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# RESPONSE OF SUNFLOWER TO DIFFERENT PRECEDING CROPS AND NITROGEN FERTILIZER LEVELS

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**ABSTRACT:** *Growth expressions of sunflower, supplied with 15, 30, or 45 kg N/ fed. after sugar beet, wheat, wheat + manuring with sugar beet tops and faba bean were examined in the summer seasons of 2001 and 2002.*

*Responses of 100-seed weight, seed weight/ head and seed yield/ fed. to the preceding crop were significant, having the maximum and minimum records following faba bean and sugar beet, respectively. Increasing the level of nitrogen fertilization up to 45 kg/ fed. significantly increased plant height, 100-seed weight, seed weight / head and seed yield/ fed., but decreased the net monetary return / kg N. Sunflower fertilized with 45 kg N/ fed. produced the maximum seed yield after faba bean and the minimum net profit / kg N following sugar beet.*

*Response of seed yield / fed. of sunflower to nitrogen fertilization was linear after sugar beet and wheat but quadratic following wheat manured with sugar beet tops and faba bean as N level increased over 30 kg/ fed. Positive and significant simple correlation coefficients were found between seed yield/ fed. and plant height (0.918), number of leaves/ plant (1.00), 100-seed weight (0.838) and seed weight / head (0.799).*

*The obtained data assured that the residual effect of legume (faba bean) or incorporation of sugar beet tops in the soil achieved higher monetary net return from sunflower planting at lower cost inputs (lower optimal N fertilization level). These findings might, also, help in decreasing the dependence on nitrogen fertilizers and, hence, improve environment through decreasing soil pollution, in addition to decreasing hazards for human health.*

**Key words :** *Sunflower, preceding crops, nitrogen fertilizer .*

## INTRODUCTION

Sunflower, which ranks the second to soybean among the world's oil crops, is receiving increasing attention in Egypt as a source of vegetable oil to decrease oil imports.

Cropping system of appropriate cropping pattern under efficient management practices may facilitate better utilization of plant resources and reduce the reliance on chemical fertilizer N. The step rise in costs of fertilizer, beside the concern of environmental safety, have urged the researchers to explore systems that may organically provide part of the crop N needs. The preceding crops, such as legumes, and incorporation of sugar beet tops into the soil were reported to increase the soil fertility and N uptake (Draycott, 1972; Page et al., 1982; Abshahi et al., 1984; Hargrove, 1986; and Danso and Papastylianou, 1992). Several investigations emphasized the role of legumes in increasing the yield of the following nonlegume crop. Danso and Papastylianou (1992) and Sparrow et al. (1995) reported high increases in grain yield and its attributes of wheat and barley grown following legumes. Maize and grain sorghum, sown after legumes, were of higher grain yields than those obtained from planting following nonlegume crops (MacColl, 1989; Khalil et al., 1999). Draycott (1972) pointed out that tops of sugar beet supplied soil with nitrogen equivalent to 19-45 kg/ ha. However, Abshahi et al. (1984) reported that nitrogen, at the rate of 62 kg/ ha., applied to wheat manured with shoots of sugar beet, produced grain yield similar to that obtained from applying nitrogen fertilizer at the rate of 124 kg/ ha.

Nitrogen controls biomass production through its effects on the number of leaves/ plant and leaf area generation as well as photosynthesis capacity (Zamski and Schaffer, 1996). The increase in N uptake, as N level increased, led to greater size of vegetative shoot system, hence, larger photosynthates partitioning into seeds (Gardner et al., 1985; and Coonor and Sadras, 1992). However, other researchers reported that the increase in N level led to higher leaf area index (LAI), while reductions in both light intensity and net assimilation rate (NAR), due to mutual shading between leaves, resulted in yield decline (Wallach, 1995 b). Moreover, other studies reported that sunflower plant height (Nawar, 1994), seed weight/ head (Bhalerao et al., 1993), seed index (Gewefiel et al., 1997), seed and straw yields (Nour El-Din et al., 1983 and Sarmah et al., 1994) were significantly affected by N fertilization level. A field study, conducted by El-Nakhlawy (1993), revealed significant linear increases in sunflower seed yield as N level increased. In addition, several studies indicated positive and significant correlations between seed yield and each of number of leaves/ plant, plant height, 100- seed weight, seed yield/ head and straw and seed yields (Nour El-Din et al., 1983; Nawar, 1994; Gewefiel et al., 1997 and Khalil, 1997). The present investigation was carried out to study the response of growth, in addition to seed yield and its attributes, of sunflower to the applied N rates when grown after different winter crops.

