RESPONSE OF SEVERAL SORGHUM VARIETIES TO POTASSIUM FOLIAR.

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ABSTRACT

A field experiment was conducted at the fields of Agriculture College , Anbar University, (alternative site Abu Ghraib) during spring and fall seasons of 2017, to study the effect of soil and foliar application of potassium (140 kg.ha^{-1}, 500, 1000 and 1500 mg-L^{-1}) on growth and yield of three varieties of sorghum (Lelo, Inkath and Ishtar), The experiment was carried out according to the design of (R.C.B.D) and in order of the split arrangement with three replicates. Results shows, the cultivar Ishtar was superior in most studied characters such as plant height and leaf area 148.67, 152.25 cm, 5210, 4767 cm^2.plant^{-1}, in two seasons, respectively. The same cultivar gave the lowest number of days (from planting to 100% flowering), also it gave highest grain yield and highest harvest index which was 81.83 days and 4.93 ton.ha^{-1} and 25.15% respectively in spring season only. While the two varieties Lelo and Ishtar gave the lowest content of proline leaves (2.11 and 0.18 mg.gm^{-1}) in spring and fall seasons respectively. The highest concentration of potassium (1000mg L^{-1}) was superior in plant height, leaf area and grain yield (150.89, 155.78 cm, 5075, 4812 cm^2 plant $^{-1}$, 5.56, and 8.32 ton.ha^{-1}) in two seasons respectively.

Keywords : grain yield , plant height , leaf area , proline
***Part of M.Sc. thesis of the second author**

إستجابة أصناف من الذرة البيضاء للرش بالبوتاسيوم

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المستخلص

نفذت تجربة حقلية في حقول كلية الزراعة – جامعة الأنبار (الموقع البديل – أبوغريب) خلال الموسمين الربيعي والخريفي لعام 2017. بهدف دراسة تأثير الإضافة الأرضية و الرش بالبوتاسيوم (140 كغم k هـ$^{-1}$ و 500 و 1000 و 1500 ملغم k لتر$^{-1}$) في نمو وحاصل ثلاثة أصناف من الذرة البيضاء (ليلو و إنقاذ و عشتار)، أستعمل ترتيب الألواح المنشقة وفق تصميم القطاعات الكاملة المعشاة (R.C.B.D) وبثلاثة مكررات وكانت أهم النتائج: تفوق الصنف عشتار في أغلب الصفات المدروسة كارتفاع النبات والمساحة الورقية (148.67 و 152.25 سم و 5210 و 4767 سم^2 نبات$^{-1}$) وللعروتين بالتتابع، كما أعطى الصنف نفسه أقل عدد أيام من الزراعة حتى 100% تزهير وأعلى حاصل حبوب ودليل الحصاد (81.83 يوماً و 4.93 طن هـ$^{-1}$ و 25.15 % بالتتابع) وللعروة الربيعية فقط. فيما أعطى الصنفين ليلو وعشتار أقل محتوى بروليين في الأوراق بلغ 2.11 و0.18 ملغم غم$^{-1}$ للعروتين الربيعية والخريفية بالتتابع. تفوقت النباتات التي رشت بالتركيز 1000 ملغم k لتر$^{-1}$ في أغلب الصفات المدروسة وأعطى هذا التركيز أعلى متوسط لصفة ارتفاع النبات والمساحة الورقية وحاصل الحبوب بلغ 150.89 و155.78 سم و 5075 و 4812 سم^2 نبات$^{-1}$ و 5.56 و 8.32 طن هـ$^{-1}$ وللعروتين بالتتابع.

