SUMMARY

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Two field experiments were carried out at West-Nubaria region during the two seasons of 1992/93 and 1993/94 to study the effect of plant spacing and nitrogen fertilization levels on growth, yield and quality of Eiva sugarbeet (*Beta vulgaris* L.) cultivar.

The study included four plant spacings, i.e. 10, 15, 20 and 25 cm apart between hills as well as five N-levels, i.e. 0, 45, 60, 75 and 90 kg/fad. The results can be summarized as follows :

I. Effect of Plant Spacing on Growth Parameters at Different Growth Stages of Sugarbeet Plant:

A. Growth analysis:

1. Plant height (cm) was significantly affected only at 142 days after sowing. The maximum and minimum plant height recorded at plant spacing of 25 and 10 cm between hills, respectively.

2. Root length (cm) was significantly affeced by plant spacing only at 163 days after sowing. Increasing plant spacing up to 20 cm increased significantly the root length.

3. Root diameter (cm) was significantly increased with increasing plant spacing up to 20 cm at 121, 142 and 163 days afer sowing.

4. The fresh weight of blades/plant (g) was significantly increased as plant spacing increased from 10 up to 25 cm at all growth stages. The highest fresh weight of blades (307.60 g/plant) was found at the fourth stage (163 days) of growth with 25 cm plant spacing.

5. Fresh weight of petioles / plant (g) was significantly increased with increasing hills spacing from 10 to 25 cm at all growth stages. At 25 cm plant spacing , the highest weights were found and ranged between 89.6 and 414.7 g/plant throughout growth stages.

6. The fresh weight of leaves / plant (g) consistently increased by increasing plant distance beween hills from 10 to 25 cm for all growth stages.

7. Root fresh weight was significantly affected throughout all growth stages, and the highest value was recorded at 25 cm plant distance between hills after 163 days from sowing.

8. Fresh weight of plant was significantly increased at all growth stages by increasing distance between hills from 10 to 25 cm. The highest value was observed at growth stage of 163 days after sowing with 25 cm plant spacing.

9. Dry weight of blades/plant (g) was significantly affected by plant spacing at 100, 142 and 163 days after sowing. Blades dry weight was consistently increased due to increasing plant spacing from 10 to 25 cm.

10. Dry weight of petioles/plant (g) increased with increasing plant distance between hills. Significant differences among plant spacing at all growth stages were found.

11. Dry weight of leaves/plant (g) was significantly at 121, 142 and 163 days after sowing. Widening distance between hills up to 25 cm resulted to the increase in leaves dry weight.

12. Dry weight of root/plant (g) was significantly increased as plant distance increased up to 25 cm at 100, 121 and 163 days after sowing.

13. The total dry weight of plant (g) was significantly increased with increasing plant distance up to 25 cm. This increase was recorded at all growth stages.

14. Leaf area/plant (cm^2) was significantly increased as plant spacing increased from 10 to 25 cm at 100, 142 and 163 days after sowing, and the highest value (5583.3 cm^2) was found at 25 cm plant spacing with 163 days of age.

B. Growth attributes:

1. Leaf area index (LAI) was significantly reduced with increasing hills spacing from 10 to 25 cm at all growth stages. On the other hand, LAI increased with increasing plant age with all plant spacings.

2. The leaf area ratio (LAR) (cm^2/g) was affected by plant spacing only after 163 days from sowing, and increasing plant spacing from 10 up to 25 cm significantly increased LAR.

3. The leaf weight ratio (LWR) was significantly affected by plant spacing at both 100 and 142 days after sowing. Increasing hills spacing from 10 to 20 cm significantly increased LWR.

4. The specific leaf area (SLA) (cm^2/g) was significantly affected by plant spacing only at 163 days growth stage. At that stage, increasing plant spacing from 10 to 20 cm significantly increased SLA.

