

The Performance of Some Durum Wheat (*Triticum turgidum* L.) Under Different Environmental Conditions of Sulaimani / Kurdistan Iraq.



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Abstract:

A field experiment was carried out during the winter season 2011-2012, to evaluate the performance of 8 new varieties of durum wheat (*Triticum turgidum* L.), namely (V1: Amidacul, V2: Bejah, V3: Guayacaninia Yuan-1/ Green-18, V4: Fadda, V5: Halio, V6: Omyavoros 79, V7: Simeto, and V8: Ovanto), under four different agro climatic conditions, namely BAKRAJO, KANI PANKA, GRDAJAN, and BAZYAN. Completely Randomized Block design (CRBD) with 3 replications were used in each location. The results shows that V7 required the shortest period for heading in all locations and their average with the exception of the 3rd location, when the V7 required the longest period for heading among the varieties. Regarding the plant height, the V4 shows a stable superiority in all locations without exception, while V8 significantly predominated in the 1000-grain weight compared to the other varieties in all locations and their average, but the maximum No. of grains spike⁻¹ were fluctuated between the varieties within the locations. Maximum grain yield obtained by the V7 in the 1st, 2nd, 4th, and the average of locations were in accordance with the shortest period for heading of V7 at those locations, but the biological yield was different in superiority among varieties within locations. Finally the results of the agronomic characters in different locations indicated that the 2nd location was suit for early planting, which causing the reduction in heading period, and increasing the grain and biological yield as average of varieties, due to the maximum period for growth and development toward the maturity in this location.

Key words: Durum wheat, Varieties, Rainfall, Soil condition, Heading, Grain yield.

Introduction:

Wheat constitutes one of the five major cereal crops in the world; used as a main source of food since the prehistoric times. Many of the crop's characteristics were probably well known 2000 years ago when it evidently was grown for food. Modern durum wheat varieties (*Triticum turgidum* L. var. durum) yield as the highest yielding bread wheat varieties and the kernels of durum wheat

are typically larger, heavier, and harder, than bread wheat. However, durum wheat dough is less elastic than that of bread wheat and, therefore, it is inferior for producing leavened loaves, but durum wheat primarily used for making burgul, noodles, and other pasta products such as macaroni and spaghetti [1].

Genotype-environment interactions are of major importance to the plant breeder in developing improved varieties. When varieties

compared over a series of environments, the relative rankings usually differ. This causes difficulty in demonstrating the significant superiority of any variety. This interaction is usually present whether the varieties are pure lines, single-cross or double-cross hybrids, top crosses, or any other material with which the breeder may be working [2,3]. Stratification of environments effectively used to reduce the genotype-environment interaction. The region, for which a breeder is developing the improved varieties, can often be so subdivided, that all environments in the sub region are somewhat similar. This stratification usually based on such macro-environmental differences as temperature gradients, rainfall distribution, and arid soil types. However, even with this refinement of technique, the interaction of genotypes with locations in a sub region, and with environments encountered at the same location in different years, frequently remains too large. Allard and Bradshaw, classify as unpredictable the environmental variation for which stratification is not effective. Since little additional progress expected in reducing genotype-environment interactions by the stratification of environments, other methods need to be investigate. One such method would be to select stable genotypes that interact less with the environments in which they are to be grown. If stability of performance, or the ability to show a minimum of interaction with the environment, is a genetic characteristic, then preliminary evaluation planned to identify the stabile genotypes [4].

As the different location within the same region reflects different environmental and soil condition, especially temperature and water status which related directly with the planting

date, it is greatly affecting the growth, yield and quality of wheat, early sowing produces higher yields than late sowing due to longer duration. Each day delay in sowing of wheat after 20th November onward in decreases grain yield at the rate of $36 \text{ kg ha}^{-1}\text{day}^{-1}$ [5]. Temperatures below or above normal, alter plant functions and productivity. In late-planted wheat, low temperature prevailing during germination substantially affects the germination and seedling emergence [6]. Generally, wheat like other cool season crop seeded early to take maximum period for growth and development toward maturity, before the possible heat stress [7, 8]. The genotypic response of wheat to planting dates varies for yield contributing characters due to different genetic potential. The decline becomes prominent in the cultivars requiring more days for heading under normal planting. Increase in temperature cause shortens of heading period [9]. Locations that permitted early sowing resulted in better development of the grains due to longer growing period. As early-planted wheat had more time for the dry matter accumulation to produce the higher grain yield [10, 11]. The response of plants to water stress depends on several factors such as developmental stage, severity, and duration of stress and cultivar genetics [12]. Development of resistant cultivars, however, hampered by low heritability for drought tolerance and a lack of effective selection strategies. Effective selection of genotypes to increase the productivity of rainfed wheat may be a convenient and efficient approach to meet this challenge. Several indices based on drought resistance or susceptibility of genotypes

evaluated, and used for selection of drought-tolerant wheat genotypes [13].