الكلمات المفتاحية: حاصل الحبوب، ارتفاع النبات، مساحة ورقية، بروليين
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INTRODUCTION

The sorghum (*Sorghum bicolor* L. Moench) is one of important graminaceae family plants. This crop has been affected by several environmental developments soil salinity, soil fertility, soil minerals and water stress, which have led to the search for high yield crops that resist this conditions that are unsuitable for the cultivation of many field crops such as maize and soybeans. The search for the appropriate variety of these conditions has the greatest role, as the varieties vary in their responsiveness and adaptation to these conditions. In this context, a number of researchers (4,7,15,22,25 and 26) indicated that varieties of sorghum differed significantly among them in many growth characteristics, such as the number of days of planting to 100% flowering, plant height, and leaf area, (10, 20 and 22) show that sorghum varieties differ in the grain yield and harvest index. several researchers (24) showed that the content of the leaves proline differed among sorghum varieties. Chemical fertilizers use has a role that is equivalent to the role of the cultivar. Therefore, the use of potassium fertilizer is very necessary for controlling the opening and closing of the stomata and thus preserving the water of the cell. The use of chemical fertilizer in large quantities when adding to the soil has negative effects on the environment and human as well as high costs, so it is necessary to find ways to reduce those negative impacts, as well as the efficiency of utilization by the plant on the other hand and the lowest economic cost, which contribute to the improvement of growth and increase productivity of the crop. Foliar application is the best way to have these specifications, as well as to meet the needs of plants with macro and micro elements in an easy and economical manner and at critical times, and can be used with the irrigation process when conducting this process sprinkler systems, as well as the advantage of this technology which have no adverse effects on the environment. several researchers found that use foliar application with potassium on the plant has great benefit and it leads to increased chlorophyll concentration in plant leaves and increase protein and sugars creation (2 , 16) , thus improve plant growth and increase of leaves effective periods. Mahdi (21) and Mohammed (22) they found that spraying high concentrations of potassium led to improve many growth characteristics of the sorghum plants and maize as the number of days from planting to 75% flowering and plant height and leaf area and harvest index. While Abdullah (1) indicated that potassium fertilization led to an increase in the yield of grains of sorghum plants. also Asgharipour (12) explained that fertilization with high levels of potassium has reduced the content of leaves proline in sorghum. The objective of this study to investigate response of some sorghum varieties to potassium foliar application

MATERIALS AND METHODS

A field experiment was conducted at experimental farm College of Agriculture, University of Anbar. Abu-Ghraib, Baghdad Iraq during Spring and Fall seasons 2017. To study the effect of foliar application with potassium and comparison with soil addition on growth and yield of several (*Sorghum bicolor* L. Moench) varieties. The layout of the experiment was split plot design with three replicates (11), potassium concentrations (140 $kg.ha^{-1}$,500, 1000, 1500 $mg.L^{-1}$) occupied the main plots, while the cultivars (Lelo, Inkath, Ishtar) occupied the sub-plots. Random samples were taken from the experimental soil at a depth of 30 cm to determine some chemical and physical soil properties. The samples were analyzed in the laboratories of the General Directorate of Agricultural Research - Abu Ghraib (Table 1). The field was divided according to the design and the total experimental units became 36 experimental units with dimensions $3 \times 3m^2$. Each experimental unit contained 6 lines. The distance between the rows 50 cm, and within rows 25 cm . Superphosphate fertilizer (45% P_2O_5) was used with 100 $kg.ha^{-1}$ with field preparation, while nitrogen fertilizer (urea 46% N) was used by 200 $kg.ha^{-1}$ added three times. While the Potassium fertilizer (soil addition) was added with each added with first part of nitrogen fertilizer. Foliar application was carried out in three growth stages, the first at the stage of 8-10 leaf per plant, and the second when the plant reaches 50% flowering. The third batch was carried out at the stage of

100% flowering. The process of spraying was carried out in the early morning, using knapsack sprayer, the holder substance (alzahi) was added to the spray solution to ensure complete wetness of the plant leaves. The Corn stem Borer was treated with liquid diazinon (60%). Using 15-20 ml of the pesticide per 20 liters of water, the first spraying after 25 days of emergence and the second spraying after 15 days of the first spraying.