## MATERIALS AND METHODS

Two field experiments were conducted at the Agricultural Research Station, Alexandria University, to study the response of sunflower (Vedok cultivar) growth aspects to 15 (=$N_1$), 30 (=$N_2$) or 45 (=$N_3$) kg N / fed. following four preceding crops in 2001 and 2002 summer seasons.

Preceding crops were sugar beet (= P1), wheat (= P2), wheat + manuring with sugar beet tops incorporated into sunflower soil (=P3) and faba bean

(=P4). The soil, in which the experiment was conducted, was a clay loamy soil with a pH value of 8.3 and its organic matter was about 1.7%.

Sunflower was sown on May $15^{th}$ and $20^{th}$ in the two successive seasons, on ridges (0.6 m wide) and in hills 20 cm apart (one seed/ hill). Nitrogen (ammonium nitrate, 33.5% N) was added in two equal doses, the first at sowing date and the second immediately before the first irrigation. All other cultural practices were conducted according to recommendations. A split-plot experimental design, replicated thrice, was used in both seasons. Preceding crops occupied the main plots, while, subplots were allocated to N levels. Each experimental unit ($16.8m^2$ in area) comprised seven ridges (each, 4m long and 0.6m wide).

At harvest, the inner ridges were taken, denoting the representative samples, for estimation of plant height (in cm), number of leaves/ plant, seed weight/ head (g), 100- seed weight (g) and straw, in addition to, seed yields / fed (kg).

Fertilization response curves were worked out for the sunflower, using the equation: $\hat{Y} = a + bx + cx^2$, where $\hat{Y}$ is the expected seed yield (kg/ fed.) for a given N rate, x = one unit of nitrogen (15 kg/ fed.), a is a constant, whereas, b and c are regression coefficients describing the linear and quadratic terms, respectively. The optimum dose of nitrogen was worked out by the formula: $\hat{X}_{op} + \frac{1}{2c}\left(\frac{P}{q} - b\right)$ (Gomez and Gomez, 1984), where $\hat{X}$ is the optimum dose of N (kg/ fed,), b and c are coefficients of the response curves, P is the price of 1 kg of sunflower (1.05 pound) and q is the price of 1 kg N (1.2 pound). Nitrogen optimum dose was calculated to estimate the monetary net return invested in 1 kilogram N.

Data were statistically analyzed, according to Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

The analysis of variance, presented in Table (1), indicated significant effects for preceding crops on 100-seed weight, weight of seeds/head and straw and seed yields/fed. Application of nitrogen fertilizer exhibited insignificant effects for both number of leaves/plant and straw yield/fed., whereas the other studied characters were significantly influenced. Preceding crops x N levels interaction showed significant effects only for seed yield/fed. and monetary net return/kg of applied N.

Table (1). Mean squares of studied characters in 2001 and 2002 seasons.

| S.O.V. | d.f | Plant height (cm) | | Numbers of leaves/plant | | 100-seed weight (g) | | Weight of seeds/head (g) | | Straw yield/ fed. (kg) | | Seed yield/fad (kg) | | Monetary n[illegible] return/kgN (Pound) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 20[illegible]2 |
| Preceding crops (A) | 3 | n.s | n.s | n.s | n.s | * | * | * | * | * | * | * | * | n.s | n.[illegible] |
| Error (a) | 6 | 19.30 | 27.9 | 7.55 | 6.81 | 0.025 | 0.088 | 2.86 | 4.33 | 8003.9 | 11946.7 | 1131.6 | 614.83 | 1.4311 | 0.2[illegible]68 |
| | | | | | | | | | | | | | | | |
| Nitrogen level (B) | 2 | * | * | n.s | n.s | * | * | * | * | n.s | n.s | * | * | * | — |
| AB | 6 | n.s | n.s | n.s | n.s | n.s | n.s | n.s | n.s | n.s | n.s | * | * | * | — |
| Error (b) | 16 | 19.30 | 24.00 | 0.120 | 0.130 | 0.039 | 0.059 | 0.619 | 0.803 | 99627.8 | 4026.2 | 489.54 | 1085.83 | 0.4694 | 0.3[illegible]18 |

