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## SUMMARY

Two field experiments were carried out at Shandaweel Research Station (Sohag Governorate,) during the growing seasons 2007/2008 and 2008/2009, to study the effect of time applying first post planting irrigation, potassium levels and withholding irrigation before harvesting as well as their interactions on growth, yield and quality of sugar cane as well as water relationships with economic evaluation on two plant crops.

Every field trail included twenty-seven treatments represented the combination between three times for the first post planting irrigations and three potassium levels as well as three withholding irrigations period before harvesting.

Randomized Complete Block design (R.C.B.D.) with four replicates was used in both seasons. Treatments were arranged as split-split plot design. The first post planting irrigation treatments were allocated in main plots, withholding irrigation before harvesting treatments were distributed in the sub plots while potassium fertilizer levels were randomly occupied in the sub-sub plots. The commercial sugar cane variety of G.T. 54-9 (*Saccharum ssp. L.*) planted during the first week of March in both seasons.

### **I. Effect of time of applying first post planting irrigation, potassium levels and their interaction on growth traits.**

#### **1. Stalk height (cm.):**

The results showed that stalk height (cm.) was significant with increasing the time of applying the first post planting irrigation in all ages in both seasons. Applying the first post planting irrigation after 7 days from planting gave the highest plants in all ages in both seasons.

Data cleared that the stalk height (cm.) was increased significantly with increasing K levels in all ages in both seasons. At these mentioned ages 48 kg K<sub>2</sub>O/fed. gave the highest plants.

### **2. Stalk diameter (cm.):**

Results cleared that the stalk diameter (cm.) was increased significantly with delaying the time of applying the first post planting irrigation in all ages in both seasons.

Data cleared that stalk diameter (cm) was increased significantly with increasing K levels in all ages in both seasons. Using 48 kg K<sub>2</sub>O/fed. gave the highest stalk diameter all ages in both seasons.

### **3. Total soluble solids (T.S.S %):**

The results cleared that the effect of time applying the first post planting irrigation on total soluble solids (T.S.S %) was significant at all three sampling dates in both seasons, expect at 210 days in the first season. Total soluble solids (T.S.S %) was increased with delaying the time of applying the first post planting irrigation in all ages in both seasons.

Total soluble solids (T.S.S %) was increased significantly with increasing K levels in all ages in both seasons.

The effect of interaction between the time of applying first post planting irrigation and potassium levels it was significant in at 240 days in the first season as well as at 210 days in the second season.

## **II. Effect of time applying first post planting irrigation, withholding irrigation, potassium levels and their interactions on harvesting studies:**

### **A. Yield and its components:**

#### **1. Stalk height (cm):**

Data indicated that the stalk height (cm.) was decreased significantly with delaying the time of applying the first post planting irrigation in both seasons.

Results distinctly showed that stalk height (cm.) significantly increased with delaying withholding irrigation in both season.

Data cleared that stalk height (cm.) was significantly increased with increasing K levels in both seasons.

All types of the interactions were insignificant, except withholding irrigation and potassium levels in the second season only.

#### **2. Stalk diameter (cm):**

Data showed that the stalk diameter (cm) was increased significantly with delaying the time of applying the first post planting irrigation in both seasons.

Results Data showed that stalk diameter (cm) increased significantly with decreased withholding irrigation in both season.

#### **3. Number of green leaves/plant:**

The results indicated that number of green leaves/plant at harvest was decreased with increasing time of applying first post planting irrigation in both seasons.

Data showed that the number of green leaves/plant was increased significantly with delaying withholding irrigation decreased in both season.

Results indicated a significant effect of potassium on number of green leaves/plant, using 48 kg K<sub>2</sub>O/fed produced the highest values of number of green leaves/plant in both seasons.

#### **5. Number of internodes/plant:**

Data showed that the number of internodes/plant was decreased significantly with delaying the time of applying the first post planting irrigation in both seasons.

The number of internodes/plant was significantly increased as withholding irrigation decreased in both seasons.

Increasing potassium levels from zero to 48 kg K<sub>2</sub>O/fed significantly increased number of internodes/plant, using 48 Kg K<sub>2</sub>O/fed produced the highest values of number of internodes/plant in both seasons.

#### **4. Leaf area (cm<sup>2</sup>):**

Data clearly showed that the leaf area (cm<sup>2</sup>) was significantly affected by time of applying first post planting irrigation at harvest, the highest values in seasons were obtained when applying the first post planting irrigation after 7 days from planting in both seasons.