Table 1. Some physical and chemical properties of experiment soil before planting in the spring and fall seasons of 2017

Charactrs	Values of two seasons		Unit
	Spring season	Fall season	
PH Soil	8.7	8.2	--
PH Water	8.0	8.1	--
E.C (1:1) Soil	2.2	2.4	ds/m
E.C (1:1) Water	4.13	4.15	ds/m
Available N	56.0	59.61	ppm
Available P	12.50	13.42	ppm
Available K	280.0	276.0	ppm
Organic matter O.M	1.74	1.62	%
Sand	7.30	6.20	%
Silt	39.2	40.33	%
Clay	53.5	53.47	%
Texture	Silty clay	Silty clay	--

RESULTS AND DISCUSSION

Number of days to 100 % flowering

Results in Table 2 shows significant differences among varieties in number of days from flowering planting to 100% in the fall season only. Lelo cultivar recorded the lowest period (84.67 days), While Ishtar cultivar took 88.67 days. The difference among genotypes may be due to their genetic nature and this response to environmental conditions during the plant growth period. This result is agreed with results of other researchers (8, 26). Results in the Table 2 refers to the significant difference among potassium concentrations in two seasons. The treatment of (140 kg ha^{-1}) in the spring season and spray with 1500 mg L^{-1} in fall season had the shortest time to reach this stage, (80.89 and 84.00 days) respectively, while spraying with 1000 mg L^{-1} and the soil addition gave longest period to reach this stage of 84.44 and 87.78 days respectively. This is due to the role of potassium in the acceleration and development of growth and maturity of parts of the plant which leds to early flowering. The results in agreement with the results of other researcher (1,13). The results also indicated that the interaction between concentrations of potassium and varieties was significant, this revealed that the sorghum cultivars response differed due to potassium concentration , Inkath genotype when treated with potassium (soil addition 140 kg.ha^{-1}) with concentration 1500 mg L^{-1} gave number of days to reached (79.67 and 80.67 days). Respectively

Table 2. Effect of potassium concentrations in number of days from planting to 100% flowering of three varieties of sorghum in spring and fall seasons 2017

Varieties V	Spring season				Means of varieties	Fall season				Means of varieties
	Potassium concentration (K)					Potassium concentration (K)				
	140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}		140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}	
Lelo	82.67	81.00	82.67	83.33	82.42	86.00	85.33	84.00	83.33	84.67
Inkath	79.67	81.67	86.33	82.67	82.58	88.33	85.67	84.33	80.67	84.75
Ishtar	80.33	80.33	84.33	82.33	81.83	89.00	89.00	88.67	88.00	88.67
Potassium Means	80.89	81.00	84.44	82.78		87.78	86.67	85.67	84.00	

Spring L.S.D 0.05 : K= 2.33 V= N.S
Interaction K*V= 2.71
Fall L.S.D 0.05 : K= 2.29 V= 1.25
Interaction K*V= 2.83

Plant height (cm)

Results in Table 3 shows that Ishtar cultivar had the highest plant height (148.67 and 152.25 cm) in both seasons respectively.

While Lelo had a lower value of this character in the spring season (135.92 cm), in fall season, the cultivar Inkath recorded a lower value (147.42 cm). The variation among varieties in plant height may be due to their different genetic structure,. This results agreed with results of other researcher (4,33), they revealed significant differences among the sorghum varieties in plant height. The results of the same Table shows significant interaction among sorghum cultivars and potassium Spraying with potassium concentration 1000 mg L^{-1} gave the highest mean reached (150.89 and 155.78 cm) respectively, and differed significantly from the rest of the spraying concentrations and the soil addition in fall and spring seasons. The concentration treatment 500 mg L^{-1} in the spring season with soil addition (140 kg ha^{-1}) in the fall season gave the lowest value of plant height reached 135.78 and 144.22 cm respectively. It may be due to the superiority of the concentration of 1000 mg L^{-1}. This is in agreement with the results of Mohammed (22). Also this is consistent with the results of Dawood (14) which indicated that the use of Potassium fertilizer by (4000 mg ha^{-1}) on maize plant resulted in the highest plant height. the interaction between the genotypes and the potassium concentrations had significant effect in the spring season only. The Ishtar cultivar with a concentration of 1000 mg ha^{-1}gave the highest plant height reached 156.67 cm. while the Lelo cultivar gave the lowest plant height at soil fertilizing (140 kg ha^{-1}) which reached 130.33 cm.

