Study of Quality Traits of Durum Wheat (*Triticum durum* Desf.) Cultivars Grown Under two Irrigation Patterns, Locations in Nineveh Province.

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Abstract

The experiment was conducted at two environmental locations in Nineveh province (Tel Kaif and Fayda) during season 2021-2022, to evaluate 30 cultivars of durum wheat under two patterns of irrigation (Rain-fed and supplementary) and their effects on the qualitative traits of flour, for this Aim, field experiments were implemented. The results showed that the Guayakan cultivar was superior in the moisture % trait for both locations (Tel Kaif and Fayda) as it reached 10.04 and 9.16% respectively, and also the superiority of the cultivar Svevo in protein% trait as it reached 13.75 and 14.42% respectively, Cham-9 also excelled in the Total carbohydrates% recorded 75.37 and 73.66% respectively. In color grade trait, the cultivar of Cham-3 was superior at 13.90 and 14.74 grade^{-1} **,** The cultivar Ari was superior in ash% at Tel Kaif location recording 3.25% While the cultivar Svevo excelled in the Fayda location for the same trait, it was recorded 3.66%. Under Supplementary irrigation, all traits were superior compared with those in the rain-fed location.

Keywords: wheat, cultivars, Quality, Irrigation**.**

Introduction

Wheat is one of the most widely cultivated crops around the world and occupies a great place in agriculture (15). It is also an important strategic crop, as it represents a food source for about 35% of the world's population and provides 20% of protein and calories for humans (12). The quality traits of wheat grains such as (protein, moisture, Ash, color, and carbohydrate content) in grains play an effective and important role in determining price policy and raising manufacturing efficiency and product quality (19**) .**

Many studies have shown that the chemical composition of the wheat grain varies from one cultivar to another for many reasons, the most important of which are the diversity of cultivars, climate, geographical location, growing season, amount of rainfall, and its distribution during the growing season, ripening date, in addition to the applied agricultural treatments (16).

Wheat is grown under different environmental conditions in the country, as it is mostly grown in the northern regions under rainy conditions, while in the central and southern regions, it is grown under supplementary irrigation conditions. Supplemental irrigation is defined as adding an amount of water to crops that are essentially dependent on rain to improve and stabilize the yield and ensure normal plant growth during times when rains fail to provide the plant with sufficient moisture during its critical growth phases (18). Iraq currently suffers from low rates of rainfall and a large variation in the distribution of rainfall during plant growth stages, which negatively affected the qualitative traits. The amount of water added to the plant by supplemental irrigation depends on the environmental conditions such

as temperature, rain, soil texture, and genetic factors related to the plant such as tolerance to water stress.

Wheat cultivars also differ in their response to supplementary irrigation to give the highest yield and quality of grain. It increases the readiness and absorption of nutrients and helps in the growth and division of cells and the process of photosynthesis (13). This study is complementary to the previous studies to prepare a database for those items to be used later by workers in the field of production and research**.**

Materials and Methods

A field experiment was conducted during the season 2021-2022 in two locations with medium rains (MRA) in the north of Nineveh Governorate, the experiment included (60) factorial treatments that represented the compatibility between (30) cultivars of durum wheat and two irrigation patterns (Supplementary and Rain-fed Irrigation). The experiment was applied using a randomized complete block design (RCBD) with three replications according to the split-plot design. Less important than the factor of the most important items that were placed in the subplot, the area of the experimental unit was (1 m) The cultivation process was carried out manually at the seeding rate (300 seed.m^{-2}), the row spacing distance (20cm), the data for the studied traits were analyzed using the computer And the adoption of the Genstat program, and the averages of the treatments were compared using the LSD test (4). Planting is 15/12/2021 and harvesting date is 6/1/2022, Physical and chemical traits for soil and rainfall are shown in Table (1).

Table 1. Soil analysis and rainfall precipitation in the (2021-2022) season.

Measurement type	Tel kief	Fayda
pH	7.4	7.07
EC ds.m-1	0.39	0.26
Organic Matter %	2.20	1.88
available Nitrogen ppm	64	43.85
Available Phosphorous ppm	4.57	15.59
Available Potassium ppm	354.4	171.42
Clay %	23.15	30.50
Silt%	47.4	26.50
Sand %	29.45	43
Texture	loam	clay loam
Total Rain PPT (mm)	281.5	216.2

Studied traits

1. Moisture content %: it was determined by the infrared (Inframatic 9500) device.
2. Ash content %: It was determined by the infrared (Inframatic 9500) device.
3. Protein content %: It was determined by an infrared (Inframatic 9500) device.
4. Total Carbohydrate%: Calculated according to the following formula: Total Carbohydrates (%) = 100- (Moisture% + Ash% + Protein %).
5. Color grade: It was determined by infrared (Kint gones and Martin color grader) device.

