EFFECT OF NITROGEN LEVELS AND ZINC APPLICATION METHODS ON THE YIELD OF SOME RICE VARIETIES

By

Samy Abd El-Gawad Abd El-Fatah El-Sa'dany

B.Sc. Co-Operative and Agriculture Sciences (1998)
Higher Inst. of Agric. Co-operation
Complimentary studies of Agronomy, Faculty of Agric., Moshtohor, Zagazig Univ., benha Branch (2002)

THESIS

Submitted in Partial Fulfillment of

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OF

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In

Agricultural Science
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Department of Agronomy

Faculty of Agriculture, Moshtohor

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2007

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INTRODUCTION

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INTRODUCTION

Rice (*Oraza sativa* L.) is a major cereal crop in Egypt. Rice crop is widely used for both human and animal feeding. The total cultivated area reached 1.468 million faddan in 2005 season with an average grain yield of 4.195 ton/fed(*).

There has been tremendous increase in rice production in Egypt during the last 15 years (1987-2001). This has been due to both the increase in yield per unite area as well as the increase of total cultivated area. Since 1987, an intensive work has been directed to improve the productivity of this crop to keep up with rapid increasing population. Furthermore, there is a strong competition between rice and other summer crops on the limited amount of irrigation water. Therefore, major emphasis was placed on developing varieties with short growth duration, high yield potentiality and resistance to pests (diseases and insects) with less irrigation water requirements **(Badawy *et al.*, 2002).** Nitrogen fertilizer is one of the most limiting factors for rice production. The amount of N required management of the N varies depending on variety, soil condition, cultural practices, crop rotation and other factors **(Yashoda, 1981)** also nitrogen is an essential fertilizer element to the growth and production of rice plants **(Balal, 1981 and Sombol *et al.*, 1981).**

Low land rice is grown on flat land with controlled irrigation flooding, the soil drastically reduced soil O_2 content and decreases

(*) Agricultural Economics of Egypt, Ministry of Agriculture, 2005.

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several electrochemical changes with influence rice growth and yield **(De Datta, 1981).**

Zinc deficiency is the most common micro nutrient problem in flooded rice particularly in alkaline soil. Zinc deficiency in flooded soil is not necessarily related to the total zinc content of the soil, which is found to rang from 10- 300 ppm, but rather to complex physico-chemical reactions and biological process .the chemistry of flooded soils is very much different from that of non flooded soils. The flooded soils is more solid phases, variables gaseous phases, and various biological components including both micro flora and high -order plants. Each of these phases play an important role in determining the solubility and availability of zinc to the rice plants **(Mikkelson and Kuo, 1970)** the major chemical electro chemical changes in flooded soils are depletion molecular oxygen, decrease in redox potential of the soil increase in pH of acid soils, decrease in pH of calcareous and sodic soils.

Therefore, the present investigation was aimed to study the effect of different nitrogen fertilization levels and zinc methods of application on the productivity of Egyptian rice varieties Giza 177, Sakha 101 and Sakha 104 under normal soil.

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REVIEW OF LITERATURE

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REVIEW OF LITERATURE

Several investigations have been carried out to study the effect of nitrogen levels and zinc application methods and their interaction on the growth, yield and its components and some technological characters of rice crop.

Dey (1980) treated rice plants with zinc sulphate as foliar application. He found that, a significant increases in number of panicles / hill, number of grains/ panicle and grain yield with zinc treatment.

Ibrahim *et al.* (1980) indicated that, a significant increases in rice grain yield was obtained by the application of 60 kg N/fed.

Mawardy *et al.* (1980) pkanted Giza 177 rice cultivar in 1977-78 seasons. They used zinc oxide as seed treatment, soil application and foliar spray. They found that, soil application was highly effective compared with the other two treatments and resulting increasing grain yield ranging from 29.76 to 30.27 ardab / faddan.

Kandil *et al.* (1981) showed that, increasing zinc application significantly increased number of panicles / hell.

Balasubramian (1983) indicated that, the increase in nitrogen supply caused increases in rice yield.

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Jadhav *et al.* (1983) in pot experiments they studied the effect of 0-48 kg $ZnSO_4$/ha applied to the soil or 0-4 kg $ZnSO_4$ foliar applied as on rice yield. They noted that, zinc soil application and foliar spray increasedgrain yield by 11.62-33.36%, respectively.

Sah and Mikkelson (1983) in pot experiments, they studied the effect of three levels of nitrogen fertilization (0.50 and 200 ppm) on rice, they cleared that, growth and nitrogen uptake by rice was increased with increasing rates of nitrogen application.

Sanada and Takkar (1983) studied the effect of zinc application on root depth in soil by concentration of 2 or 4% $ZnSO_4$ suspension, foliar spray of 1 or 2%. $ZnSO_4$, root depth combined with foliar spray and 50kg $ZnSO_4$/ha on the rice applied to the soil before transplanting 7 or 15 day later. They cleared that, grain yield and straw were increased by all methods of zinc application. Maximum yield (4.3t/ha) were obtained by application of Zn in to the soil before transplanting.

Sanchez (1983) found that broadcast application of 6 kg $ZnSO_4$/ha as (a) 4 and 3 kg $ZnSO_4$ as (b) increased paddy yield by 87 and 92% respectively. Foliar application of 630 g $ZnSO_4$/ha as (c) increased paddy yield by 51% and the seed treatment by 67%.

Singh and kumar (1983) investigated the influence of five different levels of nitrogen fertilization i.e.; 0, 29, 58, 87 and 116 kg N/ha. They demonstrated that grain yield increased consistently with increasing N application up to 87 kg N /ha.

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Thind *et al.* (1983) showed that, rice grain yield was increased by increasing nitrogen fertilizer from 60 up to 120kg N/ha.

Westcott and Guice (1983) found that, rice yield and its components were significantly increased by increasing nitrogen fertilizer.

Balasubramaniyan (1984) investigated the variation between short duration varieties i.e.; Cv. ADT31 and ADR36 under 5 different levels of nitrogen application. i.e.; 5, 30, 60, 90 and 120 kg N/ha. He pointed out that, plant height, number of panicles/hill and grain yield increased by N application up to 120 kg N/ha.

Hajra *et al.* (1984) observed that, significant genotypic differences in response to N fertilization for plant height, number of tillers/plant, panicle length, number of grains / panicle and grain yield/plant.

Karacal and Teceren (1984) found that, grain yields were significantly increased by Zn fertilizer. They also found that, the highest yields were obtained with 60 kg $ZnSO_4$/ha (5.7 and 4.25 t grain / ha in 2 yr) and with $ZnSO^4$ and 7.5t /ha).

Kumar and kandasamy (1984) studied the different levels of nitrogen fertilization i.e.; 0,60.90 and 120kg N /ha on grain yield of rice Cv. IR 20, they found that, grain yield increased with increasing nitrogen rates from zero up 120 kg N/ha .

Obcema *et al.* (1984) indicated that rice yields increased with increasing N application from 0 to 224 kg N /ha .

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Otoo *et al.* (1984) investigated the effect of three levels of nitrogen fertilization (2,8 and 169 kg/ha) on two Indica and two Japonica varieties in 1981 and four Indica and three Japonica varieties in 1982 were grown in pots. They observed that Japonica varieties had higher values for increase in grain yield. On the other hand, Indica varieties tended to have higher values for increase of leaf area, total plant weight and number of tillers, total number of spikelets per pot increased more in japonica than in indica varieties with increased N supply.

Rana *et al.* (1984) showed that, rice grain yield increased and N uptake were significantly increased up to 120 kg N/ha.

Saha (1984) applied three levels of nitrogen fertilization on rice i-e; 0,54 and 81kg N/ha. He concluded that, the highest paddy of 4.2 and 5.23t/ha at the two last N rates, respectively compared with 2.1 ton/ha without nitrogen fertilization.

Singh and Singh (1984) found that, application of 29-87kg N/ha as urea super granules (USG) and S-Coated urea (SCU) before transplanting gave paddy yields of 3.7 and 3.69 t/ha, resp., compared with 3.56t with urea in 3 split dressings 3.45 t with urea at transplanting only and 3.25 t with S-coated urea at transplanting.

Ali (1985) noted that, grain yield was increased by increasing N application up 124 or 155 kg N/ha.

Barnes (1985) studied the effect of 3 rates of nitrogen application 66.88 and 132kg N/ha for rice Cv. Bluebonnet 50 as

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ammonium sulphate He showed that, the highest grain yield was obtained at 132 kg /ha.

Kolhe and Mittra (1985) found that, yields ranged from 2.3t/ha with no applied N to 4.4t/ha with 120 kg /ha.

Khlyupina *et al.* (1985) found that, zinc application to the soil gave higher rice yields than soaking seeds for 1h in a zinc solution sulphate. They also pointed out that, increasing Zn concentration from 0 to 0.15 % increased germination from 83 to 89%. On the other hand, yields were up to 13.3% higher with 25g Zn /t seed than with NPK alone. Under forming conditions application of 50g Zn/t seed gave optimum yields of 4.24t compared with 3.79t/ha for the control.

Shaalan *et al.* (1985) found that, increasing nitrogen fertilizer up to 144 kg N/ha significantly increased yield components.

Alagarsamy and Bhaskaran (1986) found that, $ZnSO_4$ gave the highest grain yield compared with no Zn application.

Bansal and Patel (1986) reported that, rice yield increased with zinc application compared with the control (no zinc application).

Chavan and Gupta (1986) found that, dipping seedling roots in 1% ZnO or $ZnSO_4$ suspension for one h before transplanting or soil application of 5 ppm Zn or cu significantly increased paddy yield.

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Jakhro (1986) studied the effect of four levels of nitrogen application in pots (0,1,2,3 g N/pot) for three rice Cvs. He indicated that, significant differences in DM production and grain yields occurred between different N treatments and Cv. MR7 had the highest DM production and grain yield. Grain yields decreased at rates >1g N/ pot. The highest grain yield N accumulation at 1g N/pot was 0.45 g N / plant for Cv. IR 36.

Kanade and kalra (1986) studied the effect of three different levels of nitrogen application on rice Cv. Mahsuri i.e., 50, 100 and 150 kg N/ha. They demonstrated that grain yields was 3.89, 4.33 and 4.98 t/ha respectively.

Karacal and Teceren (1986). Applied 30-60 kg $ZnSO_4$ /ha basally, 1% $ZnSO_4$ solutions was foliarly applied or as a seed sook, 1% Zn- EDTA was applied foliarly and ZnO was applied as a seed coating to rice Cv. Ribe. They noticed that, mean yield ranged from 4.5 t/ha with no Zn to 5.8 t with 1% Zn- EDTA.

Khader *et al.* (1986) treated rice plants with 60-120 kg N/ha as urea briquettes or neem cake-coated urea applied by different methods in a single or 2 split dressings gave the highest paddy yields of 5.67-5.85 t/ha with 60-90kg N as urea applied with a drilling.

Maskina and Randhawa (1987) found that, the highest yields were obtained by dipping seedlings in Zn solution in the 1st year, and by applying Zn to the nursery soil in the 2nd year.

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Singh *et al.* (1987) indicated that, rice yield increased with increasing Zn application - Rice yields (3-4t /ha) were obtained with 10 kg Zn followed by foliar Zn application 2 weeks after transplanting.

Taher *et al.* (1987) investigated the effect of 5 different levels of nitrogen fertilization i.e., 0, 29, 58, 87 and 116 kg N/ha. They observed that, N application increased average grain yield from 4.4 to 5.8 t/ha in respective of N sources or rate mainly as a result of increased panicle number.

Throat and Patil (1987) investigated the effect of different levels of nitrogen application on 5 early maturing rice Cv. They detected that, increasing N rates from 0 to 60 and 120 kg N/ha increased the average of paddy yields from 1.9 to 2.9 and 3.7t and the total N uptake from 20.4 to 46.1 and 69.5 kg /ha respectively.

Abd-El-Hadi *et al.* (1988) sprayed rice plants with (Zn, Mn and Fe). They found that, the increase in grain yield ranged from 1-15%.

