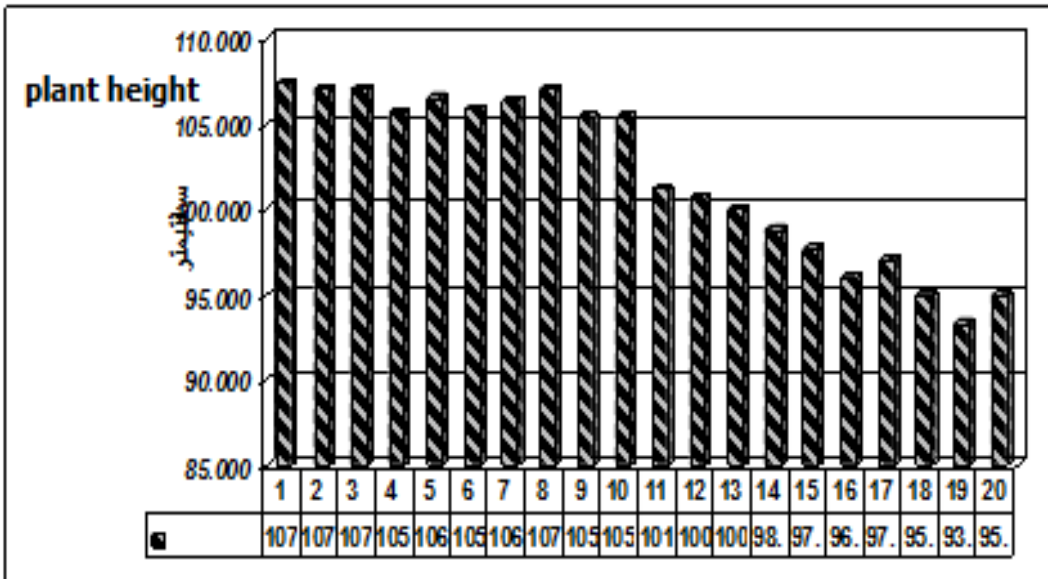

Figure 2: comparison of plant height of durum wheat cultivars examined in the first experiment

Data analysis shows that there is a significant difference ($p < 0.01$) between the studied genotypes in terms of plant height (Table 4). Among these 20 cultivars, there are two statistically important groups regarding to triats, including the group of cultivars numbers 1 to 10, which irregularly contain a height of 105 to 107 cm and have no statistical difference with each other. The controls (numbers 1 and 2) condition is that they are in the first group and among them the number 1 has a higher height.

3. Number of seed in ear

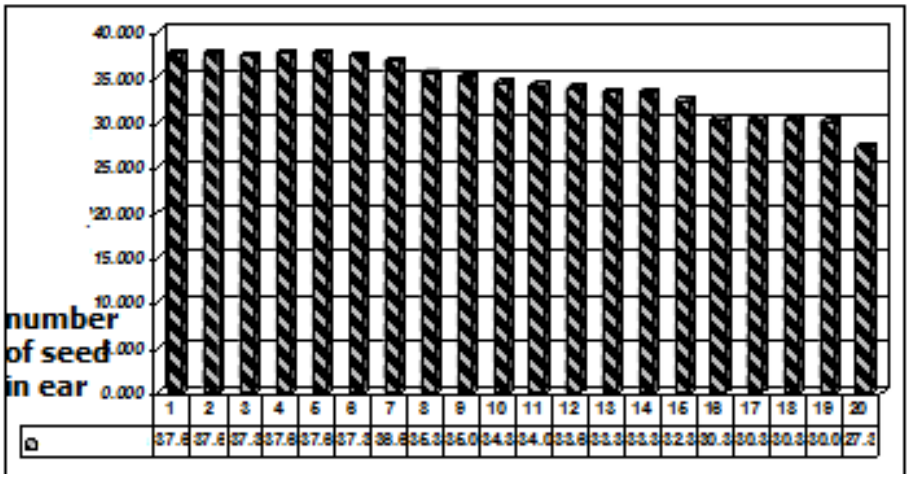

Figure 3: comparison of the mean number of seed in ear for durum wheat cultivars examined in the first experiment