Table 3. Effect of potassium concentrations in plant height of three varieties of sorghum in spring and fall seasons 2017

Varieties V	Spring season				Means of varieties	Fall season				Means of varieties
	Potassium concentration (K)					Potassium concentration (K)				
	140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}		140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}	
Lelo	**130.33**	**135.00**	**144.33**	**134.00**	**135.92**	**147.67**	**150.67**	**152.00**	**143.33**	**148.42**
Inkath	**135.67**	**132.67**	**151.67**	**145.33**	**141.33**	**140.00**	**145.00**	**156.33**	**148.33**	**147.42**
Ishtar	**144.67**	**139.67**	**156.67**	**153.67**	**148.67**	**145.00**	**150.00**	**159.00**	**155.00**	**152.25**
Potassium means	**136.89**	**135.78**	**150.89**	**144.33**		**144.22**	**148.56**	**155.78**	**148.89**	

Spring L.S.D 0.05 : K= 5.48 V= 4.18
Interaction K*V= 8.15
Fall L.S.D 0.05 : K= 4.51 V= 3.93
Interaction K*V= N.S

Leaf area (cm^2.$plant^{-1}$)

Results in Table 4 shows that the Ishtar varietiy had a higher leaf area (5201 and 4767 cm^2) in two seasons respectively, while the lowest obtained from Inkath cultivar (4775 and 4505 cm^2) respectively. The reason of the difference among varieties due to their differences in genetic components and response it to environmental conditions. This results in agreement with results of 0ther reseachers (7,24). Results in Table 4 indicate to significant differences in leaf area due to different concentrations of Potassium Fertilizer, The plants under the concentration 1000 mg L^{-1} gave The highest value of this character reached 5075 and 4812 cm^2 , respectively. While the soil fertilizing with potassium (140 kg ha^{-1}) produced the lowest value was 4828 cm^2 $plant^{-1}$ in the spring season only. In the fall season the concentration of 500 mg L^{-1} gave the lowest value 4423 cm^2. The reason of this increase in the surface area of they leaves is due to increase in the absorption of plant leaves for potassium fertilizers and its role in activating the process of photosynthesis and its control it is effect to stomata activity and reducing the loss of water and regulating the osmosis, thus increasing the leaf area (1) who shows that potassium fertilization increased leaf area. Results in Table 4 shows significant difference for interaction between two varieties, this reveal that the response of sorghum cultivars to potassium fertilize differ due to the potassium concentration. The interaction (Ishtar cultivar x 1000 mg L^{-1}) produced highest value of leaf area reached 5185 cm^2, while interaction treatment (Inkath x 500 mg L^{-1}), produced the lowest of leaf area reached 4254 cm^2 $plant^{-1}$.

Table 4. Effect of potassium concentrations in leaf area of three varieties of sorghum in spring and fall seasons 2017

Varieties V	Spring season				Means of varieties	Fall season				Means of varieties
	Potassium concentration (K)					Potassium concentration (K)				
	140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}		140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}	
Lelo	4893	4983	5006	4832	4928	4490	4408	4530	4711	4535
Inkath	4721	4655	4810	4914	4775	4539	4254	4720	4506	4505
Ishtar	4870	5389	5408	5136	5201	4531	4606	5185	4744	4767
Potassium means	4828	5009	5075	4961		4520	4423	4812	4654	

Spring L.S.D 0.05 : K= 137
V= 152 Interaction K*V= N.S
Fall L.S.D 0.05 : K= 263.5V= 136.1
Interaction K*V= 317.1

Grain yield (ton.ha^{-1})