Aidy *et al.* (1988) found that, increasing of nitrogen application increased rice yield.

Dilday (1988) studied the effect of different levels of nitrogen fertilization i.e.; 0,135 and 180 lbN / acr in a single dose before flooding or in 3 or 6 split deses, in two cultevars (lemontand Newbannent). Data pointed out that, N application reduced the percentage of whole grains after miling in both years in lemont and

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in 1987 in the second year in Newbonnet. N application increased head rice percentage in both seasons.

Hernandez *et al.* (1988) treated plants rice Cv. Amisted-82, 16.4 kg Zn/ha as a zinc sulphate soil-applied after sowing or as a foliar spray of 0.1 % Zn as zinc sulphate solution, or 1 or 2 % Zn lignosylphate (chelate) solution. They observed that, grain yield was greates (approc. 6t/ha) with Zinc sulpate applied to the soil. On the other hand, the number of panicles (378 - 468/m^2) and 1000 grain – weight) were not significantly affected by treatment. Also, the numbers of filled grains/ panicle was greatest with soil applied zinc sulphate and least with 2% zinc lingo sulphate solution.

El-Kalla *et al.* (1988) observed that, grain yield was increased by in creasing nitrogen fertilization up to 75 kg N/fed.

Reddy *et al.* (1988) evaluated 8 varieties under different levels of nitrogen application. They reported that the grain yield and dry matter of all varieties increased with N fertilizer (0 or 40 kg N/ha 0) on the other hand, the varieties capable of producing higher grain yields in response to N fertilizer in semideep water.

Shad *et al.* (1988) found that, N application increased grain yield from 2.9 t in the unfertilized control to 5.4 t from 163 kg N/ha from broodcasting sulpher-coated urea.

Bansal and Nayyar (1989) found that, grain yield increased with in creasing Zn rate up to 7.1 and 7.6 t/ha with / $ZnSO_4$ and Zn. EDTA, respectively, applied to the soil and up to 6.2 and 6.0 t with $ZnSO_4$ and Zn. EDTA, respectively.

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Jeyaraman and Ramiah (1989) gave 0 or 10 ton FYM/ha and NPk, soil application of 20, 40 or 60 kg N/ha as diammonium phosphate coated with 2.4 or 6% $ZnSO_4$or ZnO or dipping seedling roots in 2% Zn0 or foliar applications of 2% decreased seed sterility from 17-9% without Zn to 12.0 -16.3 % and increased paddy yields from 5.67 to 6.05-7.78 t/ha in the kharif. The treatments decreased spikelet sterility from 20.3 % to 15.4% - 18.6% and increased yields from 3.80 to 4.39- 6.22 in the rabi season, as well as, application of 6% Zn0- DAP was mast affective in decreasing spikelet sterility and increasing yields.

Sarkar *et al.* (1989) found that, applying Zn to the nursey soil or dipping seedling roots in 0.2% $ZnSO^4$solution with and without 1 foliar spray of Zn gave yields of 6.3 - 7.0 t/ha.

Sharma and Agarwal (1989) applied 60 kg N/ha in 2 forms and 1-3 split dressings. They showed that paddy yield was 5.08-6.51 t/ha at 60 kg N/ha compared with 4.71/ha without N application.

Weels *et al.* (1989) evaluated four cultivars of rice (Newbonnet, lemont, Tebonnet and Mnars) were grown at 3 locations and given 0,40,80,120 and 160 lb N/ acre before flooding and 0,30,60 and 90 lb N/ acre in mid season. They detected that there were significant grain yield increases for all 4 cultivars for N applications.

Hassan *et al.* (1990) reported that, increasing nitrogen rates from 15 to 45 kg N/ha significantly increased fresh weight.

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Maji and Band Yopadhyay (1990) found that, soil or foliar applications of 6 or 12 kg Fe, 9.7 or 19.4 kg Mn, 6.8 or 13.6 kg Zn and 5 or 10 kg Cu / ha had no effect an DM or grain yields or on Fe, Zn or Cu contents of the straw.

Mostafa (1990) studied the effect of different application methods i.e; 10kg $ZnSO_4$ 7 H_2O / feddan as a soil application at 40 days after sowing, foliar application of 0.75% $ZnSO_4$. H2o and foliar application of tire " Gala fertile / fadan (12% N, 4% P_2O_5, 3% K_2O, 3% 5, 0.1% Fe, 0.12 % Mn, 0.12% Zn and 0.05% Cu) at 50 day after sowing. He showed that, both application methods at 40 and 50 days after sowing were 3.40, 2.45 and 2.80t / feddan, respectively compared with 2.12 t without fertilizer.

Saraswat and Bansal (1991) found that, the highest rice grain yield was obtained with soaking seedlings (7.0 and 5.2t / ha in the first and second season respectively).

Abd-El-Rahman *et al.* (1992) observed that, increasing nitrogen rate from 0 - 40 kg N/ fed. Significantly increased rice grain yield.

Assey *et al.* (1992) indicated that, increasing nitrogen fertilizer puches rice plant to vegetative growth.

Ghanem *et al.* (1992) found that, zinc soil application, seed coating and seed soaking were yielded rice straw and grain more than spraying zinc in maximum tillering stage. However, differences between the three methods of applications were insignificant.

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Molina and Cabalceta (1992) showed that, application of 0.5 kg $ZnSO_4$ in a foliar spray (10% Zn) significantly increased grain yield by 22% from 4.65 to 5.67 t/ha.

Sharma and Reddy (1992) applied 0, 20 and 40 kg N/ha on three cultivars i.e; Utkalprabha (semi -yall), CR292 - 8051 (intermediate tall) and Fayatri (semi - dwarf). The tall cultivars performed better than the dwarf type but grain yield decreased with delay in sowing. Data presented pointed out that application of N fertilizer up to 40 kg N/ha proued beneficial to the crops sown April and May.

Srivastav *et al.* (1992) studied the effects of $ZnSO_4$ (20 kg /ha soil applied or 5 kg /ha as a foliar spray) and chelated Zn (1 kg /ha soil applied or 500 gm/ha as foliar spray) on rice Cv. IET 4094. They observed that, all Zinc compuned in both application methods yield and Zinc uptake were highest when chelated Zn was applied. Soil application of chelated Zn gave the highest yield of 6.9t/ha .

Korayem (1993) applied Zinc fertilizer to rice seedlings in the field in two methods i.e.; seed soaking and surface broadcasting. He cleared that, both application methods increased rice grain yield but the increase was only significant with the seed soaking which gave a mean increase in grain yield.

Sakal *et al.* (1993) indicated that, yield was highest (5.41 t/ha) with 25 kg $ZnSO_4$ /ha applied at transplanting. On the other hand, applying some of the Zn at tillering or panicle initiation, or using $ZnSO_4$ as foliar spray, decreased rice yield compared with basal application.

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Dixit and Khanda (1994) gave rice Cv. Sarathi $ZnSO_4$ or Zn. EDTA as soil or foliar applications and 0-90 kg N/ha Grain yield and net returns were highest with N + Zn application, increased with rate of N application and were higher with $ZnSO_4$ as a soil applications.

Khanda and Dixit (1995) found that, grain yield increased with increasing N rate from (0 to 60 kg N/ha). Grain and straw yields were further increased by foliar or soil application of Zn.

Ram *et al.* (1995) applied 40 kg $ZnSO_4$/ha basally or top dressed, or 1, 3 sprays of 0.5 $ZnSO_4$ solution with or without 20 kg $ZnSO_4$ applied basally. They seem that, grain yield was 2.7 t/ha without applied Zn and 3.3-4.0 t/ha in the fertilizer treatments, with the highest yield given by 20kg $ZnSO_4$+ 3 kg foliar applications.

Perez *et al.* (1996) found that, increasing nitrogen levels increased milled and head milled rice %.

Binod-Kumar *et al.* (1996) applied 0, 12.5 and 25kg $ZnSO_4$/ha in a nursery or seedling were sprayed with 0.5 % $ZnSO_4$ or seedling were dipped into 2% $ZnSO_4$ solution before transplanting. Alternatively, 0-25kg $ZnSO_4$ was applied to the transplated crop or 0.5% was $ZnSO_4$ sprayed 3 or 3 + 5 weeks after transplanting. They observed that, dipping the seedlings in 2% $ZnSO_4$ solution gave a high yield (5.15t/ha) as the soil application of 25kg $ZnSO_4$ (5.16t/ha) or spraying 0.5% $ZnSO_4$ once (5.22t/ha) or twice (5.19t/ha) to the transplated crop. The other treatments gave significantly lower grain yields.

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Khanda and Dixit (1996) investigated the effect of 2 sources of zinc ($ZnSO_4$ and Zn- EDTA), 2 methods of application (soil and foliar) and 4 levels of nitrogen (0, 30, 60, 90 kg/ha) applied to rice Cv. Sarathi. They pointed out that, rice yield increased with increasing N rate. On the other hand, combined application of zinc and nitrogen increased grain yield by 7.2% compared with nitrogen alone. Economic return was increased by combined with N and Zn application.

Ladha *et al.* (1996) showed that, increasing nitrogen levels, increased number of days to heading, plant height in rice plants.

Binod-Kumar *et al.* (1997) gave rice Cv. Sita 0,12.5 or 25 kg /ha $ZnSO_4$ by soil application in the nursery or three week old seedlings were sprayed with 0.5% $ZnSO_4$ or seedling roots were dipped in 2% ZnO solution. After transplanting, the rice crop was given 0, 12.5 or 25 kg $ZnSO_4$/ha, or seedlings were sprayed with 0.5% $ZnSO_4$ at 3 or 3+5 weeks after transplanting of the nursery treatments, dipping roots in Zn o gave the highest Zn concentration at all growth stages.

Binod-kumar *et al.* (1998) noticed that, best results were obtained with application of 25 kg $ZnSO_4$/ha to transplanted plants, spraying with 0.5% $ZnSO_4$ solution 3 weeks after transplanting or dipping seedling roots in 2% ZnO suspension.

El-Wehishy and Abd El-Hafez (1998) studied the effect of three levels of nitrogen fertilization i-e; 40,60 and 80kg/fed. They observed that, application of 60kg N/fed, resulted the highest value in panicle length, number of spiklets / panicle / percentage of

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unfilled grains per panicle, grain weight per panicle, biological, Straw and grain yields. While, the highest of 1000 grain weight and harvest index were obtained at application of 40kg N/fed. On the other hand, increasing N fertilization increased plant height, panicle length, percentage of unfilled grain per panicle.

Hernandez *et al.* (1999) treated rice Cv.J-104 with 0.1-1.0% Zn as seed treatments or 74.5 kg Zn /ha was applied to the soil. They pointed out that, seed treatment gave higher yields than soil application.

Slaton *et al.* (1999) indicated that, Zn applied either to seed or soil tended to increase grain yields. Additionally, application of Zn to rice seed significantly increased seedling tissue Zn concentration compared to that of the untreated control.

Ebaid (2000) concluded that, increasing nitrogen fertilization increased plant height, panicle weight, 1000 grain weight, panicls/m^2 and straw and grain yields.

Ebaid and Ghanem (2000) reported that, increasing nitrogen levels up to 144kg N/ha significantly, increased plant height, panicle length, total biomass, grain yield and its components as well as harvest index.

Ebaid *et al.* (2000) showed that, grain yield and its components significantly increased as N level increased up to 138kg N/ha. Application of nitrogen alone or with farmyard manure (FYM) caused a significant increase in L.A.I. Harvest

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index significantly reduced with the application of either nitrogen alone or nitrogen with F.Y.M.

Ebaid and El-Hissewy (2001) studied the effect of 4 different levels of nitrogen fertilization i-e; 0,55,110 and 165 kg N /ha on rice cultivar Sakha 101. They showed that, increasing nitrogen up to 165 kg N/ha significantly increased hulling%, milling % and head rice %.

