SUMMARY

Two field experiments were carried out at Bahtiem Agricultural Research Station during 1989 and 1990 seasons to study the effect of sowing dates and plant density on evapotranspiration of sesame. Some growth measurements, yield components, seed yield, oil content of seeds and the crop water use were also studied under the two variables effect. The design used was a split-plot with four replicates. Main plots were devoted to sowing dates and sub-plots to plant density treatments. The white seed variety Giza 32 was used in the two seasons. The description of the experimental treatments were as follows :

A- Main treatments (sowing dates) :

S_1 : Sowing : (mid - April).

S_2 : Moderate sowing : (Early- May).

S_3 : Late sowing : (Late - May).

The period between intervals was three weeks.

B- Sub-main treatments : Plant density :

D_1 : One plant/ hill (84,000 plants/ faddan).

D_2 : Two plants/ hill (168,000 plants/ faddan).

D_3 : Three plants/hill (252,000 plants/ faddan).

Sesame seeds at the rate of 4.0 kg/ faddan were planted in hill of 10.0 cm appart. The sub-plot area was 21.0 m^2 with 7- rows of 50 cm width. Before the first irrigation sesame plants were thinned to one, two and three plants/ hill to get the plant density treatments namely D_1, D_2 and D_3, respectively. The soil was clay loamy with pH value of 8.1. Phosphorus fertilizer at the rate of 30 kg P_2O_5 ?faddan and 50 kg potassium sulphate were applied during field preparation, whereas nitrogen fertilizer was added as ammonium nitrate at the rate of 30 kg N/ faddan in equal two doses. The normal cultural practices of growing sesame plant were followed from planting till harvesting.

Characters studied:

I- Growth measurements :

The following growth measurements of sesame at 40, 60 and 80 daysfrm sowing were studied :

1- Leaf number / plant.

2- Leaf area/ plant (cm^2).

3- Dry weight / plant (gm).

4- Plant height (cm).

II- Yield components :

1- Height of the first capsule (cm).

2- Capsule number/ plant.

3- Seed weight/ plant (gm).

4- 1000- seed weight (gm).

III- Seed yield in kg / faddan.

IV - Oil content of seeds :

1- Oil percentage of seeds % .

2- Oil yield in kg/ faddan.

V - Crop water use :

1- Seasonal evapotranspiration (cm).

2- Daily evapotranspiration rate (mm/ day).

3- Water use efficiency (kg seeds/ m^3 water).

The data were statistically analyzed by means of the combined analysis of variance for the two seasons.

I- Growth measurements :

A- Effect of sowing dates :

1- Sowing sesame on mid- April gave the highest averages of leaf number, leaf area, dry weight/ plant and plant height at 40, 60 and 80 days from sowing, as well as the plant height at harvesting.

2- Leaf number/ plant was significantly reduced as sowing date delayed from mid- April to early May by 19.7, 18.9 and 6.1 % at 40, 60 and 80 days old, respectively. More reductions were obtained when sowing date delayed to May end.

3- Leaf area/ plant reduced significantly when sowing date delayed to early May or late May at the three growthy stages.

4- Delaying sowing date from mid- April to late May gave significant reductions in dry weight/ plant by 8.4,8.3 and 8.8 % at 40, 60 and 80 days old, respectively.

5- Earlier sowing of mid - April significantly increased plant height at 40, 60 and 80 days old, as well as at harvesting by 11.7, 9.4, 8.6 and 9.6, respectively than early May sowing.

B- Effect of plant density :

1- The higher values of leaf number,leaf area and dry weight/ plant at growth stages were obtained from the thin density of 84,000 plants/ faddan (one plant/ hill).

2- Increasing plant density to 168,000 plant/ faddan significantly , reduced leaf number / plant at 40, 60 and 80 days old by 18.1, 9.5 and 7.7 %, respectively. More increase in plant density gave more reduction in leaf number /plant.

3- Leaf area/ plant significantly reduced by 24.2, 23.1 and 23.8 % at the 3- growth stages, respectively by increasing plant density to 168,000 plants/ faddan. The

reduction was 45.9 % at the three growth stages as density increased to 252,000 plants/ faddan.

4- Sowing sesame at the higher density (252,000 plants/ faddan) produced 90.0, 80.2 and 70.2 % of the dry weight/ plant, resulted from 84,000 plants/ faddan density at 40, 60 and 80 days old, respectively.