Data showed that the leaf area (cm<sup>2</sup>) was significantly decreased with delaying withholding irrigation, withholding irrigation at 30 days before harvesting gave the highest values of leaf area (cm<sup>2</sup>) in both seasons.

Data cleared that the leaf area (cm<sup>2</sup>) was significant increased with increasing K levels, using 48 kg K<sub>2</sub>O/fed produced the highest values in both seasons.

#### **6. Stalk fresh weight (kg):**

Data showed that the stalk fresh weight (kg) was decreased significantly with delaying the time of applying the first post planting

irrigation, the highest values were obtained when applying the first post planting irrigation after 7 days from planting in both seasons.

The stalk fresh weight (kg) was significantly increased as withholding irrigation decreased in both seasons.

Increasing potassium levels from zero to 48 kg K<sub>2</sub>O/fed significantly increased stalk fresh weight (kg), using 48 Kg K<sub>2</sub>O/fed produced the highest values of stalk fresh weight (kg) in both seasons.

The interaction effect between time of applying first post planting irrigation and withholding irrigation on stalk fresh weight (kg) was significant, the highest value of stalk fresh weight (kg) was obtained from applying first post planting irrigation at 7 days and withholding irrigation at 30 days before harvesting in both seasons.

The interaction among the three studied factors on stalk fresh weight (kg) was significant in both seasons. The maximum stalk fresh weight (kg) was recorded by applying first post planting irrigation at 21 days at rate 48 kg K<sub>2</sub>O/fed. and with withholding irrigation at 30 days before harvesting in both seasons.

### **7. Number of millable cane (thousand/fed.):**

The results showed that applying the first post planting irrigation after 21 days increased significantly number of millable cane (thousand/fed.) compared with 7 and 14 days in the both seasons.

Data cleared that the increasing number of days withholding irrigation before harvesting at 30 up 60 days decreased number of millable cane (thousand/fed.) in both seasons.

Data cleared that the number of millable cane was significantly increased with increasing K levels, using 48 Kg K<sub>2</sub>O/fed produced the highest values in both seasons.

The interaction effect between the time of applying first post planting irrigation and potassium levels on number of millable cane/fed. was significant in both seasons.

### **8. Top yield (ton/fed.):**

Results revealed that time applying the first post planting irrigation on top yield (ton/fed.) was significant in both seasons. Application the first post planting irrigation at 21 days increased top yield ton/fed. in both season.

Data clear that decreasing number of days withholding irrigation before harvesting from 60 to 30 days increased significantly top yield ton/fed. in both seasons.

Regarding the effect of potassium levels on top yield (ton/fed.) it was significant in both seasons. Data show that the highest values in both seasons was obtained from using 48 kg K<sub>2</sub>O/fed).

The interaction effect between the time of applying first post planting irrigation and potassium levels on top yield (ton/fed.) was significant in the second season only. The interaction effect between withholding irrigation and potassium levels on top yield (ton/fed.) was significant in both seasons. Top yield (ton/fed.) was significantly influenced by the interaction among the three studied factors in both seasons. The highest values of top yield were obtained from applying first post planting irrigation at 21days with withholding irrigation at 30 days before harvesting with 48 kg K<sub>2</sub>O/fed.

### **7. Cane yield (ton/fed.):**

Data showed that the cane yield (ton/fed.) was increased significantly with delaying the time of applying the first post planting irrigation, the highest values (58.98 and 62.88 ton/fed) in the 1<sup>st</sup> and 2nd seasons, respectively, were obtained when applying the first post planting irrigation after 21 days from planting.

Using withholding irrigation at 30 days before harvesting increased significantly cane yield ton/fed in both seasons, compared to applying withholding irrigation at 60 and 45 days before harvesting.

Results showed clearly that increasing potassium levels up to 48 kg K<sub>2</sub>O/fed. led to significant increase cane yield per feddan, using 48 kg K<sub>2</sub>O/fed increased cane yield ton/fed in both seasons, compared to zero level and 24 kg K<sub>2</sub>O/fed.

The interaction effect between the time of first post planting irrigation and withholding irrigation on cane yield (ton/fed.) was significant in both seasons. The interaction effect between of time first post planting irrigation and potassium levels on cane yield (ton/fed.) was significant in both seasons. The interaction effect between of withholding irrigation and potassium levels on cane yield (ton/fed.) was significant in both seasons. The interaction among the three studied factors on cane yield (ton/fed.) was significant in the first season only. The maximum cane yield ton/fed 68.47 was recorded by applying the first post planting irrigation at 21 days at rate 48 kg K<sub>2</sub>O/fed. and with withholding irrigation at 30 days before harvesting.