5. The crop growth rate (CGR) (mg/day) and net assimilation rate (NAR) ($mg/cm^2/day$) were significantly affected by the distance between hills at all growth periods. Increasing plant distance from 10 up to 25 cm increased consistently the CGR, whereas NAR was reduced.

6. The relative growth rate (RGR) (mg/g/day) was significantly affected by plant spacing at both periods, i.e. 100-121 and 121-142 days. Increasing distance between hills from 10 to 20 cm reduced RGR.

II. Effect of Nitrogen Levels on Growth Parameters of Sugarbeet Plants:

A. Growth analysis:

1. Plant height increased significantly by increasing nitrogen level up to 90 kg/fad at 100, 142 and 163 days after sowing. The highest values at 163 days after sowing (52.29 and 52.32 cm) were obtained with application of 75 or 90 kg N/fad, respectively.

2. Root length was not significantly affected by nitrogen application at 100, 121 and 163 days after sowing. In general, root length increased with increasing nitrogen levels. The highest measuring for length was 33.88 cm by adding 90 kg N/fad at 163 days after sowing.

3. Root diameter was increased significantly by increasing nitrogen level up to 90 kg/fad at all growth stages.

4. Fresh weight of blades/plant significantly increased as nitrogen level increased up to 90 kg/fad at all growth stages. The maximum value was obtained at 90 kg N/fad, and this result was true for all growth stages.

5. The fresh weight of petioles/plant increased due to applying nitrogen fertilizer at all growth stages. The increase was more evident at 142 and 163 days after sowing. The maximum increase percentages of weight at the same stages were recorded with applying 90 kg N/fad.

6. The fresh weight of leaves/plant significantly increased as nitrogen level increased up to 90 kg/fad at all growth stages. The maximum values also were obtained by applying 90 kg N/fad at the different growth stages.

7. Fresh weight of root/plant was significantly increased with increasing nitrogen level at both 121 and 163 days after sowing. The maximum weight was obtained by applying 90 kg N/fad at the same growth stages.

8. Total fresh weight of plant increased significantly by increasing nitrogen level up to 90 kg/fad at 121, 142 and 163 days after sowing. The highest level of nitrogen (90 kg/fad) produced the highest fresh weight at all growth stages.

9. Dry weight of blades and petioles/plant were significantly affected by nitrogen fertilizer levels up to 90 kg/fad and produced the maximum values by the same level of nitrogen at all growth stages.

10. Dry weight of leaves/plant (at 121, 142 and 163 days after sowing), root/plant (at 100, 142 and 163 days after sowing) and total plant dry weight (at all growth stages) were significantly affected by applying nitrogen fertilization. The maximum values were obtained by applying 90 kg N/fad.

11. Leaf area/plant significantly increased with increasing nitrogen level up to 90 kg/fad at all growth stages. The highest value was obtained by applying 90 kg N/fad at stage of 163 days after sowing.

B. Growth attributes:

1. Leaf area index (LAI) significantly increased as nitrogen level increased at 121 , 142 and 163 days after sowing. The maximum values in LAI was obtained with 90 kg N/fad at all growth stages.

2. The leaf area ratio (LAR) was ignificantly affected by nitrogen fertilization at 100 and 121 days after sowing. At the same growth stages , LAR increased significantly as a result of adding 60 kg N /fad.

3. Leaf weight ratio (LWR) was significantly affected by nitrogen fertilization. The highest ratio of leaf weight varied with nitrogen level applied. LWR reached its maximum value by adding 75, 75, 60 and 75 kg N/fad at 100, 121, 142 and 163 days after sowing, respectively.

4. Specific leaf area (SLA) exhibited significantly differences due to nirogen levels at 121, 142 and 163 days after sowing. The maximum value was recorded by applying 90 kg N/fad at all growth stages.

5. Crop growth rate (CGR) decreased significantly by applying 45 kg N/fad and differed significantly with all nitrogen level at the first growth period (100-121 days). At the second and third growth periods, CGR increased significantly at 90 kg N/fad with a significant difference with 0, 45 and 60 kg N/fad. It could be concluded that CGR comes to its maximum value at 90 kg N/fad at the three growth periods.

