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Assessment of Pearl Millet Genotypes for Seed Yield and its Attributes under Normal and Water Stress Conditions

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Abstract

This research was carried out at Agronomy Department Farm, Faculty of Agriculture, Assiut University, Egypt, to study the effect of water stress, genotypes and their interaction on seed yield and its attributes of pear millet. A set of twenty genotypes were sown in two experiments i.e. normal and water stress irrigation during 2019 and 2020 seasons. A split block design with three replications was used in both experiments. The results showed that the treatments of irrigation and genotypes and their interaction had a highly significant effect on the number of panicle/plant, panicle length, thickness, panicle weight, grain yield/plant, and 1000 grain weight. Mainly, the water stress caused a decrease in the number of panicle/plant, panicle length, and thickness, panicle weight, grain yield/plant, and 1000-grain weight by 28.68, 39.92, 36.98, 24.40, 24.7, and 37.1%, respectively, as the average of the two seasons. The used pear millet genotypes were classified according to drought susceptible index (DSI) into two groups, the first was tolerant to drought and the second was susceptible to drought. Genotypes seasonally differ in reduction and drought susceptible index (DSI). The superior genotypes according to DSI were genotypes no. 4, 5 and, 20 which were tolerant to drought for seed yield/plant in the average of the two seasons.

Keywords: *Pearl millet, seed yield and its components, water stress, irrigation.*

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R.Br.] is considered in many regions of the world as a multipurpose crop. It provides nutritious food for human poultry feed and fodder for ruminants compared to other cereal crops.

Pearl millet is the sixth most important cereal in the world after wheat, rice, maize, barley and sorghum (Singh *et al*., 2003). It is a major crop in the semi-arid dryland regions in Southeast Asia and Africa (Henry and Kettlewell, 1996 and Baltensperger, 2002). Mostly, Pearl millet cultivated by poor farmers in the semi-arid regions of sub-Saharan Africa and the Indian subcontinent for food and beverages (Haussmann *et al*., 2012 and Abubakar *et al*., 2019).

In USA and Australia, it is considered a high-quality forage crop (Andrews *et al*. 1993). Likewise, in Africa and Asia it provides food security to almost 90 million poor people inhabiting across their high temperate regions (National Botanical Research Institute).

Being a C4 plant enriched with a high photosynthetic efficiency and production of dry matter (Khairwal *et al*., 2007). Considering it a "high-energy" cereal, with grains of more calories than wheat, probably because of its higher oil content of 4.2% which is 50% polyunsaturated, which means such oil as maize (Nazni and

Shalini, 2010). It has neither the tannins nor the other compounds that reduce digestibility as in sorghum.

The dehusked grains have a protein content of 12.5% and calcium of 344 mg/100 g compared to wheat grain (11.8% and 41 mg/100 g), respectively (Vadez, *et al.*, 2012 and Kanatti *et al.*, 2014).

Its flour is suggested to substitute 10-20% of wheat flour in baking different types of bread (Pasternak *et al.*, 2012). Pearl millet quality as a fodder may exceed other fodder grasses, where Stobbs (1975) found that feeding forage millet to milking cows resulted in higher milk yield as compared with feeding forage sorghum.

Drought is considered as one of the most important factors limiting crop yields around the world. As climate change leads to increasingly hotter and drier summers, the importance of drought constraints on yield and its components has increased where high temperature and water stress often reduce plant growth and crop yields.

In addition, pearl millet is adapted to water-limited conditions and can stand well against such adverse conditions producing biomass and grains more than other cereals crops (Bidinger and Hash 2003). Egypt suffers from water scarcity, therefore, identifying drought–tolerant genotypes, which may be used to develop drought–tolerant varieties is a vital issue under such circumstances. Thus, identifying drought–tolerant genotypes of pearl millet will be paramount to saving water and filling in the shortage of summer forage crops.

The objectives of this study could be summarized as:

Evaluate twenty exotic germplasm of pearl millet for grain traits under normal irrigated and water-stressed environments. Besides estimating drought susceptibility index for studied genotypes under those environments.

Materials and Methods

A- Plant materials and growing conditions

A set of twenty pearl millet (eighteen accessions beside two Egyptian varieties *i.e.* Shandaweel -1 and New Valley) were used for the current study.

The previous accessions were obtained from the plant Genetic resources unit, United States USDA ARS in Table 1.