### **8. Sugar yield (ton/fed.):**

The results cleared applying the first post planting irrigation at 7 days after planting increased significantly sugar yield per feddan in the first season, while in the second season applying first post planting irrigation at 21 days after planting gave the highest values .

Concerning the effect of withholding irrigation on sugar yield (ton/fed.) at harvest was significant, irrigation (withholding irrigation at 30 days before harvesting) caused a relative increase in sugar yield ton/fed. in both seasons.



Results distinctly showed that there was a positive response on sugar yield (ton/fed.) due to potassium application. Increasing the applied dose of potassium levels from zero up to 48 kg K<sub>2</sub>O/fed. gradually increased sugar yield (ton/fed.) in both seasons.

The results indicated a significant interaction effect between the time of applying first post planting irrigation and withholding irrigation on sugar yield (ton/fed.) in both seasons. The interaction effect between the time of applying first post planting irrigation and potassium levels on sugar yield (ton/fed.) was significant in both seasons.

## **B. Quality and chemical traits:**

### **1. Brix percentage:**

The results indicated that the effect of time applying the first post planting irrigation did not significantly influence on brix% in both seasons.

Data cleared that the brix% was significantly increased with delaying withholding irrigation in both season. Withholding irrigation at 60 days before harvesting gave the highest values of brix percentage in both seasons.

The results showed that the brix percentage responded positively and gradually to the increase in the applied doses of potassium levels up to 48 kg K<sub>2</sub>O/fed in both seasons. 48 kg K<sub>2</sub>O/fed produced the highest values in both seasons.

### **2. Sucrose percentage:**

Results showed that the time of applying first post planting irrigation significantly affected on sucrose percentage in juice in the first season only. sucrose% increased with decreased time of applying first post planting irrigation.

The results obtained that the withholding irrigation at 60 days before harvesting caused a relative and significant increase in the values of sucrose

percentage in both seasons. Withholding irrigation at 60 days before harvesting increased sucrose percentage in both seasons.

Data distinctly showed that the sucrose percentage positively and gradually responded to the applied potassium levels up to 48 kg K<sub>2</sub>O/fed. in both seasons. 48 kg K<sub>2</sub>O/fed produced the highest values of sucrose percentage in both seasons.

All types of the interaction were insignificant, except, the interaction effect between time of applying first post planting irrigation and withholding irrigation on sucrose% in both seasons.

### **3. Purity percentage:**

Results show that the first post planting irrigation interval affected the purity percentage in the juice of sugarcane, but the effect was not so great enough to reach the level of significant in the second season.

Data cleared that purity percentage significantly increased with delaying withholding irrigation.

The results cleared that the purity percentage was significantly increased with increasing K levels in both seasons. 48 kg K<sub>2</sub>O/fed produced the highest values both seasons.

### **4. Fiber percentage:**

The results showed that the fiber percentage in stalk was significantly affected by first post planting irrigation in the second season only.

Concerning the effect of withholding irrigation on fiber% was significant, withholding irrigation at 30 days before harvesting gave the lowest values of fiber percentage in both seasons.

Fiber percentage in cane stalk was significantly affected by the levels of potassium, raising doses of potassium from zero to 48 kg K<sub>2</sub>O/fed. decreased fiber percentage in both seasons.

**5. Sugar recovery percentage:**

The results showed that first post planting irrigation at 7 days after planting relative and significant in the values of sugar recovery percentage in the first season only. Applying the first post planting at 7 days after planting gave the highest value of sugar recovery percentage.

Data distinctly showed that the sugar recovery percentage was positively and gradually responded to withholding irrigation in the two growing seasons. Withholding irrigation at 60 days before harvesting gave the highest values of sugar recovery percentage in both seasons.

Data distinctly showed that potassium fertilizer levels had a positive effect on sugar recovery percentage in both seasons. Increasing the applied potassium fertilizer from zero up to 48 kg K<sub>2</sub>O/fed. increased sugar recovery percentage.

The interaction effect between the time of applying first post planting irrigation and withholding irrigation on sugar recovery percentage was significant in both seasons.

**6. Reducing sugars percentage:**

The results indicated that time of applying the first post planting irrigation on reducing sugars% at harvest was significant in the first season only.

Data cleared that the reducing sugars% was significantly decreased with delaying withholding irrigation in both season. Withholding irrigation at 60 days before harvesting gave the lowest values of reducing sugars% in both seasons.

Results indicated that the increasing K level from zero to 48 kg K<sub>2</sub>O/fed. decreased reducing sugars%. in both seasons.

### **7. Potassium percentage in juice:**

The results showed that applying the first post planting irrigation at 21 days after planting increased significantly potassium percentage in juice of sugarcane in both seasons.

