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SUMMARY

Two field experiments were carried out at Shandaweel Research Station, Sohag Governorate (A.R.C.) in the two successive seasons of 2004/2005 and 2005/2006 to study the response of sugarcane grown under levels of water stress to nitrogen and potassium fertilization under Upper Egypt conditions.

Every field trial included 24 treatments represent the combination between four irrigation regimes (applying irrigation at 0.6, 0.8, 1.0 and 1.2 cumulative pan evaporation) and six levels of (nitrogen + potassium) fertilizer (160+48, 180+48, 200+48, 160+96, 180+96 and 200+96 kg $N+K_2O$/fed).

A split- plot design with four replications was used in both growing seasons. Irrigation treatments were allocated randomly in the main plots. Nitrogen + Potassium levels were randomly distributed in the sub plots. The experimental unit area was 21 m^2 with 6 ridges of 3.5 meters in length and 1.0 m apart.

Sugarcane variety, i.e., Ph. 8013 was planted on 8^{th} March in the first season and 12^{th} March in the second season and harvested after 12 months from sowing in both experiments.

The obtained results could be summarized as follows:

1.Effect of irrigation regime, (nitrogen + potassium) fertilization and their interaction on growth characters.

1. Number of plants/m:

The results cleared that irrigation sugarcane plant at 0.6 CPE almost attained the highest values of plants/m^2 at ages of 60, 90 and 120 days in the 1st and 120 days in the second seasons, while irrigation sugarcane plant at 1.0 CPE attained the highest values of plants/m^2 in the second seasons at age 60 and 90 days

Concerning the effect of (nitrogen + potassium) fertilization on the number of plants/m significant effect on this trait, except at 60 days in the first season only.

Number of plants/m^2 was significantly affected by the interaction between irrigation regimes and (nitrogen + potassium) fertilization at age of 90 and 120 days in the first season and 60, 90 and 120 days in the second season,.

2. Stalk height:

Application water to sugarcane plant at 1.2 CPE attained a relative increase in the stalk height, this effect was significant in the stages of growth (165, 210 and 300 days in 1st season and 165, 210, 255 and 300 day in 2nd season. However, irrigation regime at 0.6 CPE attained the lowest value in stalk height in both seasons.

Stalk height was significantly affected by (nitrogen + potassium) fertilization in the two seasons at the various growth stages.

Stalk height was significantly influenced by the interaction between irrigation regime and (nitrogen + potassium) fertilization in the second seasone only, while in the first season this effect was significant at 210 days from planting only.

3. Stalk diameter:

The results cleared that the differences in stalk diameter among the tested irrigation regimes were significant in the two seasons stalk diameter significantly affected by the applied dose of (nitrogen + potassium) fertilization in the 1st and 2nd seasons.

Stalk diameter was significantly affected by the applied dose of (nitrogen + potassium) fertilization in the 1st and 2nd seasons.

Stalk diameter was significantly affected by the interaction between irrigation reigme and (nitrogen + potassium) fertilization at the different growth stages in both seasons, except at 255 days in the first season.

4. Total soluble solids percentage (TSS%):

The results cleared that total soluble solids percentage was increased with increasing both plant age and irrigation intervals in both seasons, this effect was significant at the four sampling dates (210, 240, 270 and 300 days after planting) in both seasons. Applying irrigation to sugarcane at 0.6 CPE significantly recorded higher value of TSS% compared with the other studied irrigation regimes.

The results showed that TSS% was significantly affected by N+ K_2O levels at the periods of growth in the 1st and 2nd seasons. It was noticed that applying nitrogen + potassium fertilizer at rate of 200 kg N/fed + 96 kg K_2O /fed gave the highest values of TSS% at different growth ages, i.e., 210, 240, 270 and 300 days, in both seasons.

The effect of interaction between irrigation intervals and (nitrogen + potassium) fertilization level on total soluble solids percentage at four growth periods in both seasons was significant at all growth periods in both

seasons, except at 270 days after planting in the first season. Irrigation at 0.6 with applying (nitrogen + potassium) fertilization level at rate of 200 kg N/fed + 96 kg K_2O /fed gave the highest values of TSS%.

II. Effect of irrigation regime, (nitrogen + potassium) fertilization and their interactions on Juice quality.

1. Brix percentage:

The results indicated that irrigation regimes significantly influenced on brix% in both seasons. Irrigation sugarcane plants at 0.6 CPE caused a significant increase in brix percentage, while applying water at 1.2 CPE intervals recorded the lowest values of this trait in both seasons.

Nitrogen + Potassium fertilization significantly affected on brix percentage in both seasons. The results showed that brix percentage responded positively and gradually to the increase in the applied doses of (nitrogen + potassium) in the two seasons.

