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Responses of Some Bread Wheat Genotypes (*Triticum aestivum* L.) For Different Levels of Potassium Oxide Spraying

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ABSTRACT

The study was applicated at an agricultural farm in Al-Alam district of Salahuddin Governorate (10 km east Tikrit University) during the winter season 2018-2019 by using a Randomized complete Block Design in a split-plot arrangement with three replications. Potassium foliar application levels (0, 1 and 2%) were in the main plot and 14 genotypes of bread wheat in the sub-plot. Spraying was at two stages: booting and anthesis stage. The characteristics of the study are plant height (cm), flag leaf area (cm^2), a number of spikes m^2, number of grains per spike, 1000grain weight, grain yield ($ton.h^{-1}$), and protein percentage in the grains (%). The results revealed a significant difference among potassium levels, genotypes and their interaction. The third concentration of potassium oxide spray was significantly superior to the characteristics of plant height (95.03 cm), flag leaf area (57.50 cm^2), the weight of 1000 grains (43.92 gm), grain yield (5.27 $ton.h^{-1}$), and protein percentage (10.05 %). EBAA 99 genotype was significantly superior by giving the highest average plant height (96.74 cm), flag leaf area (57.76 cm^2), and protein percentage (11.65 %). The best interaction treatment was between Ebaa 99 genotype and third concentration of potassium in plant height (101.13 cm), and protein percentage (11.93 %). Hedhab genotype with the second concentration of potassium gives the number of grains (50.93 $grain.spike^{-1}$) & Boro with the third concentration of potassium gave (49.43 $grain.spike^{-1}$). The first level (without spraying) scored the lowest averages for all characteristics studied.

INTRODUCTION

Wheat is one of the most important cereal crops which cultivated widely for great food value benefit, and one-third of the world's population depends on it (Khaeim a, 2019). It grows almost all over the world at various altitudes from the sea levels, (Nasim et al., 2012); (Drebee, et al, 2014). Iraq regarded one of the original regions of bread wheat which give the availability of success factors but its productivity remains low compared to global productivity (Hussein, et al., 2019). Wheat grain possess important potential food facts: high energy of carbohydrates, and gluten which made its flour adequate in dough processing for producing a loaf (Jeber et al, 2019). Quantitative and Qualitative improvements in grain yield May be done by using agricultural practices (such as Nutrients spray), that affect potential yield and grain content (Baker, et al, 2018). Many types of research refer that bread wheat genotypes differ from each other in productivity and performance in grain yield and it,s components according to nutrients application (Khaeim,b, et al, 2019). Potassium element plays an important role in increasing grain yield and improving quality traits when used in a critical stage of plant growth in adequate mount (Ali et al, 2019). Wheat requires potassium for optimal growth and

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development. Adequate potassium results in the superior quality of grain due to improved efficiency of photosynthesis, increased resistance to some diseases, and greater water use efficiency. It helps maintain a normal balance between carbohydrates and proteins. Sufficient potassium results in stronger wheat straw and grain filling. The objectives of this study were summarized in Evaluating the performance of 14 genotypes of wheat bread under the influence of different concentrations of potassium spray and their overlapping together.

METHODS AND MATERIALS

This experiment was carried out in a farm field at AL-Alam District (10 km east of the Tikrit Governorate) at a longitude of 43.35 degrees east and 34.27 degrees north latitude in the 2018-2019 winter agricultural season. Fourteen genotypes were used (Table 1), sprayed by potassium oxide (0,1 and 2%) in two stages (booting and anthesis stages). Soil preparation is applied as demands though plowing, leveling, and splitting according to the research scheme. Potassium spray concentrations occupied the main plots while the genotypes occupied the secondary plot, and each genotype was planted with three lines with three replications. The seeds were planted on November 20, 2018, in mixed sandy soil at a depth of 5 cm in the form of lines and a seeding rate of 160 kg. h-1. Irrigation and other crop management applied as needed. A field harvested on May 10, 2019.

Studied traits

The studied traits were: plant height, flag leaf area, number of spikes.m-2, number of grains.spike-1, 1000 grain weight, and protein content.

RESULTS AND DISCUSSION

Plant height (cm)

It is noted from Table (1) the means of plant height showed highly significant in the effect of genotypes and potassium spray concentrations and their interaction, potassium spray led to a significant increase in plant height for the treatment (2% k2o) and gave the highest average reached (95.03 cm). Whereas, the two treatments (1% and 0) gave a lower mean (92.05 and 88.75 cm) respectively. This is due to the role of potassium in its positive effect in the process of dividing and expanding cells, especially the spike internodes because the spraying was in the booting and flowering stages. This is consistent with what Nehme et al. (2011) found, about the positive effects of potassium in increasing plant height.