Results cleared that applying withholding irrigation before harvesting at 60 days had significant increase potassium percentage in juice at harvest, in both seasons.

The results obviously showed that the potassium percentage in juice significantly affected by the applied dose of potassium levels raised from zero to 48 kg K<sub>2</sub>O/fed. in both seasons.

### **8. Potassium percentage in stalk:**

The results showed that applying the first post planting irrigation at 21 days after planting increased significantly potassium percentage in stalk sugarcane compared in both seasons.

The results cleared that applying the withholding irrigation before harvesting at 60 days had significant increase potassium percentage in stalk at harvest, in both seasons

The results obviously showed that potassium percentage in stalk significantly affected by the applied dose of potassium levels raised from zero to 48 kg K<sub>2</sub>O/fed. in both seasons.

### **9. Nitrogen percentage in stalks:**

Results cleared that applying first post planting irrigation at 7 days after planting increased significantly nitrogen percentage in stalk sugarcane in both seasons.

The results revealed that the increasing withholding irrigation before harvesting from 30 to 60 days was accompanied with a gradual and

significant decrease in nitrogen percentage in stalks at harvest, in both seasons.

Data showed that the nitrogen percentage in stalks was increased gradually and significantly as the applied potassium levels raised from zero to 48 kg K<sub>2</sub>O/fed. in both seasons.

### **III. Effect of time applying first post planting irrigation, withholding irrigation and potassium levels on water relations:**

#### **1. Actual water consumptive use (C.U).**

The results showed that applying the first post planting irrigation at 7 days recorded the highest seasonal water consumptive use by sugar cane crop (6995.46 and 6882.34 m<sup>3</sup>) in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, while applying the first post planting irrigation at 21 days after planting gave the lowest values of water consumptive use i.e., (6370.91 and 6014.90 m<sup>3</sup>) in both seasons, respectively.

Concerning the effect of withholding irrigation on water consumptive use it was increased with delaying withholding irrigation in both seasons. Withholding irrigation at 60 days before harvesting gave the lowest values of water consumptive use i.e., (6343.60 and 6092.89 m<sup>3</sup>) in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively.

With reference to the effect of potassium levels on water consumptive use data cleared that water consumptive use was increased with decreasing K levels in both seasons. Using 48 kg K<sub>2</sub>O/fed. produced the lowest values of water consumptive use (6568.52 and 6226.60m<sup>3</sup>) in both seasons.

The results showed that the maximum water consumptive use (7.665.19 and 7561.59 m<sup>3</sup>/fed was recorded by applying first post planting irrigation at 7 days, withholding irrigation at 30 days before harvesting with zero potassium in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively.

**2. Water use efficiency on cane yield basis (WUE):**

The results obtained showed that applying the first post planting irrigation on at 21 days after planting caused a relative and increase in the values of water use efficiency on cane yield basis (kg cane stalk/m<sup>3</sup>). Applying the first post planting irrigation at 21 days after planting gave the maximum values of water use efficiency on cane yield basis (9.26 and 10.45 kg cane stalk/m<sup>3</sup>) in both seasons, respectively.

The results showed that the highest values of water use efficiency on cane yield basis (8.66 and 9.46 kg cane stalk/m<sup>3</sup>) was obtained when withholding irrigation applied at 30 days before harvesting in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively

Regarding potassium effect on water use efficiency on cane yield basis it was found that increasing dose given sugarcane plants from zero to 48 kg K<sub>2</sub>O/fed caused gradual increased in the values of water use efficiency in the both seasons

The maximum value of water use efficiency on cane yield basis (10.75 and 11.38 kg cane stalk/m<sup>3</sup>) was obtained by applying first post planting at 21 days after planting and withholding irrigation at 30 days and 45 days in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively.

**3. Water use efficiency on sugar yield basis (WUE):**

The results showed that applying the first post planting irrigation at 21 days after planting caused a relative and increase in the values of water use efficiency on sugar yield basis (kg sugar/m<sup>3</sup>) in the 1<sup>st</sup> and 2<sup>nd</sup> seasons. Applying the first post planting irrigation at 21 days after planting gave the maximum values of water use efficiency on sugar yield basis (1.01 and 1.26 kg sugar/m<sup>3</sup>) in both seasons, respectively.

The results showed that the highest values of water use efficiency on sugar yield basis was obtained when withholding irrigation applied at 60 and 45 days before harvesting in both seasons.