Many high yielding wheat cultivars suggested for general cultivation in the past. These cultivars are losing their yield potential owing to segregation and climate change. Therefore, the aim of this study was the performance of some new varieties of durum wheat, which evaluated under different environment and soil conditions, to identify the best-suited variety for certain, or over all the locations.

Materials and Methods:

A field experiment was carried out during winter season 2011-2012 on the performance of some varieties of durum wheat (*Triticum turgidum* L.), namely (V1: Amidacul, V2: Bejah, V3: Guayacaninia Yuan-1/ Green-18, V4: Fadda, V5: Halio, V6: Omyavoros 79, V7: Simeto, and V8: Ovanto), at four stations of directorate of agricultural researches of Sulaimani governorate/ Kurdistan Iraq. First was located in BAKRAJO [35° 32' 30" N; 45° 21' 00" E; 760 masl], the soil at this location site was silty clay in texture, and contained 1.4% organic matter, 0.12% N, and 10.43 ppm available phosphorus, the soil pH was 7.5, and the rainfall of that winter season was 490.5mm. Second station was located at KANI PANKA [35° 22' 25" N; 45° 43' 25" E; 550 masl], the soil at this location site was also silty clay with contents of 1.6% organic matter, 0.21% N, and 11.8 ppm available phosphorus. The soil pH was 7.2, and the rainfall was 385.0mm its distribution was exactly fitting the growth stages water requirement. The third station located at GRDAJAN, [36° 12' 11" N; 44° 47' 03" E; 540 masl], its soil texture was silty clay

loam contain 1.4% organic matter, 0.14% N, and 11.5 ppm available phosphorus, pH of the soil was 7.4, and the total precipitation was 580.4mm. The fourth station was located at BAZYAN, [35° 36' 31" N; 45° 07' 54" E; 845 masl], its soil texture was silty clay with contents of 1.72% organic matter, 0.14% N, and 15.6 ppm available phosphorus. The pH of the soil was 7.3, and the total precipitation was 437.6mm. The experiment was laid out in Completely Randomized Block design (CRBD), replicated three times in each location, each replication consists of eight plots, and each plot has six lines of 5m length and 0.2m apart between lines, the harvested area of each plot was 4m². The seeds were sown as a rate of 120 kg ha⁻¹ on Dec.01 in the 1st location, on Nov.27 in the 2nd location, Dec.05 in the 3rd location, and Dec.07 in the 4th location, while harvested dates were June.15, June.17, June.11, and June.6 in the locations respectively. The crop attended as per routine cultural practices at each location, rate and type of fertilization were 160 kg ha⁻¹ N: P: K (18:24:0), which applied with seeding, and 80 kg ha⁻¹ urea 46% N at tellering stage. Soil of the experiment prepared for cultivation by tilling the field two times using mold plow and harrowed. Weeds controlled by hand when needed. The studied characters were number of days for heading, and plant height, 1000-grain weight, number of grains spike⁻¹, grain yield ton ha⁻¹, and biological yield ton ha⁻¹. Analysis of variance used as a general test in each location, and combined analysis for the locations were done, while the means were tested using the least significant difference LSD_{0.05}, confirmed by [14].