Result and Discussion

Tel kaif location

The cultivars were arranged in the tables according to their average values from top to bottom to facilitate the explanation process.

In all table supplementary Irrigation= SI .

Moisture content %: It was found from Table (2) that the average moisture percentages of the grains of the studied cultivars differed significantly among themselves, as the (Guayakan) cultivar achieved the highest moisture percentage in the grains, which amounted to 10.04%, while it was found that the lowest moisture percentage of the grains was when the (Parasiful) cultivar reached 9.10%, which did not differ. Significantly with the values of the cultivars (Wahat AlIraq, Cham-3, and Sardar), The reason may be due to the genetic Factors of the cultivar in creating a sufficient root system to increase the efficiency of water absorption from the soil down to the grain, especially at the last stages of plant growth and grain filling, and this is consistent with (8).

It was also observed that the cultivars grown under supplemental irrigation gave the highest grain moisture, which amounted to 9.56%, compared to the cultivars grown under rain-fed irrigation, which amounted to 9.23%, The reason for this may be due to the genetic factor of the cultivar in its response to irrigation, and these results are consistent with his findings (14) Which showed that the genetic factors of wheat crop cultivars play a major role in determining the moisture content of the grain**.**

The two interactions showed that the rain-fed cultivated (Guayakan) cultivar achieved the highest grain moisture percentage of 10.09%, which did not differ significantly from the rain-fed cultivated same cultivar, which amounted to 9.99%, As for the rain-fed cultivated (Sardar) cultivar, it also achieved the lowest grain moisture, which amounted to 8.66%**.**

Table 2. Effect of cultivars and irrigation type on the Moisture content % (Tel Kaif).

Cultivars	**SI**	**Rain-fed**	**Mean**
Artoglo	9.35	9.36	9.35
Acsad-65	9.45	9.23	9.34
Kardenenay	9.42	9.24	9.33
Cham-9	9.43	9.21	9.32
Saribasak	9.54	9.02	9.28
Ovanto	9.29	9.27	9.28
Zeviko	9.42	9.11	9.26
Ari	9.23	9.23	9.23
Wahat aliraq	9.20	9.20	9.20
Cham-3	9.58	8.70	9.14
Sardar	9.58	8.66	9.12
Parasiful	9.46	8.74	9.10
Average	**9.56**	**9.23**	**9.40**
LSD (0.05)			
Irrigation type			**0.0485**
Cultivars			**0.1247**
Irrigation type * Cultivars			**0.1747**

Cultivars	**SI**	**Rain-fed**	**Mean**
Guayakan	9.99	10.09	10.04
Bakrajo-1	9.68	9.68	9.68
Karoneyah	9.78	9.55	9.67
Svevo	9.55	9.56	9.56
Atras	9.84	9.24	9.54
Bahgdad-2	9.74	9.32	9.53
Secondrous	9.93	9.03	9.48
Dor-85	9.55	9.39	9.47
Cham-5	9.78	9.09	9.43
Dor-29	9.57	9.26	9.42
Fadda-98	9.59	9.22	9.41
Miki-3	9.56	9.24	9.40
Iraqi-7	9.36	9.42	9.39
Aum Rabee	9.70	9.07	9.39
Firat-93	9.57	9.21	9.39
Erbil-3	9.57	9.19	9.38
LDE 357	9.78	8.98	9.38
Smito	9.35	9.36	9.36

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Ash content %: The results of the laboratory tests in Table (3) showed that the cultivar (Ari) recorded the highest ash percentage in its grains, amounting to 3.25% compared to the grains of the cultivars under study, while the cultivar (Kuyacan) recorded the lowest ash percentage, amounting to 1.94%, The reason for this may be due to the different genetic factors and their interaction with the environmental factors of the cultivars in terms of the concentration of minerals in the layers of the coverings surrounding the grain and its thickness, and these results are consistent with what he found (9), That the outer layers of the grain (bran) contain metal elements (Mg, K, Fe, Zn, Si, Ca) and that the highest percentage of ash was concentrated in the outer layers of the grain. The movement and absorption of water and nutrients play a major role in activating the process of photosynthesis and grain filling, which leads to variation in ash content among the cultivars under study**.**

It was also observed in Table (3) that there was a differs between the averages of the factor of irrigation patterns in the trait of the ash content in the grains, as the supplementary irrigation pattern achieved a significant decrease in the ash content in the grains of the cultivars grown under it, which amounted to 2.26% compared to the percentage of ash for the grains produced under the rain-fed irrigation pattern. gave 2.71% and these results are consistent with (10) Those who showed, through their study of cultivars of durum wheat, that the ash content in their grains was strongly affected by the severe drought conditions they were exposed to**.**

The interactions between the factors of the study showed that the cultivar (Baghdad-2) grown under the rain-fed irrigation pattern gave the highest ash percentage in its grains amounting to 3.84% compared to the cultivar (Secondrous) grown under the SI pattern, which recorded the lowest ash percentage amounted to 1.90%.