* Significantly different at 0.05 probability level
n.s. = Not significant

Means of the studied characters, as affected by the two studied factors in both seasons, are presented in Table (2).

Differences in 100 – seed weight among the four preceding crops were significant, greater for sunflower after faba bean (P4), followed by P3, compared to the two other preceding crops, (P1 and P2). These results might be attributed to the more availability of soil N with respect to P4 (faba bean) and P3 (wheat + manuring), leading to hgiher N uptake (Abshahi et al., 1983; Narwal et al., 1983; Loubser and Human, 1992), which enhanced photosynthesis and production of photoassimilates (Zamski and Schaffer, 1996). In addition, there was an increase in photoassimilates translocation into seeds (Coonor and Sadras, 1992). The negative results after sugar beet might be attributed to longer growth duration of sugar beet and greater N depletion from soil, hence, lower N availability for sunflower. Meanwhile, reductions in 100-seed weight for sunflower after wheat might be due to the soil supply with lower organic N and / or greater N uptake from soil by the preceding wheat. The 100-seed wheat, as an average of the two seasons, for sunflower grown after P1, P2 and P3 (sugar beet, wheat and wheat + manuring) were 83.0, 87.0 and 90.0%, respectively, of the 100-seed weight obtained after P4 (faba bean).

Weight of seeds/head after faba bean was superior to those after sugar beet (P1) and wheat (P2), but was statistically similar to weight of seeds / head of sunflower after wheat soil manured with sugar beet top (P3). Doubtless, increased soil availability of N increased N uptake in P4 and P3, compared to P1 and P2, resulting in the increase of LAI, light capture and conversion into photoassimilates translocated to the heads, hence increased both number of fertile seeds per head and individual seed weight (Loomis and Coonor, 1992; Wallach, 1995 b). Compared to $P_1$ and $P_2$, increases in this trait for P4 and P3, preceding crops reached 7.33 and 5.52 g in the first season, and 6.55 and 4.79 g in the second season, respectively. The lowest sunflower seed production/head was obtained after sugar beet, and that might be explained by its higher soil N removal due to its longer growth duration.

Straw yield/fed. had the maximum and minimum values after faba bean and sugar beet, respectively, in both seasons. Wheat, as a preceding crop + manuring, produced straw yields lower than or almost equal to those of faba bean in 2001 and 2002 seasons, respectively. Improved soil N status following P4 and P3 (compared to P2 and P1) increased vegetative growth in terms of increased plant height (though not significant) and final straw yield. Reductions in straw yields for P1, P2 and P3 compared to P4, were 29.84, 19.11 and 14.55% in 2001 and 27.6, 16.90 and 7.8 % in 2002, respectively .

Table (2). Means of studied characturs as affected by preceding crops and nitrogen levels in 2001 and 2002 seasons.

| Treatments | Plant height (cm) | | Number of leaves/plant | | 100-seed weight (g) | | Weight of seeds/head (g) | | Straw yield/ fed. (kg) | | Seed yield/fed (kg) | | Monetary net return/kg N. (Pound) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 |
| Preceding crop | | | | | | | | | | | | | | |
| Sugar beet (P1) | 166.00 | 172.50 | 22.47 | 22.16 | 6.57 | 6.79 | 24.39 | 28.22 | 1606.22 | 1330.33 | 827.22 | 886.56 | 26.35 | 24.23 |
| Wheat (P2) | 165.00 | 172.94 | 22.57 | 22.53 | 6.76 | 7.43 | 26.33 | 29.83 | 1728.56 | 1452.78 | 896.60 | 950.00 | 26.56 | 24.29 |
| Wheat + manuring sug. beet tops (P3) | 165.56 | 173.50 | 23.64 | 2263 | 6.92 | 7.94 | 30.44 | 35.20 | 1826.11 | 1575.11 | 927.27 | 967.78 | 26.62 | 24.34 |
| Faba bean (P4) | 166.33 | 174.17 | 26.01 | 22.87 | 7.31 | 8.77 | 31.72 | 36.47 | 2137.00 | 1697.67 | 1009.44 | 1052.21 | 26.69 | 24.49 |
| L.S.D. 05 | n.s. | n.s. | n.s. | n.s. | 0.18 | 0.34 | 1.96 | 2.40 | 103.20 | 126.08 | 16.44 | 27.77 | n.s | n.s |
| Nitrogen level | | | | | | | | | | | | | | |
| 15 | 159.40 | 168.90 | 23.20 | 22.38 | 6.43 | 7.25 | 24.80 | 28.30 | 1848.30 | 1510.90 | 857.25 | 900.00 | 32.8 | 30.64 |
| 30 | 166.90 | 172.60 | 23.70 | 22.60 | 6.80 | 7.67 | 28.20 | 32.40 | 1848.80 | 1515.30 | 937.08 | 980.17 | 26.90 | 22.16 |
| 45 | 170.10 | 178.12 | 24.20 | 22.70 | 7.43 | 8.30 | 31.70 | 36.50 | 1851.80 | 1522.08 | 936.25 | 1011.60 | 18.39 | 20.01 |
| L.S.D.05 | 3.80 | 4.24 | n.s | n.s | 0.17 | 0.21 | 0.79 | 0.90 | n.s | n.s | 22.11 | 32.91 | 0.59 | 0.53 |

n.s. = Not significant

Differences among preceding crops in seed yield per fed. of sunflower were significant in both seasons. Faba bean (P4) resulted in the highest significant seed yield / fed., compared to those obtained from P1 , P2 and P3. These results were attributed to the good residual effect of faba bean on soil fertility, greater N uptake and conversion into photoassimilates, resulting in the increase of seed yield attributes and seed yield/fed. (Narwal et al., 1983). The previous findings might, also, in general, be attributed to the beneficiary effects of legumes and beet tops as organic manures in increasing soil fertility and enriching the soil with organic nitrogen. These results were in accordance with those obtained by Draycott (1972), Abshahi et al. (1984), Danso and Papastylianou (1992) and Sparrow et al (1995) who concluded that legume crops and beet tops added a part of N needs of the following non-legumes and could, in turn, increase their yields.

Increasing the level of nitrogen fertilization from 15 to 30 Kg N/fed. significantly increased plant height in both seasons. However, further increase of nitrogen (45 kg/fed.) significantly increased plant height only in the second season (Table 2). Increases in N level increased N uptake, leading to greater vegetative growth and consequently, taller sunflower plants (Steer and Hocking, 1984; Gardner et al., 1985 and Gheith et al., 1986).

Increases in 100-seed weight and weight of seeds/ head were insignificant at 30, but significant at 45 kg N/fed. in both seasons. Compared to N1, increases in 100-seed weight of $N_2$ and $N_3$ averaged 0.30 and 1.00 g, respectively. However, $N_2$ and $N_3$ were superior to $N_1$ in seed weight/head by 3.8 and 7.6 g, as averages of both seasons, respectively.

Application of nitrogen at a rate up to 30 Kg/fed. significantly increased seed yield/fed., while further increase in N application up to 45/fed. led to an insignificant increase (in 2002) in that trait. Lesser N uptake during seed development and maturity, as a result of applying lower N levels might reduce photosynthates translocation into the developing seeds, resulting in small or infertile seeds (Steer and Hocking, 1984 and Loubser and Human, 1993). This might explain the reductions in 100-seed weight and seed weight/head. These findings are in agreement with results reported by several investigators indicating that increasing the nitrogen fertilizer rate led to substantial increase in plant height, 100-seed weight, weight of seeds/head and seed yield/fed. (Narwal and Malik, 1985; Bhalerao et al., 1993; El-Nakhlawy, 1993; Nawar, 1994; Sarmah et al., 1994; Gewefiel et al., 1997; and Halvorson et al., 1999).

The monetary net return invested in one kilogram of applied N was inversely related to nitrogen rates, where the maximum and minimum responses of 31.42 and 22.20 Egyptian pounds, as an average of the two seasons, were observed for 15 and 45 Kg N/fed., respectively. Increasing N fertilization level might have increased production costs, which was not compensated for by a proportional increase in outputs.

Differences in seed yield for the combined treatments of the two factors were significant, as indicated by preceding crops X N levels interaction in both seasons (Table 3). The maximum seed yield was obtained from P4 at 45 Kg N/fed., whereas one resulted from P1 (in 2001) and P2 (in 2002) at 15 Kg N/fed. Data showed that increases in seed yield were of lower magnitude for P1 and P2 in the two seasons, compared to those of P3 and P4 at 30 Kg N/fed., while the reverse trend was obtained at 45 Kg N/fed. Application of $N_3$ rate to a soil higher in soil fertility (N status; i.e., P3 and P4) allowed vigorous growth over a longer vegetative period, resulting in reduction for seed yield, comparing to the application of 45 kg/fed. to P1 and P2, which were of low soil N status. Similar findings were reported by Narwal et al. (1983).

Preceding crops × N levels interactions, also, were significant for the monetary net return per kilogram of applied N. The values for such scale were inversely related to N levels, (Table 3). The maximum and minimum net profits were found at 15 and 45 Kg N/fed. across the different preceding crops, where returns attributed to grain yield increases did not compensate for the excess costs as N level increased. Differences in the economic use of one kilogram N under the same N level, among the different preceding crops, depended upon N status after the preceding crop, where soil higher in N content increased such profit. As a result, the monetary net returns, invested in nitrogen fertilizer unit, were the largest when sunflower was grown after faba bean, followed by wheat + manuring with sugar beet tops, where soil organic N contributed to increasing seed yield and its attributes with additional costs. The lower profits after sugar beet, at the highest N level, indicated that the increase in production costs was higher than any increase in seed yield, if any, resulting from application of higher N rates.

The response equations of seed yield to nitrogen fertilization levels under different preceding crops, in both seasons, are presented in Table (4). The polynomial equation, in both seasons, indicated that seed yield of sunflower after both sugar beet and wheat increased linearly as nitrogen fertilizer increased up to 45 Kg/fed. The increases in seed yield were 16.50 and 13.62 Kg (in 2001 season) and 12.33 and 14.00 Kg (in 2002 season) after sugar beet and wheat, respectively. The coefficients of determination ($R^2$) for sunflower linear response to nitrogen indicated that 100 and 96% in 2001, as well as 99.40 and 92.00% in 2002, of the total variation in the seed yield after sugar beet and wheat, respectively, were due to seed yield regression on the nitrogen rate. That finding might indicate the possibility of obtaining higher seed yield in sunflower through application of N fertilizer levels higher than 45 kg fed. after wheat and sugar beet. Meanwhile, response of seed yield to nitrogen after P3 and P4 preceding crops was included both linear and quadratic responses with respective determination coefficients of 94.30 and 94.00%, as well as 93.60 and 91.80% in the first and second seasons, respectively. The negative quadratic coefficients indicated that increasing N level above 30 kg/fed. would cause progressive reduction in seed yield. The economic level for sunflower was 36.40 and 31.25 kg N /fed., in the first season, in addition to 36.88 and 33.40 kg N/fed. in the second season when grown following P3 (wheat + beet tops) and P4 (faba bean), respectively, suggesting that faba bean, as a preceding crop, reduced the nitrogen requirement of sunflower (Narwal and Malik, 1985).