Table 1. The name and origin of the studied genotypes

Item	Accessions	Plant Name	Country
1	PI 661274	Grif 16613	India
2	PI 661269	Grif 16608	India
3	PI 661268	Grif 16607	India
4	PI 613105	NM-2A4	United States, Nebraska
5	PI 613102	NM-1A4	United States, Nebraska
6	PI 613101	NM-1A1	United States, Nebraska
7	PI 596510	ICMA 92666	India Andhra Pradesh
8	PI 587024	15012	Saudi Arabia
9	PI 587023	12010	Yemen
10	PI 587022	1272	Yemen
11	PI 587014	1128	Yemen
12	PI 587010	1100	Yemen
13	PI 587004	1084	Yemen
14	PI 586993	1019	Yemen
15	PI 586992	1017	Yemen
16	PI 564585	TIFT 8677	United States, Georgia
17	PI 537070	C042	Niger
18	PI 535955	Dogona	Cameroon
19	New valley		Egypt
20	Shandaweel -1		Egypt

The aforementioned genotypes were grown during two growing summer seasons (2019 and 2020) in Agricultural Research Station, Faculty of Agriculture, Assiut University, Egypt (27.19 N , 31.17 E) (Table 2).

Table 2. Some physical and chemical properties of the experiment soil.

Soil properties	2019 and 2020
1- Physical properties	
Sand %	25.90
Silt %	24.70
Clay %	49.40
Soil texture	Clay
Water saturation %	71.2
Field capacity %	44.2
2- Chemical properties	
pH (1:2.5) suspension	7.80
Organic matter %	1.62
Total nitrogen %	0.09
Total $CaCO_3$ %	1.20

These twenty genotypes were sown in a strip plot design with three replications. The irrigation system was arranged in vertical strips and the genotypes in horizontal stripes. Plot size was one row of 2 m in length and 60 cm apart. The distance between hills was 15 cm. After full emergence seedlings were thinned leaving one plant/hill.

The sowing dates were 10th and 15th June in the first and second seasons respectively.

Treatments involved two irrigation systems, optimal and drought conditions, genotypes were irrigated regularly took 1 m^3 for optimum irrigation however, in the drought condition each one was taken 0.5 m^3 for 12 m^2 area.

All other cultural practices were maintained at optimum level for maximum pearl millet production.

The plants were left for flowering and seed production without cutting.

Seed yield and its attributes

At seed maturity stage the following data were recorded on a sample of ten plants randomly collected from the center of the row for each genotype, then the average was taken i.e.

- Number of panicles/plant

- Panicle length (cm)
- Panicle thickness (cm)
- Panicle weight/plant, g
- Grain yield/plant (g).
- Thousand grain weight (g): from each genotype a sample of 1000 seed were weighted. Then the average of 1000 seeds weight was recorded.

C. Statistical analysis

The separate analysis of variance was done on a mean basis according to Gomez and Gomez (1984) Means were compared using R L.S.D. test at a 5% level of probability.

Variances of all studied traits between two seasons were detected and have no homogeneity, consequently the combined analysis cannot be performed according to Bartlett`s test (1939).

Analysis of variance for all studied traits was analyzed using PROC GLM in SAS v.9.0 (The SAS Institute Inc., Cary, NC, USA).

Table 3. Analysis of variance for irrigation in each experiment

Source of variance	d.f	
Replications (r)	r-1	=2
Irrigation treatment (T)	t-1	= 1
Error (a)	(t-1)(r-1)	= 2
Genotypes (G)	g-1	=19
Error(b)	(g-1)(r-1)	=38
G X T	(g-1)(t-1)	=19
Error (c)	(g-1)(t-1)(r-1)	= 38

Drought susceptibility index (DSI):

The drought susceptibility index was calculated according to the method of Fischer and Maurer (1978). The yield of individual genotypes was determined under stress (Yd) and favorable well-watered (Yw) conditions. The average yield of all studied genotypes under drought (xd) and well-watered conditions (xw) were used to calculate drought intensity (D) as D= (1-xd/xw). The mean drought susceptibility index (DSI) of individual genotype was calculated as S = (1-Yd/Yw)/D. Genotypes with average susceptibility or tolerance to drought have an S value of 1.0 indicate less susceptibility and great tolerance to drought. Meanwhile, a value of S = 0.0 indicates maximum possible drought resistance (no effect of drought on yield).