Protein content %: The results of Table (4) showed that there was a significant difference between the cultivars under study, as the highest average of the protein content in grains in the cultivar (Fadda-98) was 13.90%, which did not differ from the values of the cultivars (Svevo and Kardenya), while the lowest value of the protein content in grains was 11.39%. The cultivar (Saribasak), did not differ from cultivars (Dor-85, Ovanto, Guayakan, Cham-9, and Dor-29), The reason for this may be due to the genetic factor in the efficiency of converting the amine group into amino acids and building proteins in grains, as well as the small size of the grains as a result of their relative reduction of dry matter, which was inferred by the clear decrease in the percentage of carbohydrates for these cultivars, as in Table (6) of The carbohydrates content in the grains, which increased the protein content in the superior grains**.**

Table (4) showed that the irrigation treatments differed significantly in terms of the protein content in the grains, as it was noted that the cultivars grown under rain-fed irrigation achieved the highest protein content in their grains, amounting to12.78% compared to the cultivars grown to under supplemental irrigation, which amounted to 11.88%, and these results are consistent with (21), Who showed that the drought stress, especially during the grain filling stage, increased the protein content in the grain. Or the reason for this may be due to the increase in the moisture content in the SI, which led to the enhancement of the proteolysis enzymatic activity, which reduced the percentage of protein in the grain in nutrients (7).

The two interactions showed that the highest protein content in the grains was found in the cultivar (Fadda-98) grown under the rain-fed irrigation pattern, which recorded 14.37%, while the lowest protein content in the grains appeared when cultivar (LDE 357) was grown under the supplemental irrigation pattern, as it reached 11.0%.

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Table 3. Effect of cultivars and irrigation type on the Ash content % (Tel Kaif).

Cultivars	SI	Rain-fed	Mean
Sardar	2.09	2.54	2.32
Dor-85	2.03	2.56	2.30
Dor-29	2.14	2.46	2.30
Firat-93	2.05	2.54	2.30
Miki-3	2.01	2.55	2.28
Smito	2.08	2.41	2.25
Svevo	1.96	2.53	2.25
Erbil-3	2.03	2.44	2.24
Cham-9	2.08	2.35	2.22
Secondrous	1.90	2.34	2.12
LDE 357	1.97	2.23	2.10
Guayakan	1.94	1.94	1.94
Average	**2.26**	**2.71**	**2.48**
LSD (0.05)			
Irrigation type			**0.0663**
Cultivars			**0.1079**
Irrigation type * Cultivars			**0.1531**

Cultivars	SI	Rain-fed	Mean
Ari	2.86	3.64	3.25
Cham-3	2.54	3.68	3.11
Bahgdad-2	2.34	3.84	3.09
Atras	2.74	2.88	2.81
Bakrajo-1	2.60	3.02	2.81
Wahat aliraq	2.21	3.35	2.78
Karoneyah	2.65	2.72	2.69
Kardenenay	2.57	2.77	2.67
Artoglo	2.57	2.75	2.66
Aum Rabee	2.33	2.84	2.59
Fadda-98	2.41	2.61	2.51
Ovanto	2.15	2.86	2.50
Cham-5	2.14	2.84	2.49
Acsad-65	2.34	2.56	2.45
Iraqi-7	2.13	2.64	2.39
Zeviko	2.21	2.56	2.39
Saribasak	2.32	2.38	2.35
Parasiful	2.26	2.42	2.34

Table 4. Effect of cultivars and irrigation type on the Protein content % (Tel Kaif).