Regarding potassium effect on water use efficiency on sugar yield basis kg sugar/m<sup>3</sup> it was found that increasing dose given sugarcane plants from zero to 48 kg K<sub>2</sub>O/fed caused gradual increased in the values of water use efficiency in both seasons.

The results pointed that the maximum value of water use efficiency on cane yield basis kg sugar/m<sup>3</sup> was obtained by applying first post planting at 7 days after planting and withholding irrigation at 60 days in the 1<sup>st</sup> season, while in the 2<sup>nd</sup> season kg sugar/m<sup>3</sup> obtained by applying first post planting at 21 days after planting and withholding irrigation at 45 days.

#### **IV. Effect of time of applying first post planting irrigation, withholding irrigation and potassium levels on economic evaluation:**

##### **1. Gross income (by Egyptian pound):**

Gross income (by Egyptian pound) was increased with delaying time of applying first post planting irrigation in both seasons. Applying the first post planting irrigation at 21 days after planting gave the maximum values of gross income i.e. 11796 and 12576 L.E. in both seasons.

Gross income (by Egyptian pound) was decreased with delaying withholding irrigation in both seasons. Withholding irrigation at 30 days before harvesting gave the greatest gross income.

With reference to the effect of potassium levels on gross income (by Egyptian pound). Data cleared that gross income (by Egyptian pound) was increased with increasing K levels in both seasons. 48 Kg K<sub>2</sub>O/fed produced the greatest values gross income.

The maximum gross income i.e. 13710 and 13742 L.E. was obtained from applying first post planting irrigation at 14 and 21 days from planting and withholding irrigation at 30 days before harvesting with 48 kg K<sub>2</sub>O/fad. in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively.

## **2. Net income (by Egyptian pound):**

Net income (by Egyptian pound) was increased with delaying time of applying first post planting irrigation in both seasons. Applying the first post planting irrigation at 21 days after planting gave the greatest values of net income (by Egyptian pound) i.e. 4282 and 5062 L.E. in both season respectively.

Concerning the effect of withholding irrigation on net income (by Egyptian pound) it was increased with delaying withholding irrigation in both seasons. Withholding irrigation at 30 days before harvesting gave the greatest values i.e., 4748 and 5340 L.E. in both seasons, respectively.

Net income affected by potassium levels in both seasons, increasing K levels from zero to 48 kg K<sub>2</sub>O/fad. increased net income from 2838 to 4870 L.E. and 3852 to 5070 L.E. in both seasons, respectively.

The maximum net income i.e. 5998 and 6030 L.E. was obtained from applying first post planting irrigation at 14 and 21 days from planting and withholding irrigation at 30 days before harvesting with 48 kg K<sub>2</sub>O/fad. in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively.

## **3. Profitability (%):**

Profitability (%) increased with delaying the time of applying first post planting irrigation in both seasons. Applying the first post planting irrigation at 21 days after planting gave the highest profitability(%). i.e. 56.99 and 67.37% in both seasons, respectively.



Concerning the effect of withholding irrigation on profitability (%) it was increased with delaying withholding irrigation in both season.

Data cleared that profitability (%) was increased with increased K levels in both seasons. 48 Kg K<sub>2</sub>O/fed produced the highest profitability (%) in both seasons.

The maximum profitability (%) i.e. 77.77 and 78.19% was obtained from applying first post planting irrigation at 14 and 21 days from planting and withholding irrigation at 30 days before harvesting with 48 kg K<sub>2</sub>O/fad. in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively.

#### **4. Gross income (by Egyptian pound) for water consumed unit (1000 m<sup>3</sup>):**

Effect of the time of applying the first post planting irrigation on gross income for water consumed unit was increased with delaying time of applying first post planting irrigation in both seasons. Applying the first post planting irrigation at 21 days after planting gave the highest values of gross income for water consumed unit i.e. 1851.5 and 2090.8 L.E./1000 m<sup>3</sup> in both seasons respectively.

Withholding irrigation at 30 days before harvesting gave the highest values (1732.2 and 1892.1 L.E./1000 m<sup>3</sup>) in 1<sup>st</sup> and 2<sup>nd</sup> season, respectively.

Gross income for water consumed unit was increased with increasing K levels in both seasons. 48 Kg K<sub>2</sub>O/fed produced the maximum values (1910.6 and 2047.7 L.E./1000 m<sup>3</sup>) in both seasons, respectively.

The maximum Gross income for water consumed unit i.e., 2150.9 and 2228.9 L.E./1000 m<sup>3</sup> was obtained from applying first post planting irrigation at 14 and 21 days from planting and withholding irrigation at 30 days before harvesting with 48 kg K<sub>2</sub>O/fad. in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively.