SUMMARY

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Two field experiments were conducted at the Farm of Agric. Res. Center, Giza, Egypt during 1991 and 1992 seasons to study the effect of irrigation at different levels of available soil moisture (ASM), i.e. (I_1): 20 - 25 %, (I_2): 40 - 45%, (I_3): 60 -65 % and (I_4): 80 -85 % and nitrogen fertilizer levels (N_1 : 0, N_2 : 45, N_3: 60 and N_4: 75 kg N/ fed., on sunflower growth, yield and yield components, seed oil content, the crop water use and growing degree day. Sunflower cultivar namely Maiak was used in both seasons. The experimental design was split- plot with four replications. The soil was clay loamy with pH value of 7.4.

Calcium super phosphate (15.5 P_2O_5) was applied at the rate of 150 kg/ fed. during the field preparation. Nitrogen fertilization was added according to the sub- plot treatments N_1, N_2, N_3 and N_4 (ammonium nitrate 33.5 % N) in two equal doses before the 1 st and 2 nd irrigations). Sowing dates were May 22 nd and 25 th in 1991 and 1992 seasons, respectively. The plants were harvested on August 26 th and 31 st in the two respective seasons. Application of irrigation regimes started after the 2 nd irrigation. The preceding crop was wheat in both seasons. Each plot was isolated from other plots by leaves 1 - 2 m to avoid the effect of lateral movement of irrigation water. The normal cultural practices of growing sunflower in Egypt were adopted from planting till harvesting.

Characters studied :

I- Growth measurements :

1- Plant height (cm) at 55 days old and at harvesting.

2- Stem diameter (mm.) at 55 days old and at harvesting

3- Dry weight/ plant (gm) at 55 days old and at harvesting

4- Number of leaves/ plant at 55 and 75 days from sowing.

5- leaf area/ plant (cm^2) at 55 and 75 days from sowing.

II- Yield and yield components :

1- Head diameter (cm).
2- Head dry weight (gm).
3- Number of seeds/ head.
4- Seed weight/ plant (gm)
5- 100- seed weight (gm).
6- Seed yield (kg/ fed.).
7- Seed oil content (%).
8- Oil yield (kg/ fed.).

III- Crop water use :

1- Actual seasonal evapotranspiration (ETc) in cm.
2- Daily ETc (mm/ day).
3- Potential evapotranspiration (Eto), calculated by Penman-Monteith formula.
4- Crop coefficient (Kc).
5- Water use efficiency (WUE) in kg seeds/ m^3 water.

IV- Growing degree day in ^{o}C (GDD).

The main results can be summarized as follows :

I. Growth measurements :

A- Effect of irrigation regimes :

1- Irrigation regimes had a significant effect on plant height, stem diameter, dry weight/ plant, number of green leaves/ plant and leaf area/ plant at th two growth stages, in the two seasons.

2- Plant height, stem diameter and dry weight/ plant at 55 days from planting and at harvesting increased significantly by increasing the available soil moisture or by irrigation at short intervals.

3- Irrigating sunflower at 80 - 85 % ASM gave the highest values of plant height, stem diameter and dry weight/ plant at 55 days old and at harvesting in both seasons. The lowest values were obtained from irrigation at 20 - 25 % ASM.

4- Irrigating sunflower at 80 - 85% ASM resulted in increasing significantly the number of leaves/ plant and leaf area/ plant at 55 and 75 days from sowing in both seasons.

B- Effect of N fertilizer levels :

1- The plant height, stem diameter and dry weight/ plant at 55 days old and at harvesting were significantly affected by nitrogen fertilizer levels in both seasons.

2- Applying 75 kg N/ fed. gave the highest values of plant height, stem diameter and dry weight/ plant at 55 days old and at harvesting in both seasons.

3- The leaf number/ plant and leaf area/ plant at 55 and 75 days from sowing increased significantly, as nitrogen level increased from zero to 45, 60 and up to 75 kg N/ fed.

C) Effect of the interaction (Ax B) :

1- The interaction between irrigation regimes and nitrogen levels in both seasons had a significant effect on growth parameters of sunflower plants at 55, 75 days old and at harvesting.

2- Decreasing the irrigation intervals increasing nitrogen level applied to sunflower plants caused significant increases in plant height, stem diameter and dry weight/ plant at 55 days old and at harvesting.

3- The highest values of plant height, stem diameter and dry weight/ plant were resulted from irrigating sunflower at 80 - 85 % ASM and applying 75 kg N/ fed.

4- The leaf number / plant and leaf area/ plant at 55 and 75 days from sowing significantly increased to the highest values when sunflower irrigated at the wet level (80 - 85 % ASM) and 75 kg N/ fed. applied when compared with other treatments .

II- Yield and yield components :

A) Effect of irrigation regimes :

1- Irrigation regime treatments had a significant effect on sunflower seed yield/ fed. and yield components, seed oil content and oil yield in the two seasons.

2- Head diameter, head dry weight, 100- seed weight and seed yield/ fed. significantly increased when sunflower plants were irrigated at 80 - 85 % ASM (short irrigation intervals).. Whereas, number of seeds/ plant, seed weight/ plant, seed oil content and oil yield/ fed. significantly increased under moderate irrigation intervals (irrigation at 60 - 65 % ASM).