Ebaid and Shehata (2001) treated some rice cultivars namely, Giza 176, Giza 177, Giza 178, Sakha 101, Sakha 102, Sakha 103, sakha 104, Giza 181, Giza 183 and Egyptian yassmine with zinc fertilizer as a foliar application. $ZnSO_4$ was used with the rates of (0, 2 and 4%) as a foliar application two weeks after transplanting. They observed that, increasing zinc rates as foliar application from 0 to4% significantly increased days to heading, number of panicles/hill, number of grains/panicle, 1000-grain weight, grain yield/hill.

Lora *et al.* (2002) found that, the best effect on yield was observed at 16 kg $ZnSO_4$ /ha for rice Cv. R-I, selecta and tailandia III. A significant effect on number of grains/ panicle and seed weight.

Khan *et al.* (2003) investigated the comparative effect of 3 different methods of Zinc application on Cv.IRRI.6 in calcareous soil. Three methods were used, i.e.; nursery root dipping in 1% $ZnSO_4$ 0.20% $ZnSO_4$ solution spray after transplanting, and 10kg Zn /ha by field broadcast method. They observed that, the yield and yield parameters increased significantly for all the methods. Among

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the methods used the effect of zinc was insignificant on yield components like tillers m^2, spiklets/panicle, filled grain%, 1000 grain weight and straw yield. However, soil application of $ZnSO_4$ at 10kg/ha produced higher paddy yield.

Das *et al.* (2004) they treated rice plants was Zn EDTA with the rate of 0.05 % twice as foliar application. They found that, increasing Zn content uptake furthermore, increases in both grain and straw yields.

Ebaid (2005) studied the effect of four nitrogen levels (0, 48, 96 and 144 kg N/ha) and three methods of zinc application (seed soaking, soil and foliar spray) on the performance of Sakha 104 rice cultivar. He pointed out that increasing nitrogen levels up to 144 kg N/ha number of delayed to 50% heading by increasing vegetative growth period and significantly increased plant height, yield and its components and chemical composition of rice grains (N%, protein %, Zn% and zinc uptake by rice grain). On the other hand, the rate of 96 kg N/ha was adequate for the highest harvest Index%.

Ebaid and El-Rewainy (2005) studied the effect of five different levels of N fertilization i.e.0, 69, 92, 115 and 138kg N/ha on eight rice cultivars, i.e. Giza 177, Giza 178, Giza 182, Sakha 101, Sakha 102, Sakha 103, Sakha 104 and Egyptian yassmine. They found that, increasing nitrogen levels up to 138 kg N/ha significantly increased number of days to 50% heading, plant height, while, 115kg/ha was adequate for yield and its attributrs such as number of productive tillrs/hill, panicle weight, number of fielled grain/ panicle, straw and grain yield, 1000 grain weight, and

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harvest index%. They olso faund that, Giza 178, Sakha 101 and Egyptian Yasmine recorded the highest values of agronomic efficiency under 69 kg N/ha

Ebaid and Shebl (2006) studied the influence of four different levels of nitrogen fertilization i-e. 0, 46, 92 and 138kg N/ha as a urea form 46% N. They showed that, increasing nitrogen levels up to 138kg N/ha significantly increased plant height, panicle weight, number of grains / panicle, 1000 grain weight, plant biomess and grain yield. The rate of 92kg N/ha was suitable for the highest values of number of panicles/m^2 and harvest index.

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MATERIALS AND METHODS

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MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm of Etai El-Baroud Agricultural Research Station. (Behaira Governorate) -Agricultural Research Center (ARC) during 2003 and 2004 seasons to study the effect of nitrogen levels and methods of zinc application on the productivity of Giza 177, Sakha 101 and Salha 104 rice varieties.

Rice varieties.

The three rice varieties which used in this work were Giza 177, Sakha 101 and Sakha 104 as presented in Table (1).

Table (1): Types and some important characters of rice varieties under study.

Rice varieties	Type	Parentage	Duration period (day)	Grain type
Giza 177	Japonica	Giza171/ yomji No/piNo.4	125	Short
Sakha 101	Japonica	Giza176/milyang79	140	Short
Sakha 104	Japonica	G Z4096-8-1/GZ4100-9-1	135	Short

Nitrogen levels and methods of zinc application were tested under manual transplanting.

Soil samples from the experimental sites were collected from 0 to 30 cm depth and composite sample were done, air dried and ground to pass a 2mm sieve. Sub samples were taken into the laboratory and prepared prior to chemical analysis in Rice Research

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and Training Center Lab., Sakha, Kafr El-Sheikh- Egypt according to **Black *et al.* (1965)** as shown in Table (2).

Table (2) : Soil chemical properties of the experimental sites .

Characters	2003	2004
1- EC (dS / m*)	2.6	2.5
2- pH	8.3	8.2
3- OM %	3.16	3.17
4- Total N%	0.25	0.31
5- Available P (ppm)	36	26.5
6- Available K (ppm)	892	784
7- Available Zn (ppm)	1.8	1.7
8- total soluble salts (mg/L)	10.4	10.3

EC: Electrical conductivity measures as dS/m i.e., Decisiemens / m, i.e. mmhos/cm/25°C

1- Nitrogen levels and zinc applications

Transplanting is the common method of rice planting in Egypt. About 80% of the rice growers are very much customized for this method, in transplanting method, farmers are save water for almost one month (nursery) besides less weed infection is occurs compared with the direct seeding methods.

Under this method of planting, two field experiments were conducted through two season to study the response of Giza 177. Sakha 101 and Sakha 104 rice varieties to nitrogen levels and zinc application can be effectively used under this method. The experiments were condueted as follows.

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A. Raising nursery:

Seedlings were raised in a well prepared seed bed. The seed bed was tillage three times then dry and water leveled. Phosphorous at the rate of 36 kg P_2O_5 / ha (15kg P_2O_5 / fed).

Seeds of Giza 177, Sakha 101/ and Sakha 104 at the rate of 143 kg / ha were soaked in enough water for 24 hour and incubated for 48 hours to enhance germination. Pregerminated seeds were uniformally broadcasted into the seed bed on the 20th of May in both seasons.

Herbicide (Saturn 50%) at the rate of 5 liters / ha (2L/ fed) mixed with enough sand to make it easy for homogenous distribution, and was applied 7 days after seeding. The herbicide was applied into 2 cm water depth and kept without to increase the flushing until all the water in the nursery was absorbed efficiency of the herbicide for controlling weeds. Nursery watered to keep water stand at 5 cm depth. Rice seedlings were carefully pulled from the nursery after one month from seeding then, transferred to the permanant field.

Nursery zinc application methods .

Zinc sulphate ($ZnSO_4$-$7H_2O$) was used as zinc source (22%).

Three zinc application methods were used namely.

1- Seed soaking at 1% $ZnSO_4$ concentration.

2- Soil application. Zinc sulphate was applied just before seed broadcasting with the rate of 22 kg / ha.

3- Foliar application 1% zinc sulphate 15 days after sowing.

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B. Permanent field preparation:

Permanent field was mechanically tillage three times and dry leveled. Phosphorous at the rate of 36.5 P_2O_5 / ha (15kg P_2O_5 / fed) was broadcasted on the dry soil and incorporated into the dry soil.

The experimental site was divided into 36 plots with 3x5 m in dimension, seprated by ditches and levels with three replications.

Four levels of nitrogen fertilizer namely zero. 110, 165, 220 kg N / ha, in urea form (46.5% N) were applied two splits (2/3) basally and incorporated into the dry soil and (1/3), 7 days before panicle initiation according to each variety. All plots were floded and leveled in the presence of water.

Three seedlings 30 days old were transplanted into the plots at 20x20 cm spacing between rows and hills to give 25 hills/ m^2.

Thiobencarb (Saturn 50%) at the rate of 5 L/ ha was applied 5days after transplanting for weed control.

All plots were continuously flooded with 7-10 cm water depth along the season except at the time of the second dose of nitrogen application .

Plots were drained for 4 days then reflooded after broadcasting the second nitrogen fertilizer dose.

All other cultural practices were done as recommended. Fifteen days after maturity, all plots were flushed, irrigation was stopped two weeks before harvesting to facilitate harvesting process.

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C. Experimental Design :

Treatments were arranged in a split-split-plot design with three replications in the two seasons of study.

Whereas, the main plots were designated for rice varieties, while sub-plots were designated for nitrogen levels and sub-sub-plots were designated for zinc application methods.

Studied characters

A) Vegetative growth characters

1- Plant height (Cm).

The height of the main stem was measured at harvesting from the soil surface to the top of the main panicle.

2- Flag leaf area :

At heading time plant samples (5 hills / each sub- sub plot) were randomly collected and flag leaf area was determined (maximum leaf length x maximum leaf width x 0.75) **(Yoshida, 1981).**

3- Crop Growth rate (CGR) :

Its defined as the dry matter increase with time **(Radford 1967)** using the formula.

CGR = (w2 - w1) / (T2 - T1) g / hill / day .

Where: w1 and w2 refer to total dry weight at time T1 and T2, respectively.

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4- **Shoot - Root. Ratio at heading :**

At heading time 3 hills from each sub plots were colleated to determining shoot root ratio in dry weight.

5- **Number of days to 50% heading :**

Number of days to heading were recorded as the number of days from sowing to 50% of heading for each sub-sub-plot.

6- **Root depth at heading (cm) :**

Five hills from each sub plots were pulled with roots at heading time, then carefully washed and the depth of roots was measured by (cm).

B) Yield and its components :

1- Number of panicles / hill :

Seven days before harvesting, number of panicls was counted in ten random hills in each sub- plot .

2- Number of filled grains / panicle .

Ten panicles were randomly collected from each sub-plot and the average of filled grains per panicle was calculated.

3- Panicle length (cm):

Average of panicle length was measured in centimeters using ten randomly from each sub-sub-plot and results were recorded.

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4- Panicle weight (g):

Ten panicles were randomly collected from each sub-sub-plot and actual weights were determined, then the average of each sub-sub-plot was recorded.

5 -1000 - Grain weight (g):

Thousand of rough grains were picked at random from each plot at the time of harvesting and weighted to the nearest 0.01g and the average of the treatments was recorded.

6- Biological and grain yields (ton / ha):

Ten square meters from the center of each sub-sub-plot were manually harvested and air- dried, bundles were weighted. Then mechanically threshed and total grain was recorded. Total grain weight was adjusted to 14% moisture content. Grain and straw yield then were transformed as ton per hectare.

7- Harvest index (HI) :

Harvest index was determined according to the following equation.

$$H.I = \frac{\text{Grain yield (Economic yield)}}{\text{Above ground biomas (biological yield)}} \times 100$$

As reported by **Yoshida (1981).**

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C) Grain technology characters:

1- Hulling percentage:

Hulling percentage was determined by dehuling of 100 g of grains selected randomly from each plot by means of huling machine. The brown rice weight was estimated as a percentage of the total Weight of the 100 g.

2- Milling percentage:

The milled rice percentage was determined by milling 100 g brown rice by experimental milling machine. The total milled rice was computed as a percentage relative to the total weight.

3- Head rice percentage:

Weight of unbroken grains were taken and computed as percent from the total weight of the rough rice **(Julliano and Villarel, 1981)**.

Statistical analysis:

Analysis of variance for the studied characters were done according to procedures of **Gomez and Gomez (1984).** Differences among treatment means were compared using the L.S.D and 0.05 level of significance.

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RESULTS AND DISCUSSION

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RESULTS AND DISCUSSION

The present study aimed to investigating the N fertilizer (0, 110, 156 and 220 kg N/ha) and three methods of zinc applications (seed soaking, soil and foliar applications) on some growth characters, heading dates, grain yield and its components of three varieties of rice (Giza 177, Sakha 101 and Sakha 104). Also, some grain technology characters as affected by N, method of zinc applications and varieties were studied. The interaction effects of the three experimental factors on the studied traits were considered.

I- Vegetative growth characters:

The effect of nitrogen levels and zinc methods of application on Giza 177, Sakha 101 and Sakha 104 rice varieties in 2003 and 2004 seasons are presented in tables (3 and 4).

1- Plant height (cm):

1-a- Effect of rice varieties.