There is a significant difference ($p < 0.01$) between different genotypes in terms of the number of seeds per ear (Table 4). Genotypes 1-10 have the highest number of seeds per ear (about 38-34), which have no significant difference according to the mean comparison test. In contrast, the genotypes 16-20 with about 27-30 seeds per ear have the lowest number of seeds per ear. The maximum number (37.7 seeds per ear) belonged to controls (cultivars 1 and 2).

4. Number of tillers

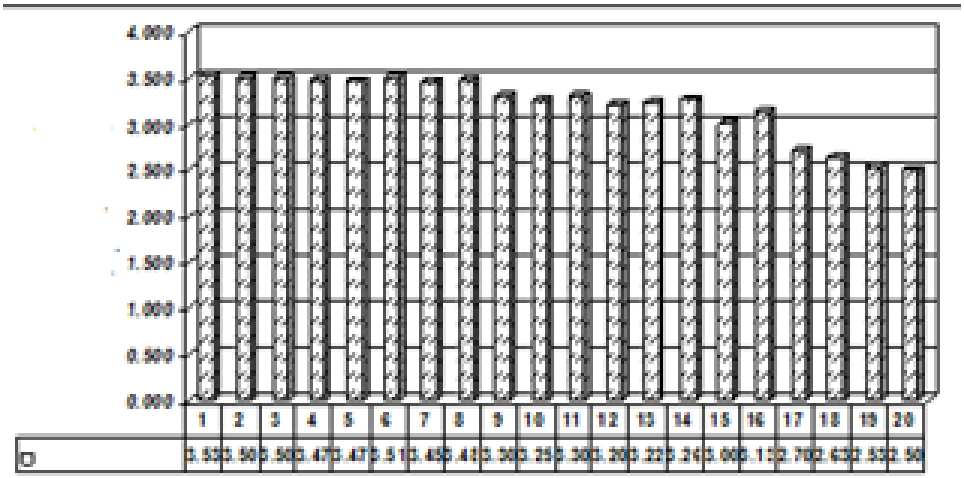

Figure 4: comparison of the mean number of tillers in durum wheat cultivars in the first experiment

According to the ANOVA table (Table 4), there is no statistical difference between the cultivars and genotypes in terms of number of tillers and these 20 genotypes had 2.5 - 3.5 tillers per plant, but according to Duncan's mean comparison test for number of tillers per plant, cultivars 1-8 have the highest number of tillers. Since two control cultivars were in the first group

(maximum), they also have the highest number of tillers, and only cultivars 6 and 3, have been able to differentiate between these two controls with a slight difference.

5. 1000-seed weight

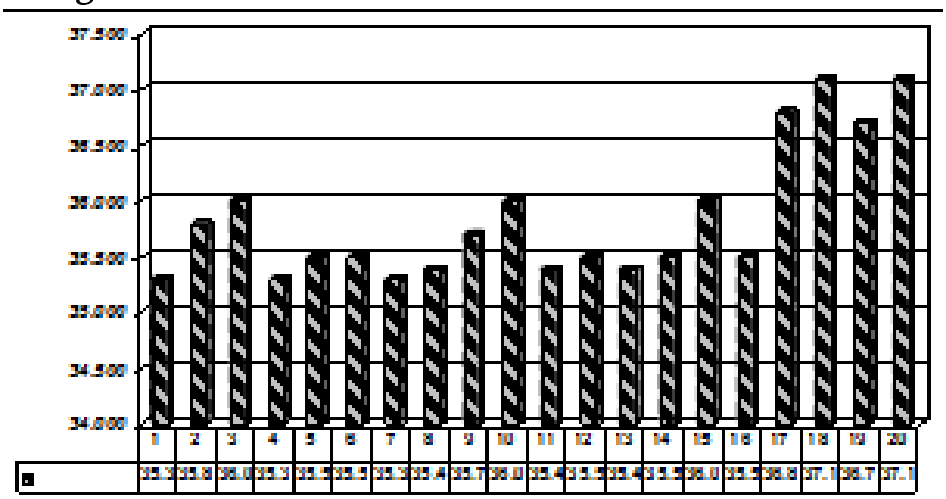

Figure 5: comparison of mean 1000-seed weight for durum wheat cultivars in the first experiment