Brix percentage was significantly affected by the interaction between irrigation regimes and nitrogen + potassium fertilization in the second season only.

2. Sucrose percentage:

The results indicated that irrigation regimes significantly influenced sucrose percentage in both seasons, irrigation sugarcane plants at 0.6 CPE caused a significant increase in sucrose percentage in both seasons, while applying water at 1.2 CPE recorded the lowest values of this trait in both seasons.

Data showed that sucrose percentage positively and gradually responded to the increase in the applied doses of nitrogen + potassium fertilization in the two growing seasons.

Data showed that the interaction effect between irrigation regime and nitrogen + potassium fertilization level on sucrose percentage in the juice was significant in both seasons. Irrigation at (0.6 CPE) with 200 kg N/fed + 96 kg K_2O /fed.) gave the highest values of sucrose percentage (18.28 and 18.84%), while irrigation at 1.2 and 1.0 CPE with 160 kg N/fed + 48 kg K_2O /fed obtained the lowest value of sucrose percentage (16.67 and 16.73 %) in the first and second seasons, respectively.

3. Purity percentage:

The results cleared that the differences due to the studied irrigation regimes the purity percentage of sugarcane juice at harvest in the two seasons were significant.

Increasing nitrogen + potassium fertilization level caused a relative increase in purity % in the two growing seasons, this effect was significant in both season.

The results show that the interaction effect between irrigation regime and potassium + nitrogen fertilization level was significant on purity percentage in the second season only.

4. Sugar recovery percentage (S.R.%):

The results revealed that there was a gradual increase in the values of (S.R%) by increasing the irrigation intervals up to 0.6 CPE in both season.

Increasing nitrogen + potassium fertilization level significantly increased SR% in the 1^{st} and 2^{nd} seasons.

Sugar recovery percentage was significantly affected by the interaction between irrigation regimes and nitrogen + potassium fertilization application in the second season only.

5. Fiber percentage of sugarcane stalk:

The results showed that irrigation at 1.2 CPE recorded the lowest values of fiber percentage in the two season.

It was found that the highest level of nitrogen + potassium fertilization gave the lowest fiber percentage, while (160 kg N/fed + 48 kg K_2O/fed) increased significantly fiber percentage. This result was true in both seasons.

The results of both growing seasons showed that fiber percentage of cane stalks was insignificantly affected by the interaction between irrigation regime and nitrogen + potassium fertilization.

III. Effect of irrigation regime, (nitrogen + potassium) fertilization and their interactions on yield and yield components.

1. Stalk length:

The results cleared that stalk length was significantly affected by the studied irrigation regimes in both seasons. Short irrigation interval at (1.2 CPE.) caused a relative increase in the values of stalk height, while prolonging irrigation interval (0.6 CPE.) caused a relative decrease in the values of stalk height.

Nitrogen + Potassium fertilization level attained a positive and significant effect on stalk height in both seasons.

The results showed that the interaction effect between irrigation regimes and nitrogen + potassium fertilization level was significant in both

seasons. Fertilizing sugar cane with 200 kg N/fed + 96 kg K_2O/fed and irrigating at 1.0 and 1.2 CPE produced the tallest sugar cane stalks in the 1st and 2nd seasons.

2. Stalk diameter:

The results obtained that the differences in this trait among the studied irrigation regimes were significant in both seasons.

Potassium + nitrogen fertilization levels had significant effect on stalk diameter in both seasons.

The results showed that stalk diameter was significantly affected by the interaction between irrigation regimes and nitrogen + potassium fertilization application in both seasons.

3. Number of internodes/stalk:

The results pointed out that the difference in this trait amonges the studied irrigation regimes was significant in both seasons. Irrigation interval (1.2 CPE) caused a relative increase in the number of internodes/stalk. While prolonging irrigation interval (0.6 CPE) caused a decreased relative in the number of internodes/stalk.

Data showed that increasing nitrogen + potassium fertilization level caused a relative increase in internodes/stalk in the two growing seasons, this effect was significant in both season.

The number of internodes/stalk significantly responded to the interaction between irrigation regimes and nitrogen + potassium fertilization in the 1st season only.

4. Stalk weight/plant:

The results showed that shortening irrigation interval (1.2 CPE) caused a positive and significant increase in the values of stalk weight/plant. in both seasons, while irrigation at 0.6 CPE caused a relative decrease in the values of stalk weight/plant in the 1st and 2nd season, respectively.

Sugarcane stalk weight was positively and significantly responded to the applied doses of nitrogen + potassium fertilization levels.

The results showed that stalk weight/plant was significantly affected by the interaction between irrigation regimes and nitrogen + potassium fertilization in both seasons.