Data in Table (3) indicated that, Sakha 104 rice variety recorded the tallest plants followed by Giza 177 while, Sakha 101 recorded the shortest plants in 2003 and 2004 seasons, respectively. These data could be attributed to the rice varieties it self as genetic character.

1-b- Effect of nitrogen levels.

Data in Table (3) showed that increasing nitrogen levels from 0 to 165 kg N /ha significantly increased plant height regardless rice varieties, whereas no significant differences between

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165 and 220 kg N / ha in this character in both seasons. This increase in plant height may be due to the role of nitrogen fertilizer in cell division and elongation and merestimatic activity in plant organs. These data are agreement with those reported by **El-Wehishy and Abd El-Hafez (1998), Ebaid (2000) and Ebaid *et al.* (2000).**

1- c- Effect of zinc treatments:

Results in Table (3) showed also that, no significant effect due to zinc methods of application on plant height in both seasons. **Ghanem *et al.* (2002)** found that, the differences among all methods of Zn application were significantly all most traits studied.

2- Flag leaf area (cm^2).

2-a- Effect of rice varieties:

Data in Table (3) showed also that, no significant different between Giza 177 and Sakha 104 rice verities in both seasons in flag leaf area. On the other hand, there is a significant effect between Sakha 101 rice variety and the other two varieties in both seasons. Differences among rice varieties in most growth characters were also reported by **Ebaid and Shehata (2001).**

2-b- Effect of nitrogen levels:

Flag leaf area was affected significantly with increasing nitrogen application up to 165 kg N/ ha, Table (3). Data showed that, no significant different between 165 and 220 kg N / ha in both seasons on flag leaf area regardless rice verities. **Ebaid *et al.* (2000) and Ebaid (2005)** found the same trend.

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Table (3): Effect of nitrogen levels and method of zinc application in some rice varieties on vegetative growth characters in 2003 and 2004 seasons.

Characters / Treatments	Plant height (cm)		Flag leaf area (cm)		Crop Growth Rate (g / day)	
	2003	2004	2003	2004	2003	2004
A- Varieties						
Giza 177	91.40	100.50	20.55	21.80	1.59	1.51
Sakha 101	81.25	91.61	18.67	20.59	1.95	2.45
Sakha 104	94.36	106.56	21.62	23.16	2.84	3.43
L.S.D 0.05	**1.92**	**2.25**	**1.88**	**1.98**	**0.11**	**0.13**
B- N levels kg / ha						
0	83.44	92.15	17.71	21.20	1.35	1.72
110	88.15	102.85	20.05	28.43	1.88	2.32
165	93.56	105.15	23.66	30.78	2.33	2.64
220	93.89	106.07	24.96	30.99	2.87	3.07
L.S.D 0.05	**1.25**	**2.09**	**1.65**	**1.63**	**0.18**	**0.12**
C- Zinc application						
Soaking	88.47	101.94	20.52	26.57	1.74	2.13
Soil application	88.61	101.42	21.42	27.72	2.30	2.55
Foliar spray	89.94	101.31	22.31	28.26	2.39	2.56
L.S.D 0.05	**N.S**	**N.S**	**1.35**	**1.27**	**0.19**	**0.11**

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It could be concluded that the application of N had a positive effect on flag leaf area of rice plant which indicates the vital role of N in plant growth. The encouraging effect of N on the vegetative growth of rice plant is clearly illustrated. The results are also good manifestation of the role of N as an essential element for all plants in general and cereal in particular.

2-c- Effect of zinc treatments:

Data in Table (3) indicated that, a significant effect due to zinc methods of application on flag leaf area in both seasons. Seed soaking method recorded the lowest value while, no significant different between the other two methods.

3- Crop Growth Rate (CGR).

3- a- Effect of rice varieties:

Data in Table (3) summarized the differences among the three rice varieties in crop growth rate in 2003 and 2004 seasons. Sakha 104 recorded the highest rate 2.84 and 3.43 g/day in 2003 and 2004, respectively, Giza 177 recorded the lowest rate 1.59 and 1.51 g / day in the two seasons, respectively. While, Sakha 101 rice variety was intermediate, these results could be attributed to the growth force of the rice variety it self.

3- b- Effect of nitrogen levels:

Data in Table (3) indicated that, increasing nitrogen levels up to 220 kg N / ha significantly increased crop growth rate in both seasons compared with the control (no nitrogen added) this result could be attributed to the role of nitrogen fertilizer in enhancing tillering ability in rice crop. This result was agreement with the data which reported by **Ebaid and El-Rewaniy (2005)**.

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3-c- Effect of zinc treatments.

Foliar spray of 1% $ZnSO_4$ solution and soil application of 22 kg $ZnSO_4$ / h produced the highest value of CGR (g/day) in rice in 2003 and 2004 seasons. However, the difference between the methods of application in CGR was insignificant. On the other hand, seed soaking at 1% $ZnSO_4$ solution gave the lowest one. This was true in both seasons.

Interaction effect :

A- varieties X Nitrogen levels interaction .

Data in Table (4) summarized the interaction effect between three tested rice varieties Giza 177, Sakha 101 and Sakha 104 under 0, 110 and 220 kg N / ha on plant height, flag leaf area in 2003 season while, no significant effect due to the interaction was decayed in 2004 seasons. Also data showed that a significant effect due to the interaction on crop growth rate in both seasons (2003 and 2004).

A- a- Plant height.

Data in Table (4) indicated that increasing nitrogen levels up to 220 kg N / ha increased plant height in the three rice varieties in 2003 season. Data indicated also that, 110 kg N / ha nitrogen level was adequate for Giza 177 because no significant different between 110 kg N / ha 165 and 220 kg N / ha. concerning Sakha 101 and Sakha 104 rice varieties, data showed that 165 kg N / ha was the best nitrogen rate for plant height (83.8 and 98.8 cm) respectively, whereas no significant different between 165 and 220 kg N / ha on this trait.

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Table (4): Plant height (cm) flag leaf area and crop growth rate as affected by the interaction between rice varieties and nitrogen levels in 2003 and 2004 seasons.

Characters / Rice varieties	Plant height (cm)				L.S.D 0.05	Flag leaf Area (cm^2)				L.S.D 0.05	Crop growth Rate (g / day)				L.S.D 0.05
	N levels Kg / ha					N levels Kg / ha					N levels Kg / ha				
	0	110	165	220		0	110	165	220		0	110	165	220	
2003															
Giza 177	85.3	90.8	91.1	92.6	2.16	18.40	22.84	25.41	27.54	2.98	0.90	1.50	1.76	2.18	0.31
Sakha101	77.8	80.0	83.8	84.4		17.63	18.06	18.90	20.88		1.17	1.82	2.04	2.57	
Sakha104	87.2	93.9	98.8	98.9		16.11	19.25	24.67	26.45		1.98	2.32	3.19	3.87	
2004															
Giza 177											0.95	1.19	2.09	2.79	0.20
Sakha101											1.30	2.97	2.55	2.76	
Sakha104											2.19	2.99	4.48	4.56	

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A- b- Flag leaf area.

Data in Table (4) showed that, the lowest flag leaf are was 16.11 cm in Sakha 104 rice variety under zero nitrogen level and the highest value was 27.54 cm in Giza 177 under 220 kg N / ha. Data showed also that 165 kg N / ha was adequate level for the highest flag leaf area in the three rice varieties.

A-c- Crop Growth Rate (CGR).

Data in Table (4) indicated that a significant effect due to the interaction between rice varieties and nitrogen levels in 2003 and 2004 seasons. Data indicated that increasing nitrogen levels up to 220 kg N / ha significantly increased crop growth rate in the three tested rice varieties in 2003 season. The same trend was detected in 2004 season. whereas 2.79, 2.76 and 4.56 g / day was recorded for Giza177, Sakha 101 and Sakha 104 respectively under 220 kg N / ha.

B- Nitrogen X Zinc application methods interaction :

B- a- Plant height (cm) .

Data in Table (5-a) summarized the effect of the interaction between nitrogen levels and zinc methods of application on plant height (cm) in 2003 season. Data didn't show any significant effect on this trait in 2004 season.

The lowest plant height was observed when rice plant sprayed with zinc sulphate were observed under 220 kg N / ha.

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Table (5-a): Plant height (cm), flag leaf area and crop growth rate as affected by the interaction between nitrogen levels and zinc methods of application in 2003 and 2004 seasons.

Characters / N. levels Kg/ha	Plant height (cm)			L.S.D 0.05	Flag leaf area (cm^2)			L.S.D 0.05	Crop growth Rate (g / day)			L.S.D 0.05
	Zinc treatments				Zinc treatments				Zinc treatments			
	soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray	
2003												
0	82.2	81.4	80.7	2.95	22.1	22.1	19.36	3.31	0.98	1.31	1.75	0.38
110	88.3	88.9	87.2		31.5	25.5	28.3		1.77	2.11	1.76	
165	90.0	91.7	90.0		30.5	36.9	30.9		1.62	2.98	2.37	
220	93.3	98.5	95.8		30.2	32.3	30.5		2.57	3.19	2.86	
2004												
0									1.35	1.91	1.88	0.23
110									2.66	1.83	2.46	
165									2.40	3.70	3.02	
220									2.09	3.83	2.88	

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B- b- Flag leaf Area .

Data in table (5-a) indicated that, the lowest flag leaf area was recorded when rice plants were sprayed with zinc sulphate solution + zero nitrogen fertilizer added (19.36 cm^2) and the highest value of flag leaf area was recorded when zinc sulphate was added as soil application under 165 kg N / ha in 2003 season.

B-c- Crop Growth Rate (CGR).

Data in Table (5-a) showed that crop growth rate character was affected by the interaction between nitrogen levels and zinc methods of application in 2003 and 2004 seasons. Data showed that, the lowest values of crop growth rate were recorded under soaking treatment and unfertilized nitrogen added (0.98 and 1.35 g / day) in 2003 and 2004 seasons, respectively. The highest values of CGR were recorded under zinc soil application and nitrogen fertilizer was added at the rate of 165 or 220 kg N /ha (3.19 and 3.83 g / day) in 2003 and 2004 respectively.

C- Rice varieties X zinc treatments interaction (V x Zn):

C-a- Crop growth rate

Crop growth rate (g/day) as affected significantly by the interaction between rice varieties and methods of $ZnSO_4$ application in 2003 growing season only (Table 5-b). Results showed that, soil application of ZnSo4 for Sakha 104 Cv. Produced the highest value of CGR (3.95 g/ day) and the lowest one (1.35 g/day) was recorded from seed soaking with Giza 177 Cv. In 1% $ZnSO_4$ solution.

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Table (5-b): Crop Growth rate as affected by the interaction between rice varieties and zinc methods of application in 2003 season.

Rice Varieties	Crop Growth rate (g/day)			L.S.D 0.05
	Zinc treatments			
	Soaking	Soil application	Foliar spray	
Giza 177	1.35	1.45	1.74	0.20
Sakha 101	2.07	2.54	2.57	
Sakha 104	2.96	3.95	3.38	

D- Rice varieties X nitrogen levels X zinc methods of application interaction.

D-a- Crop growth rate

Data in Table (6) showed the effect of interaction among rice varieties, nitrogen levels and zinc methods of application on crop growth rate in 2003 and 2004 seasons Data showed that Sakha 101 recorded the lowest value (0.4 g / day) when rice plants didn't fertilized with nitrogen at all and zinc sulphate was added as soil application in 2003 season. The same trend was detected in 2004 season. On the other hand, Sakha 104 recorded the highest value under 220 kg N / ha when zinc sulphate was added as soil application followed by Sakha 101 under 165 kg N / ha and zinc soil application, while Giza 177 under 220 kg N / ha and zinc sulphate was added to the rice plant as foliar spray. Data showed also that in 2004 season the best combination was when Sakha 104 fertilized with 165 kg N / ha under zinc soil application method. The same trend was observed with Sakha 101. While, Giza 177 recorded the highest value under 220 kg N / ha and zinc was applied as foliar spray.

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Table (6): Crop growth rate as affected by the interaction between rice varieties, nitrogen levels and zinc methods of application in 2003 and 2004 seasons.

Rice varieties	N. levels Kg / ha	Crop Growth rate (g / day)			L.S.D 0.05
		Zinc treatments			
		Soaking	Soil application	Foliar spray	
	2003 season				
Giza 177	0	1.2	1.0	0.5	0.66
	110	1.4	1.7	1.4	
	165	1.3	2.3	1.6	
	220	1.8	2.1	2.5	
Sakha 101	0	0.5	0.4	2.6	
	110	2.o	1.9	1.6	
	165	0.9	3.6	1.6	
	220	2.1	3.2	2.5	
Sakha 104	0	1.2	2.5	2.2	
	110	1.9	2.7	2.3	
	165	2.6	3.0	4.0	
	220	3.8	4.2	3.6	
	2004 season				
Giza 177	0	1.4	1.1	0.40	0.39
	110	1.6	0.7	1.3	
	165	1.7	1.8	2.8	
	220	0.6	2.2	2.5	
Sakha 101	0	0.7	0.5	1.8	
	110	3.4	2.2	3.4	
	165	1.7	3.7	2.2	
	220	2.4	2.9	3.0	
Sakha 104	0	1.9	3.2	3.5	
	110	3.0	2.7	2.7	
	165	3.7	5.6	4.1	
	220	3.2	4.3	3.2	

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4- Number of days to 50% heading .

4-a- Effect of rice varieties .

Data in Table (7) indicated that a significant effect among rice varieties in 2003 and 2004 seasons which, Sakha 101 recorded the longest period from sowing up to 50% heading followed by Sakha 104 while, Giza 177 recorded the shortest period in 2003. On the other hand, insignificant difference between Sakha 104 and Giza 177 cultivar in this character in the second season. The same trend were also reported in 8 tested varieties by **Ebaid and El-Rewainy (2005).**

4-b- Effect of nitrogen levels :

Data in Table (7) showed that increasing nitrogen levels from zero up to 220 kg N / ha significantly increased number of day to heading in both seasons. Regardless rice varieties 220 kg N / ha delayed the rice plant heading date by increasing vegetative growth period these data are in agreement with those reported by **Ladha *et al.* (1996), Ebaid and Shehata (2001) and Ebaid and El-Rewainy (2005).**

4-c- Effect of zinc treatments.

Data in the same table indicated that a significant effect was observed under zinc treatments, whereas zinc soil application and foliar application treatments significantly increased vegetative growth period consequently delayed rice heading while, seed soaking treatment recorded the shortest period to heading in rice plant in 2003 and 2004 seasons.

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5- Shoot – Root ratio at heading :

5-a- Effect of rice varieties .

Data in Table (7) summarized the effect of rice varieties on shoot – root ratio at heading time in 2003 and 2004 seasons. No significant differences between Giza 177 and Sakha 101 rice varieties in this trait. This result could be attributed to these two rice varieties are sime dwarf. On contrast Sakha 104 Cv. recorded the highest shoot- Root ratio in both seasons.

5-b- Effect of nitrogen levels.

Data in Table (7) showed that, insignificant difference among nitrogen levels on this character in both seasons. These results may be due to the role of nitrogen fertilizer on the growth of both shoot and root with the same portion.

5-c- Effect of zinc treatments:

Data in Table (7) showed also that, insignificant difference between seed soaking and zinc foliar spray on shoot / root ratio in both seasons. Zinc soil application treatment showed a significant effect on this traits may be attributed to the effect of zinc application directly in the soil for increasing number of tillers / hill due to encouragement tillers production **(Bansal and Patel 1986).**

6- Root depth (cm).

6-a- Effect of rice varieties.

Data in Table (7) indicated that insignificant differences among rice varieties in root depth character in 2003 and 2004 seasons. This result may be attributed to no problems for rice plants for looking for water.

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Table (7): Effect of rice varieties nitrogen levels and zinc methods of application on number of days to 50% heading, shoot-root ratio and root depth (cm) in 2003 and 2004 seasons.

Character / Treatments	No of days to 50% heading		Shoot / root ratio at heading		Root depth (cm)	
	2003	2004	2003	2004	2003	2004
A- Varieties						
Giza 177	89.22	92.00	4.94	4.32	17.83	17.72
Sakha 101	101.81	97.22	4.20	4.89	17.64	19.03
Sakha 104	94.36	92.47	6.86	5.96	15.39	16.11
L.S.D 0.05	**0.67**	**0.62**	**0.55**	**0.96**	**N.S**	**N.S**
B- N levels kg / ha						
0	90.70	92.74	4.82	4.23	17.33	19.41
110	92.48	93.41	4.56	4.84	17.52	17.11
165	94.67	94.33	4.83	4.62	16.52	17.8
220	95.67	95.11	5.47	4.72	16.44	16.15
L.S.D 0.05	**0.56**	**0.49**	**N.S**	**N.S**	**N.S**	**1.51**
C- Zinc treatments						
Soaking	93.81	94.19	4.94	4.58	17.42	17.75
Soil application	95.56	96.72	5.14	5.23	16.67	17.33
Foliar spray	95.53	96.68	4.68	4.71	16.78	17.78
L.S.D 0.05	**0.36**	**0.33**	**0.37**	**0.39**	**N.S**	**N.S**

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6- b- Effect of nitrogen levels.

Data in Table (7) showed that insignificant effects due to nitrogen levels on root depth character in 2003 season. In 2004 season there is a significant effect on this trait, whereas, increasing nitrogen levels up to 220 kg N / ha reduced root depth.

6- c- Effect of zinc treatments

Data in Table (7) showed that no significant effect due to zinc methods of application on root depth character in both seasons.

Interaction Effect :

A- Varieties X Nitrogen levels .

Data in Table (8) summarized the effect of the interaction among the three tested rice varieties Giza 177, Sakha 101 and Sakha 104 and nitrogen levels in 2003 and 2004 seasons on number of day to 50% heading and shoot – root ratio characters.

A-a- Number of day to heading.

Data showed that Sakha 101 rice variety recorded the longest period from sowing up to 50% heading (108.9 day) under 220 kg N / ha, while Giza 177 Cv. recorded the shortest period (80.3 day) when no nitrogen fertilizer added in 2003 season. The same trend was detected in 2004 season.

A-b- Shoot – Root ratio .

Data in Table (8) showed that, Giza 177 rice variety recorded the highest shoot- root ratio under the highest nitrogen level 220 kg N / ha in 2003 seasons, while Sakha 101 rice variety recorded the lowest value of this trait when no nitrogen fertilizer added. The same trend was observed for this character in 2004 season, whereas Giza 177 Cv. recorded the highest value (3.67 ratio) under 220 kg n / ha and Sakha 104 recorded the lowest value (1.70 ratio) under zero nitrogen level.

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Table (8): Number of days to 50% heading and shoot – root ratio as affected by the interaction between rice varieties and nitrogen levels in 2003 and 2004 seasons.

Characters / Rice varieties	No of days to 50% heading				L.S.D 0.05	Shoot / root ratio at heading				L.S.D 0.05
	N levels kg / ha					N levels kg / ha				
	0	110	165	220		0	110	165	220	
	2003									
Giza 177	80.3	86.0	88.0	92.6	1.24	3.48	3.68	3.80	4.13	0.68
Sakha 101	101.8	102.9	105.6	108.9		2.36	1.78	2.18	3.13	
Sakha 104	90.0	94.6	96.0	98.4		1.89	2.50	2.66	2.62	
	2004									
Giza 177	89.5	92.0	92.4	94.0	0.86	2.04	2.92	3.00	3.67	0.38
Sakha 101	97.6	98.0	98.7	103.8		1.74	1.88	1.99	2.80	
Sakha 104	91.1	92.3	92.9	93.6		1.70	2.06	2.22	2.51	

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B- Varieties x Zinc treatments interaction:

B-a- Shoot – root ratio (SRR) .

Data in Table (9) summarized the effect of the interaction among the three tested rice varieties and zinc methods of application on shoot – root ratio at 50% heading in 2003 and 2004 seasons. Data in this character showed that, Giza 177 Cv. under zinc foliar spray recorded the highest values 4.3 and 6.16 in 2003 and 2004 respectively. While, Sakha 101 recorded the lowest values under zinc foliar spray 3.09 and 3.28 ratio in 2003 and 2004 seasons, respectively.

Table (9): Shoot – root ratio as affected by the interaction between rice varieties and zinc methods of application in 2003 and 2004 seasons.

Characters / Rice Varieties	Shoot / root ratio at heading			L.S.D 0.05
	Zinc treatments			
	Soaking	Soil application	Foliar spray	
2003				
Giza 177	3.53	3.97	4.30	0.34
Sakha 101	3.73	3.57	3.09	
Sakha 104	3.17	3.70	3.62	
2004				
Giza 177	4.66	5.13	6.16	0.84
Sakha 101	3.88	3.60	3.28	
Sakha 104	5.18	4.85	4.68	

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C- Nitrogen levels X zinc treatments interaction :

Data in Table (10) summarized the effect of the interaction between nitrogen levels and zinc treatments in number of 50% days to heading and root depth in 2003 seasons only. Whereas no significant effect in 2004 season was detective on these two characters.

C- a- Number of days to 50% heading :

Data in table (10) indicated that the combination between 220 kg N/ha and zinc soil application delayed 50% heading up to 98.8 days, while seed soaking in zinc sulphate solution treatment with zero nitrogen fertilizer added decreased the period to 50% heading 90.0 day.

C- b- Root depth.

Data in Table (10) indicated that, the highest root depth was obtained when zinc sulphate was added as soil application and nitrogen fertilizer added at all. While the lowest root depth was recorded when zinc sulphate was added as foliar spray under 165 kg N/ha.

Table (10): Number of days to 50% heading and root depth (cm). as affected by the interaction between nitrogen levels and zinc methods of application in 2003 season.

Characters / N. levels Kg / ha	No of days to 50% heading			L.S.D 0.05	Root depth (cm)			L.S.D
	Zinc treatments				Zinc treatments			
	Soaking	Soil application	Foliar spray		Soaking	Soil application	Foliar spray	
0	90.0	90.9	92.7	0.86	15.9	16.6	14.6	3.09
110	94.7	94.1	94.7		15.3	15.6	14.7	
165	95.3	93.4	95.2		14.1	14.7	13.0	
220	96.7	98.8	96.6		13.8	14.9	14.1	

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II – Panicle characters .

1- Panicle length (cm) .

1- a- Effect of rice varieties :

Data in table (11) indicated that a significant differences among rice varieties in panicle length in both seasons. Sakha 101 Cv. recorded the longest panicles followed by Sakha 104 and Giza 177 Cv. recorded the shortest panicles. These result may be due to the genetic characters to rice varieties it self.

1- b- Effect of nitrogen levels :

Data in table (11) indicated that, increasing nitrogen levels up to 220 kg N/ha significantly increased panicle length in both seasons. However, the difference between 165 and 220 kg N levels in this trait was non significant in 2004 season. It could be concluded that the role of N as an essential element in increasing rice panicle length due to its effect on photosynthetic activity in plants and its positive effects on rice growth. Similar results were also obtained by **Ebaid (2005) and Ebaid and Shebl (2006)**. They reported that the increase to N level up to 138 kg N/ha increased panicle length and weight.

1-c- Effect of zinc treatments.

Data in Table (11) showed that insignificant differences among zinc treatments on panicle length in both seasons. The same trend was obtained by **Ghanem *et al.* (1992).**

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2- Panicle weight (g).

2-a- Effect of rice varieties.

Data in Table (11) indicated that significant differences were observed among rice varieties on panicle weight in both seasons, Sakha 101 Cv. recorded the heaviest panicles weight 3.53 and 3.89 (g) in 2003 and 2004 seasons, respectively. However, insignificant differences between Giza 177 and Sakha 104 Cvs. in this trait in both seasons.