Results and Discussion

The results obtained from the current investigation are presented as follows:

Seed yield and its attributes:

1- Number of panicles/plant

The number of panicles/plant is one of the important components which plays a major role in determining the seed yield. The analysis of variance for panicles number /plant in 2019 and 2020 seasons were shown in Table 4.

The analysis of variance reveals that this trait was highly significant influenced by irrigation systems (normal and water stress) in the two seasons. Also, it was highly significant among studied genotypes. Moreover, the interaction between irrigation and genotypes was significant in both seasons.

The variance of number of panicles/plant between the two seasons was detected as it was not homogenous, consequently the combined analysis was not performed.

The average number of panicles/plant in the 2019, 2020 and over the two seasons as affected by normal irrigation and water stress conditions and twenty genotypes are presented in Table 5.

Number of panicles/plant of the different genotypes differed in rank from normal irrigation to water stress in first season.

In 2019 season, number of panicles/plants under normal irrigation ranged from 4.55 for genotype No. 16 to 10.48 for genotype No. 11 with an average of 7.00. Seven and eleven genotypes significantly surpassed number of panicles/ plant than the average overall genotypes and the check cultivar Shandaweel-1, respectively.

Meanwhile, under water stress, it ranged from 3.12 for genotype No. 17 to 7.69 for New Valley genotype with an average of 4.9 panicles/plant genotype. Seven genotypes significantly surpassed both of average overall genotypes and check cultivar Shandaweel-1.

It is of clear result that seven genotypes exceeded significantly the overall average of genotypes over both water treatments.

In 2020 season, number of panicles/plant under normal irrigation condition ranged from 5.1 for genotype No. 5 to 10.29 for genotype No. 11 with an average of 7.81 panicles/plant. Six and seventeen genotypes significantly surpassed the average overall genotypes and check cultivar Shandaweel-1, respectively. Also, under water stress it ranged from 3.19 for genotype No. 5 to 8.9 for genotype No. 11 with an average of 5.71 panicles/plant. Seven and twelve genotypes significantly surpassed number of panicle/plant than the average overall genotypes and check cultivar Shandaweel-1, respectively (Table 5).

It is obvious that seven genotypes surpassed significantly the overall mean of genotypes over both water treatments.

The response of the studied genotypes under different irrigation conditions varied from season to another. The reason of this may be due to the differences in climatic conditions.

The general average overall normal and water stress conditions revealed that genotype No. 11 was in the first ranking (9.32 panicles/ plant) under both conditions.

Generally, water stress reduced number of panicles/plant by 29.93, 29.43 and 28.47% compared to normal irrigation in the first, second and over the two seasons, respectively, overall genotypes (Table 5). Yadav and Rai (2011) found panicle number of crosses was significantly higher than that of composites but significantly lower than that of landraces. Also, Yadav and Kumar (2013) indicated that effective tillers was significantly higher under irrigated condition than rainfed environment.

Drought susceptibility index (DSI) of some genotypes varied from a season to another. Thirteen, ten and twelve genotypes were less than unity for drought susceptibility index in first, second and over the two seasons, respectively, and could be considered tolerant to drought respect to number of panicles/plant.

2- Panicle length (cm)

Panicle length is one of the components to determine the seed yield. The analysis of variance for panicle length in 2019 and 2020 is shown in Table 4.

The analysis of variance revealed highly significant influence by treatments of irrigation (normal and water stress) in the two seasons. Also, it was highly significant among genotypes in both seasons. Moreover, the interaction of irrigation x genotypes was highly significant in both seasons.

The variance of panicle length between the two seasons was detected and not homogeneous, consequently, the combined analysis was not done.

The average panicle length in first and second seasons as affected by treatments of irrigation and twenty genotypes are presented in Table 6.

In the first season (2019), panicle length, cm under normal irrigation ranged from 23.10 for genotype No. 11 to 35.45 for genotype No. 18 with an average of 28.77 cm. Four genotypes surpassed significantly the average overall genotypes. Under water stress condition, panicle length, varied from 12.30 for genotype No. 13 to 18.07 for genotype No. 3 with an average of 15.28 cm (Table 6).

As well as no genotype was significantly surpassed both of average overall genotypes and the check cultivar Shandaweel-1. Four genotypes surpassed significantly the overall average of genotypes over both of water treatments (Table 6).