5. Top yield:

The results cleared that the differences in top yield among the studied irrigation regimes were significant in both seasons. Shortening irrigation interval (1.2 CPE) caused a relative increase in the values of top yield in both seasons.

Potassium + nitrogen fertilization levels had a positive and significant effect on top yield in both seasons.

Top yield significantly affected by the interaction between irrigation regime and nitrogen + potassium fertilizer in the second season.

6. Number of millable cane/fed:

The results obtained cleared that the differences in this trait among the studied irrigation regimes were significant in both season. However, the highest number of millable cane per feddan was obtained with irrigation at 1.2 CPE in both seasons.

Increasing the applied doses of nitrogen + potassium fertilizer significantly improved number of millable cane/fed in both seasons.

The number of millable cane was significantly affected by the interaction between irrigation regime x nitrogen + potassium fertilizer in both seasons.

7. Cane yield:

The results indicate that the differences in cane yield among the studied irrigation regimes were significant in both seasons, shortening irrigation interval (1.2 CPE) caused a relative increase in the values of cane yield in both seasons.

Nitrogen + potassium fertilizer level had a positive effect on cane yield in both seasons.

Cane yield was not significantly affected by the interaction between irrigation regime interval and nitrogen + potassium fertilizer levels in both seasons.

8. Sugar yield:

The results cleared that the differences in sugar yield among the studied irrigation regimes, were significant in both seasons. Shortening irrigation interval (1.2 CPE) caused a relative increase in sugar yield per feddan in both seasons.

There was a positive response on sugar yield due to nitrogen + potassium fertilizer application in both seasons.

The results showed that the interaction effect between irrigation regime and nitrogen + potassium fertilizer on sugar yield was significant in the second season and insignificant in the first season.

IV. Effect of irrigation regime, (nitrogen + potassium) fertilization and their interactions on water relations:

1. Water consumptive use (CU):

The results showed that applying irrigation at 1.2 CPE recorded the highest seasonal CU (7829 and 8066 m^3/fed) in the 1st and 2nd season, respectively. The results also pointed out that the fourth irrigation regime (applying water at 1.2 CPE) increased water consumptive use by 1084 m^3/fed (13.84%), 2019 m^3/fed (25.79%) and 3118 m^3/fed (39.83%) compared to the three irrigation regimes (applying water at 1.0, 0.8 and 0.6 CPE) in the 1st season, corresponding to 1069 m^3/fed (13.25%), 1923 m^3/fed (23.84%) and 3002 m^3/fed (37.22%), in the 2nd season respectively.

The results indicated a gradual increase in CU as K_2O + N-level increased kg /fed in both seasons. The highest value of CU (6413 and 6753 m^3/fed) was obtained by applying (200 kg N/fed + 48 kg K_2O /fed) in the 1st and second seasons, respectively.

The results showed that the maximum CU (7941 and 8240 m^3/fed) was recorded by applied with applying (200 kg N/fed + 48 kg K_2O /fed and irrigation at 1.2 CPE, in the 1st and 2nd seasons, respectively, while the minimum CU (4697 and 5005 m^3/fed) was recorded by applying (160 kg N/fed + 48 kg K_2O /fed and irrigation at 0.6 CPE, in the 1st and 2nd seasons, respectively.

2. Water Use Efficiency (WUE) on cane yield basis:

The results showed that the highest value of WUE (10.76 kg cane stalks/m^3 water) was obtained when irrigation was applied at 0.6 CPE in both seasons.

Increasing nitrogen + potassium fertilizer given to sugarcane plants from 160 + 48 to 200 + 48 or 160 + 96 to 200 + 96 kg N + K_2O /fed caused a gradual increased in the values of WUE in the 2nd season. Meanwhile, the obtained values of WUE were approximately equal (8.57 and 8.54 kg cane stalks/m^3 water) when sugarcane was fertilized with 180 + 48 and 200 + 48 kg N + K_2O /fed, in the 1st season.

The maximum value of WUE (11.13 and 10.41) was obtained by irrigation at 0.6 CPE and fertilized with 180 + 96 kg N + K_2O /fed in the 1st and 2nd season, respectively.

3. Water Use Efficiency (WUE) on sugar yield basis:

The results showed that the highest value of WUE (1.270 kg sugar/m^3 water) was obtained when irrigation was applied at 0.6 CPE, while the lowest WUE was recorded with irrigation at 1.2 CPE in both seasons.

The highest value of WUE (1.030 and 1.030 kg sugar/m^3 water) was obtained by applying 180 + 96 and 200 + 96 kg N + K_2O /fed in the 1st and 2nd seasons, respectively,

The maximum value of WUE (1.30 and 1.25) was obtained by irrigation at 0.6 CPE and fertilized with 200 + 96 kg N + K_2O /fed (in the 1st and 2nd season, respectively.