2-b- Effect of nitrogen levels :

Data of the main panicle weight as affected by nitrogen levels are presented in table (11). Results showed that, panicle weight significantly increased as the nitrogen levels increased up to 165 kg N/ha in 2003 and 2004 seasons. Data showed also that, insignificant difference between 165 and 220 kg N/ha levels in this trait in both seasons. The weight of panicle is result of number of branches / panicle, number of filled grains, number of grains / panicle and 1000 grain weight. The increasing in panicle weight could be attributed to the vital role of N in forming and building up heavy rice panicle weight which in turn is reflected in an increase in rice grain yield. The present results is quite expected since N markedly increased length, number of filled grains and weight rice of panicle and positively affected growth characters of rice plants. The effect of nitrogen on these result are in agreement with those reported by **Attia *et al.* (1994) and Ebaid and Shebl (2006).**

2- c- Effect of zinc treatments:

Data in Table (11) didn't show any significant differences among zinc treatments on panicle weight in 2003 and 2004 seasons. This result could be attributed to the zinc fertilizer efficiency on rice plant regardless the method of application.

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3- Number of filled grains / panicle :

3-a- Effect of rice varieties .

Data in Table (11) indicated that a significant differences among the three tested rice varieties which, Sakha 101 recorded the highest number of filled grains / panicle followed by Sakha 104 Cv. while, Giza 177 Cv. recorded the lowest number of filled grains / panicle in both seasons.

3- b- Effect of nitrogen levels :

Data in Table (11) showed that increasing nitrogen levels up to 165 or 220 kg N/ha level significantly increased number of filled grains / panicle in 2003 and 2004 seasons. The highest number of filled grains / panicle was 96.28 and 127.13 in 2003 and 2004 seasons, respectively. Data recorded that no significant difference between 165 and 220 kg N/ha rates on this trait in both seasons. The present results show that, the role of N on yield components of rice are general agreement with those reported by **Ebaid and El–Rewainy (2005)** they found that increasing N level significantly increased number of filled grains / panicle of rice. They reported that up to 138 kg N/ ha was adequate for the highest number of filled grains / panicle.

3-c- Effect of zinc treatments.

Data in Table (11) indicated that a significant effect due to the different methods of zinc application on number of filled grains / panicle in 2004 season only. Zinc soil application and foliar recorded the highest number of filled grains / panicle 111.78 and 107.8 in 2004 season. While, soaking method recorded the lowest one. **Khan *et al.* (2003)** found the same result.

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Table (11): Effect of nitrogen levels and zinc methods of application in some rice varieties on panicle length, panicle weight and number of filled grains / panicle in 2003 and 2004 seasons.

Character / Treatments	Panicle length (cm)		Panicle weight (g)		No of filled grains / panicle	
	2003	2004	2003	2004	2003	2004
A- Varieties						
Giza 177	18.21	19.99	2.80	2.69	83.63	93.11
Sakha 101	19.58	22.63	3.53	3.89	99.63	109.15
Sakha 104	18.48	20.09	2.92	2.66	91.01	99.44
L.S.D 0.05	**0.65**	**0.50**	**0.55**	**0.65**	**5.2**	**6.13**
B- N levels kg / ha						
0	17.87	17.66	2.00	2.09	75.39	80.74
110	18.37	20.18	2.72	2.62	88.85	110.20
165	19.15	21.27	3.89	3.61	96.22	127.13
220	19.64	21.70	3.98	3.63	96.28	126.54
L.S.D 0.05	**0.26**	**0.70**	**0.48**	**0.51**	**6.82**	**7.8**
C- Zinc treatments						
Soaking	18.60	20.18	2.68	3.08	87.58	100.07
Soil application	18.74	21.13	2.89	3.07	94.49	111.78
Foliar spray	18.94	20.76	2.79	2.89	92.19	107.86
L.S.D 0.05	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**6.4**

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III – Yield and its components:

1- Number of panicles / hill .

1-a- Effect of rice varieties .

Data in Table (12) showed that a significant differences among rice varieties on number of panicles / hill in 2003 and 2004 seasons. Sakha 101 Cv. recorded the highest number of panicles / hill in both seasons followed by Sakha 104, while Giza177 recorded the lowest number of panicles / hill. These results could be attributed to the tillering ability for rice varieties it self. However, the difference between Sakha 101 and 104 in this character was insignificant in the 1st season.

1- b- Effect of nitrogen levels.

Data in Table (12) indicated that increasing nitrogen levels up to 220 kg N/ ha significantly increased number of panicles / hill compared with the control in 2003 and 2004 seasons. These data are in agreement with those reported with **Balasbramaniyan (1984) and Ebaid and Shehata (2001)**. They reported that increasing nitrogen levels increased the productive tillers in rice plant.

1- c- Effect of zinc treatments.

Data in Table (12) indicated that insignificant differences among zinc treatments in number of panicles / hill in both seasons.

2- Biological yield (t/ha).

2- a- Effect of rice verities.

Data in Table (12) indicated that a significant differences among rice varieties in biological yield in 2003 and 2004 seasons. Whereas, Sakha 104 yielded the highest values 28.91 and 27.08 t /

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ha in 2003 and 2004 seasons respectively followed by Sakha 101 Cv. Whereas, Giza 177 Cv. yielded the lowest ones in both seasons.

2- b- Effect of nitrogen levels .

Data in Table (12) indicated that increasing nitrogen fertilizer levels from 0 to 220 kg N / ha significantly increased biological yield in 2003 and 2004 seasons. This result could be attributed to the role of nitrogen fertilizer in increasing number of productive tillers / hill, plant height and panicle weight. These data are in agreement with **Shaalan *et al.* (1985), El–Wehishy and Abd El-Hafez (1998)** and **Ebaid (2005).**

2- c- Effect of zinc treatments .

Data in Table (12) showed that, a significant differences among zinc methods of application on biological yield in both seasons. Foliar and soil application of Zn sulphate produced the highest biological yield in 2003 season. Whereas, soil application of $ZnSO_4$ only gave the highest value of biological yield in 2004 season. Seed soaking method recorded the lowest values in both seasons. **Ghanem *et al.* (1992), Das *et al.* (2004)** found the same results.

3- Grain yield (t / ha) .

3- a- Effect of rice varieties .

Data in Table (12) indicated that a significant differences among rice varieties in grain yield in 2003 and2004 seasons. Sakha 101 yield the highest grain yield (8.89 and 8.64 t/ha) in 2003 and 2004 respectively followed by Sakha 104 while, Giza 177 yield the lowest grain yield (7.66 and7.78 t/ha) in 2003 and 2004

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respectively. Similar results were also reported by **Ebaid and Shehata (2001) and Ebaid and El-Rewainy (2005).**

3- b- Effect of nitrogen levels.

Data in Table (12) showed that, increasing nitrogen levels from 0 to 220 kg N / ha significantly increased grain yield in both seasons. The increase in grain yield could be due to the role of nitrogen fertilizer in increasing the vegetative growth and yield components (number of panicles / hill, panicle length and weight, number of filled grains / panicle and 1000 grain weight). Similar conclusion was made by many investigators among them **Wells *et al.* (1989), Abd El- Rahman *et al.* (1992), El–Wehishy and Abd El–Hafez (1998), Ebaid *et al.* (2000), Ebaid (2005)** and **Ebiad and Shebl (2006).**

3- c- Effect of zinc treatments .

Data in Table (12) showed that significant differences among zinc methods of application on grain yield (t/ha) in 2003 and 2004 seasons. Zinc soil application method gave the highest values (8.21 and 8.34 t/ha) in 2003 and 2004, respectively, followed by foliar spray while, soaking method gave the lowest values in both seasons. These findings are in agreement with **Binod-Kumar *et al.* (1996), Slaton (1999), Khan *et al.* (2003)** and **Das *et al.* (2004).** They reported that soil application method is the best method followed by foliar spray for getting the highest grain yield in rice plant.

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Table (12): Effect of nitrogen levels and zinc methods of application in some rice varieties on number of panicles / hill, biological yields and grain yield (t/ha) in 2003 and 2004 seasons.

Characters / Treatments	No. of panicles / hill		Biological yield (T/ha)		Grain yield (T/ha)	
	2003	2004	2003	2004	2003	2004
A- Varieties						
Giza 177	20.28	20.03	21.79	24.65	7.66	7.78
Sakha 101	28.75	28.11	25.12	26.48	8.89	8.64
Sakha 104	26.97	23.31	28.91	27.08	8.39	8.36
L.S.D 0.05	**1.92**	**1.83**	**0.29**	**0.49**	**0.30**	**0.25**
B- N levels kg / ha						
0	18.15	17.63	19.59	22.02	5.78	5.83
110	20.07	21.52	22.99	26.29	7.49	7.76
165	23.78	23.85	24.74	27.65	9.07	8.84
220	25.70	24.93	27.09	28.31	10.39	9.28
L.S.D 0.05	**1.75**	**0.69**	**0.45**	**0.44**	**0.20**	**0.31**
C- Zinc treatments						
Soaking	24.00	22.86	23.26	25.39	7.82	7.73
Soil application	23.81	22.08	23.71	26.91	8.21	8.34
Foliar spray	24.19	22.50	23.84	25.91	8.01	7.71
L.S.D 0.05	**N.S**	**N.S**	**0.27**	**0.28**	**0.13**	**0.23**

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4- Harvest index :

4- a- Effect of varieties :

Data in Table (13) indicated that a significant differences among rice varieties on harvest index in 2003 and 2004 seasons . Sakha 101 rice Cv. variety recorded the highest harvest index 0.39 and 0.39 in 2003 and 2004 seasons, respectively. While, insignificant difference between Giza 177 and Sakha 104 Cvs. in 2003 season. Some trend was observed in 2004 season.

4- b- Effect of nitrogen levels :

Results in Table (13) indicated that increasing nitrogen fertilizer levels up to 165 kg N / ha significantly increased harvest index in both seasons, while, insignificant difference between 165 and 220 kg N / ha on this trait in both seasons. These data are agreement with those reported by **Ebaid and Ghanem (2000), Ebaid and El–Rewainy (2005).**

4-c- Effect of zinc methods of application.

Data in Table (13) showed that, soil application and foliar spray of $ZnSO_4$ methods recorded the highest values in harvest index compared with seed soaking method which recorded the lowest values in both seasons.

5- Thousand grain weight .

5- a- Effect of rice varieties .

Results in Table (13) indicated that a significant differences among the three rice varieties on 1000 grain weight in both seasons. Giza 177 recorded the heaviest weight (28.72 and 28.30) in 2003 and 2004 respectively followed by Sakha 104 while, Sakha 101 recorded the lowest values in 1000 weight in both seasons.

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Table (13): Effect of nitrogen levels and zinc methods of application in some rice varieties on harvest index and 1000 grain weight (g) 2003 and 2004 seasons.

Characters / Treatments	Harvest Index		1000 grain weight (g)	
	2003	2004	2003	2004
A- Varieties				
Giza 177	0.34	0.36	28.72	28.30
Sakha 101	0.39	0.39	26.61	26.71
Sakha 104	0.34	0.36	27.47	27.29
L.S.D 0.05	**0.02**	**0.02**	**0.52**	**0.57**
B- N levels kg / ha				
0	0.29	0.26	26.41	26.00
110	0.37	0.36	27.48	27.26
165	0.38	0.38	28.82	28.60
220	0.39	0.38	28.70	28.40
L.S.D 0.05	**0.01**	**0.02**	**0.07**	**0.09**
C- Zinc treatments				
Soaking	0.34	0.36	27.31	27.75
Soil application	0.36	0.39	28.03	28.92
Foliar spray	0.36	039	27.42	27.68
L.S.D 0.05	**0.01**	**0.01**	**0.37**	**0.11**

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5- b- Effect of nitrogen levels .

Data in Table (13) indicated that, increasing nitrogen levels up to (165 kg N / ha significantly increased 1000 grain weight) while, followed by 220 kg N/ha. These results are in agreement with those reported by **Ebaid (2000), Ebaid and Shehata (2001)** and **Ebaid and El–Rewainy (2005),** They reported that, increasing nitrogen levels up to 165 kg N / ha significantly increased 1000 grain weight in rice plant.

5- c- Effect of zinc methods of application.

Data in Table (13) showed that, soil application of $ZnSO_4$ significantly increased, 1000 grain weight compared with the other two methods whereas, insignificant difference between soaking and foliar spray on this trait in both seasons.