In the second season (2020), panicle length under normal irrigation ranged from 17.67 for genotype No. 15 to 32.4 for genotype No. 18 with an average of 25.81 cm. Nine and sixteen genotypes were significant and surpassed the average overall genotypes and check cultivar Shandaweel-1, respectively. Under water stress condition, panicle length varied from 11.07 for genotype No. 15 to 22.73 for genotype No. 18 with an average of 17.14 cm (Table 6). Eight and thirteen genotypes significantly surpassed the average overall genotypes and check cultivar shandaweel-1, respectively (Table 6).

Over the two water treatments, seven genotypes surpassed significantly the overall average of genotypes.

Generally, mean of panicle length for all genotypes were higher under normal irrigation than water stress in both and over the two seasons. The panicle length was decreased by 46.48, 33.36 and 40.57% under water stress compared to normal conditions in first, second and over two seasons, respectively (Table 6).

These results are in agreement with those obtained by Khairwal *et al*. (2007) who found that pearl millet genotypes differed significantly with each other.

Drought susceptibility index (DSI) of panicle length (Table 6) indicated that ten, ten and eleven genotypes tend to be tolerant to drought in first, second and over the two seasons, respectively, due to they possessed DSI less than unity. Such results could be expected because panicle length is mainly genetic makeup, and water stress affected grain filling and or fertility of the portion of the panicle than panicle length itself.

3- Panicle thickness, cm

Panicle thickness is possible in determining the seed yield. The analyses of variance for panicle thickness, in first and second seasons are presented in Table 4.

The analysis of variance revealed highly significant differences among the irrigation treatments in both seasons. These results confirm the variance response of pear millet genotypes to the irrigation treatments conditions (normal and drought stress). Furthermore, the statistical analysis clearly showed it highly significant among twenty genotypes of pear millet in both seasons. The interaction between treatments of irrigation (normal and water stress) and genotypes had significant effect on panicle thickness in both seasons.

The variance of panicle thickness between two seasons was detected and not homogeneous, consequently, the combined analysis was not done.

Mean panicle thickness in first and second seasons are presented in Table 7.

Panicle thickness for different genotypes differed in rank from normal irrigation to water stress, and from season to season (Table 7).

In 2019 season, panicle thickness under normal irrigation ranged from 1.567 for genotype No. 15 to 2.847 for genotype No. 9 with an average of 2.106 cm overall genotypes. Six and eight genotypes significantly surpassed the average overall genotypes and check cultivar Shandaweel-1, respectively. Meanwhile, under water stress, it ranged from 0.94 for genotype No. 7 to 1.920 for genotype No. 14 with an average of 1.317 cm overall genotypes. four and one genotypes significantly surpassed the average overall genotypes and check cultivar Shandaweel-1, respectively. Moreover, five genotypes surpassed significantly the overall average of genotypes over both water treatments (Table 7).

In 2020 season, panicle thickness under normal irrigation ranged from 1.933 for genotype No. 18 to 2.767 for genotype No. 12 with an average of 2.439 cm overall genotypes. Six genotypes significantly surpassed the check cultivar Shandaweel-1. Meanwhile, under water stress condition, it ranged from 1.033 for genotype No. 3 to 2.007 for genotype No. 12 with an average of 1.512 cm overall genotypes. Four and eight genotypes significantly surpassed average overall genotypes and check cultivar Shandaweel-1, respectively. Moreover, the genotypes mean over both water treatment revealed that five genotypes surpassed significantly the overall mean of genotypes.

Generally, water stress reduced panicle thickness by 36.35, 37.61 and 37.33% compared to normal irrigation in the first, second and over the two seasons, respectively, overall genotypes (Table 7). The best genotype in number of panicle/plant or panicle length and panicle thickness is not always the best in grain yield/plant indicating that other characters such as number of grains/panicle and grain weight are also contributors to grain yield.

Drought susceptibility index (DSI) of some genotypes varied from season to season. Thirteen, eleven and twelve genotypes were less than unity for drought susceptibility index in first, second and over the two seasons, respectively, and could be considered tolerant to drought respect to panicle thickness (Table 7).

4- Panicle weight, plant (g)

Panicle weight/plant is one of the essential factors in determining the seed yield. The analysis of variance for panicle weight/plant in first (2019) and second (2020) seasons are presented in Table 8.

The analysis of variance revealed highly significant differences among the treatment of irrigation (normal and water stress) in both seasons. Furthermore, the statistical analysis clearly showed highly significant differences among twenty genotypes of pear millet in both seasons. The interaction between treatments of irrigation and genotypes had significant effect on panicle weight/plant in both seasons.