Cultivars	SI	Rain-fed	Mean
Parasiful	11.60	12.48	11.60
Sardar	11.92	12.11	11.92
Atras	11.72	12.21	11.72
Bahgdad-2	11.22	12.67	11.22
Aum Rabee	11.73	12.11	11.73
LDE 357	11.00	12.54	11.00
Dor-85	11.41	11.99	11.41
Ovanto	11.29	11.95	11.29
Guayakan	11.22	11.83	11.22
Cham-9	11.09	11.95	11.09
Dor-29	11.22	11.77	11.22
Saribasak	11.10	11.68	11.10
Average	**11.88**	**12.78**	**11.88**
LSD (0.05)			
Irrigation type			**0.0554**
Cultivars			**0.3125**
Irrigation type * Cultivars			**0.4353**

Cultivars	SI	Rain-fed	Mean
Fadda-98	13.44	14.37	13.90
Svevo	13.25	14.25	13.75
Kardenenay	13.15	14.29	13.72
Ari	12.90	13.86	13.38
Zeviko	12.87	13.72	13.30
Artoglo	12.16	14.17	13.17
Firat-93	12.64	13.11	12.88
Iraqi-7	12.58	13.16	12.87
Smito	11.68	13.05	12.36
Cham-3	11.84	12.84	12.34
Acsad-65	11.84	12.63	12.24
Cham-5	11.51	12.93	12.22
Erbil-3	11.54	12.87	12.21
Wahat aliraq	11.50	12.85	12.18
Bakrajo-1	12.06	12.30	12.18
Secondrous	11.57	12.66	12.12
Miki-3	11.61	12.56	12.08
Karoneyah	11.72	12.37	12.05

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Total Carbohydrate %: The results in Table (4) showed that there were significant differences between the averages, as the (Cham-9) cultivar recorded the highest percentage of carbohydrates in the produced grains, amounting to 75.37%, and it did not differ significantly from the cultivars (Ovanto and Dor-29), while the cultivar (Kardenya) recorded the lowest percentage of carbohydrates, amounting to 71.94%, and it did not differ significantly with cultivars (Ari, Svevo, and Fadda-98) and these results agree with (3) which showed the percentage of carbohydrates in wheat may reach 75%, The reason for the different cultivars under study may be attributed to this trait to the difference in the proportions of other chemical components of the bean because carbohydrates are calculated by the difference**.**

The percentage of carbohydrates in grains for cultivars grown under supplemental irrigation increased, recording 74.47%, compared to 73.00% for cultivars grown under rain-fed irrigation, The reason for this may be due to the increase in the efficiency of the photosynthesis process with the availability of water, the extension of the grain ripening period, and the increase in dry matter sedimentation in the grain, which increased the proportion of carbohydrates. These results are consistent with (10) Who showed that water stress affects the efficiency of the photosynthesis process, which reduces the synthesis of carbohydrates in the stage of vegetative growth and reduces the transfer of carbohydrates to grains at the stage of filling grains, which reduces the proportion of carbohydrates in grains**.**

It was found through the two interactions that the percentage of carbohydrates in the grains of the (Cham-9) cultivar treated with the supplemental irrigation method recorded the highest values of 76.06% compared to the other treatments, while the cultivar (Artoglo) cultivated under rain-fed irrigation recorded the lowest value of the percentage of carbohydrates amounting to 70.84%.

Color grade (geade^{-1}): The results indicated in Table (5) that the cultivars differed significantly in the trait of the color grade, as it was noted that the two cultivars (Cham-3 and Artoglo) achieved the highest values (13.90 and 13.87 grade^{-1}) respectively, while the cultivar (Secondrous) gave the lowest value for the color grade amounted to 12.92 grades $^{-1}$, and the reason for this may be due to the different of cultivars in the ash content in the grains due to the concentration of carotene pigment in the outer covers of the grain. Note Table (3).

The results also showed that the irrigation patterns differed significantly in the color grade, as the rain-fed irrigation gave the highest average color grade of 13.29 grade$^{-1,}$ while the lowest of this trait was recorded in the grains in the supplementary irrigation pattern, which amounted to 12.54 grade^{-1}, and the reason for this may be due to The ash content in the grains decreased when the supplemental irrigation pattern compared to the rain-fed irrigation**.**

The two interactions showed that the (Artoglo) cultivar treated with rain-fed irrigation gave the highest color grade in the grains amounting to 14.30 grade^{-1}, while the (Secondrous) cultivar treated with the supplemental irrigation method achieved the lowest color grade of 12.54 grade^{-1}.

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Table 5. Effect of cultivars and irrigation type on the Total Carbohydrate % (Tel Kaif).

