EFFECT OF PLANT DISTRIBUTION AND NITROGEN LEVELS ON GROWTH, YIELD, YIELD ATTRIBUTES AND SOME QUALITY TRAITS OF SUNFLOWER IN FAYOUM PROVINCE

by
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SUMMARY

A study was made to trace sunflower hybrid ***G101*** developments all along its season under different plant distribution, nitrogen levels and their interaction.

For this purpose two field experiments were designed and excuted at the farm of the Faculty of Agriculture Fayoum, Egypt, in summer of the two years of 1995 and 1996. Soil site was mechanically and chemically analysed for assaying its fertility status. The two experiments were identical in plan and other treatments.

Each experiment was of 18 treatment combinations of plant distribution and nitrogen levels with three replicates. The statistical design was split-plots where the whole plot was assigned for plant distribution and the split plots were assigned for nitrogen levels.

Phenological sunflower characters were followed progressively during the growth season and recorded.

An analysis of plant growth and development was made. Sunflower leaves were sampled at plant age of 55 days and chemical analysis for pigments was made. Yield and yield attributes were studied under every treatments. sunflower seeds from every treatments were sampled and analysed for oil and protein percentage. Oil and protein yields were calculated.

The data obtained were statistically analyzed. The treatment means compared according to LSD test at 5 % level of significance. The results could be summarized as follows:

I-Growth measurements

I-1. Plant distribution effects

1- In the first season, plant distribution highly significantly and significantly affected plant height at 70 and 85 days from planting. In both stages, plant distribution A_6 (75x15 cm=37333 plants/fed) gave significantly the tallest plants while plant distribution of A_1 (50x40 cm=21000 plants/fed) gave significantly the shortest plants. Similar trend was observed in the second season but without significant differences.

2- Significant effect on number of green leaves was observed due to plant distribution at only plant age of 40 and 85 days in the first season. Significantly the highest number of green leaves was recorded under plant distribution of A_1 (50x40 cm=21000 plants/fed), A_2 (50x30 cm= 28000 plants/fed), A_3 (60x25 cm=28000 plants/fed) and A_5 (75x20 cm 28000 plants/fed) in the first growth stages and A_1, A_3 as well as A_5 in the final growth stage. It is clearly evident that increasing plant spacing (between row or hills) which in turn decreased plant population significantly increased number of green leaves.

3- Significant effect on stem diameter induced by plant distribution only at plant age of 70 and 85 days in the first and second seasons, respectively. Thicker stem was obtained by distribution A_1, A_3 and A_5 in the first season as well as A_1 and A_2 in the second season.

4- Head diameter highly significantly affected by plant distribution at plant age of 70 and 85 days in only 1996 season, in favour of wider hill spacings.

5- In general, leaf area per plant and leaf area index increased as plant advanced in age up to 70 days after planting and then decreased. This is true for all treatments under study in both seasons. Significant effect on leaf area per plant induced by plant distribution at plant age of 55 days only in the first season was observed. Data clarified in this stage that distribution A_4 (60x20 cm=35000 plants/fed) and A_6 (75x15 cm=37333

plants/fed) gave the lowest values for leaf area per plant and this means that increasing plant density decreased leaf area per plant.

6- Highly significant differences among plant distribution with respect to leaf area index at growth stage of 85 days from planting in both seasons and a significant differences at 40 days from planting in only the second season were observed. The lowest value for leaf area index was found in the variance in which plant to plant distance was close to row distance.

7- Highly significant effect was detected for plant distribution on dry weight of leaves at plant age of 55 days in only 1996 season. Distribution A_1, (50x40 cm=21000 plants/fed) and A_2 (50x30 cm =28000 plants/fed) gave significantly the highest dry weight of leaves per plant while distribution A_6 (75x15 cm=37333 plants/fed) gave the lowest weight.

8- The differences in stem dry weight induced by plant distribution were significant at 70 and 85 days after planting in the first season and highly significant at 85 days old in the second season. Data indicated that as plant density decreased or plant spaces increased stem dry weight per plant increased.

9- Dry weight per plant without root was highly significantly affected by plant distribution at only 85 days after planting in 1995 season. Comparison among plant distribution means in this stage indicated that plant distribution A_1, gave significantly the highest top dry weight per plant while distribution A_4 and A_6 gave significantly the lowest dry weight per plant. This means that as plant density increased top dry weight per plant decreased.

10- No significant effect on head dry weight, specific leaf weight, leaf weight ratio, relative growth rate and crop growth rate at all growth stages or intervals in both seasons was observed due to plant distribution.

I-2. Nitrogen level effects:

1-Regarding to nitrogen application, there was a highly significant effect on plant height and number of green leaves at all sampling dates in the two growing seasons. Increasing nitrogen level significantly increased plant height and number of green leaves. This is true at all growth stages in both seasons.

2- The differences in stem diameter due to nitrogen levels were highly significant at all growth stages in both seasons. Nitrogen rate of 60 kg/ feddan produced significantly thickest stem while the rate of 30 kg/feddan produced significantly the thinnest ones. This is true at all growth stages in both seasons.

3- Highly significant effect on head diameter was found due to nitrogen fertilization during the three growth stages of 1995 and 1996 seasons. Head diameter was largest with 60 kg N /feddan and significantly decreased in size as nitrogen level was reduced to 45 or 30 kg/feddan. This is true in both seasons.

4- Nitrogen fertilization had a significant effect on leaf area per plant in the first stage in 1995 season and highly significant effect in other growth stages at the same season and all growth stages in the second season. The highest leaf area per plant was recorded by the highest N levels i.e. 60 kg/feddan.

5- The effect of nitrogen fertilization was highly significant on leaf area index (LAI) at all growth stages in both seasons except at plant age of 40 days in the first season a significant effect was detected. It is obvious clear that LAI increased consistently with increasing nitrogen fertilizer up to 60 kg N /feddan.