Result and Discussion:

Results in table 1 shows some agronomic characters of different varieties in the 1st location (Bakrajo), both varieties V6 and V7 required less number of days for heading 118 days followed by 119 days for heading by V4 and V5, they were all significant compared to the maximum requirement days for heading 123 days occurred with both V2 and V8. Regarding to the plant height, the differences between varieties at this location were shows that the maximum plant height occurred in V4, 91.33cm, it was predominated all other varieties significantly, while the less height 74.00cm observed in V7. The maximum 1000-grain weight observed in V8 was 38.227g followed by V4 with 37.932g, V6 with 36.963g, and V7 with 36.909g, they were significantly exceeded other varieties, however, the less 1000-grain weight occurred in V3 was 31.021g. According to the least

significant difference 13.555 $P \leq 0.05$ in regard to the No. of grains spike⁻¹ as shown in table 1, the maximum No. 64 grain spike⁻¹ gained by V1, it was significant compared with the minimum No. 50 grains spike⁻¹ occurred in V7, while the differences between other varieties were not significant. The higher grain yield as observed in table 1. Were gained by V6 and V7 with 3.810 and 3.762 ton ha⁻¹ respectively followed by V5 and V4 with 3.621 and 3.609 ton ha⁻¹ respectively, and they were all out yielded than other varieties, however, the minimum grain yield in this location showed by V8 with 3.064 ton ha⁻¹. Obtained result regards to the biological yield in table 1. Shows that, except the significant difference between the highest value 9.875 ton ha⁻¹, which gained by V3 and the minimum value 8.250 ton ha⁻¹ observed in V8, the other varieties were not differ significantly in this trait

Table 1: Some agronomic characters of different varieties of durum wheat, cultivated in Bakrajo location.

Varieties	No of Days to Heading	Plant Height (cm)	1000 Grain Weight (g)	No of grains Spike ⁻¹	Grain Yield ton ha ⁻¹	Biological Yield Ton ha ⁻¹
V1	120.000	77.667	35.373	64.000	3.389	9.417
V2	123.000	79.667	34.581	59.000	3.309	9.083
V3	120.000	81.000	31.021	60.000	3.437	9.875
V4	119.000	91.333	37.932	53.000	3.609	9.167
V5	119.000	78.333	33.563	52.000	3.621	9.750
V6	118.000	78.333	36.963	55.000	3.810	9.625
V7	118.000	74.000	36.909	50.000	3.762	9.208
V8	123.000	77.000	38.227	56.000	3.064	8.250
LSD _{0.05}	2.651	6.362	2.787	13.555	0.354	1.316

Data in table 2 represent the result of the studied characters at 2nd location (Kanipanka).

Regarding the No. of required days for heading, there were similarity with the results

of the 1st location, the minimum required days for heading was 118 days occurred by V7 and V4, and the longest period needed for heading was 122 days observed in V8. In addition, the highest significant plant height 102.443cm obtained by V4 and similarly the shortest plant height 77.667cm observed in V7. Maximum 1000-grain weight 44.667g obtained by V8, while the minimum value 38.667g observed in V3 and V4, but the results of No. of grains spike⁻¹ take another trend not as the 1st location, the V4 gained highest number 60.667 grain spike⁻¹, while V6 showed lowest No. 47.333 grain spike⁻¹. Results obtained from

table 2 shows that V7 gained the highest yield of grain 5.947 ton ha⁻¹ followed by V4 with 5.944 ton ha⁻¹. Although their differences were acceptable compared to other varieties, but they were predominated significantly only the minimum yield 4.500 ton ha⁻¹, that gained by V8, because of the high value of the least significant difference LSD_{0.05} 1.286 ton ha⁻¹. The last result shown in table 2 was the difference in biological yield between the varieties, it was observed that V4 gained the highest significant value 16.617 ton ha⁻¹ compared to the lowest value 13.467 ton ha⁻¹ occurred in V8.

Table 2: Some agronomic characters of different varieties of durum wheat, cultivated in Kanipanka location

Varieties	No of Days to Heading	Plant Height (cm)	1000 Grain Weight (g)	No of grains Spike ⁻¹	Grain Yield ton ha ⁻¹	Biological Yield Ton ha ⁻¹
V1	120.000	79.670	41.333	54.167	5.475	15.350
V2	120.000	81.667	42.667	54.167	5.150	15.150
V3	120.000	81.113	38.667	49.333	5.445	15.500
V4	118.000	102.443	38.667	60.667	5.944	16.617
V5	119.000	79.557	39.333	50.167	5.241	14.058
V6	120.000	83.000	40.667	47.333	5.021	14.917
V7	118.000	77.667	43.333	51.333	5.947	16.225
V8	122.000	78.443	44.667	48.333	4.500	13.467
LSD _{0.05}	2.458	6.222	4.315	9.741	1.286	2.315