Cultivars	SI	Rain-fed	Mean
Cham-5	74.45	72.59	74.45
Atras	73.64	73.33	73.64
Iraqi-7	73.97	72.80	73.97
Bahgdad-2	74.97	71.74	74.97
Wahat aliraq	74.90	71.75	74.90
Bakrajo-1	73.59	72.91	73.59
Zeviko	74.15	72.27	74.15
Artoglo	73.99	70.84	73.99
Ari	73.08	71.34	73.08
Svevo	73.45	70.93	73.45
Fadda-98	72.57	71.54	72.57
Kardenenay	72.77	71.11	72.77
Average	**74.47**	**73.00**	**74.47**
LSD (0.05)			
Irrigation type			**0.0997**
Cultivars			**0.4049**
Irrigation type * Cultivars			**0.5647**

Cultivars	SI	Rain-fed	Mean
Cham-9	76.06	74.69	75.37
Ovanto	75.81	74.33	75.07
Dor-29	75.69	74.23	74.96
LDE 357	75.53	74.25	74.89
Saribasak	74.98	74.60	74.79
Dor-85	75.31	74.02	74.67
Smito	75.48	73.51	74.49
Sardar	74.36	74.63	74.49
Guayakan	75.14	73.42	74.28
Erbil-3	75.32	73.19	74.25
Parasiful	74.65	73.60	74.12
Secondrous	74.46	73.52	73.99
Aum Rabee	74.06	73.81	73.93
Firat-93	74.36	73.50	73.93
Miki-3	74.64	73.05	73.85
Acsad-65	74.21	72.93	73.57
Cham-3	74.52	72.60	73.56
Karoneyah	74.00	73.09	73.55

Table 6. Effect of cultivars and irrigation type on the Color grade (Tel Kaif).

Cultivars	SI	Rain-fed	Mean
Cham-3	13.51	14.29	13.9
Artoglo	13.44	14.30	13.87
Fadda-98	13.42	14.15	13.79
Acsad-65	13.16	13.89	13.53
Smito	12.86	13.80	13.33
Firat-93	12.88	13.76	13.32
Erbil-3	12.75	13.4	13.08
Secondrous	12.54	13.29	12.92
Average	**13.07**	**13.86**	**13.46**
LSD (0.05)			
Irrigation type		**0.0517**	
Cultivars		**0.1033**	
Irrigation type * Cultivars		**0.1461**	

Fayda location

The cultivars were arranged in the tables according to their average values from top to bottom to facilitate the explanation process.

Moisture content %: The results contained in Table (7) showed that the mean moisture content in wheat grains ranges between (9.16-8.56%) which is within the safe limits for grain storage or handling, (23) was noted that the moisture content in grains should not be more than 14% and the high moisture helps the growth of bacteria and fungi and thus reduces the shelf life and affects the price value of the grains. The studied cultivars

differed significantly among themselves, as the grains of the cultivar (Guayakan) achieved the highest moisture content, which did not differ significantly from the values of cultivars (Karonya, BakraJo-1, Parasiful, Acsad-65, Sardar, LDE 357, Iraqi-7, Firat-93, Secondrous, Smito, Cham-9, Dor-85, Dore-29 and Zeviko), While the cultivar (Svevo) recorded the lowest value of grain moisture and did not differ with cultivars (Artoglo, Kardnya, and Wahat AlIraq), The reason may be due to the genetic factor of the cultivar, and these results are consistent with (1) Those who noticed that there were significant differences between the five cultivars that they studied, and they attributed the reason for this difference to the fact that the genetic and environmental factor had a significant impact on the moisture content of the grain**.**

It was also observed an increase in grain moisture for cultivars treated with supplemental irrigation, reaching 9.19% Compared to cultivars treated with rain-fed irrigation, which recorded 8.69%, The reason for this may be due to the long period of transfer of water and dry matter to the grain in the case of supplementary irrigation, and the short period of transfer of water to the grain in the case of rain-fed irrigation, and these results are consistent with (17) Who noticed that the reduction of humidity in the soil and the plant gave the lowest percentage of moisture in the grain compared to the availability of moisture at the required levels**.**

The interaction between cultivars and irrigation patterns showed that cultivar (LDE 357) treated with supplemental irrigation achieved the highest moisture percentage in grains amounting to 9.44% compared to cultivar (Svevo) treated with rain-fed irrigation pattern, which achieved the lowest moisture percentage of 8.01%.

Table 7. Effect of cultivars and irrigation type on the Moisture content % (Fayda).

Cultivars	**SI**	**Rain-fed**	**Mean**
Bahgdad-2	9.23	8.63	8.93
Ovanto	8.97	8.88	8.93
Cham-5	9.25	8.61	8.93
Saribasak	9.21	8.60	8.91
Miki-3	9.17	8.62	8.90
Cham-3	9.29	8.45	8.87
Fadda-98	9.24	8.47	8.85
Erbil-3	9.13	8.50	8.82
Artoglo	8.96	8.54	8.75
Kardenenay	9.14	8.34	8.74
Wahat aliraq	8.87	8.39	8.63
Svevo	9.10	8.01	8.56
Average	**9.19**	**8.69**	**8.94**
LSD (0.05)			
Irrigation type			**0.0419**
Cultivars			**0.2060**
Irrigation type * Cultivars			**0.2871**