Interaction effect

A- Varieties X N levels .

A- a- Biological yield (t / ha) .

Data in Table (14) indicated that Sakha 104 yielded the highest value (29.31 and 29.84) in 2003 and 2004 respectively under high nitrogen level 220 kg N / ha while, Giza 177 recorded the lowest value of biological yield (19.56 and 18.86 t/ha) in 2003 and 2004 seasons, respectively, under control treatment.Same trend was observed in 2004 season.

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Table (14): Biological yield (T/ha) , grain yield (T/ha) and number of panicles / hill as affected by the interaction between rice varieties and nitrogen levels in 2003 and 2004 .

Characters / Rice Varieties	Biological yield (T/ha) N levels Kg / ha				L.S.D 0.05	Grain yield (t/ha) N levels kg / ha				L.S.D 0.05	No of panicles / hill N levels kg / ha				L.S.D 0.05
	0	110	165	220		0	110	165	220		0	110	165	220	
	2003														
Giza 177	19.56	21.90	21.50	24.19		5.67	7.01	8.22	9.74		15.3	21.3	22.67	24.8	
Sakha 101	20.28	24.38	28.04	27.78	0.77	6.11	8.32	10.83	11.70	0.34	16.0	22.0	26.9	26.7	4.41
Sakha 104	18.94	22.70	24.68	29.31		5.56	8.14	9.14	10.73		17.0	23.6	28.8	28.8	
	2004														
Giza 177	18.86	25.69	27.65	28.43		5.00	6.91	7.78	8.44						
Sakha 101	22.10	25.93	28.23	28.64	0.76	6.33	8.17	9.33	10.72	0.53					
Sakha 104	25.10	27.26	28.11	29.84		6.14	7.20	8.42	8.68						

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A- b- Grain yield (t / ha).

Data in Table (14) showed a significant effect due to the interaction between rice varieties and nitrogen levels Sakha 101 yield the highest grain yield under 220 kg N /ha (11.70 t/ha) in 2003 while Giza 177 Cv. recorded the lowest value when no nitrogen added (5.67 t/ha). The same trend was observed in 2004 season. On the other hand, Sakha 104 was intermediate in both seasons.

A- c- Number of panicles / hill

Results in Table (14) summarized the interaction effect between tested rice varieties and nitrogen levels on number of panicles / hill. No significant effect on this trait in 2003 season. The highest number of panicles / hill (28.8) was obtained when Sakha 104 fertilized with 165 kg N / ha. On the other hand, Giza 177 recorded the lowest number of panicles / hill (15.3) when no nitrogen fertilizer added.

B- Varieties X zinc methods.

B-a- Biological yield (t / ha).

Data in Table (15) indicated that, no significant differences among zinc methods of application on Sakha 101 rice variety in 2003 and 2004 seasons. This data may be due to that Sakha 101 has a law sensitivity to zinc deficiency compared with the other two rice varieties under study while, Giza 177 recorded the lowest values in this trait in both seasons.

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Table (15): Biological yield (t/ha), grain yield (t/ha) and 1000 grain weight as affected by the interaction between rice varieties and zinc methods of application in 2003 and 2004 seasons.

Characters / Rice Varieties	Biological yield (t/ha)			L.S.D 0.05	Grain yield (t/ha)			L.S.D 0.05	1000- grain weight (g)			L.S.D 0.05
	Zinc treatments				Zinc treatments				Zinc treatments			
	soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray	
	2003											
Giza177	20.73	21.68	21.67	0.48	7.53	7.53	7.88	0.25	27.50	28.58	27.92	0.63
Sakha101	24.30	24.33	24.73		8.83	8.67	7.98		27.33	27.58	27.92	
Sakha104	23.75	24.15	24.18		8.61	8.39	8.18		27.08	28.08	27.55	
	2004											
Giza177	22.32	22.97	22.66	0.48	7.50	8.03	7.51	0.39	27.98	28.66	28.27	0.19
Sakha101	25.44	25.59	25.60		7.17	8.81	7.54		27.57	27.66	27.18	
Sakha104	24.40	27.17	24.67		8.03	8.48	8.07		27.00	27.43	26.73	

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B-b- Grain yield (t / ha).

Data in Table (15) showed that Sakha 101 soil application of Zn gave the highest grain yield (8.87 and 8.81) in 2003 and 2004 seasons, respectively while, Giza 177 recorded the lowest values of grain yield in both seasons. This data could be due to Giza 177 has a high sensitivity to zinc deficiency.

B -c- 1000 grain weight.

Data in table (15) showed that Giza 177 recorded the highest 1000 grain weight 28.58 and 28.66 t/ha in 2003 and 2004 seasons, respectively when zinc sulphate was added as soil application, while Sakha 104 recorded the lowest values of 1000 grain weight when rice seeds were soaked in zinc sulphate solution in both seasons.

C- Nitrogen levels X zinc application methods interaction :

C- a- Biological yield (t/ha).

The results in Table (16) showed that the best combination to get the highest values of grain and straw yield when rice plants were fertilized with 220 kg N / ha and zinc sulphate was applied as a soil application. Then this treatment yielded 27.57 and 29.49 t/ha in 2003 and 2004 seasons respectively. These data are inagreement with those reported with **Khanda and Dixit (1995)**.

C-b- Grain yield (t/ha).

Data in Table (16) indicated that the highest grain yield was obtained with the combination between 220 kg N / ha and zinc soil application method in both seasons. While the lowest grain yield was obtained when no nitrogen fertilizer added and soaking rice

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Table (16): Biological yield (t/ha) ,grain yield (t/ha) and 1000 grain weight as affected by the interaction between nitrogen levels and zinc methods of application in 2003 and 2004 seasons.

Characters / N level (kg/ha)	Biological yield (t/ha)			L.S.D 0.05	Grain yield (t/ha)			L.S.D 0.05	1000- grain weight (g)			L.S.D 0.05
	Zinc treatments				Zinc treatments				Zinc treatments			
	soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray	
	2003											
0	18.44	19.22	21.11	0.55	5.64	5.64	6.06	0.29	28.75	28.57	29.07	0.22
110	23.12	23.53	22.32		7.80	7.59	7.09		27.09	28.59	26.10	
165	25.08	24.52	24.62		9.34	8.94	8.91		27.63	29.31	28.85	
220	26.40	27.57	27.31		10.51	10.68	9.99		27.53	27.19	27.49	
	2004											
0	20.44	24.08	21.53	0.55	5.92	6.10	5.46	0.45				
110	26.82	25.86	26.20		7.67	7.99	7.62					
165	26.57	28.21	28.18		8.60	9.12	8.81					
220	27.71	29.49	27.72		8.75	10.16	8.93					

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seed in zinc sulphate solution **Khanda and Dixit (1996)** found the same result. **Ebaid (2005)** reported that Sakha 104 rice variety gave the highest grain yield under 165 kg N /ha and zinc sulphate was added as soil application.

C-c- Thousand grain weight .

Data in Table (16) indicated that in 2003 seasons the best combination between nitrogen levels and zinc methods of application is 165 kg N /ha under zinc soil application and the lowest 1000 grain weight was obtained when rice plants were fertilized with 110 kg N / ha and zinc foliar application. Data didn't show any significant effect in 2003.

III- Grain technology characters.

1- Hulling %

1- a- Effect of rice varieties :

Data in Table (17) indicated the effect of rice varieties on hulling % rice grain in 2003 and 2004 seasons. Results showed that, Giza 177 rice variety recorded the highest hulling percentage in both seasons followed by Sakha 104, while Sakha 101 recorded the lowest are in this trait. These data could be due to the genetically character in the variety it self.

1- b- Effect of nitrogen levels

Results in Table (17) showed that a significant differences among nitrogen levels on hulling % in both seasons. Increasing nitrogen levels up to 165 kg N /ha significantly increased this trait regardless the varieties. However, insignificant difference between

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165 and 220 kg N/ha in this trait in both seasons. These data are in agreement with those reported by **Ebaid and El-Hissewy (2001)**.

1- c- Effect of zinc treatments.

Results in Table (17) indicated that no significant differences among zinc treatments on hulling percentage in 2003 and 2004 seasons.

2- Milling % .

2- a- Effect of rice varieties .

Results in Table (17) indicated that a significant differences among rice varieties on milling % in 2003 and 2004 seasons. Giza 177 recorded the highest milling % followed by Sakha 104, while Sakha 101 recorded the lowest milling % in both seasons. However, the differences between Sakha 101 and Sakha 104 in this character was insignificant in 2003 season.

2- b- Effect of nitrogen levels .

Data in Table (17) showed that, a significant differences among nitrogen levels in 2003 and 2004 seasons. Increasing nitrogen levels from 0 to 220 kg N /ha significantly increased milling % in both seasons. Adding, 220 Kg N / ha recorded the highest milling % (72.84 and 72 .85) in 2003 and 2004 seasons, respectively. **Ebaid and El-Hissewy (2001)** found the same result.

2- c- Effect of zinc treatments .

Results in Table (17) indicated that, a significant difference between seed soaking and the other two methods. Consequently, no significant difference between zinc soil application and foliar spray in both seasons.

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Table (17): Effect of nitrogen levels and zinc methods of application in some rice varieties on some grain technology characters in 2003 and2004 seasons.

Characters / Treatments	Hulling %		Milling %		Head rice %	
	2003	2004	2003	2004	2003	2004
A- Varieties						
Giza 177	81.89	82.58	72.34	73.93	67.16	71.36
Sakha 101	81.40	81.62	71.75	71.49	65.49	69.51
Sakha 104	81.68	82.20	71.80	72.20	64.06	68.36
L.S.D 0.05	**0.12**	**0.13**	**0.21**	**0.18**	**0.15**	**0.21**
B- N levels kg / ha						
0	81.42	81.96	70.06	70.39	65.19	69.70
110	81.48	82.26	71.38	72.63	65.31	69.69
165	81.94	82.76	71.56	72.80	65.99	69.92
220	81.99	82.26	72.84	72.85	65.88	69.88
L.S.D 0.05	**0.13**	**0.04**	**0.12**	**0.04**	**0.19**	**0.16**
C- Zinc treatments						
Soaking	81.57	82.23	71.58	72.48	64.17	68.88
Soil application	81.58	82.22	72.29	72.88	65.45	69.60
Foliar spray	81.58	82.23	72.28	72.86	66.50	69.71
L.S.D 0.05	**N.S**	**N.S**	**0.09**	**0.05**	**0.30**	**0.12**

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3- Head rice .

3- a- Effect of rice varieties .

Data in Table (17) indicated that, a significant difference among rice varieties in head rice %. Giza 177 recorded the highest values in both seasons followed by Sakha 101, while Sakha 104 recorded the lowest values in both seasons.

3- b- Effect of nitrogen levels .

Data in Table (17) showed that increasing nitrogen levels up to 165 kg N / ha significantly increased head rice % in both seasons. However, the differences between zero and 110 kg N/ha as well as between 165 and 220 kg N/ha in this character was insignificant in both seasons. These data are in agreement with **Ebaid and El-Hissewy (2001)** they reported that 165 kg N / ha was adequate for the highest head rice %.

3- c- Effect of zinc treatments.

Data in Table (17) indicated that, zinc soil application and foliar spray methods were the best methods for the head rice % under study while, soaking rice seed in zinc solution gave the lowest head rice % in both seasons. Difference between soil and foliar application in the 2nd season was insignificant.

Interaction effect .

A- Varieties X Zinc methods of application .

A- a- Hulling % .

Data in Table (18) indicated that a significant effect due to the interaction between the tested rice verities and zinc methods of

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Table (18): Some grain technology characters as affected by the interaction between rice varieties and zinc methods of application in 2003 and 2004 seasons .