According to the summary table of ANOVA, there is a significant difference between the mean 1000-seed weight of cultivars and genotypes ($p < 0.01$), so that the highest 1000-seed weight has been obtained about 40 g of cultivars 16, 17, 18, 19 and 20, while the lowest weight of 1000 seeds from cultivars 1 to 10 has been obtained about 32.5.

6. Leaf surface index

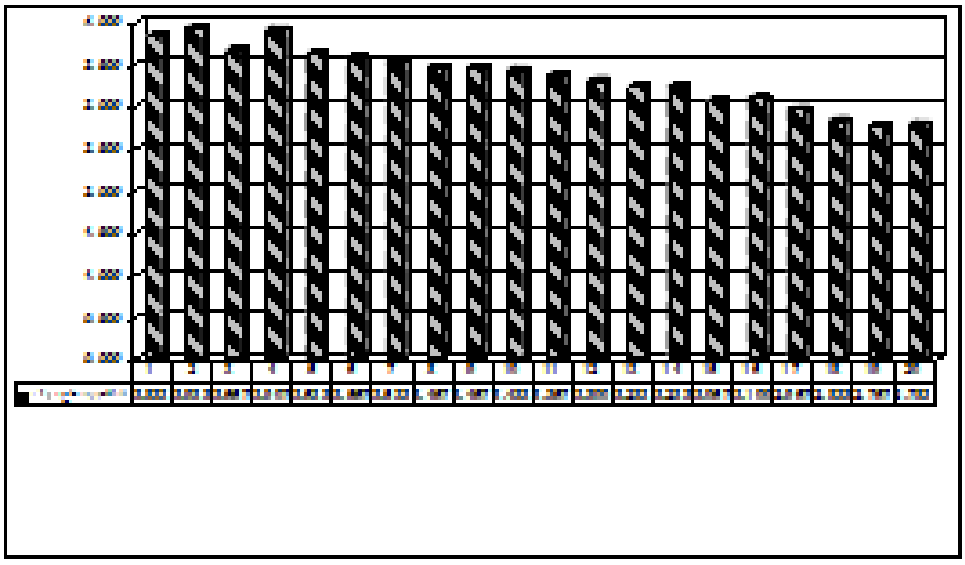

Figure 6: comparison of mean leaf surface for durum wheat cultivars in the first experiment

In this experiment, there is a statistically significant difference between the means of leaf surface index measured for the studied genotypes ($p < 0.01$), so that the highest leaf surface index of is for cultivars 2, 4, 1, 3 and 5 in the range of 3.6 to 3.9 which shows a very favorable vegetative growth and these cultivars are statistically classified in the first group and have no statistical difference with each other. The controls (cultivars 1 and 2) in this experiment are also in the same group. In contrast, cultivars 15, 17, 18, 19 and 20 with the lowest leaf surface index in the range of 2.7 to 3 are in the last group, which indicates a lack of optimal vegetative growth compared to cultivars of the first group.