Cultivars	**SI**	**Rain-fed**	**Mean**
Guayakan	9.36	8.96	9.16
Karoneyah	9.36	8.90	9.13
Bakrajo-1	9.26	8.91	9.09
Parasiful	9.28	8.87	9.08
Acsad-65	9.24	8.89	9.06
Sardar	9.10	8.98	9.04
LDE 357	9.44	8.63	9.03
Iraqi-7	9.12	8.93	9.02
Firat-93	9.18	8.85	9.02
Secondrous	9.43	8.58	9.01
Smito	8.97	9.03	9.00
Cham-9	9.23	8.77	9.00
Dor-85	9.25	8.72	8.99
Dor-29	9.16	8.76	8.96
Zeviko	9.18	8.72	8.95
Atras	9.41	8.47	8.94
Aum Rabee	9.19	8.69	8.94
Ari	9.02	8.87	8.94

Ash content %: The values of the averages in Table (8) showed that the ash content in the grains differed significantly according to the different cultivars, The cultivars Svevo and Artoglo, which did not differ significantly, recorded the highest values (3.66 and 3.58%), respectively, While the cultivars (Firat-93, LDE 357 and Guayakan), which did not differ

significantly among themselves, recorded the lowest values (2.54, 2.51 and 2.48%), respectively. We note that these values were higher than the normal level due to the reduction of rain and the drought that accompanied the growth and fullness of grains, which negatively affected the increase in ash content, and this was observed in the weight values of 1000 grains for cultivars (Firat-93 and Svevo), and these results are consistent with what was reached (5) Who is confirmed that the ash content in the grains is negatively related to the weight of 1000 grains**.**

Supplementary irrigation recorded the lowest ash content in grains at 2.74%, while this content increased by 10.09% in rain-fed irrigation, which reached 3.04%. Short and the transfer of minerals from the vegetative parts of the plant after the appearance of premature aging in the leaves as a result of a reduction of water than the actual need, which leads to a small size of the grain and an increase in the ash content in it, These results are consistent with (5).

The interaction between the factors showed that the (Baghdad-2) cultivar grown under the rain-fed irrigation pattern gave the highest average ash percentage 3.89%, while the cultivar (LDE 357) cultivated under the supplemental irrigation pattern gave the lowest average ash percentage 3.89%.

Table 8. Effect of cultivars and irrigation type on the Ash content % (Fayda).

Cultivars	**SI**	**Rain-fed**	**Mean**
Erbil-3	2.58	2.85	2.72
Parasiful	2.58	2.82	2.70
Secondrous	2.60	2.79	2.70
Dor-29	2.66	2.73	2.69
Sardar	2.59	2.75	2.67
Dor-85	2.55	2.77	2.66
Cham-9	2.53	2.75	2.64
Smito	2.58	2.65	2.62
Saribasak	2.46	2.78	2.62
Firat-93	2.48	2.60	2.54
LDE 357	2.32	2.70	2.51
Guayakan	2.39	2.57	2.48
Average	**2.74**	**3.04**	**2.89**
LSD (0.05)			
Irrigation type			**0.0153**
Cultivars			**0.1061**
Irrigation type * Cultivars			**0.1477**

Cultivars	**SI**	**Rain-fed**	**Mean**
Svevo	3.47	3.84	3.66
Artoglo	3.38	3.79	3.58
Bakrajo-1	3.24	3.52	3.38
Wahat aliraq	3.14	3.45	3.29
Bahgdad-2	2.54	3.89	3.21
Aum Rabee	3.03	3.24	3.13
Atras	2.90	3.19	3.05
Ovanto	2.82	3.15	2.99
Karoneyah	2.89	3.01	2.95
Ari	2.81	3.05	2.93
Iraqi-7	2.78	3.06	2.92
Fadda-98	2.75	3.04	2.90
Kardenenay	2.81	2.97	2.89
Acsad-65	2.79	2.99	2.89
Miki-3	2.66	3.11	2.89
Cham-5	2.64	3.09	2.87
Zeviko	2.66	3.00	2.83
Cham-3	2.48	2.96	2.72

