SUMMARY

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Effect of intercropping faba bean and nitrogen fertilizer on growth and yield of sugar beet:-

This study was carried out at Nubaria Research Station, Beheira governorate during 2002/2003 and 2003/2004 winter seasons. The objective of this research was to study the effect of three sowing dates and three plant densities under three nitrogen fertilizer levels on growth, yield and yield components of faba bean and sugar beet.

Intercropping systems were as follows:

1. Intercropping sugar beet on both sides of ridge (1.20 m wide) at 20 cm between plant to give 35000 plants/fed (100 % of sole crop)
2. Intercropping faba bean on the back of ridge (1.20 m wide) in two rows, 20 cm between plants leaving one, two and three plants per hill to give plant density of (35000 , 70000, and 105000 plant/fed 25.0,50.0and75.0% of the faba bean sole crop).
3. Pure stand of sugar beet was grown on one side of ridge (0.60 m wide), at 20 cm between plants to give 35000 plants/fed.
4. Pure stand of faba bean was grown on two sides at a distance of 20cm between hill and leaving tow plants per hill to give 14000 plant/fed.

I. Sowing dates were as follows:

A. Faba bean:-

1. November 1st (after 15 days from sugar beet planting) (S1).

2. November 15th (after 30 days from sugar beet planting) (S2).
3. December 1st (after 45 days from sugar beet planting) (S3).

B. Sugar beet:

- Sowing dates of sugar beet in 15th of October in both seasons.

II. Intercropping system of faba bean and sugar beet:

a- Growing 35000 sugar beet plants + 35000 faba bean plants/fed (D1).

b- Growing 35000 sugar beet plants + 70000 faba bean plants/fed (D2).

c- Growing 35000 sugar beet plants + 105000 faba bean plants/fed (D3).

d- Growing 35000 plant/fed in pure stand of sugar beet.

e- Growing 140000 plant/fed in pure stand of faba bean.

III. Nitrogen fertilizer levels were as follows:

a. 60 kg N/fed (N1)

b. 80 kg N/fed (N2)

c. 100 kg N/fed (N3)

Split-split block design was used with three replications. Sowing dates were placed randomly the main plots, while intercropping systems of faba bean were placed in sub plots and sub-sub plots were filled by nitrogen fertilizer levels. Sugar beet cv. Kawamera and faba bean cv. Giza 3 were used.

First. Characters of sugar beet under study:

A. To study the characters of sugar beet and its components, ten plants were taken randomly from each sub-sub plot at age of 150 and 180 days from planting sugar beet where the following characters were studied:

1. Number of leaves /plant.
2. Root length and Root diameter (cm).
3. Fresh weight of leaves, root and total fresh weight/plant (gm).
4. Dry weight of leaves, root and total dry weight/plant (gm).

B. Yield and its components of sugar beet under study at harvest after 210 days from planting sugar beet:

5. Root length and diameter (cm).
6. Fresh weight of leaves, root and total weight/plant (gm).
7. Top yield, root yield, biological yield and sugar yield /fed (ton).

C. Technological properties of sugar beet at harvest were determined as follows:

1. Total soluble solids (T.S.S) %.
2. Sucrose % .
3. Purity % .

Second. Characters of faba bean under study:

1. Plant height (cm).
2. Number of branches and pods/plant.
3. Number of seeds/pods and seeds/plant

4. Weight of pods and seeds/ plant (gm).
5. Seed yield/plant(gm)
6. Weight of 100-seeds (gm).
7. Harvest index %.
8. Seed, straw and biological yields/fed (ton).

Third. Competitive relationships and gross economic:

A. **Competitive relationships and yield advantages:**

1- Land equivalent ratio (LER).

2- Relative crowding coefficient (K).

3- Aggressivity.