7. Biological performance

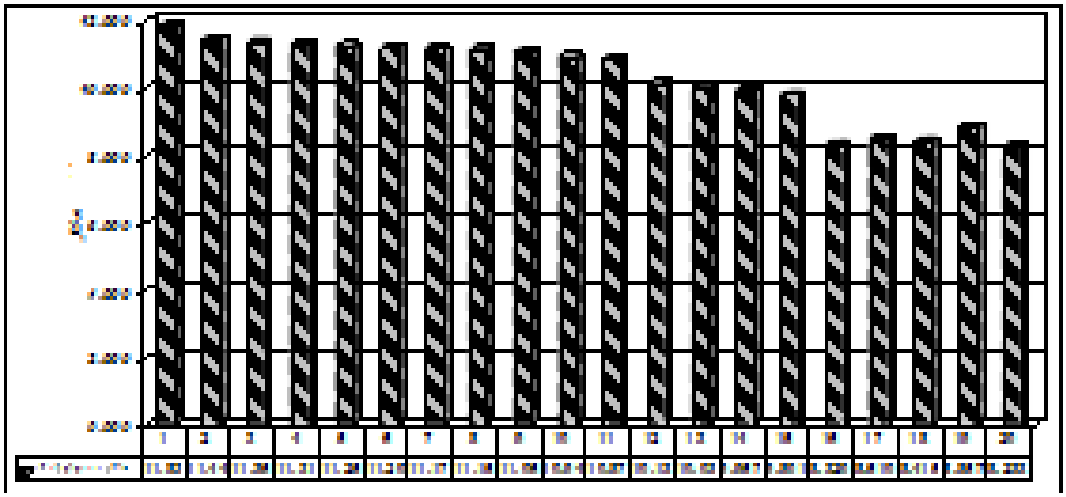

Figure 7: comparison of mean biologic performance for durum wheat cultivars in the first experiment

The results showed in the ANOVA table and the comparison of the mean biological performance of 20 durum wheat cultivars indicate that all cultivars with higher number of ears, number of seeds per ear, plant height, 1000-seed weight, leaf surface index, have a desirable biological performance among which cultivar one with a biological performance of 11.84 tons per hectare has the first rank among the 20 cultivars examined. Cultivars 2-9 are in a statistical group with cultivar 1 and there is no statistical difference between them and the biological performance of the two control cultivars in this experiment are also included in this group.

8.Seed performance (economic performance)

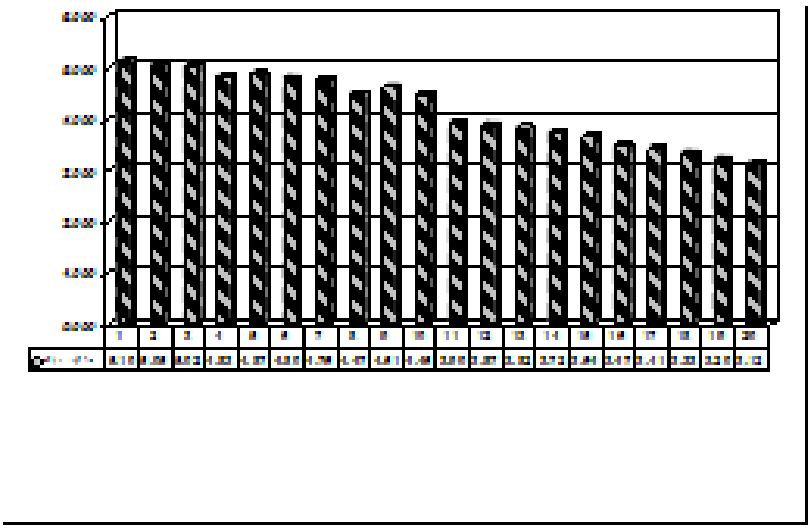

Figure 8: comparison of mean seed performance for durum wheat cultivars in the first experiment

According to the results shown in the table of ANOVA, the table of correlation coefficients, and a comparison of the mean (Figure 8), there is a significant difference between the mean grain yield of the studied cultivars at the 0.01 level such that performance range which has been estimated from 2.95 to 5 tons per hectare.

The highest grain yield is for to cultivars 1-7, which have a yield between 4.7 to 5.1 tons per hectare. With regard to the low values of the number of ears per square meter, the number of seeds per ear and ... in cultivars 17-20, these cultivars with a yield of about 3 tons per hectare are in the last group in terms of economic performance, which have no statistical differences with each other and are in same statistical group.