Results in Table 5 shows significant differences among cultivars in grain yield production. Ishtar cultivar produced the highest grain yield (4.93 ton ha^{-1}), in spring season, while the cultivar Inkath had the highest grain yield (7.80 ton ha^{-1}) for the fall season, while the Lilo cultivar produced the lowest mean (4.26 and 7.19 ton ha^{-1}) in both seasons respectively. The differences in this character may due to differences between genetic composition of the genotypes and the environmental conditions differences between the two seasons of the experiment has a significant effect on this character. The superiority of the Ishtar cultivar may be due to its superiority in plant height and leaf area (Tables 3 and 4). This superiority reflected to increase the yield components in this cultivar. This results in agreement with results of (5,7), which indicated significant differences between the sorghum varieties in the grain yield. The results of the same Table showed significant differences among potassium concentrations. The treatment 1000 mg L^{-1} produced the highest means 5.56 and 8.32 ton.ha^{-1} in the spring and fall seasons respectively, while the plants under concentration of potassium 500 mg L^{-1} produced the lowest means of this character 3.76 ton ha^{-1} in spring season, while the soil fertilizing (140 kg ha^{-1}) gave the lowest value of grain yield (6.16 ton ha^{-1}) in the fall season. the use of potassium fertilizer without fixation in soil as in the soil addition led to increased utilization by the plant, which has the role of increasing the leaf area and the activation of many enzymes, which led to a direct increase of the plant height and leaf area (Tables 3 and 4) thus causes grain yield increases . This is in agreement with results of authors (19, 23) who have showed in their study that the grain yield has increased with increasing the potassium fertilization and different doses, whether in the process of foliar application or soil fertilization. The results of Table 5 shows significant differences between the interaction of the study factors (varieties and potassium concentrations). The treatment of Ishtar with 1000 mg L^{-1} produced the highest mean (7.13 and 8.77 ton ha^{-1}) in spring and fall seasons respectively, while the Inkath cultivar with 500 mg L^{-1} gave the lowest values 3.40 ton ha^{-1} in spring season, while the Lelo cultivar with the soil addition (140 kg ha^{-1}) gave lowest value of this character reached 5.66 ton ha^{-1} in the fall season.

Table 5. Effect of potassium concentrations in grain yield (ton ha^{-1}) of three varieties of sorghum in spring and fall seasons 2017

Varieties V	Spring season Potassium concentration (K) 140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}	Means of varieties	Fall season Potassium concentration (K) 140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}	Means of varieties
Lelo	3.78	4.00	4.52	4.74	4.26	5.66	8.10	7.44	7.54	7.19
Inkath	3.85	3.40	5.04	4.97	4.31	6.60	8.14	8.76	7.69	7.80
Ishtar	4.44	3.88	7.13	4.28	4.93	6.22	7.48	8.77	7.98	7.61
Potassium Means	4.02	3.76	5.56	4.66		6.16	7.91	8.32	7.74	

Spring L.S.D 0.05 : K= 0.66 V= 0.50 Interaction K*V= 0.97==Fall L.S.D 0.05 : K= 0.85 V= 0.35 Interaction K*V= 0.95

Harvest index (%)

Results in Table 6 shows that the varieties did not differed significantly in harvest index in the spring season, while significant differences were found in fall season. The Inkath cultivar was superior in harvest index in the fall season (35.98%). The lowest harvest index was 32.93% obtained from lelo cultivar. The superiority of the inkath cultivar may be for its superiority in grain yield (Table 5).Wahib (27) indicated that the harvest index is increased by increasing the grain yield. This results in agreement with the results of other researcher (2,4), which indicating to significant differences between the sorghum varieties in the harvesting index. Potassium fertilization levels were significantly differed in both seasons. Potassium spraying concentrations 1000 and 500 mg L^{-1} produced highest values in harvest index reached (28.06 and 37.75%) respectively in the spring and fall seasons, while the concentration 500 mg L^{-1} and soil fertilizing (140 kg ha^{-1}), gave lowest values (21.00 and 29.20%) in both season respectively, the superiority of concentration 1000mg L^{-1} may be due to its superiority in grain yield (Table 5). This result in agreement with the results of the study indicated by other researcher (1,18), that the increase in potassium fertilizers led to increases in the values of the harvest index. The results showed that there was a significant effect between the two study factors (interaction treatments, varieties and potassium fertilization) in the harvest index and in the spring season only. The ishtar cultivar with potassium level 1000 mg L^{-1} gave the highest mean of harvest index reached 32.51% ,while the interaction treatment inkath with concentration 500 mg L^{-1} gave lowest value of harvest index was 18.72%.