B. **Cereal units and economic evaluation:**

1. Cereal units.
2. Gross return.

Results obtained were as follows:

First. Sugar beet :

A. Sowing date:

- Delaying sowing date of faba bean intercropped with sugar beet from November 1st to 15th and December 1st significantly increased number of leaves/plant, root length and diameter and fresh, dry and total weight/plant in both seasons at age of 5 months as well as at 6 months except number of leaves /plant at 6 months in both seasons only.
- Top yield, root yield and its components (root length and diameter, fresh weight /plant) biological yield and sugar yield/fed (ton) significantly increased by delaying sowing

date of intercropped faba bean from November 1st to December 1st. The increase in root yield/fed were 20.56% in first season and was 13.91% in the second season whereas sugar yield increased by 15.81% and 20.00% respectively in the first and second season as compared to intercropping faba bean in November 1st in both seasons.

- Technological characters, namely, total soluble solids %, sucrose % and purity % significantly reduced by delaying intercropping faba bean with sugar beet as compared to early date in November 1st in both seasons.

B. <u>Plant densities:</u>

- Increasing plant density from 35000 to 70000 and 105000 plant/fed of faba bean plant intercropped with sugar beet significantly reduced all studied of sugar beet characters, namely, number of leaves/plant, root length and diameter, fresh and dry weight of plant components at 5 months age compared to the plant density at 35 thousand plant/fed in both seasons. On the other hand insignificant effect was observed for plant density on number of leaves /plant in both seasons and dry weight of leaves /plant in the first season at age of 6 months of planting, whereas all characters were significantly reduced at 6 months in both seasons.
- Increasing plant density of faba bean intercropped with sugar beet from 70 thousand to 105 thousand plant/fed significantly reduced top, roots, biological and sugar yields/fed (ton) compared to plant density at 35 thousand plant/fed in both seasons. The reduction in root yield/fed

were 15.90% and 12.45% and were of sugar yield 7.39 % and 8.79%/fed compared to plant density at 35 thousand plant/fed in first and second seasons respectively.

- Increasing plant density of faba bean intercropped with sugar beet significantly reduced all technological characters studied, namely, total soluble solids %, sucrose % and purity % with increasing plant density from 35 thousand to 70 thousand to 105 thousand plants/fed in both seasons.

C. Nitrogen fertilizer:

- Increasing nitrogen fertilizer level from 60 to 100 kg N/fed significantly increased number of leaves, root length and diameter, fresh and dry weight of plant components at 5 and 6 months in both seasons except number of leaves /plant at age of 6 months only in both seasons.
- Top yield, root yield, biological yield and sugar yields/fed significantly increased by increasing nitrogen fertilizer levels rate from 60 to 100 kg N/fed in both seasons. The increases in root yield/fed reached to 9.83% and 8.82% and sugar yield/fed 18.03% and 12.01% at the rate of 80 and 100 kg N/fed compared to the lowest rate 60 kg N/fed in both seasons respectively.
- Technological characters, namely, total soluble solids %in the first season, sucrose % and purity % were significantly reduced by increasing nitrogen fertilizer levels from 60 to 100 kg N/fed in both seasons. While total soluble solids % was not reached to significant level in the second season only.

Second. Faba bean:

A. Sowing date:

- Delaying date of intercropping faba bean with sugar beet from the 1st of November to 15th of November and the 1st of December significantly reduced all studied characters of faba bean plant, namely, length of plant, number of branches, number of pods and seeds/plant, number of seeds/pod, seed, weight/plant compared to the 1st of November in both seasons.
- Seeds straw and biological yields/fed, seed index and harvest index percentage were significantly reduced by delaying sowing date from the 1st of November to 15th of November and the 1st of December in both seasons. The decreases in seed yield/fed were to 9.55% and 33.73% in the first season and were 11.36% and 38.30% in the second season compared to intercropping earlier date in the 1st of November in both season respectively.

B. Plant density:

- Increasing plant density of faba bean intercropped with sugar beet significantly reduced number of branches/plant, pods and seeds/plant and dry weight of faba bean with increasing plant density from 35 thousand to 70 thousand and 105 thousand plant/fed, whereas plant high and harvest index significantly increased by increasing plant density in both seasons.
- Increasing plant density of faba bean intercropped with sugar beet significantly reduced seed yield of plant and seed

index. On the other hand seed, straw and biological yields/fed significantly increased by increasing plant density up to 105 thousand in both seasons. The increases in seed yield/fed were 55.46% and 92.07% in the first season and were 91.60% and 81.49% in the second season due to the increase in plant density up to 70 thousand and 105 thousand plant/fed compared to plant density of 35 thousand plant/fed in both seasons consequently.