B)- Effect of N fertilizer levels :

1- Nitrogen fertilizer level significantly affected sunflower seed yield/ fed, head diameter, head dry weight, number of seeds/ plant, 100- seed weight, seed weight/ plant, seed oil content and oil yield/ fed. in both seasons .

2- Head diameter, head dry weight, 100- seed weight, seed weight/ plant, seed yield/ fed. and oil yield/ fed increased by increasing nitrogen level up to 75 kg N/ fed.

3- The highest number of seeds/ plant was resulted from applying 60 kg N/ fed.

4- Seed oil content reached maximum value by applying 45 kg N/ feed.

C)- Effect of the interaction (A x B) :

1- The interaction between irrigation regimes and nitrogen fertilizer levels in both seasons had a significant effect on head diameter, head dry weight, number of seeds/ plant, 100- seed weight, seed yield/ plant, seed yield/ fed., oil percentage and yield.

2- Head diameter, head dry weight, 100- seed weight. in the two seasons, and oil yield/ fed. in 1991 season increased significantly by irrigating sunflower plant at 80 - 85% ASM (frequent irrigations) and applying 75 kg N/ fed. (I_4 x N_4 treatment) when compared with other treatments under study.

3- Moderate irrigation intervals i.e. irrigation at 60 - 65% ASM and applying 75 kg N/ fed. caused a significant increase in seed weight/ plant in both seasons and seed yield/ fed in 1991 season only (I_3 x N_4 treatment), however, applying 60 kg N/ fed. and moderate irrigation intervals (I_3 treatment) resulted in increasing significantly the number of seeds/ plant in the two seasons, seed and oil yields/ fed. in 1992 season only (I_3 x N_3 treatment).

4- The seed oil content significantly increased by irrigation at 60- 65% ASM and applying 45 kg N/ fed. (I_3 x N_2 treatment).

III- Crop water use :

Seasonal evapotranspiration by sunflower crop (ETc) as a function of irrigation regimes and nitrogen levels were 46.o1 and 46.18 cm, in 1991 and 1992 seasons, respectively.

1- Seasonal water consumptive use (ETc) was increased by decreasing irrigation intervals. The highest values were 51.58 and 51.52 cm in 1991 and 1992 seasons, respectively, obtained from irrigating sunflower at 80 - 85 % ASM.

2- Seasonal ETc increased by increasing nitrogen fertilizer level up to 75 kg N/ fed, which gave values of 48.83 and 50.05 cm in the two successive seasons, respectively.

3- The highest values of ETc were 54.70 and 55.91 in 1991 and 1992 seasons, respectively, resulted from irrigation at 80 - 85 % ASM and applying 75 kg N/fed. (I_4 x N_4 treatment).

4- The daily ETc rates were low during the initial period and increased to reach its maximum value when plants aged 55 - 75 days from sowing (during July), then decreased again at late season till harvesting.

5- The daily ET rate by sunflower plants increased as the available soil moisture increased or by decreasing irrigation intervals during July and August months.

6- Increasing nitrogen fertilizer level up to 75 kg N/fed. resulted in increasing the daily ET rate to high values.

7- The interaction between the wet treatment I_4 and high nitrogen level 75 kg N/ fed. caused a marked increase in the daily ETc during June and July months in both seasons.

8- Potential or reference evapotranspiration (ETo) was low during May (5.5 and 5.8 mm/ day) then increased in June (6.0 and 6.3 mm/ day) with maximum values during July (6.2 and 6.3 mm/ day) in 1991 and 1992 seasons, respectively.

9- The crop coefficient (Kc) of sunflower was low at the beginning of the growing season, then increased gradually to reach its maximum value in July (mid- season), thereafter it declined to reach lower value at maturity.

10- Crop coefficient (Kc) of (*Helianthus annus* L.) in Giza was 0.79 and 0.77 in 1991 and 1992 seasons, respectively.

11- Irrigating sunflower at 60 - 65 % ASM (moderate irrigation intervals) gave the highest values of water use efficiency i.e. 0.850 and 0.833 kg seeds/ m^3 water consumed in the 1 st and 2 nd seasons, respectively.

12- Increasing nitrogen level applied to sunflower up to 60 kg N/ fed. produced the highest water use efficiency values (0.868 and 0.870 kg seeds/ m^3 water) in 1991 and 1992 seasons, respectively.

13- Irrigating sunflower plants at 60 - 65% ASM and applying 60 kg N/ fed. is more efficient in water utilization for high yield production.

IV- Growing degree day (GDD) :

1- Days and GDD summations differed among seasons at any growth stage after planting.

2- Days summation increased at stages from planting to 1 st flower, to the beginning of seed filling and to physiological maturity by increasing the available soil moisture in the root zone of sunflower plants.

3- Increasing the ASM from 20 - 25 % to 40 - 45 %, 60 - 65 % and 80- 85% increased the GDD from planting to physiological maturity from 1823.2 to 1864.8, 1896.4 and 1926 ^{o}C in 1991 season, respectively. In 1992 season, the irrespective increase in ASM increased the GDD values from 1906.6 to 1946.9, 1967.8 and 1981.8 ^{o}C, respectively. This trend was found to be true from planting to the 1 st flower or to beginning of seed filling.