The data obtained from table 3 confirmed the significant differences between the studied traits of different varieties cultivated at 3rd location (Grdajan). The required days for heading were different compared to the 1st and 2nd locations. In this location V7 and V4

needed longest period 123 days for heading, which was significantly differ compared to the shortest period 118 days for heading occurred in V8, while the superiority of V4 in the highest plant height with 76.667cm, and V8 in 1000-grain weight with 52.333g were similar

to the results of the previous mentioned locations. The No. of grains spike⁻¹, as it was fluctuated between the varieties due to different locations, in this location the V5 gained the highest significant value with 71.667 grains spike⁻¹. Regarding to the grain yield, the data in table 3 shows that V8

obtained the highest significant yield 3.808-ton ha⁻¹ compared to other varieties, and V3 was the variety with the maximum significant biological yield 8.929-ton ha⁻¹ compared with the minimum value 6.854-ton ha⁻¹ observed in V8

Table 3: Some agronomic characters of different varieties of durum wheat, cultivated in Grdajan location.

Varieties	No of Days to Heading	Plant Height (cm)	1000 Grain Weight (g)	No of grains Spike ⁻¹	Grain Yield ton ha ⁻¹	Biological Yield Ton ha ⁻¹
V1	119.000	68.667	46.167	59.667	3.425	8.775
V2	120.000	74.000	45.667	60.667	3.208	7.946
V3	120.000	69.333	41.000	65.000	3.129	8.929
V4	123.000	76.667	45.000	67.000	3.150	7.326
V5	121.000	70.333	46.500	71.667	3.291	7.083
V6	120.000	70.333	41.667	57.000	3.137	7.154
V7	123.000	66.000	48.000	61.000	3.054	7.633
V8	118.000	66.000	52.333	63.333	3.808	6.854
LSD_{0.05}	2.305	7.441	4.514	13.325	0.676	1.386

Table 4 shows the results that occurred at the 4th location (BAZYAN), there were some similarity and some differences in the trend of the traits with other locations. V7 required the minimum period for heading 120 days, while V4 needed maximum period 131 days for heading. Still V4 gained the highest plant height with 84.067cm, predominated significantly other varieties, also V8 as in the

other locations, gained highest significant 1000-grain weight 35.563g compared to other varieties, but the highest No. of grains spike⁻¹ was 45.667 gained by V3. Regarding the grain yield and biological yield, the V7 always obtained maximum values 3.508 and 12.542 ton ha⁻¹ respectively, while the minimum values of these two traits were 2.429 and 8.667 ton ha⁻¹ respectively observed in V4

Table 4: Some agronomic characters of different varieties of durum wheat, cultivated in Bazyan location.

Varieties	No of Days to Heading	Plant Height (cm)	1000 Grain Weight (g)	No of grains Spike ⁻¹	Grain Yield ton ha ⁻¹	Biological Yield Ton ha ⁻¹
V1	128.000	70.100	33.133	39.333	2.821	9.917
V2	130.000	71.600	32.400	39.667	2.567	9.042
V3	126.000	71.833	32.267	45.667	3.033	9.833
V4	131.000	84.067	31.073	40.333	2.429	8.667
V5	128.000	70.067	30.817	39.667	2.567	9.250
V6	122.000	72.200	29.743	40.667	3.083	10.625
V7	120.000	73.733	32.613	40.000	3.508	12.542
V8	128.000	69.100	35.563	41.667	2.433	10.083
LSD_{0.05}	2.232	7.223	3.424	5.506	0.898	2.432

Table 5 represents the means of the studied characters of the different varieties as an average of the locations. The minimum number of days for heading showed by V7 with 119.75days, while the highest value 123.25days occurred in V2, the highest plant height showed by V4 with 88.628cm, which was predominated significantly the other varieties, while the shortest plant height 72.636cm observed in V8. The maximum

weight of 1000-grain weight as an average of locations was 42.697g gained by V8, while V4 showed the maximum value 55.250-grain spike⁻¹ and the lowest value 50.000-grain spike⁻¹ occurred in V6. Regarding the grain yield and biological yield as shown in table 5, V7 obtained the highest significant values 4.068 and 11.402-ton ha⁻¹ respectively compared to the other varieties