9.Harvest index

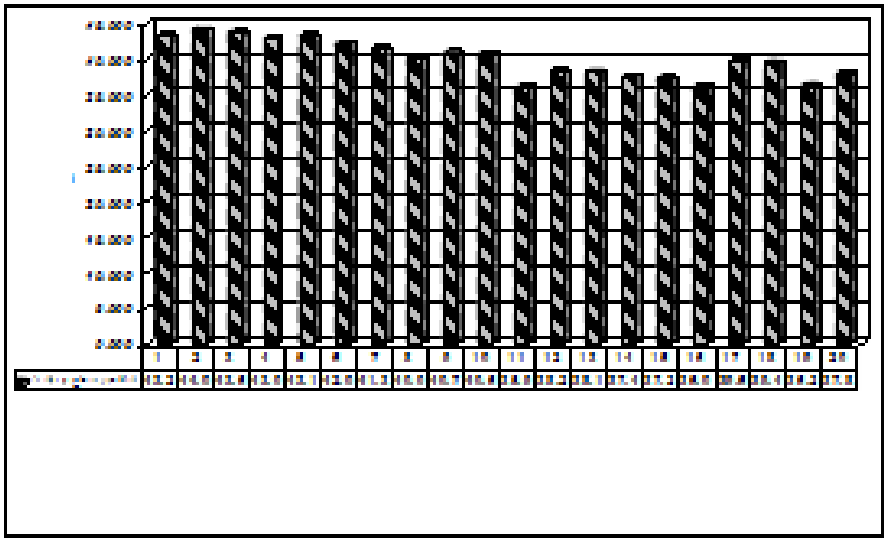

Figure 9: comparison of mean harvest level index for durum wheat cultivars in the first experiment

Considering that the harvest index was calculated and statistically analyzed in all experimental plots with three replications and also doing the comparison test, the mean harvest index shows that the cultivar 1 with 43.22% has the highest harvest index.

analysis of variance for quantitative parameters of second experiment

source of variation	degree of freedom	number of ear per surface	number of seed per ear	plant height	100-seed weight	number of tillers	leaf surface index	seed performance	biologic performance	harvest index
iteration	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
cultivar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
experiment error	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
variation coefficient	-	13.32	[illegible]	13.40	13.02	14.81	[illegible]	[illegible]	15.17	[illegible]

n.s there is no significant difference among examined parameters

* there is significant difference among examined parameters at 0.05

** there is significant difference among examined parameters at 0.01

Table 5: ANOVA for quantitative parameters of the second experiment

1. The effect of the number of ear per square meter

According to Table 5 (ANOVA for quantitative parameters of the second experiment), and comparing the mean number of ears per square meter of cultivars, the effect of the number of ears per square meter has a significant effect ($p < 0.01$). Among these 20 cultivars and genotypes of all treatments (cultivars and line), except cultivars 14 and 17 which are in different statistical classes, other cultivars have no statistical differences with each other. They are in the same statistical class, and the important point is that the two cultivars 1 and 2, which are considered as controls, are also in the same class with this group of cultivars and there is no significant statistical difference between them.

2.Plant height

Data analysis shows that there is a significant difference ($p < 0.05$) between the studied genotypes in terms of plant height. It is important to note that one of the controls (cultivar 2) among these 20 cultivars has the highest plant height of 106 cm, while the other control (cultivar 1), with a height of 98 cm is about 7 cm different from the maximum height obtained.

3.Number of seed per ear

According to the results, there is a significant difference between these 20 lines and the cultivar. Moreover, there is a statistical difference between the two controls in this regard, so that the cultivar 2 is in the maximum group and cultivar 1 is in the minimum group.