C. Nitrogen fertilizer:

- Plant height and number of branches/plant significantly increased with increasing nitrogen fertilizer level from 60 to 100 kg N/fed in both seasons. On the contrary number of pods, number of seeds/pods and seeds/plant significantly reduced by increasing nitrogen fertilizer in both seasons, but dry weight of plant increased by increasing nitrogen fertilizer in both seasons. The highest values were recorded with 60 kg N/fed in both seasons.
- Seed yield/plant, straw yield/plant, seed index, harvest index% and seed yield significantly reduced with increasing nitrogen fertilizer level from 80 to 100 kg N/fed compared with 60 kg N/fed in both seasons, but straw yield and biological yield/fed increased with increasing nitrogen fertilizer level from 80 to 100 kg N/fed compared with 60 kg N/fed in both seasons.

Third. Intercropping:

I- Effect of intercropping on sugar beet:

- Growth characters of sugar beet intercropped with faba bean namely, umber of leaves/plant, root length and diameter, fresh weight of leaves, root and total/plant dry weight of leaves, roots and total/plant decreased compared to pure planting in both seasons.
- Root, sugar and biological yield significantly reduced due to intercropping faba bean with sugar beet as compared to pure standing of sugar beet in both seasons.
- Technological characters of sugar beet namely, T.S.S. %, sucrose% in the first season , and purity % were significantly reduced by intercropping faba bean with sugar beet.

II- Effect of intercropping on faba bean:

- Faba bean characters under study, namely, plant height, number of branches and pods/plant, number of seeds /pod number of seeds/plant and dry weight/plant were decreased by intercropping faba bean with sugar beet as compared to pure stand of faba bean in both seasons.
- Yield /plant, seed index and harvest index% of faba bean were not decreased by intercropping faba bean with sugar beet. On the other side straw yield and biological yield/fed were significantly affected in both seasons.

Fourth. Interaction:

I- Sugar beet

A- Interaction between sowing date and plant density:

- Roots diameter, roots fresh and dry weight of plant organs (leaves, roots and total plant) were significantly affected by

the interaction between sowing dates and plant densities of faba bean at 5 months age except root length in the first season. While significant effect was observed for fresh leaves, dry root and total plant weight at 6 months age in both seasons.

- Interaction between sowing dates and plant densities significantly affected for root length and diameter, leaves fresh weight/plant, top yield and sugar yield /fed in both seasons. As well as sugar yield and biological yield/fed. The highest values were obtained at the latest planting December 1st and low plant density at 35 thousand plant/fed.
- Sucrose % and purity % were significantly affected by interaction between sowing dates and faba bean plant density in both seasons. The highest values were obtained at early sowing date with high plant density.

B- <u>Interaction between sowing date and nitrogen fertilizer:</u>

- Interaction between sowing date and nitrogen fertilizer had no any effect on studied characters at 5 months age in both seasons, except root diameter in the second season. On the other hand leaves fresh weight, dry weight of roots and total weight/plant at 6 months age were significantly affected by the interaction between sowing date and nitrogen fertilizer in both seasons. The highest results were obtained when faba bean was sown late and under the highest nitrogen fertilizer level (100 kg N/fed) in both seasons.

- Interaction between faba bean sowing date and nitrogen fertilizer levels had no significant effect on studied characters yield and yield components, except root length, top yield and biological yield in both seasons as well as sugar yield in the first season were significantly affected by the interaction between sowing date and nitrogen fertilizer level. The latest sowing date and nitrogen fertilizing level of 80 kg N/fed recorded the highest values of root length, while the latest sowing date with 100 kg N/fed produced in the highest value of top yield and biological yields. Sugar yield/fed recorded the highest value at the latest sowing date and maximum nitrogen fertilizer level (100 kg N/fed).
- Total soluble solids %, sucrose % and purity % was significantly affected by interaction between faba bean sowing date and nitrogen fertilizer levels in both seasons. The highest values at the earliest of sowing date and nitrogen fertilizer rate of 80 kg N/fed compared to later planting and higher nitrogen fertilizer in both seasons.