5- Plant height at 40, 60, 80 days old and at harvesting increased significantly as plant density increased. The maximum height was obtained from 252,000 plants/ faddan.

C- Effect of the interactions :

1- The interaction between sowing dates and plant density treatments had significant effects on leaf number, / plant, leaf area/ plant and plant height at all growth stages .

2- The highest averages of leaf number and leaf area/ plant of sesame at 40, 60 and 80 days old were obtained from sowing sesame on mid- Arpil at the lowest density (84,000 plants/ faddan).

3- Sowing sesame on late May at 252,000 plants/ faddan produced the lowest values of leaf number and leaf area/ plant at the three growth stages.

4- Maximum plant height was obtained from mid April sowing at the highest density (252,000 plants/faddan) at 40, 60 and 80 days old, as well as at harvest.

5- The differences between the averages of all growth measurements at all growth stages were significant due to sowing dates and plant density.

II- Yield components :

A- Effect of sowing dates :

1- Sowing date had a significant effect on height of the 1st capsule, capsule number, seed weight/ plant and 1000-seed weight .

2- Sowing on mid- April gave the highest values of yield components of sesame plant and the 1st capsule at low point.

3- The first capsule height significantly increased by 13.2 and 21.8 cm when sowing date delayed from mid- April to early and late May, respectively.

4- Delaying sowing date to early May significantly reduced capsule number/ plant, seed weight/ plant and 1000-seed weight by 13.3, 12.9 and 0.3 %, respectively. More delaying to late May produced more reduction in the above mentioned yield components by 39.2, 20.1 and 6.0 %, respectively.

B- Effect of plant density :

1- Increasing plant density from 84,000 to 168,000 or 252,000 plants/ faddan significantly increased the height of the first capsule by 27.4 and 14.7 %, respectively.

2- Capsule number/ plant was significantly reduced by 18.1 and 38.4 % when plant density was increased from 84.000 to 168,000 and 252,000 plants/ faddan, respectively.

3- The highest seed weight/ plant was 7.16 gm obtained from thin density of 84,000 plants/ faddan. Increasing plant density to 168,000 or 252,000 plants/faddan gave significant reductions in seed weight/ plant by 42.7 and 55.2 %, respectively.

4- The 1000- seed weight reduced significantly by 4.7 and 9.4 % as plant density increased from 84,000 to 168,000 or 252,000 plants/ faddan, respectively.

5- It could be concluded that the thin density gave the highest averages of capsule number /plant, seed weight / plant and 1000- seed weight. Plants of thin density gave their first capsule at low height.

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

1- The averages of sesame yield components differed significantly due to the interaction effect between sowing dates and plant density.

2- Sowing sesame on mid- April at 84,000 plants/faddan significantly increased capsule number/ plant, seed weight/ plant and 1000- seed weight to the highest values comparing with other interaction treatments.

3- The lowest averages of capsule number/ plant, seed weight/ plant and 1000-seed weight resulted from late sowing (May end) at highest density of 252,000 plants/ faddan (S_3 x D_3 treatment).

4- Early sowing (mid- April) at low density of 84,000 plants/ faddan significantly reduced height of the first capsule to its lowest value.

III- Seed yield in kg/ faddan :

A- Effect of sowing dates :

1- Seed yields in kg/ faddan differed significantly due to sowing date treatments.

2- Sowing sesame on mid- April produced the highest average of seed yield/ faddan (750.7 kg/ faddan).

3- Early May or late May sowing produced 87.7 and 78.8 % of mid- April seed yield/ faddan.

B- Effect of plant density :

The highest average of seed yield/ faddan (759.2 kg / faddan) was obtained from sowing at thickest density of 252,000 plants/ faddan (3- plants/ hill).

2- Seed yield in kg/ faddan, reduced significantly by 6.2 and 30.2 % as plant density reduced to 168,000 and 84,000 plants/ faddan, respectively.

3- Although the individual plant of the higher density gave the lowest values of all yield components, but the high number of plants/ unit area compensated these reductions and produced the highest yield.

C- Effect ofthe interaction (A x B):

1- Seed yield/faddan of sesame significantly affected by the interaction between sowing dates and plant density treatments.