The variance of panicle weight/plant between two seasons was detected and not homogenous, consequently, the combined analysis was not performed.

The mean panicle weight/plant in the two seasons as affected by treatments of irrigation (normal and drought) and twenty pear millet genotypes are shown in Table 8.

Panicle weight/plant of the different genotypes differed in rank from season to another and almost from normal irrigation to water stress.

In 2019 season, panicle weight/plant under normal irrigation ranged from 107.74 for genotype No. 19 to 254.29 for genotype No. 17 with an average of 195.64 g/plant. Seven and sixteen genotypes significantly surpassed the average overall genotypes and check cultivar Shandaweel-1, respectively. Meanwhile, under water stress, it ranged from 77.66 for genotype No. 19 to 207.66 for genotype No. 8 with an average of 151.68 g/plant. Nine and fourteen genotypes significantly surpassed the average overall genotypes and check cultivar Shandaweel-1, respectively. Over the water treatments, eight genotypes surpassed significantly the overall average of genotypes (Table 8).

In 2020 season, panicle weight/plant under normal irrigation ranged from 108.85 for genotype No. 13 to 278.37 for genotype No. 11 with an average of 189.42 g/plant. Eight and fifteen genotypes significantly surpassed average overall genotypes and check cultivar Shandaweel-1, respectively. Meanwhile, under water stress condition it ranged from 94.13 for genotype No. 14 to 242.7 for genotype No. 11 with an average of 136.97 g/plant. Five genotypes were significantly surpassed both of average overall genotypes and check cultivars Shandaweel-1. Moreover, eight genotypes exceeded significantly the overall average of genotypes upon the two water treatments (Table 8).

The general average overall environments revealed that the genotype No. 11 was in the first ranking (234.17) followed by the genotype No. 8 (208.32).

Generally, water stress reduced panicle weight/plant by 22.55, 26.25 and 24.97% compared to normal irrigation in the first, second and over the two seasons, respectively, overall genotypes (Table 8). These results are in line with those reported by Kholova *et al*. (2010) who found that the drought affects parts of the plants.

Drought susceptibility index (DSI) of some genotypes varied from season to season. Ten, fourteen, and thirteen genotypes were less than unity for drought susceptibility index in first, second and over the two seasons, respectively, and could be considered tolerant to drought respect to panicle weight/plant (Table 8).

5- Grain yield/plant (g)

The analysis of variance of grain yield/plant of the twenty pear millet genotypes under normal and water stress conditions during the two seasons is presented in Table 9.

The results indicated that the treatments of irrigation (normal and drought irrigation) differed in highly significantly on grain yield/plant in the two seasons. Also, the grain yield/plant was highly significantly affected by genotypes in both seasons. Moreover, the analysis of variance showed the treatments of irrigation x genotypes interaction had a significant difference in both seasons (Table 9). The variance of grain yield/plant between two seasons was detected and was not homogeneous, consequently, the combined analysis was not performed.

The mean of seed yield/plant in the two seasons as affected by normal and water stress and twenty pear millet genotypes are shown in Table 9.

In 2019 season, grain yield/plant under normal irrigation conditions ranged from 10.73 for genotype No. 13 to 15.46 for genotype No. 17 with an average of 12.96 g/plant. Five and twelve genotypes were significantly surpassed average grain yield/plant and check cultivar Shandaweel-1, respectively.

Under drought conditions, grain yield/plant varied from 8.44 for genotype 13 to 12.46 for genotype No. 17 with an average of 9.86 g/plant. Four and seven genotypes were significantly surpassed the average of grain yield and check cultivar Shandaweel-1, respectively. Moreover, six genotypes exceeded significantly the overall average of genotypes upon the two water treatments (Table 9).

In 2020 season, grain yield/plant under normal irrigation condition ranged from 12.22 for Shandaweel-1 cultivar to 18.83 for genotype No. 17 with an average of 14.89 g/plant. Four and fifteen genotypes were significantly surpassed the average of grain yield/plant and check cultivar Shandaweel-1, respectively. Moreover, under drought condition, grain yield/ plant ranged from 8.94 for genotype No. 13 to 13.25 for genotype No. 2 with an average of 11.03 g/plant. Four and seven genotypes were significantly out-yielded the average of grain yield/plant and check cultivar Shandaweel-1, respectively. Also, six genotypes exceeded significantly the overall mean of genotypes over the two water treatments (Table 9).