Table 6. Effect of potassium concentrations in harvest index of three varieties of sorghum in spring and fall seasons 2017

Varieties V	Spring season Potassium concentration (K) 140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}	Means of varieties	Fall season Potassium concentration (K) 140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}	Means of varieties
Lelo	20.40	21.26	23.69	25.38	22.68	26.28	35.86	34.34	35.23	32.93
Inkath	20.75	18.72	27.98	27.61	23.76	29.65	41.03	36.78	36.45	35.98
Ishtar	23.20	23.02	32.51	21.87	25.15	31.66	36.38	34.53	36.71	34.82
Potassium Means	21.45	21.00	28.06	24.95		29.20	37.75	35.22	36.13	

Spring L.S.D 0.05 : K= 3.10 V= N.S Interaction K*V= 4.96

Fall L.S.D 0.05 : K= 2.80 V= 2.41 Interaction K*V= N.S

Leaves content of proline (mg.gm^{-1})

Results in Table 7 shows that the varieties differed significantly in their proline content of the leaves. The Lelo variety had the lowest leaves content of proline reached (2.11 mg gm^{-1}) in the spring season, while the Ishtar variety gave the lowest content of leaves proline which was 0.18 mg.gm^{-1} in the fall season. Ishtar variety recorded the highest value of this character (2.45 mg gm^{-1}) in the spring season, while the Lelo variety produced plants with leave highest content of proline 0.52 mg

gm^{-1} in the fall season. The difference between genotypes may be attributed to different genetic characters, as well as differences in susceptibility of genotypes in response to environmental conditions and temperature changes between the two seasons of the experiment. These results in agreement with the results of Abood and Al-lahham (3,9), which indicated to significant differences between the sorghum varieties in their proline content. The results of the same table indicate that there are significant differences between the treatments of potassium concentrations in the content of proline in the leaves, the treatment of potassium spraying 1500 mg L^{-1} gave the lowest content of the leaves proline reached 2.06 and 0.12 $mg.kg^{-1}$ in the spring and fall seasons respectively, The treatment of soil fertilizing (140 kg ha^{-1}) gave the highest mean of this character reached 2.51 and 0.47 mg kg^{-1} in both seasons. The increase in potassium fertilization led to an increase in plant height and leaf area (Tables 3 and 4) and improving plant photosynthesis. These results in agreement with the results of Al-hujairy and Asghripour (6,12) they concluded that the increasing in potassium fertilization decreases the proline content in sorghum and wheat crop plants. The results of the same Table shows significant differences between the study factors (interaction treatments) in the content of the proline leaves. The Lelo variety with the highest concentration of potassium fertilizers 1500 mg L^{-1} gave the lowest content of leaves proline reached (1.41 mg kg^{-1}) in the spring season. The same variety Lelo with concentration of 500 mg L^{-1} gave the lowest content of proline reached 0.02 mg kg^{-1} in the fall season. while the treatment of the comparison (soil fertilizing with Inkath cultivar (140 kg ha^{-1}) gave the highest content of leaves proline which was 3 40 mg kg^{-1} in the spring season, while the Lelo variety at the same concentration had the highest content of proline in the leaves reached 1.20 mg kg^{-1} in fall season

Table 7. Effect of potassium concentrations in leaves content of proline of three varieties of sorghum in spring and fall seasons 2017

Varieties V	Spring season				Means of varieties	Fall season				Means of varieties
	Potassium concentration (K)					Potassium concentration (K)				
	140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}		140 Kg ha^{-1}	500 Mg L^{-1}	1000 Mg L^{-1}	1500 Mg L^{-1}	
Lelo	**2.29**	**2.50**	**2.22**	**1.41**	**2.11**	**1.20**	**0.02**	**0.73**	**0.14**	**0.52**
Inkath	**3.40**	**2.22**	**2.27**	**1.71**	**2.40**	**0.14**	**0.48**	**0.66**	**0.17**	**0.21**
Ishtar	**1.84**	**2.13**	**2.76**	**3.05**	**2.45**	**0.07**	**0.56**	**0.05**	**0.04**	**0.18**
Potassium Means	**2.51**	**2.28**	**2.41**	**2.06**		**0.47**	**0.35**	**0.28**	**0.12**	

Spring L.S.D 0.05 : K= 0.22
V= 0.33 Interaction K*
V= 0.57 Fall L.S.D 0.05 : K= 0.09
V= 0.05 Interaction K*V= 0.12

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