2- Sowing sesame on mid- April at the highest density of 252,000 plants/ faddan, outyielded all other interaction treatments, producing 855.5 kg. seeds/ faddan.

3- The lowest seed yield in kg/ faddan was (478.3) obtained from sowing sesame on late May with 84,000 plants, faddan.

IV- Oil content of seeds :

A- Effect of sowing dates :

1- Seed oil percentage was significantly affected by sowing date treatments.

2- Delaying sowing date from mid- April to early or late May significantly reduced seed oil percentage from 53.1 % to 52.1 % and 51.6 %, respectively.

3- The highest oil yield in kg/ faddan was (397.5) gained from the early sowing of mid- April.

4- Oil yield in kg/ faddan was significantly reduced by 13.8 and 23.3 % as sowing date delayed from mid- April to early- May or late- May, respectively.

B- Effect of plant density :

1- The combined averages of oil percentage were significantly different according to plant density treatments.

2- Seed oil percentage was reduced significantly from 53.1 % to 52.2 % and 51.4 % when plant density was increased from 84,000 to 168,000 and 252,000 plants/ faddan, respectively.

3- Sesame seed oil percentage increased significantly as plant density/ unit area decreased.

4- The highest density of 252,000 plants/ faddan gave the highest oil yield in kg/ faddan (390.9).

5- Sesame oil yield/ faddan was significantly reduced by 24.4 and 28.0 %, when plant density was reduced from 252,000 to 162,000 and 84,000 plants/ faddan, respectively.

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

1- Seed oil percentage was not significantly affected by the interaction between sowing dates and plant density treatments.

2- Sesame oil yield / faddan was significantly affected by the interaction between sowing dates and plant density.

3- The highest oil yield (446.8 kg/ faddan) was obtained from sowing sesame on mid- April at 252,000 plants / faddan.

4- It can be noticed that delaying sowing date than mid- April and reducing plant density to 252,000 plants / faddan gave significant reductions in oil yield/ faddan.

V- Crop water use :

1- Seasonal evapotranspiration (ET.) :

* The average values of seasonal ET. by sesame crop irrespective to sowing dates and plant density were 43.05 and 42.0 cm in 1989 and 1990 seasons, respectively.

* The low difference between the ET. average of both seasons was due to the low variation in climatic factors of the two successive seasons.

A- Effect of sowing dates :

1- The seasonal evapotranspiration values were 45.79, 43.24 and 40.13 cm for sowing sesame on mid- April, early May and late- May, respectively, in 1989 season. However, in 1990 season the respective values were 44.34, 42.16 and 39.50 cm for the respective sowing dates.

2- Delaying sowing date of sesame after mid- April reduced the seasonal evapotranspiration, as a result of reducing the growing season period, and the reduction in vegetative growth and yield components.

B- Effect of plant density :

1- Increasing plant density of sesame from one plant /hill (84,000 plants/ faddan) to two or three plants/ hill (168,000 or 252,000 plants/ faddan) increased evapotranspiration from 39.25 to 43.19 and 46.71 cm in 1989 season, respectively. Whereas, in 1990 season the same increase in plant density increased seasonal ET, from 38.69 to 41.97 and 45.35 cm, respectively.

2- Increasing plant density of sesame/ unit area increased seasonal ET. values.

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

1- The highest values of seasonal evapotranspiration were 49.40 and 48.12 cm, in 1989 and 1990 seasons,

respectively, obtained from the interaction betwen sowing sesame on mid- April and plant density of 252,000 plants / faddan, (3- plants/ hill).

2- The lowest seasonal ET. values were 36.83 and 36.72 cm, resulted from sowing sesame on late- May at thin plant density of 84,000 plants/ faddan (one plant/ hill) in 1989 and 1990 seasons, respectively.

3- Early sowing of sesame at higher plant density increased seasonal evapotranspiration.

2- Daily evapotranspiration rates :

The daily ET. rates were low during the seedling and early crop development stages, and increased to reach its peak of water consumption during June- July (mid- season), then redecreased again at the late season stages (during August).

A- Effect of sowing dates :

1- The maximum average values of daily ET. rates were 4.23 and 4.25 mm./day obtained from sowing sesame on late May in 1989 and 1990 seasons, respectively. However, the minimum averages were 4.06 and 4.00 mm/day, resulted from mid-April sowing date in 1989 and 1990 seasons, respectively.