4.Number of tillers

According to the table of ANOVA (Table 5) for the second experiment, there is a statistically significant difference between the cultivars and genotypes in terms of number of tillers and these 20 genotypes showed diversity in terms of number of tillers in the range of 3-4. There is no statistical difference between these 20 genotypes and 15 cultivars in terms of number of tillers. The highest number of tillers is for cultivar 11 with 3.8 tillers per plant, while cultivar 8, which is in the last rank in terms of yield and has the lowest value with 3,133 tillers per plant.

5.1000-seed weight

According to the table of ANOVA there is a significant difference at the 0.01 between mean 1000-seed weight of cultivars and genotypes studied, so that the highest 1000-seed weight has been obtained about 55 g for cultivars 1, 8, 14, and 19, while the lowest weight of 1000 seeds has been obtained about 43 g for cultivars 12-18 and 20.

6.Leaf area index

In this experiment, there is a statistically significant difference between the means of leaf surface index measured for the studied genotypes 0.01, so that the highest leaf surface index is 3.63 to 3.9 for cultivars 4, 9, 11, 13, which indicates a very favorable vegetative growth that these cultivars. They are statistically classified in the first group and have no statistical difference with each other. In contrast, cultivars 6-8 and 14 with the lowest leaf area index of 2.7 to 3 are in the last group, which indicates a lack of optimal vegetative growth compared to cultivars in the first category.

7. Biological performance

The results showed in the ANOVA table and the comparison of the mean biological yield of 20 durum wheat cultivars studied in this study indicate that all cultivars with more ears, number of seeds per ear and height have higher biological performance. They are also more desirable, which includes a large range of cultivars studied in this experiment. The most significant cultivars are cultivars 2 and 18, whose biological performance is 16.04 and 15.96 tons per hectare, respectively. These cultivars were also more voluminous, taller and juicier than other cultivars.

8. Seed performance (economic performance)

The results of ANOVA indicate that the cultivars are very different from each other in terms of grain yield and their economic performance varies from 6,894 tons per hectare to 5.087 tons per hectare. The highest yield is for cultivars 2, 4, 9 and 11 equal to 6675, 6730, 6,894, and 6,595 tons per hectare, respectively, which one of the studied controls (cultivar 2) is in this category or statistical class.

9. Harvest index

Considering that harvest index was calculated and statistically analyzed in all experimental plots with three replications for each of them, and considering mean harvest index test, cultivar 3 with 48.17% has the highest harvest index, while many cultivars with the same value in the mean comparison test are in the same group, including the two control cultivars.

Conclusions

The results showed that the number of ears per square meter has a very significant effect in the plan, so that the highest number of ears per square meter have been obtained for cultivars 1, 2, 3, 4, 5, 6, and 7 with a value in the range 350 – 356. Moreover, there is a significant difference ($p < 0.01$) between the studied genotypes in terms of plant height. Among these 20 cultivars, two groups are significant which are the group of cultivars 1 to 10, which have a height of 105 to

107 cm. there is a significant difference ($p < 0.01$) between different genotypes in terms of number of seeds per ear. Genotypes 1-10 with about 38-34 seeds have the highest number of seeds per ear.

According to the ANOVA (Table 4), there is no statistical difference between the cultivars and genotypes in terms of number of tillers and these 20 genotypes are in the range of 2.5-3.5 tillers per plant. However, according to Duncan's mean comparison test on number of tillers per plant, cultivars 1 to 8 have the highest number of tillers. Moreover, there is a significant difference between mean 1000-seed weight of cultivars and genotypes ($p < 0.01$). There is a significant difference between the means of leaf surface index measured for the studied genotypes ($p < 0.01$), such that the highest leaf surface index is for cultivars 1, 2, 3, 4, and 5 in the range of 3.6 to 3.9.

According to the results, there is a significant difference between the mean grain yield of the studied cultivars ($p < 0.01$), so that the range of these yields is estimated from 2.95 to 5 tons per hectare. Moreover, mean harvest index test shows that the cultivar 1 with 43.22% has the highest harvest index.

Acknowledgment:

none

Conflict of Interest:

none

Funding:

none

Ethical statements:

none

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