C- <u>Interaction effects between faba bean plant density and the nitrogen fertilizer:</u>

- Interaction effect between faba bean plant density and nitrogen fertilizer had no significant effect on studied characters at 5 months age, except of fresh weight of root and dry weight of leaves, root and total dry weight in both seasons. Whereas dry weight of plant roots and total dry weight/plant were significantly affected at 6 months. The highest values were obtained from the lowest plant density

(35 thousand plant/fed) and highest nitrogen fertilizer level (100 kg N/fed) in both seasons.

- Biological yield was significantly affected by interaction between plant density and nitrogen fertilizer in the first and second season. The highest value of biological yield was recoded at the lowest density of faba bean 35 thousand plant/fed and highest nitrogen fertilizer level (100 kg N/fed) in both seasons.
- Sucrose% and purity% were significantly affected by interaction of faba bean plant density and nitrogen fertilizer level in both seasons. The highest values resulted from intercropping faba bean at plant density of 105 thousand plant/fed and nitrogen fertilizer rate 80 kg N/fed in both seasons.

D- <u>Second order interaction for treatments :</u>

- Triple interaction affects had no significant effect on growth characters under study at 5 and 6 months in both seasons except dry weight of root and total/plant. The highest values resulted from the latest sowing date (December 1st) and the lowest plant density (35 thousand plant/fed) and the highest nitrogen fertilizer level (100 kg N/fed) in both seasons.
- Yield and yield components were not significantly affected by triple interaction effects, except fresh weight of leaves /plant, top yield, biological yield and sugar yield/fed in both seasons. The highest values recorded for fresh weight of leaves /plant were at the latest sowing date (December 1st)

and plant density of 70 thousand plant /fed with high nitrogen level of 100 kg N/fed in both seasons. On the other side, the highest values of top yield and biological yield/fed were produced from latest sowing date and the lowest plant density 35 thousand plant/fed with the highest level of nitrogen fertilizer 100 kg N/fed in both seasons. Sugar yield gave the highest value at the latest sowing date of faba bean and the lowest plant density fertilized with 100 kg N/fed in the first season only.

- Total soluble solids % and sucrose %, as well as purity % were significantly affected by triple interaction in both seasons. The highest values of the total soluble solids %, sucrose % and purity % were produced by earliest sowing date of faba bean with the highest plant density (105 thousand plant/fed) and nitrogen fertilizer level of 80 kg N/fed in the first and second seasons.

II- <u>Faba bean:</u>

A- <u>Interaction between sowing date and plant density:</u>

- Number of pods and seeds/plant, 100 seed weight, seed yield /plant, harvest index, seed yield, straw yield and biological yield/fed were significantly affected by interaction between sowing date and plant density of faba bean plant in both seasons. The highest values for number of pods, number of seeds/plant, seed index and seed yield/plant were produced by faba bean plants intercropped with sugar beet in the 1st of November with the lowest plant density at (35 thousand plant/fed) in both seasons. Also highest values for seed yield, straw yield and

biological yield/fed of faba bean were recorded when faba bean was intercropped with sugar beet early in the 1st of November with highest plant density at (105 thousand plant/fed) in both seasons. Whereas the highest values of harvest index was the result of delaying sowing date with the lowest plant density at (35 thousand plant/fed) in second season, and at the early sowing date with the mid plant density at (70 thousand plant/fed) in first season.

B- <u>Interaction between sowing date and nitrogen fertilizer :</u>

- All studied characters except seed, straw and biological yields/fed were not significantly affected by interaction between sowing date and nitrogen fertilizer in both seasons. The highest values of seed yield were obtained with the earliest sowing date the 1st of November and the lowest nitrogen fertilizer (60 kg N/fed). As for straw yield and biological yields, the highest values were recorded with the earliest sowing date and the highest nitrogen fertilizer level at 100 kg N/fed in both seasons.