Regarding the genotypes, we note the superiority of the Ibaa 99 genotype, which gave the highest average for this trait (96.74 cm), with significant differences from the other genotypes. The interaction was significant in Ibaa 99 genotypes with the third concentration(2%) which gave the highest mean value for this trait (101.13 cm).

Flag leaf area (cm^2)

The results in Table (2) indicate of presence significant differences in the flag leaf for potassium spraying levels. The third treatment gave the highest average area (57.50 cm2) and with a significant increase of (8.12 and 18.80) % compared to the two concentrations (0 and% 1), respectively. This is due to the role of potassium of stimulating plant growth regulators that directly enhance the elongation and expansion of leaf cells and thus increasing leaf area(Mohammed, 2002), as well as its role in increasing the chlorophyll content and prolonging the flowering period, which has caused an increase in the area of the flag leaf. These results agree with (Nehme et al, 2011). Ibaa 99 gave the highest average for this trait (57.76 cm2) due to the difference in the genetic makeup, the extent of its response to the added fertilizer, as well as the different growth periods and expansion of the flag leaf. The overlap of the genotype (Ibaa 99) with the third concentration of potassium gave the highest rate for this trait (61.63 cm2).

Table (1): Means of plant height of wheat genotypes exposed to foliar application of potassium oxide fertilizer (cm).

Genotypes	Levels of foliar potassium oxide application			Means
	0%	1%	2%	
Sham 6	87.96	90.46	93.30	90.57
Ibaa 99	91.43	97.66	101.13	96.74
Florka	84.90	88.86	91.73	88.50
Cazo	88.66	91.63	94.73	91.67
Adana	90.23	95.73	97.83 b	94.60
Ali	88.43	91.56	95.53	91.84
Rizkari	92.50	96.53	98.86	95.96
Clark	90.06	92.50	97	93.18
Abo Graib	86.80	88.30	89.46	88.18
Hithab	88.16	90.23	93.10	90.50
Boro	88.73	91.33	94.33	91.46
Milan	86.76	89.03	91.76	89.18
Site Mall	89.53	93.71	94.93	92.72
Oises	88.36	91.23	96.73	92.11
Means	88.75	92.05	95.03	

L.S.D: fertilizer = 0.4, genotypes = 0.37, and their overlap = 0.64

Table (2): Effect of potassium oxide fertilization on several wheat bread varieties and their overlap for the trait of flag leaf area (cm^2).

Genotypes	Levels of foliar potassium oxide application			Means
	0%	1%	2%	
Sham 6	49.90	56.92	59.73	55.51
Ibaa 99	52.46	59.22	61.63	57.76
Florka	46.46	50.33	55.40	50.73
Cazo	47.80	51.93	56.90	52.21
Adana	45.83	51.33	54.96	50.71
Ali	48.11	52.80	57.76	52.88
Rizkari	50.33	57.36	61.53	56.41
Clark	49.22	54.03	56.93	53.38
Abo Graib	48.23	51.60	55.63	51.82
Hithab	48	51.93	56.33	52.07
Boro	49.63	53.86	59.63	54.36
Milan	46.86	51	54.33	50.73
Site Mall	48.86	52.60	58.73	53.40
Oises	46.03	49.71	55.53	50.42
Means	48.40	53.18	57.50	

L.S.D: fertilizer = 0.474, genotypes = 0.435, and their overlap = 0.754

Number of spikes (m^{-2})

It is clear from Table (3) that the treatment 2% was superior in no.spikes.m^{-2} by giving the highest average valve (348.73 spike.m^{-2}) but did not differ significantly from the treatment of 1% (347.51 spike.m^{-2}), but it significantly differs from control treatment which gave (336.59 spike. m^{-2}), with an increase of 3.57%, due to the role of potassium in increasing vegetative growth and the optimal use of incident rays and increases the efficiency of photosynthesis and their product which increase the effectiveness of formation yield components (Yassin, 2001). The genotype Flora gave the highest average for this trait (352.02 spike.m^{-2}) compared to the genotype Rzkari which gave the lowest average (340.33 spike.m^{-2}). With regard to the overlap of the genotypes with potassium spray levels, the genotype Florca was exceeded with the treatment (2%) and gave the highest average of this trait (376.75 spike.m^{-2}) compared to the other genotypes.