6. Ne assimilation rate (NAR) was significantly affected by nitrogen fertilization at all growth periods. In general, it could be concluded that NAR was significantly decreased as nitrogen level increased up to 75 kg/fad.

7. Relative growth rate (RGR) was significantly affected at the second and third growth periods, i.e. 121-142 and 142-163 days after sowing. In general, RGR was significantly increased by increasing nitrogen level up to 75 kg/fad, but excess nitrogen over this level decreased it.

III. Yield and Yield Attributes:

A. Effect of plant spacing:

1. Root yield (tons/fad) significantly increased as plant spacing increased from 10 up to 20 cm in both seasons and their combined analysis. The highest increase percent (19.97%) was recorded at 25 cm plant spacing.

2. Top yield (tons/fad) significantly increased due to increasing plant spacing from 10 to 25 cm in the second season as well as combined analysis. In the combined there was an increase reached about 25.41, 40.60 and 52.91% at 15, 20 and 25 cm plant spacing, respectively.

3. Growth sugar yield (tons/fad) was significantly affected by plant spacing in both seasons as well as combined analysis. A significant increase in sugar yield in tons/fad was obtained by planting at 20 and 25 cm between hills,and the higher yield of gross sugar resulted from planting at 25 cm plant spacing.

4. Sugar production (kg/day/fad) was significantly affected by plant spacing in both seasons and their combined analysis. Increasing plant spacing from 10 to 25 cm markedly increased sugar production in kg/day/fad. In combined analysis, any increase in plant spacing was always followed by a significant increase in sugar production in kg/day/fad. The higher sugar production in day/fad resulted from 25 cm apar between hills.

B. Effec of nitrogen levels:

1. Root yield (tons/fad) was significantly affected by nitrogen fertilization in both seasons as well as combined analysis. In the combined analysis, nitrogen fertilization significantly increased the root yield, and any increase in nitrogen applied was followed by a respective increment in root yield in tons/fad. The increase in root yield of sugarbeet was about 92.06% due to applying **90 kg N/fad** as compared with zero level.

2. Top yield (tons/fad) responded to nitrogen fertilization in both seasons and their combined. In the combined analysis, when sugarbeet plants were fertilized with 90 kg N/fad, top yield increased with about 98.29%, as compared with zero level.

3. Gross sugar yield (tons/fad) was substantially improved by about 1.91 tons/fad by increasing nitrogen level up to 60 kg/fad in the combined analysis as compared with zero level. Thereafter, further application of nitrogen had no significant effect on sugar yield.

4. Sugar production (kg/day/fad) was significantly affected by nitrogen fertilizaion in both seasons as well as in the combined analysis. In the combined analysis, there was not significant difference between 60 and 75 kg N/fad. The increase in sugar production due to applying 90 kg N/fad was about 99.01% as compared with zero level.

IV. Root Characters:

A. Effect of plant spacing:

1. Root length (cm) was significantly affected by plant spacing in both seasons and their combined. The differences between plant spacing 10 and 15 cm apart between hills in both seasons and the combined analysis were not significant. In general, root length increased as plant spacing increased from 10 to 25 cm between hills.

2. Root diameter (cm) increased significantly as plant spacing increased in both seasons as well as the combined. In the combined analysis , the maximum increase in root diameter (20.61%) was obtained at 25 cm plant spacing.

3. Root weight (g) was gradually increased by increasing plant spacing from 10 to 25 cm. This was the fact in both seasons as well as the combined analysis. The differences between the four plant spacings (i.e. 10, 15, 20 and 25 cm) used were significant.

B. Effect of nitrogen levels:

1. Roo length (cm) was significantly affected by nitrogen levels in both seasons and their combined analysis. Increasing nitrogen level up to 90 kg/fad significantly increased root length.