Protein content %: Table (9) shows that there is a significant discrepancy between the average protein percentages, which ranged between (14.57-12.16%). These percentages fall within the normal and acceptable limits in the manufacture of durum wheat products (pasta, spaghetti, and bulgur). This is what he referred to (20) durum wheat, which has a protein content of between 12-13%, is suitable for making pasta. The cultivars (Kardnya and Svevo) achieved the highest protein percentage (14.57 and 14.42%), respectively, and differed significantly from the cultivars under study, while the cultivar (Saribasak) recorded the lowest protein percentage and did not differ significantly from the cultivars (Parasiful, Atras, Cham-9, Dor-85, Guayakan and Dor-29), The reason for this difference in

the percentage of protein may be due to the difference in the percentage of moisture in grains, as it was found in Table (7) that the cultivars (Kardenya and Svevo), which achieved the lowest moisture percentage in grains, excelled in the proportion of protein compared to other cultivars. In the same context, we find that the superior cultivars In terms of moisture content, it gave the lowest percentage of protein in grains, and these results are consistent with (2), who showed, through his study of four cultivars of wheat, that there was a negative relationship between the moisture content of grains and the percentage of protein in them.

It was also noted that the rain-fed irrigation gave the highest percentage of protein in the grains, amounting to 13.19%, compared to the supplementary irrigation, which amounted to 12.74% protein in the grains, The reason for this may be due to the high temperature and the decrease in the amount of rain falling during the season, which amounted to 216.2 mm, as it reduced the grain filling period and thus the production of small grains, which caused an increase in the percentage of protein in the grains, and these results are consistent with (2) Which showed that the water stress with the rise in temperature caused an increase in the percentage of protein, and with the application of the supplementary irrigation system, the percentage of protein decreased in the grains under study.

The interaction between two factors showed that the cultivar (Kardnya) grown under demi-irrigation recorded the highest percentage of protein in grains amounting to 14.84%, while the cultivar (Saribasak) grown under supplemental irrigation recorded the lowest percentage of protein in grains amounting to 11.82%. These results were similar to the results of the experimental factors and they are unique, meaning that the reasons that were dealt with above are the same that explain the results of the interaction.

Total Carbohydrate %: The results showed in Table (10) that the percentage of carbohydrates in the cultivars under study differed significantly between them, as it ranged between 73.66% for the cultivar (Firat-93), which corresponded significantly with the cultivars (Cham-9, Dur-85, LDE 357, Ovanto, Guayakan) and between the cultivar (Svevo), which scored 70.47%, which did not differ significantly with the cultivar (Artoglo), The reason for this may be due to the genetic factor represented by the different physiological and biological processes of each cultivar, which are responsible for processing and transporting metabolic materials from the source to the downstream, This result is consistent with (11).

It was also observed through the values of the average percentage of carbohydrates that there was a significant difference between the irrigation systems, as the supplementary irrigation achieved the highest value for this characteristic, amounting to 72.86%, compared to the rain-fed irrigation, which amounted to 72.37%. These results are consistent with his findings (6), That the drought and heat stress reduced the percentage of starch in grains, which is the largest component of carbohydrates, The reason for this may be due to the increase in the percentage of proteins, which are the second largest components in proportion to grains when irrigated by demi-water, which caused a decrease in the percentage of carbohydrates.

The interaction between the factors of the study showed that the cultivar (Firat-93) cultivated with the supplementary irrigation pattern gave the highest average percentage of carbohydrates amounting to 74.08%, with a significant difference from the cultivar (Svevo) cultivated with the rain-fed irrigation pattern, which recorded the lowest average percentage of carbohydrates, which amounted to 70.27%, In general, we find that the percentage of carbohydrates in table (10) is within the limits indicated by (3) that the average percentage of carbohydrates in wheat may reach 75

%.

Table 9. Effect of cultivars and irrigation type on the Protein content % (Fayda).

Cultivars	SI	Rain-fed	Mean
Karoneyah	12.43	12.75	12.59
Ovanto	12.54	12.54	12.54
Bakrajo-1	12.25	12.83	12.54
Sardar	12.21	12.80	12.51
Miki-3	12.25	12.69	12.47
Parasiful	12.08	12.76	12.42
Atras	12.25	12.58	12.41
Cham-9	12.15	12.54	12.34
Dor-85	12.06	12.58	12.32
Guayakan	12.08	12.54	12.31
Dor-29	11.89	12.57	12.23
Saribasak	11.82	12.50	12.16
Average	**12.74**	**13.19**	**12.96**
LSD (0.05)			
Irrigation type			**0.1312**
Cultivars			**0.2948**
Irrigation type * Cultivars			**0.4142**

Cultivars	SI	Rain-fed	Mean
Kardenenay	14.29	14.84	14.57
Svevo	14.39	14.45	14.42
Fadda-98	13.85	14.46	14.16
Ari	13.89	14.17	14.03
Zeviko	13.80	14.08	13.94
Artoglo	13.60	14.26	13.93
Firat-93	13.26	13.56	13.41
Smito	12.88	13.59	13.24
Cham-3	13.17	13.29	13.23
Iraqi-7	12.75	13.31	13.03
Secondrous	12.77	13.06	12.92
Cham-5	12.51	13.19	12.85
Erbil-3	12.65	13.03	12.84
Wahat aliraq	12.58	13.01	12.79
Acsad-65	12.57	13.00	12.79
Aum Rabee	12.60	12.79	12.70
LDE 357	12.23	13.01	12.62
Bahgdad-2	12.35	12.87	12.61

Table 10. Effect of cultivars and irrigation type on the Total Carbohydrate % (Fayda).