**Table (3) Means of sunflower as influenced by preceding crops X N levels interaction in 2001 and 2002 seasons.**

| N levels / Preceding crops | Seed yield / fed. (kg) | | | | | | Monetary net return / kg N (pound) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | | | 2002 | | | 2001 | | | 2002 | | |
| | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 |
| Sugar beet (P1) | 783.33 | 816.67 | 871.67 | 813.33 | 866.67 | 956.67 | 30.68 | 18.49 | 14.27 | 31.15 | 18.60 | 13.76 |
| Wheat (P2) | 845.00 | 875.00 | 955.00 | 883.33 | 943.33 | 1023.33 | 36.38 | 20.43 | 15.33 | 31.98 | 21.11 | 15.93 |
| Wheat + manuring sug. beet tops (P3) | 868.33 | 951.67 | 973.33 | 912.67 | 983.33 | 1003.33 | 43.63 | 23.67 | 17.05 | 36.84 | 23.63 | 16.44 |
| Faba bean (P4) | 908.33 | 1055.00 | 1065.00 | 966.67 | 1093.33 | 1106.67 | 52.49 | 27.28 | 18.90 | 38.67 | 25.32 | 18.75 |
| L.S D 0.05 | 16.27 | | | 16.19 | | | 1.19 | | | 1.07 | | |

**Table (4) Response equations of seed yield to N fertilization levels under the different preceding crops i[redacted]n 2001 and 2002 seasons.**

| Preceding crops | 2001 | | 2002 | |
|---|---|---|---|---|
| Sugar beet (P1) | $\hat{Y}$ = 2410.8 + 16.50 X | *R2 = 100% | $\hat{Y}$ = 2533.1 - 12.33 X | $R^2$ = 99.40% |
| Wheat (P2) | $\hat{Y}$ = 2220.0 + 13.62 X | $R^2$ = 96% | $\hat{Y}$ = 2430.6 - 14.00 X | $R^2$ = 92 00% |
| Wheat + manuring sug. beet tops (P3) | $\hat{Y}$ = 735 + 73.5 X - 0.942 $X^2$ | $R^2$ = 94.3% , $\hat{X}_{op}$ = 36.40 | $\hat{Y}$ = 7.66 + 70.20 X - 0.9400 $X^2$ | $R^2$ = 93 60% . $\hat{X}_{opt}$ = 36.88 |
| Faba bean (P4) | $\hat{Y}$ = 376 + 45.5 X - 714 $X^2$ | $R^2$ = 94 0% , $\hat{X}_{op}$ = 31.25 | $\hat{Y}$ 308.9 + 43.00 X - 0.6312 $X^2$ | $R^2$ = 91 80% . $\hat{X}_{opt}$ = 33 40 |

* $R^2$ = Coefficient of determination.

** $\hat{x}_{op}$ = Nitrogen optimum dose (Kg/ fed.).

Simple correlation coefficients, presented in (Table 5), indicated positive and significant relationships between seed yield/fed. and each of plant height, number of leaves/plant, 100-seed weight and seed weight/head over the two seasons. Meanwhile, straw yield/fed. was significantly and positively correlated with plant height, number of leaves/plant and 100-seed weight and seed weight per head. Simple correlation coefficients were significant and positive both plant height when 100-seed weight was correlated to number of leaves/plant, whereas, the association between number of leaves/plant and plant height was positive and significant in both seasons. The simple correlation between number of leaves/plant with seed weight/head, straw yield and seed yield/fed. might indicate the possibility of using these characters as reliable indicators of seed yield potential and growth aspects under varying growth conditions, as those of the present research. Different studies reported positive and significant correlation between seed yield with number of leaves/plant, plant height, 100-seed weight, seed weight/head and straw and seed yields (Nour El-Din et al., 1983; Nawar, 1994; Gewefiel et al., 1997 and Khalil, 1997).

The present study showed that sunflower seed yield responded significantly to the different preceding crops and nitrogen fertilization levels. Organic fertilization, through legume crops or turning under of sugar beet tops in the soil, led to high seed yield and monetary net return/ kg N at lower nitrogen fertilization levels, indicating the possibility of increasing seed yield of sunflower at lower cost inputs. That was emphasized by the lower optimal N fertilization level needed for sunflower after faba bean and soil manured with sugar beet tops, compared to those after wheat or sugar beet. These findings, also, might help in decreasing the dependence on nitrogen fertilizers and, hence, improve environment through decreasing pollution, in addition to decreasing hazards for human health.