2. Root diameter(cm) significantly increased with increasing nitrogen levels in both seasons as well as the combined analysis. The highest increase percent (28.7%) was obtained by applying 90 kg N/fad.

3. Root weight (g) was significantly affected by nitrogen levels in both seasons as well as in the combined analysis. Each nitrogen increment was associated with a gradual increase in root weight. The combined analysis indicated that applying 90 kg N/fad increased the root weight with about 46.92% as compared with zero level.

V. Yield Quality:

A. Effect of plant spacing:

1. Total soluble solids (TSS) % was significantly decreased, generally, with increasing plant spacing from 10 to 15 or 20 cm apart between hills in both seasons as well as combined analysis.

2. Sucrose conten percentage was significantly affected by plant spacing in both seasons and in their combined analysis. Increasing plant spacing decreased sucrose percentage in sugarbeet roots. The combined analysis showed no significant differences in sucrose conent between plant spacing of 10 and 15 apart as well as between 20 and 25 cm apart.

3. Apparent purity percentage was not significantly affected by plant spacing in both seasons and in the combined analysis. In general, it could be sated that increasing plant spacing from 10 to 15 cm between hills improved the purity percentage, while increasing the distance from 15 up to 25 cm caused decrease in purity percentage.

4. Impurities (alpha-amino-nitrogen, potassium and sodium conents) were significantly affeced by plant spacing. Increasing plant spacing from 10 up to 25 cm apart between hills caused a significant increase in impurity components in terms of α-amino-N, K and Na in both seasons and in the combined analysis. The increase in the α-amino-N, K and Na contents ranged from 0.58 to 1.49 , from 0.08 to 0.44

and from 0.16 to 0.38 milliequivalens, respectively, as compared with planting at 10 cm between hills.

B. Effect of nirogen level:

1. Toal soluble solids (TSS) and sucrose percentages were significantly increased by increasing nitrogen level up to 60 kg/fad , and any increase in nitrogen applied (from 60 to 90 kg/fad) was followed by a respective decrease in both of them.

2. Apparent purity percentage was significantly affected by nitrogen level only in the second season. Increasing nitrogen level from zero to 90 kg/fad significanly increased purity percentage from 82.63 to 85.15%.

3. Impurities (alpha-amino-nitrogen, potassium and sodium contents), generally, were significantly affeced by increasing nitrogen level. Each nitrogen increment up to 90 kg/fad resulted in a significant increase in α-amino-N, K and Na contents in sugarbeet roots in both seasons as well as in the combined analysis.

Effect of Some Fertilization Treatmens and Plant Density on Yield of Sugarbeet

Plant spacing affected significantly most of growth characters (i.e. root diameter, fresh and dry weight of sugarbeet plant and its organs, LA, CGR, NAR and RGR). It could be concluded that most of these traits increased significantly as plant spacing increased from 10 up to 25 cm between hills at most of growth stages. Also, at harvest, plant spacing significantly affected root characters (length, diameter and weight), root yield, top yield, sugar yield, and quality characters of sugarbeet (total soluble solids, sucrose content, purity percentage and impurity components). In general, increasing plant spacing from 10 o 25 cm increased these traits.

Nitrogen levels exhibited a significant effect on most of growth characters,i.e. plant height,root diameter,fresh and dry weight of sugarbeet plant as well as LA, LAI, LWR, SLA, CGR, NAR and RGR. Generally, it could be concluded that adding N-fertilizer levels from 45 to 90 kg/fad significantly increased these traits (except ~~NAR~~ RGR which depressed with increasing N-level) at most of growth stages. At harvest,the results revealed that N-fertilization levels significantly affected root yield, sugar yield, top yield, root characters (length, diameter and weight) and quality characters (total soluble solids, sucrose content, purity percentage and impurity components). It could be concluded that , in general , increasing N-level from 45 up to 75 or 90 kg/fad significantly increased these traits.