C- <u>Interaction effects between plant density and nitrogen fertilizer:</u>

- All studied characters except straw yield were not significantly affected by the interaction between plant density and nitrogen fertilizer in both seasons. The highest values of straw yield were obtained with the highest plant density (105 thousand plant/fed) of faba bean plants and the highest nitrogen fertilizer level (100 kg N/fed). Whereas the lowest values was obtained at the lowest plant density (35

thousand plant/fed) and the lowest nitrogen fertilizer level (60 kg N/fed) in both seasons.

D- Triple interaction effect :

- All studied characters of faba bean except straw and biological yield/fed were not significantly affected by triple interaction between sowing date, plant density of faba bean and nitrogen fertilizer levels in both seasons. The highest values for straw and biological yield /fed were recorded when faba bean was sown in the 1st of November with the highest plant density (105 thousand plant /fed) and the highest nitrogen fertilizer level (100 kg N/fed). The highest values for seed yield /fed were recorded when faba bean was sown in the 1st of November with the highest plant density (105 thousand plant /fed) and the lowest nitrogen fertilizer level (60 kg N/fed).

Fifth. The competitive relationships and yield advantage:

- Land equivalent ratio of each crop in the component was less than unit. Land equivalent ratio increased with earliest sowing date, increased plant density and highest nitrogen fertilizer level. The highest values 1.507 and 1.445 were produced from intercropping faba bean plants on mid November at the highest plant density (105 thousand /fed) and highest nitrogen fertilizer level (100 kg/fed) in the first and second seasons, respectively.

- Relative crowding coefficient increased with delaying sowing date, higher plant density and higher nitrogen fertilizer level in both seasons.
- The highest values for relative crowded coefficient (K) were produced the earlier intercropping of faba bean on 15th of November, with the highest plant density (105 thousand plant/fed) and nitrogen fertilizer level of 100 kg/fed in both seasons.
- Aggressivity values of sugar beet were positive (dominant) and faba bean values were negative (dominated) with delaying faba bean sowing date up to the 1st of December under any plant density and nitrogen fertilizer level in both seasons. And also at earlier and medium sowing date with the lowest and medium plant density under different nitrogen fertilizer levels. While aggressivity were negative for sugar beet and positive for faba bean at earliest sowing date of faba bean with the moderate and highest plant density under different nitrogen fertilizer levels.

Sixth. <u>Cereal units and gross return/fed :</u>

- Cereal units produced from intercropping treatments under different sowing dates, plant densities and nitrogen fertilizer levels were superior to that of faba bean pure stand in both seasons.
- Cereal units produced from intercropping faba bean with sugar beet in the latest date (1st December) and moderate faba bean plant density (70 thousand plant/fed) and the highest nitrogen fertilizer level (100 kg/fed) were superior

to pure stand of sugar beet in both seasons. The highest values were recorded for this treatment (116.00 and 109.88 cereal units), compared to sugar beet pure stand (113.66 and 108.00 cereal unit) in the first and second seasons, respectively.

- Gross return/fed produced from intercropping faba bean with sugar beet under different tri-treatments was higher than that obtained from faba bean sole crop (3352.05 and 3465.20 LE) or sugar beet sole crop (6389.47 and 6154.11 LE) in both seasons. The highest values of gross return for intercropping faba bean with sugar beet was (7433.38 LE) in the first season as a result of delayed sowing date at the 1st of December and higher plant density 105 thousand plant/fed and highest nitrogen fertilizer level 100 kg N/fed compared to sugar beet alone (6383.38 LE). This value in the second season was (7089.53 LE) which was obtained from sowing faba bean late on the 1st of December with plant density of 70 thousand plant/fed and nitrogen fertilizer level of 100 kg N/fed compared to sugar beet sole crop (6553.03 LE).
- It could be said that the highest gross return per fed intercropped with sugar beet and faba bean was obtained by sowing faba bean on sugar beet ridges late on the 1st of December with plant density of 70 thousand plant/fed fertilized with 100 kg N/fed, where the average gross return for the two seasons of study was (7200.38 LE).