Table (5) Simple correlation coefficients cr-values between some studied characters in 2001 and 2002 seasons.

| Characters | Number of leaves/ plant | | 100-seed weight (g) | | Seed weight/ head (g) | | Straw yield/ fed (kg) | | Seed yield/ fed (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 | 2001 | 2002 |
| Plant height | 0.990* | 0.975* | 0.559 n.s | 0.572 n.s | 0.950* | 0.905* | 0.970* | 0.925* | 0.928* | 0.90[illegible]* |
| Number of leaves/ plant | | | 0.916* | 0.872* | 1.00* | 1.00* | 1.00* | 1.00* | 1.00* | 1.00[illegible]* |
| 100 – seed weight | | | | | 0.967* | 0.931* | 0.948* | 0.918* | 0.888* | 0.78[illegible]* |
| Seed weight/ head | | | | | | | 0.993* | 0.964* | 0.834* | 0.75[illegible]* |
| Straw yield/ fed. | | | | | | | | | 0.507 n.s | 0.510[illegible] n.s |

* Significant at 0.05 probability level.
n.s. = Not significant

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# استجابة عباد الشمس للمحاصيل السابقة المختلفة ومستويات السماد النيتروجيني

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## الملخص العربي

تمت دراسة استجابة عباد الشمس لثلاثة مستويات من التسميد النتروجيني (١٥، ٣٠، ٤٥ كجم نتروجين/ فدان) المنزرع بعد بنجر السكر، القمح، القمح + بقايا خضرية لبنجر السكر والفول البلدي بمزرعة محطة التجارب بكلية الزراعة – جامعة الإسكندرية وذلك فى الموسم الصيفي لعامي ٢٠٠١ ، ٢٠٠٢.

ويمكن إيجاز أهم النتائج المتحصل عليها كما يلي :-

- كانت استجابة وزن المائة بذرة ووزن بذور النورة الرأسية ومحصول البذور بالفدان للمحاصيل السابقة معنوية حيث تم الحصول على أعلى قيمة لهذه الصفات بعد محصول الفول البلدي بينما أقلها بعد محصول بنجر السكر.
- أدت زيادة مستوى التسميد النيتروجيني حتى ٤٥ كجم/فدان إلى زيادة معنوية في ارتفاع النبات ووزن المائة بذرة ومحصول البذور بالنورة الرأسية و محصول البذور بالفدان إلا أن هذه الزيادة أدت إلى النقص المعنوي لصافى العائد النقدي لكل وحدة نيتروجين.
- كانت استجابة محصول البذور بالفدان في عباد الشمس للتسميد النتروجينى استجابة خطية عندما تمت زراعته عقب بنجر السكر والقمح، بينما كانت تلك الاستجابة تربيعية عند زراعة عباد الشمس بعد الفول البلدي أو القمح مع التسميد العضوي بمخلفات البنجر، وذلك عند زيادة معدل السماد النيتروجيني أكثر من ٣٠ كجم بالفدان.
- أظهرت معاملات التلازم البسيط وجود علاقة موجبة ومعنوية بين محصول البذور بالفدان وكل من ارتفاع النبات (٠,٩١٨) وعدد الأوراق بالنبات (١,٠٠) ووزن المائة بذرة (٠,٨٣٨) ووزن البذور بالنورة الرأسية (٠,٧٩٩).
- أكدت البيانات التي تم التوصل إليها أن التسميد العضوي من خلال زراعة محاصيل بقولية أو خلط التربة بعروش بنجر السكر حقق زيادة في صافي العائد النقدي لكل وحدة نتروجين وذلك عند زراعة عباد الشمس تحت أقل المدخلات الزراعية (أقل مستويات نتروجينية مثلي)، ربما تساعد تلك الحقائق في تقليل الاعتماد علي الأسمدة النيتروجينية لتحسين البيئة عن طريق تقليل التلوث وحماية صحة الإنسان من مخاطرها.