Table (3): The effect of potassium oxide fertilization on wheat genotypes and their overlap for the number of spikes.m^{-2}.

Genotypes	Levels of foliar potassium oxide application			Means
	0%	1%	2%	
Sham 6	338.27	344.21	347.56	343.34
Ibaa 99	342.23	348.01	350.03	346.75
Florka	335.00	344.32	376.75	352.02
Cazo	335.71	343.27	347.59	342.19
Adana	340.39	349.13	348.91	346.14
Ali	336.29	345.65	347.07	343.00
Rizkari	331.58	342.33	347.10	340.33
Clark	336.24	347.57	348.45	344.09
Abo Graib	341.08	349.89	349.48	346.82
Hithab	331.14	345.28	347.25	341.22
Boro	341.04	349.66	350.38	347.02
Milan	332.62	346.85	346.37	341.95
Site Mall	337.70	348.62	347.85	344.72
Oises	333.02	343.58	346.71	341.10
Means	336.59	347.51	348.73	

L.S.D; N.S

The number of grains. Spike^{-1}

The number of grains is one of the most important components of the final yield. Table (4) refers that the application of potassium led to a significant increase in the number of grains per spike. The treatment of 2% K2O resulted in the highest mean for this trait (46.59 grains.spike-1) with a significant increase of (14.16 and 1.79)% compared to the other two treatment levels (0 and 1%) K2O respectively. This is attributed to the role that potassium plays in controlling plant hormones that affect the growth and pollination of florets, as well as its role in raising the efficiency of photosynthesis and increasing proteins. This is consistent with what Ali and Ahmed (2017) found. Hidhab cultivar gave the highest mean value for this trait (47.18 grains.spike-1) and did not differ significantly from the varieties of Ibaa 99, Oasis, and Boro that gave an average of 46.90, 46.48, and 46.22 grains.spike-1, respectively. The variation among genotypes in this trait may be due to its difference in exploiting the available factors for growth, especially during the flowering stage to form the largest possible number of fertile florets and then the number of grains per spike .

Regarding the overlap, the Hithab with the second level resulted in the highest rate for this trait (50.93 grains.spike-1) which increased over the treatments excluding the two treatments Puro (2)% and Ibaa 99 (2)% that gave (49.43 and 49.14) grains.spike-1. The varieties of Flora with the comparison treatment resulted in the lowest rate for this trait was (38.83 grains.spike-1) as shown in Table (4).

Table (4): Effect of potassium oxide fertilization on wheat genotypes and their overlap for the number of grains.spike^{-1}.

Genotypes	Levels of foliar potassium oxide application			Means
	0%	1%	2%	
Sham 6	41.10	44.08	43.64	42.94
Ibaa 99	44.72	46.82	49.14	46.90
Florka	38.83	41.59	44.47	41.63
Cazo	42.54	44.31	44.52	43.79
Adana	39.30	42.17	44.89	42.12
Ali	39.37	44.83	45.80	43.33
Rizkari	41.79	47.46	47.85	45.70
Clark	40.32	44.79	45.72	43.61
Abo Graib	39.04	47	47.29	44.44
Hithab	41.94	50.93	48.67	47.18
Boro	40.29	48.94	49.43	46.22
Milan	39.47	42.36	45.23	42.35
Site Mall	40.43	46.90	47	44.78
Oises	42.15	48.62	48.67	46.48
Means	40.81	45.77	46.59	

L.S.D = 0.69, genotypes = 1.06, and their overlap = 1.83

Weight 1000 grains

The third level of potassium oxide resulted in the highest average of 1000 grains weight (43.92 g) (table 5) with a significant difference from the second and first levels of K2O (1.88 and 14.26), respectively. However, the lowest average of 1000 grains weight was with the control treatment, which gave a mean of (38.23 g). This is due to the role of potassium in increasing the efficiency of photosynthesis, which increases the accumulation of photosynthesis products then transported from the source to the grains and its important role in prolonging the filling period of the grains,(Zaboon et al, 2016).

The genotype of Milan significantly differs from all others by giving the highest average for this trait (45.01 g) while Sham-6 resulted in the lowest average of 1000 grains weight (38.91 g) which that due to the different genetic factors of these genotypes especially in the different ability to benefit from agricultural processes and applied fertilizers and the different tolerance for environmental conditions.