2- The peak of water consumption occurred at 65-78 , 50- 64 and 50- 62 days after sowing for sowing dates of mid-April, early and late May, respectively in both seasons.

3- The highest values of daily ET. rates during the peak period of water consumption were 6.23 and 5.58 mm. day, resulted from sowing sesame on mid- April in 1989 and 1990 seasons, respectively.

4- The lower daily ET. rates during peak period were 5.38 and 5.09 mm/ day, obtained from early May sowing date in 1989 and 1990 seasons, respectively.

B- Effect of plant density :

1- The average values of daily ET. rates were increased from 3.77 mm/ day to 4.15 and 4.48 mm/day when sesame plant density increaswed from one plant / hill to two and three plants/ hill, respectively, in 1989 season. In 1990 season, the corresponding increases were from 3.79 to 4.11 and 4.44 mmn/day, respectively.

2- Increasing plant density of sesame/ unit area increased the daily ET. rates.

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

1- The highest averages of daily ET. rates were 4.58 and 4.53 mm/ day, obtained from sowing sesame on late- May with thick density of three plants/ hill i.e. 252,000 plants /faddan, in 1989 and 1990 seasons, respectively.

2- The peak of water consumption occurred at 65-78 , 50- 64 and 50- 62 days after sowing for sowing dates of mid-April, early and late May, respectively in both seasons.

3- The highest values of daily ET. rates during the peak period of water consumption were 6.23 and 5.58 mm. day, resulted from sowing sesame on mid- April in 1989 and 1990 seasons, respectively.

4- The lower daily ET. rates during peak period were 5.38 and 5.09 mm/ day, obtained from early May sowing date in 1989 and 1990 seasons, respectively.

B- Effect of plant density :

1- The average values of daily ET. rates were increased from 3.77 mm/ day to 4.15 and 4.48 mm/day when sesame plant density increaswed from one plant / hill to two and three plants/ hill, respectively, in 1989 season. In 1990 season, the corresponding increases were from 3.79 to 4.11 and 4.44 mmn/day, respectively.

2- Increasing plant density of sesame/ unit area increased the daily ET. rates.

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

1- The highest averages of daily ET. rates were 4.58 and 4.53 mm/ day, obtained from sowing sesame on late- May with thick density of three plants/ hill i.e. 252,000 plants /faddan, in 1989 and 1990 seasons, respectively.

2- Sowing sesame on mid- April at low density of one plant/hill (i.e. 84,000 plants/faddan) gave the lowest values of daily ET. rates in 1989 and 1990 seasons (3.70 and 3.65 mm/ day), respectively).

3- Water use efficiency (W.U.E.) :

The average values of water use efficiency in kg seeds/ m^3 water utilized irrespective to sowing dates and plant density treatments were 0.378 and 0.363 in 1989 and 1990 seasons, respectively.

A- Effect of sowing dates :

1- The highest water use efficiency values were 0.397 and 0.392 kg seds/m^3 water consumed, obtained from sowing sesame on mid-April in 1989 and 1990 seasons, respectively.

2- Sowing sesame on late- May produced the lowest values of W.U.E., which were 0.363 and 0.341 kg seeds/ m^3 water consumed in the two successive seasons, respectively.

B- Effect of plant density :

1- The highest utilization of water to produce maximum seed yield was obtained from sowing sesame at the moderate plant density (2- plants/ hill) of 168,000 plants/ faddan.

2- Sowing sesame at 168,000 plants/ faddan, produced the highest values of W.U.E., which were 0.399 and 0.391 kg seeds/ m^3 water consumed in 1989 and 1989 seasons, respectively.

3- The lowest W.U.E. values were 0.332 and 0.314 kg seeds/ m^3 of water consumed, obtained from sowing sesame at plant density of one plant/ hill (84,000 plants/ faddan), in 1989 and 1990 seasons, respectively.

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

1- The highest average values of water use efficiency were 0.422 and 0.420 kg seeds/ m^3 of water consumed, obtained from sowing sesame on mid- April at 168,000 plants /faddan (2- plants/ hill), in 1989 and 1990, seasons, respectively.

2- Sowing sesame on late - May at thin density of 84,000 plants/ faddan, gave the lowest values of water use efficiency, which were 0.321 and 0.298 kg seeds/ m^3 of water consumed in 1989 and 1990 seasons, respectively.