The reduction in grain yield/plant due to water stress in the first, second and over two seasons were 23.79, 25.56 and 24.68% compared to normal irrigation, respectively (Table 9).

These results may be due that the normal irrigation produce more metabolites required for increasing all agronomical traits than the water stress condition. Also, the role of water encouraging metabolite processes, consequently, it will be effective for all agronomical traits.

The obtained results reflect the genetic differences among the studied genotypes of pearl millet and their different reactions under water stress. Consequently, some of those genotypes could be used as promised genotypes under water stress.

These results are in line with those obtained by Brocke *et al.* (2003) found that the drought was strongest in some variety with a 73% reduction of grain yield, Gebre (2014) in Ethiopia found significant variations among genotype under different environments were observed for all traits. Kumar *et al.* (2014) in India, reported that significant differences among genotypes for all the characters studied i.e. grain yield. Also, Yadav *et al.* (2014) found that irrigated condition recorded significantly higher grain yield than rainfed condition.

Drought susceptibility index (DSI) indicated that fifteen, ten and nine genotypes were tolerant to water stress in first, second and over the two seasons, respectively. Some of these genotypes were low yielding, but the other genotypes could be considered susceptible to drought. Also, some of these genotypes differed from season to season for drought susceptibility index.

6- The 1000-grain weight (g)

The analysis of variance for 1000-seed weight trait showed that treatments of irrigation conditions and genotypes were highly significant differed in 1000-grain weight in both seasons. Also, the interaction between treatments of irrigation and genotypes were highly significant in both seasons (Table 10).

The results indicated that the response of the studied genotypes under different treatments of irrigation varied from season to another. These results may be due to the different climatic conditions. The variance of 1000-grain weight between two seasons was detected and was not homogeneity, consequently, the combined analysis was not done.

The average of 1000-grain weight in the two seasons as affected by normal and water stress irrigation and genotypes are presented in Table 10.

In the first season (2019), under normal irrigation the 1000-grain weight varied from 8.76 for genotype No. 5 to 10.86 for genotype No. 14 with an average of 9.87 g. No genotypes were significantly heaviest 1000-grain weight than average overall genotypes or check cultivar Shandaweel-1. Under water stress condition, the 1000-grain weight ranged from 5.18 for genotype No. 15 to 7.54 for genotype No. 10 with an average of 6.24 g. No genotypes were significantly heaviest 1000-grain weight than bot average overall genotypes or check cultivars.

On the other hand, three genotypes exceeded significantly the overall average of all genotypes.

grain yield/plant and check cultivar Shandaweel-1, respectively. Under drought conditions, grain yield/plant varied from 8.44 for genotype 13 to 12.46 for genotype No. 17 with an average of 9.86 g/plant. Four and seven genotypes were significantly surpassed the average of grain yield and check cultivar Shandaweel-1, respectively. Moreover, six genotypes exceeded significantly the overall average of genotypes upon the two water treatments (Table 9).

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The reduction in grain yield/plant due to water stress in the first, second and over two seasons were 23.79, 25.56 and 24.68% compared to normal irrigation, respectively (Table 9).

These results may be due that the normal irrigation produce more metabolites required for increasing all agronomical traits than the water stress condition. Also, the role of water encouraging metabolite processes, consequently, it will be effective for all agronomical traits.

The obtained results reflect the genetic differences among the studied genotypes of pearl millet and their different reactions under water stress. Consequently, some of those genotypes could be used as promised genotypes under water stress.

These results are in line with those obtained by Brocke *et al.* (2003) found that the drought was strongest in some variety with a 73% reduction of grain yield, Gebre (2014) in Ethiopia found significant variations among genotype under different environments were observed for all traits. Kumar *et al.* (2014) in India, reported that significant differences among genotypes for all the characters studied i.e. grain yield. Also, Yadav *et al.* (2014) found that irrigated condition recorded significantly higher grain yield than rainfed condition.

Drought susceptibility index (DSI) indicated that fifteen, ten and nine genotypes were tolerant to water stress in first, second and over the two seasons, respectively. Some of these genotypes were low yielding, but the other genotypes could be considered susceptible to drought. Also, some of these genotypes differed from season to season for drought susceptibility index.

6- The 1000-grain weight (g)

The analysis of variance for 1000-seed weight trait showed that treatments of irrigation conditions and genotypes were highly significant differed in 1000-grain weight in both seasons. Also, the interaction between treatments of irrigation and genotypes were highly significant in both seasons (Table 10).