Cultivars	SI	Rain-fed	Mean
Iraqi-7	72.94	72.21	72.57
Secondrous	72.57	72.56	72.57
Cham-3	72.44	72.59	72.52
Bakrajo-1	72.76	72.25	72.50
Wahat aliraq	72.75	72.11	72.43
Acsad-65	72.50	72.12	72.31
Zeviko	71.99	71.44	71.72
Ari	71.94	71.34	71.66
Fadda-98	71.71	71.44	71.58
Kardenenay	70.97	70.84	70.91
Artoglo	71.29	70.37	70.83
Svevo	70.27	70.68	70.47
Average	**72.86**	**72.37**	**72.61**
LSD (0.05)			
Irrigation type			**0.1540**
Cultivars			**0.4110**
Irrigation type * Cultivars			**0.5758**

Cultivars	SI	Rain-fed	Mean
Firat-93	74.08	73.24	73.66
Cham-9	73.89	73.44	73.66
Dor-85	73.87	73.34	73.60
LDE 357	73.76	73.23	73.50
Ovanto	73.59	73.06	73.32
Guayakan	73.59	72.90	73.25
Sardar	73.59	72.85	73.22
Saribasak	73.41	72.92	73.16
Erbil-3	73.40	72.90	73.15
Parasiful	73.40	72.51	72.95
Dor-29	73.17	72.72	72.94
Smito	73.39	72.46	72.93
Atras	72.84	73.01	72.92
Miki-3	73.12	72.58	72.85
Bahgdad-2	73.57	71.83	72.70
Aum Rabee	72.71	72.69	72.70
Cham-5	73.52	72.32	72.67
Karoneyah	72.75	72.53	72.64

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Color grade (grade^{-1}): It was observed through the results of table (11) that the cultivars had a significant effect on the color grade trait, as the cultivars (Artoglo and Cham-3) gave the highest averages for the color values recorded (14.78 and 14.74 grade $^{-1}$), respectively, while the cultivars (Erbil-3 and Secondrous) gave the lowest The averages for the color grade are (13.87 and 13.84 grade^{-1}), respectively, These results are consistent with **(**22), Which attributed the reason for the differ of cultivars in the color grade to the genetic factor of the cultivar and its interaction with environmental factors**.**

It was also found that there was a significant difference between the irrigation patterns in the color grade trait of the grain, as the rain-fed irrigation pattern gave the highest average value of the color grade of 14.72 grade $^{-1}$, while the value of the color grade of grain decreased by 5.8% when treating the supplementary irrigation pattern to record 13.93 grade $^{-1}$**.**

The interaction between two factors showed that the cultivar (Artoglo), treated with the rain-fed irrigation method, gave the highest color value of 15.24 grade^{-1}, while the (Secondrous) cultivar, treated with the supplementary irrigation method, gave the lowest value of 13.5 grade^{-1}.

Table 11. Effect of cultivars and irrigation type on the Color grade (Fayda).

Cultivars	**SI**	**Rain-fed**	**Mean**
Artoglo	14.32	15.24	14.78
Cham-3	14.33	15.16	14.74
Fadda-98	14.08	14.99	14.54
Firat-93	13.88	14.76	14.32
Acsad-65	13.9	14.69	14.3
Smito	13.88	14.55	14.21
Erbil-3	13.57	14.17	13.87
Secondrous	13.5	14.19	13.84
Average	**13.93**	**14.72**	**14.325**
LSD (0.05)			
Irrigation type		**0.0651**	
Cultivars		**0.1302**	
Irrigation type * Cultivars		**0.1841**	

Conclusion

We conclude from this study that the cultivars of durum wheat differed among themselves and affected the qualitative traits, It was observed that the cultivars (Guayakan, Svevo, Cham-9, and Artoglo) were superior in the trait (grain moisture content, grains protein content, percentage of total carbohydrates in grains and color grade), respectively, for both locations**.**

It was also noted that irrigation patterns also affected the studied qualitative traits, Supplemental irrigation showed a sense of quality compared to durum irrigation under the conditions of the two experimental locations.

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