Regarding the overlap, Milan with the third level of potassium oxide resulted in the highest average of 1000 grains weight (46.76 gm) and non-significantly increase as compared to Clark with the second level of the treatment and Hidhab with the third level which gave 46.13 and 46.06 gm, respectively. The varieties of Cazo and the comparison treatment gave the lowest rate for this trait (36.22 g), as shown in Table (5).

Table (5): Effect of potassium oxide foliar application on wheat genotypes and their overlap for the trait of 1000 grain weight (g).

Genotypes	Levels of foliar potassium oxide application			Means
	0%	1%	2%	
Sham 6	37.46	39.04	40.22	38.91
Ibaa 99	36.01	41.69	43.10	40.26
Florka	39.91	42.08	43.21	41.73
Cazo	36.28	42.34	43.09	40.57
Adana	37.22	41.60	42.36	40.39
Ali	38.46	40.62	40.95	40.01
Rizkari	36.51	40.00	40.83	39.11
Clark	37.44	46.13	45.90	43.16
Abo Graib	38.82	43.98	43.82	42.20
Hithab	38.97	43.90	46.06	42.98
Boro	40.53	44.85	45.09	43.49
Milan	41.79	46.48	46.76	45.01
Site Mall	38.97	43.77	45.41	42.71
Oises	36.95	43.91	44.90	41.92
Means	38.23	42.88	43.69	

L.S.D = 0.62, genotypes = 0.77, and their overlap = 1.34

Grain yield

The components of the grain yield are the number of spikes.m-2, number of grains.spike-1, and 1000 grains weight, which may positively or negatively correlate with the grain yield. Table (6) shows that the application of potassium oxide led to an increase in grain yield. The application of potassium oxide at (2)% resulted in the highest average for this trait (5.27 to.h-1), which is significantly different from the other two treatments, with a significant increase of 14.06 and 26.68% for 0 and 1% treatment respectively. This is because the foliar application of potassium has led to increased activity of plant enzymes also of transporting carbohydrates from their places of manufacture (source) to grains (sink) as well as encouraging vegetative growth. This increase the efficiency of photosynthesis, which led to an increase in the number of grain and grains weight (tab 4 and) .

Ibaa99 cultivar revealed a high average of grain yield (5.12 tons.h-1) which significantly more than other wheat genotypes. The lowest average for this trait was recorded for the Milan cultivar (4.35 to.h^{-1}). Results can be interpreted by the superiority of genotypes in plant height, leaf area, and the number of grains spike-1(tables 3, 4 and 6) which indicate the efficiency of these genotypes of exploiting leaf area in increase the number of grains.spike-1 which reflected in the final yield per unit area. The fertilization by genotype overlap revealed the superiority of Ibaa 99 genotype with the third treatment (2% k2o) in grain yield (5.89 to.h-1) .overlap was 3.80 to.h-1 for Milan with control treatment. Increasing grain yield may have resulted from a sufficient quantity of potassium which led to an increase in the production of pollen grains, as a result of photosynthesis activities which increase the fertilization percentage and increasing the number of grains.spike-1.Thus, the accumulated material that is stored in the grain increases which leads to an increase in the weight of the grain, which also increased the grain yield, (Imran (2004).

Table (6): The effect of potassium oxide foliar application on wheat genotypes and their overlap for the trait of grain yield (ton.h^{-1})

Genotypes	Levels of foliar potassium oxide application			Means
	0%	1%	2%	
Sham 6	4.23	4.84	5.68	4.91
Ibaa 99	4.49	4.99	5.89	5.12
Florka	3.93	4.25	4.99	4.39
Cazo	4.52	4.66	5.14	4.77
Adana	4.11	4.65	5.25	4.67
Ali	3.95	4.46	5.37	4.59
Rizkari	4.35	4.94	5.52	4.94
Clark	3.83	4.36	5.21	4.47
Abo Graib	4.16	4.61	5.10	4.62
Hithab	4.32	4.81	5.20	4.78
Boro	4.36	4.86	5.25	4.82
Milan	3.80	4.24	5.003	4.35
Site Mall	3.95	4.32	5.02	4.43
Oises	4.28	4.77	5.2	4.75
Means	4.16	4.62	5.27	