6- Dry weight of leaves and stem per plant, head dry weight and dry weight of plant without root highly significantly affected by nitrogen fertilization at all growth stages in both seasons. The rate of 60 kg N/ feddan gave significantly higher dry weight of leaves and stem per plant,

head dry weight as well as dry weight per plant without roots than other two rates which significantly vary from each other.

7- Regarding nitrogen application, a significant effect on specific leaf weight was found at plant age of 40 days in 1995 season only. In this stage nitrogen level of 60 kg/feddan was significantly higher in specific leaf weight than only N level of 30 kg/feddan which did not significantly differ from N level of 45 kg /feddan.

8- Leaf weight ratio significantly influenced by nitrogen levels at plant age of 70 days in the first season only. In this stage nitrogen level of 60 kg/ feddan gave significantly higher leaf weight ratio than the other two rates that did not vary from each other.

9- Relative growth rate was not significantly affected by nitrogen levels at all growth intervals in both seasons.

10- Increasing nitrogen levels increased crop growth rate , the differences being highly significant in the growth intervals of 40-55 and 55-70 days after planting in both seasons.

I-3. Interaction effects

Highly significant effects were observed only on number of green leaves per plant, head dry weight at plant age of 85 days in 1995 season and stem diameter at plant age of 55 and 70 days in 1996 season due to plant distribution x N levels interaction. Only stem dry weight per plant at plant age of 85 days in 1995 was significantly affected by the interaction between plant distribution and nitrogen levels.

II-Yield and yield attributes

II-1. Plant distribution effects:

1- Plant height, head diameter both at harvest as well as seed yield per plant or per head were not significantly affected by plant distribution in

both seasons of experimentation. However, the tallest plants with lowest head diameter and seed yield per plant were obtained by distribution A_6 (75 x 15 cm = 37333 plants /fed) and the shortest plants with highest head diameter and seed yield per plant or per head were obtained by distribution A_1 (50x40 cm=21000 plants/fed).

2- The effect of plant distribution was significant on head dry weight at harvest. Distribution A_1 gave significantly the highest head dry weight per plant at harvest in both seasons.

3- The differences in 100-seed weight induced by plant distribution were not significant in both seasons.

4- Plant distribution had a significant and highly significant effect on seed and oil yields per feddan in the first and second seasons, respectively. Regarding protein yield per feddan, insignificant and highly significant effect in the first and second seasons, respectively, was observed. Distribution A_6 (75x15 cm=37333 plants/fed.) in the first season and A_6 as well as A_4 (60x20 cm=35000 plants/fed.) in the second one gave significantly the higher seed yield per feddan than all other plant distribution in both seasons. This indicated that increasing plant density either with decreasing distance between plants or between rows significantly increased seed yield per feddan. Similar trend was observed concerning oil yield and protein yield per feddan.

5- No significant effect was induced by plant distribution on straw yield per feddan in both seasons. However distribution A_6 and A_4 tended to produce the highest weight of straw yield per feddan in the first and second seasons, respectively.

II-2. Nitrogen level effects:

1- Addition of nitrogen up to 60 kg/feddan increased final plant height at harvest but the differences were highly significant in the second season only.

2- Nitrogen fertilization had a highly significant effect on head diameter at harvest. The superiority in this respect was for nitrogen levels of 60 and 45 kg/feddan in 1995 season and 60 kg/feddan only in 1996 season.

3- The effect of nitrogen fertilization on head dry weight at harvest was significant in both seasons of experimentation. The heaviest heads were recorded by 60 and 45 kg N /feddan in both seasons and the lowest dry weight of head was recorded for 30 kg N /feddan in both seasons.

4- Increasing nitrogen levels up to 60 kg/feddan highly significantly influenced 100-seed weight, seed yield per plant or per head and seed yield per feddan in both seasons of experimentation. Similar trend was observed with respect to straw yield per feddan as well as oil and protein yields in both seasons. Significantly the highest values for all mentioned characters were obtained with nitrogen rate of 60 kg N /feddan.

II-3. Interaction effects

There were no significant effect due to the interaction between plant distribution and nitrogen levels except on straw and protein yields per feddan in 1995 season and 100-seed weight in 1996 season, significant interaction effects were observed.

III- Chemical analysis

III-1. Plant distribution effects:

1- When plants were 55 days old a significant effect only on chlorophyll (b), in the first season, and chlorophyll (a) in the second season due to plant distribution was found. Highly significant effect was observed on carotenoids in the second season only. Distribution A_1 (50x40 cm=21000 plants/fed) gave significantly the highest values from chlorophyll (b) and

(a), respectively. Distribution A_1, A_4(60x20 cm=35000 plants/fed) A_5(75x20 cm=28000 plants/fed) and A_6(75x15 cm=37333 plants/fed) being insignificantly different gave significantly the highest values for carotenoids.

2- No pronounced effect for plant distribution on oil or protein percentage was observed in both seasons.

III-2. Nitrogen level effects

1- Increasing nitrogen levels increased photosynthetic pigments in sunflower leaves. The differences being significant and highly significant for chlorophyll (a) and (b), respectively in the second season only. Concerning carotenoids, the differences being highly significant in both seasons.

2- Highly significant influence on seed oil and protein percentage during the two seasons of experimentation was observed. Comparison among oil percentage means revealed that the highest seed oil percent was obtained when plants received 30 kg N /feddan however, the lowest seed oil percent was obtained by 60 kg N /feddan. This is true in both seasons of experimentation. With respect to seed protein percentage the reverse was the case in both seasons.

III-3. Interaction effects

Only seed oil percentage in 1995 season was significantly affected by plant distribution X nitrogen levels interaction.