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The average of 1000-grain weight in the two seasons as affected by normal and water stress irrigation and genotypes are presented in Table 10.

In the first season (2019), under normal irrigation the 1000-grain weight varied from 8.76 for genotype No. 5 to 10.86 for genotype No. 14 with an average of 9.87 g. No genotypes were significantly heaviest 1000-grain weight than average overall genotypes or check cultivar Shandaweel-1. Under water stress condition, the 1000-grain weight ranged from 5.18 for genotype No. 15 to 7.54 for genotype No. 10 with an average of 6.24 g. No genotypes were significantly heaviest 1000-grain weight than bot average overall genotypes or check cultivars.

On the other hand, three genotypes exceeded significantly the overall average of all genotypes.

In the second season, under normal irrigation, the 1000-grain weight ranged from 7.93 for genotype No. 9 to 11.03 for genotype No.12 with an average of 9.75 g. Five genotypes were significantly heaviest in 1000-grain weight than average overall genotypes. Under water stress conditions, the 1000-grain weight ranged from 4.88 for genotype No. 18 to 6.95 for genotype No. 6 with an average of 6.05 g. Three genotypes were significantly heaviest 1000-grain weight than the check cultivar Shandaweel-1. Moreover, two genotypes surpassed significantly the overall average of genotypes over the two water treatments (Table 10).

The obtained results are expressing the different response of studied genotypes and some of them could be used as promised genotypes when the seed index applied as selection critaria.

These results are in agreement with those reported by Khairwal *et al.* (2007), Demuyakor *et al.* (2013) and Gebre (2014) who found significant difference between studied pearl millet genotypes for grain weight.

Drought susceptibility index (Table 10) varied greatly from season to season with inconsistent direction. Drought susceptibility index (DSI) were less than unity for ten in first, nine in second and eight over the two seasons. Genotypes and it could be considered tolerant to drought respect to 1000-grain weight.

DSI of the combined means indicated that genotypes No. 2, 8, and 9 were the best tolerant genotypes for seed index to water stress conditions.

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تقييم أداء تراكيب الوراثية للدخن لمحصول البذور ومساهماته تحت الري العادي والإجهاد المائي

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الملخص

أجري هذا البحث بمزرعة قسم المحاصيل – كلية الزراعة – جامعة أسيوط لدراسة تأثير الإجهاد المائي علي المحصول البذري ومكوناته لبعض التراكيب الوراثية في الدخن. استخدم لذلك عشرون تركيب وراثي زرعت في تجربتين احداهما تحت الري العادي والأخرى تحت ظروف الإجهاد المائي خلال موسمين ٢٠١٩ ، ٢٠٢٠ في تصميم الشرائح الكاملة باستخدام ثلاث مكررات. وكان أهم النتائج المتحصل عليها كما يلي:

كانت هناك فروق معنوية جداً لكل من معاملات الري والتراكيب الوراثية والتفاعل بينهما علي صفات عدد النورات للنبات، طول وسمك النورة ووزن النورات/للنبات، محصول البذور للنبات وكذلك وزن ١٠٠٠ حبة.

- تأثرت جميع الصفات المدروسة وفي كلا الموسمين بمعاملة الاجهاد المائي وأدت إلي الانخفاض النسبي لجميع الصفات المدروسة وكان مقدار هذا الانخفاض هو ٢٨,٥ ، ٤٠,٦، ٣٧,٣ ، ٢٥,٠، ٢٤,٧ ، ٣٧,١% لصفات عدد النورات/النبات، طول وسمك النورة، وزن النورات/النبات، محصول البذور/للنبات، ووزن ١٠٠٠ حبة علي التوالي كمتوسط للموسمين.- أظهرت التراكيب الوراثية اختلاف في تحملها للجفاف باستخدام دليل معامل الحساسية فقد أعطت بعض التراكيب الوراثية معامل حساسية أقل من واحد (متحملة) بينما الأخرى أعطت معامل حساسية أكثر من واحد (غير متحملة للجفاف) واختلف ذلك في بعض التراكيب الوراثية من موسم إلي آخر.
- كان أكثر التراكيب الوراثية تحملاً للجفاف هما أرقام ٤ ، ٥ و ٢٠ وذلك لمحصول البذور/للنبات وفي كلا الموسمين.