Table5. Some agronomic characters of different varieties of durum wheat, as an average of the locations

Varieties	No of Days to Heading	Plant Height (cm)	1000 Grain Weight (g)	No of grains Spike ⁻¹	Grain Yield ton ha ⁻¹	Biological Yield Ton ha ⁻¹
V1	121.750	74.026	39.002	54.292	3.777	10.865
V2	123.250	76.733	38.829	53.375	3.558	10.305
V3	121.500	75.820	35.739	55.000	3.761	11.034
V4	122.750	88.628	38.168	55.250	3.783	10.444
V5	121.750	74.573	37.553	53.375	3.680	10.035
V6	120.000	75.967	37.260	50.000	3.763	10.580
V7	119.750	72.850	40.214	50.583	4.068	11.402
V8	122.750	72.636	42.698	52.333	3.451	9.663
LSD_{0.05}	1.129	3.191	1.786	5.150	0.407	0.902

On the view of the above results, it can be concluded that V7 required shortest period for heading, hence it was predominated significantly the other varieties in the grain yield and biological yield at three locations. In addition, V8 confirmed the negative relation between the period for heading and the grain yield in the 3rd location, and these results were in accordance to [7, 8, and 9]. In spite of the fluctuations occurred in grain and biological yield due to the environmental interactions. The variety with less period requirement for heading at any location, remains as a super variety, due to that early heading variety lead to avoiding high temperature at grain filling stage, and increase development of grain, ultimately increasing the grain number and grain weight [10]. Some varieties shows stabile characters during their growth under different locations, such as the highest plant height in V4, and the maximum 1000-grain weight in V8, may be refers to that these traits were less environmentally affected, while No. of grains spike⁻¹ affected by different agro climatic condition as it was fluctuated between the varieties and locations [1 and 2].

The influence of the environmental and soil conditions of different locations under this study on the agronomic characters showed in table 6. The 2nd location (Kanipanka) exceeded other locations in the lowest period required for heading with 119.625days followed by the 1st location (Bakrajo) and 3rd location (Grdajan) with 120.000 and 120.500days respectively, which were not significantly difference between themselves, but predominated significantly the longest period for heading 126.625days, which occurred at 4th

location (Bazyan). The obtained data in table 6 also confirmed that the 2nd location gained the highest significant plant height 82.945cm in compare to other locations. These results may be due to the appropriate condition at the 2nd location especially the early rainfall of the season, which permits the early planting date. The higher temperature of air and soil at early planting cause shortens of heading period, similarly, late planting date cause poor crop establishment, more chances of winter injury, and reduces plant height and other growth characters [5 and 6]. Regarding to the effect of environmental condition of the 3rd location on increasing the 1000-grain weight and No. of grains spike⁻¹, which were 45.792g and 63.167grain spike⁻¹ respectively compared to other locations, may be due to that the total amount of precipitation was more in the 3rd location especially at the grain filling stage, these results agreed with [12]. The maximum grain yield and biological yield obtained at the 2nd location (Kanipanka) with 5.390 and 15.160 ton ha⁻¹ respectively were significantly dominated other locations followed by 1st location (Bakrajo) and 3rd location (Grdajan), while the 4th location (Bazyan) gained the minimum grain yield, only 2.805 ton ha⁻¹. The superiority in grain and biological yield of the varieties at (Kanipanka) may be due to the longest period of growth taken up to maturity compared to the other locations [3,4,7,and8], while the high temperature at (Bazyan) stretches the period of grain filling, resulting in reduced development of grain, ultimately decreasing the grain number and grain yield [9].

Table 6. Effect of different locations on some agronomic characters, as an average of different varieties of durum wheat.

Locations	No. of Days to Heading	Plant Height (cm)	1000 Grain Weight (g)	No of grains Spike ⁻¹	Grain Yield ton ha ⁻¹	Biological Yield Ton ha ⁻¹
Bakrajo	120.000	79.667	35.571	56.250	3.500	9.359
Kanipanka	119.625	82.945	41.167	51.938	5.390	15.160
Grdajan	120.500	70.167	45.792	63.167	3.250	7.713
Bazyan	126.625	72.838	31.701	40.375	2.805	9.995
LSD_{0.05}	1.260	4.291	6.249	6.487	1.541	2.768

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