L.S.D: fertilizer = 0.05, genotypes = 0.12, and their overlap = 0.20

The protein content of grain

The results of the statistical analysis in Table (7) indicate significant effects of potassium foliar application levels. It shows that the fertilization level of (2)% resulted in the highest mean for this trait (10.05%). The two treatments (0 and 1)% gave a significant increase (5.67 and 2.23)%, respectively. This increase due to the amount of potassium applied in sufficient levels for the plant, which increases the availability of potassium in plant tissues and stimulates enzymes that affect protein synthesized (Elbaz et al 2008). The variety of Ibaa 99 resulted in the highest mean of the protein content (11.65)% which significantly differs from all other cultivars. while Florka gave the lowest average for this trait (7.62)%. Concerning the overlap, the Ibaa 99 variety with the 2 k2o% treatment resulted in the highest average for this trait (11.93%) which is significantly more than the other overlap treatments. The lowest average of this trait was between the Flork variety with a control treatment (7.28 %).

Table (7): The effect of potassium oxide on wheat genotypes and their overlap for the trait of protein content in the grains (%).

Genotypes	Levels of foliar potassium oxide application			Means
	0%	1%	2%	
Sham 6	11.08	11.37	11.73	11.39
Ibaa 99	11.32	11.68	11.93	11.65
Florka	7.28	7.65	7.92	7.62
Cazo	9.75	10.02	10.24	10.00
Adana	8.96	9.23	9.40	9.20
Ali	10.25	10.58	10.83	10.55
Rizkari	9.003	9.34	9.53	9.29
Clark	10.32	10.68	10.85	10.61
Abo Graib	8.13	8.36	8.64	8.38
Hithab	9.11	9.59	9.78	9.49
Boro	10.47	10.74	10.90	10.70
Milan	9.65	9.81	9.98	9.81
Site Mall	8.42	8.78	8.96	8.72
Oises	9.48	9.76	10.00	9.75
Means	9.51	9.83	10.05	

L.S.D: fertilizer = 0.03, genotypes = 0.51, and their overlap = 0.08

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استجابة عدة تراكيب وراثية من حنطة الخبز (*Triticum aestivum* L.) لمستويات مختلفة من الرش بأوكسيد البوتاسيوم

داود سلمان مدب العبيدي ومحمد صباح سليمان العزاوي

قسم المحاصيل الحقلية– كلية الزراعة– جامعة تكريت – العراق

المستخلص

إجريت هذه الدراسة في أحد حقول ناحية العلم في محافظة صلاح الدين التي تبعد 10 كم. شرق جامعة تكريت، خلال الموسم الزراعي (2018-2019)، وفق تصميم القطاعات العشوائية الكاملة وبثلاث مكررات وبنظام الألواح المنشقة، أحتلت فيها مستويات رش البوتاسيوم الألواح الرئيسية، و14 تركيبا وراثيا من حنطة الخبز كانت في الألواح الثانوية. وتم تنفيذ المعاملات في مرحلتي البطان والتزهير، وتم دراسة الصفات: ارتفاع النبات (سم) و مساحة ورقة العلم (سم^2) و عدد السنابل.م$^{-2}$ و عدد الحبوب في السنبلة و وزن 1000 حبة و حاصل الحبوب (طن.هـ$^{-1}$) ونسبة البروتين في الحبوب (%).

أظهرت مستويات الرش بالبوتاسيوم والتراكيب الوراثية وتداخلهما معا اختلافات معنوية في اغلب الصفات المدروسة عند مستوى احتمال 1% و 5% حيث تفوق المستوى الثالث من الرش بأوكسيد البوتاسيوم معنويا في صفات ارتفاع النبات 95.03 (سم)، مساحة ورقة العلم 57.50(سم^2) , وزن 1000 حبة 43.92 (غم) , حاصل الحبوب 5.27(طن.هـ$^{-1}$) ونسبة البروتين 11.65(%). وكان أفضل تداخل معنوي للتركيب الوراثي اباء99 مع المستوى الثالث من السماد البوتاسي في صفة ارتفاع النبات 101.93 (سم) و نسبة البروتين في الحبوب 11.93 (%), كذلك تفوق التركيب الوراثي هضاب مع المستوى الثاني من السماد البوتاسي في صفة عدد الحبوب بالسنبلة 50.93 و التركيب الوراثي بورو في نفس الصفة مع المستوى الثالث حيث اعطى 49.43 حبة/سنبلة$^{-1}$. وسجل المستوى الأول (بدون رش) اقل متوسط للصفات المدروسة جميعها.

الكلمات المفتوحة : حنطة الخبز ، اوكسيد البوتاسيوم , الرش.