Characters / Rice Varieties	Hulling %			L.S.D 0.05	Milling %			L.S.D 0.05	Head rice %			L.S.D 0.05
	Zinc treatments				Zinc treatments				Zinc treatments			
	soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray	
	2003											
Giza177	81.7	81.9	82.0	0.19	71.9	72.6	72.4	0.16	62.5	66.7	68.3	0.26
Sakha101	81.2	81.7	81.4		71.0	72.4	71.2		65.2	66.2	66.0	
Sakha104	81.8	81.0	82.3		71.2	71.8	72.8		63.8	63.5	64.8	
	2004											
Giza177	81.5	82.6	82.6	0.08	73.1	73.9	74.2	0.08	71.2	71.8	71.6	0.20
Sakha101	81.0	81.5	81.3		71.5	71.8	72.0		69.0	69.8	68.9	
Sakha104	81.3	81.9	82.8		71.7	73.4	74.8		68.1	68.4	68.6	

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application on hulling % in 2003 and 2004 seasons. The highest head rice % was detective when Sakha 104 rice variety was sprayed with zinc solution (82.3), while, the lowest value was obtained when Sakha 101 seeds were soaked in zinc solution in 2003 season (81.2). The same trend was observed in 2004 season.

A- b- Milling %.

Results in Table (18) showed that, the highest valves of milling % were observed when Sakha 104 was sprayed with zinc solution (72.8 & 74.8) in 2003 and2004 seasons, respectively. Sakha 101 under soaking seeds in zinc solution recorded the lowest values (71.0 & 71.5) in 2003 and 2004, respectively.

A- c- Head rice % .

Results in Table (18) showed that, the highest head rice% was recorded when Giza 177 sprayed with zinc solution 68.3 in 2003 season. The lowest values were recorded when the same variety seeds were soaked in zinc solution. In 2004 season, soil application of $ZnSO_4$ for Giza 177 Cv. Gave the highest head rice % (71.8) whereas, Sakha 104 Cv. Treated by soaking method of 1% $ZnSO_4$ produced the lowest one (68.1).

B- Nitrogen levels X zinc methods of application .

B- a Hulling % .

Results in Table (19) showed that the best combination was 165 kg N /ha under zinc soil application (82.23 & 82.88) in 2003 and 2004 seasons, respectively. On the other hand, the lowest values of hulling % were obtained when no nitrogen fertilizer added under soil zinc application in both seasons.

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B- b – Milling % .

Results in Table (19) show that milling %. Whereas, 165 Kg N / ha under zinc soil application method gave the highest milling % (72.99 & 72.91%) in 2003 and 2004 seasons, respectively. While no nitrogen added at all and zinc was added as seed soaking method (70.46 & 70.69%) in 2003 and 2004 seasons, respectively.

B- c- Head rice %.

Data in Table (19) showed that, the highest values of head rice % were obtained under 220 kg N / ha and zinc foliar spray (67.6 & 70.7 %) in 2003 and 2004 season, respectively while, the lowest head rice % were (63.63 & 68.79%) in 2003 and 2004 seasons, respectively when 220 kg N /ha was added and soaking rice seeds in zinc solution.

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Table (19): Some grain technology characters as affected by the interaction between nitrogen levels and zinc methods of application in 2003 and 2004 seasons.

Characters / N level (kg/ha)	Hulling %			L.S.D 0.05	Milling %			L.S.D 0.05	Head rice %			L.S.D 0.05
	Zinc treatments				Zinc treatments				Zinc treatments			
	soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray		soaking	Soil application	Foliar spray	
	2003											
0	82.06	80.57	81.63	0.22	70.46	71.92	71.80	0.19	66.17	66.10	65.60	0.26
110	81.59	82.14	82.21		72.14	71.76	71.75		66.13	64.93	64.88	
165	81.29	82.23	81.81		70.88	72.99	71.19		64.06	64.76	66.15	
220	81.32	82.17	81.88		71.80	72.89	71.31		63.63	66.18	67.60	
	2004											
0	82.18	80.95	81.73	0.09	70.69	72.21	72.29	0.09	70.16	69.30	69.87	0.24
110	82.28	82.87	82.24		72.39	72.72	72.77		69.87	69.90	69.29	
165	82.08	82.88	82.30		72.39	72.91	72.05		69.69	70.26	69.85	
220	82.44	81.78	82.25		71.45	71.69	72.90		68.79	69.15	70.70	

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SUMMARY

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SUMMARY

Two field experiment were conducted at the Experimental Farm of Etai: El Baroud Agricultural Research Station (Behaira Governorate) – Agricultural Research Center (ARC), during 2003 and 2004 seasons to study the effect of nitrogen fertilization levels and methods of zinc application on the productivity of some rice varieties Giza 177, Sakha 101 and Sakha 104.

Split–split–plot design was used with four replications which rice varieties were allocated in the main plots, nitrogen levels were in sub plots whereas, zinc methods of application were allocated in sub – sub plots four nitrogen levels were as urea from (46.5% N) as following 0.110, 165 and 220 kg N / ha N levels were applied in two splits 2/3 basally and incorporated into the dry soil just before flooding and 1/3, 7 days before panicle initiation according to each rice variety.

Three zinc methods of application were used namely seed soaking in 1% zinc sulphate solution 24 hours before broadcasting, soil application with the rate of 22 kg Zn SO_4 / ha were applies in to the weted nursery before seed broadcasting and zinc sulphate foliar application with the rate of 1% zinc sulphate solution 20 days after seed broadcasting.

Rice seed were predicated in May 20 in both seasons at the rate of 144 kg / ha.

With three or four seedling /hill. thirty days old seedlings were transplanted manually into the plots 15 m^2 at 20 X 20 cm between rows and hills to give 25 hills / m^2.

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Saturn 50% (Thiobencarb) at the rate of 5 L/ ha was applied 9 days after farms planting for weed central All cultural practices were done as recommended.

Studied characters :

A- Vegetative growth characters .

1- Plant height :

A significant differences were detective among rice varieties. Sakha 104 recorded the highest plant height followed by Giza 177 while, Sakha 101 recorded the shortest plant. Increasing nitrogen levels significantly increased plant height up to 165 kg N/ ha. On the other hand zinc methods of application didn't show any significant effect on this trait in both seasons.

2- Flag leaf area (cm^2):

Sakha 101 rice variety recorded the highest values of flag leaf area while, no significant difference between Giza 177 and Sakha 104 in this character. Increasing N levels up to 165 kg N / ha significant increased flag leaf area regardless rice variety. Soaking rice seeds in zinc solution significantly increased flag leaf area. No significant difference between the other two zinc methods of application in both seasons.

3- Crop Growth Rate (CGR).

Sakha 104 rice variety recorded the highest values. Giza 177 was the lowest one. Sakha 101 was intermediate in both seasons of study. Increasing nitrogen levels up to 220 kg N / ha significantly increased crop growth rate. Foliar spray of zinc significantly

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increased crop growth rate followed by soil application while, seed soaking didn't show any significant effect on this trait.

4- Number of days to 50% heading.

Sakha 101 rice variety recorded the longest period form sowing up to 50% flowering followed by Sakha 104 while, Giza 177 recorded the shortest period. Increasing nitrogen levels up to 220 kg N / ha significantly increased number of days to heading. Soil application of zinc and foliar spray increased the period while seed soaking didn't show any significant effect on this trait.

5- Shoot – Root ratio at heading time .

Sakha 104 rice variety recorded the highest ratio while, no significant difference between the other varieties. Insignificant effect due to nitrogen levels on this trait in both seasons. Zinc soil application showed significant effect on this trait while, no significant difference between the other two methods of application in both seasons on this trait.

6- Root – depth (cm).

No significant differences among rice varieties on this trait in both seasons. Some trend was observed in the first seasons for nitrogen effect on root depth. Increasing nitrogen levels up to 220 kg N / ha significantly decreased root depth in 2004 season. No significant effect due to the method of zinc application on this trait in both seasons in all rice variety under study.

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B- Yield and its components.

1- Panicle length (cm) .

Sakha 101 recorded the longest panicles followed by Sakha 104 while, Giza 177 recorded the shortest panicles in both seasons. Increasing nitrogen up to 165 kg N / ha significantly increased panicle length. On the other hand, zinc methods of application didn't show any significant effect on this trait.

2- Panicle weight (g).

Sakha 101 rice variety recorded the heaviest panicles while, no significant difference between Sakha 104 and Giza 177 in both seasons on this trait. Increasing nitrogen fertilizer up to 165 kg N/ ha significantly increased panicle weight in both seasons. No significant effect due to zinc methods of application on this trait in both seasons.

3- Number of filled grains / panicle.

Sakha 101 rice variety yielded the highest number of filled grain / panicle followed by Sakha 104 while Giza 177 recorded the lowest number of filled grains /panicles 165 kg N / ha was adequate for the highest number of filled grains / panicle. Zinc soil application method gave the highest number of filled grains / panicle followed by zinc foliar spray while, seed soaking method gave the lowest number of filled grains / panicle.

4- Number of panicles / hill .

Sakha 101 rice variety produces the highest number of panicle /hill followed by Sakha 101 while, Giza 177 recorded the lowest number of panicle / hill. Increasing nitrogen fertilizer up to

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220 kg N / ha significantly number of panicles / hill. No significant effect due to zinc methods of applications on this trait in both seasons.

5- Biological yield (t/ ha).

Sakha 104 rice variety produced the highest biomass followed by Sakha 101 while Giza 177 yield the lowest biomass in both seasons. Increasing nitrogen levels from 0 to 220 kg N / ha significantly increased biomass in both seasons. Concerning the effect of zinc methods of application on this trait, soil application gave the highest value followed by foliar spray while, seed soaking gave the lowest value of this trait in both seasons.

6- Grain yield (t/ha).

Sakha 101 rice variety recorded the highest value of grain yield followed by Sakha 104 while Giza 177 recorded the lowest grain yield / ha in both seasons. Increasing nitrogen levels up to 220 kg N /ha significantly increased grain yield. Zinc soil application gave the highest value of grain yield followed by foliar spray methods while, seed soaking gave the lowest grain yield in both seasons.

7- Harvest index.

Sakha 101 rice variety recorded the highest values of harvest index. Insignificant difference between the other two rice varieties, No significant difference between 165 and 220 kg N / ha on this trait in both seasons. Zinc soil application methods gave the highest value of harvest index followed by foliar spray while seed soaking didn't show any significant increase.

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8- Thousand grain weight (g).

Giza 177 rice variety recorded the highest 1000 grain weight followed by Sakha 104 while, Sakha 101 recorded the lowest value of this trait. Increasing nitrogen levels up to 165 kg N / ha significantly increased 1000 grain weight in both seasons. Zinc soil application gave the highest value and no significant difference between the other two methods.

C- Grain technology characters.

1- Hulling % .

Giza 177 rice variety recorded the highest percentage of hulling followed by Sakha 104 while, Sakha 101 recorded the lowest value. Increasing nitrogen levels up to 165 kg N / ha significantly increased hulling %. No significant effect due to zinc methods of application on this trait in both seasons.

2- Milling %:

Giza 177 rice variety recorded the highest hulling% followed by Sakha 104 while, Sakha 101 recorded the lowest value. Increasing nitrogen levels up to 220 kg N/ha significantly increased hulling % in both seasons. No significant effect due to zinc methods of application on this trait in both seasons.

3- Head rice %.

Giza 177 rice variety recorded the highest head rice % followed by Sakha 101 while Sakha 104 recorded the lowest values in both seasons. Increasing nitrogen levels up to 165 kg N/ ha. Soil application methods gave the highest head rice% followed by foliar

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spray while seed soaking gave the lowest values on this trait in both seasons.

Effect of the interaction:

1- The effect of the interaction between the tested varieties of rice and N levels was significant on plant height, root depth, No. of panicles / hill and 1000-grain weight in 2003 season, flage leaf area, CGR, at heading, shoot/root ratio at heading, biological yield and grain yield in 2003 and 2004 growing seasons.

2- Plant height, flage leaf area, at heading, root depth, No. of panicles / hill in the 1st season, CGR, biological yieldt / ha and grain yieldt / ha in both seasons were significantly influenced by the interaction between N levels and methods of $ZnSO_4$ application.

3- Crop growth rate in 2003 season, shoot / root ratio at heading, biological yieldt / ha, grain yieldt / ha and 1000 grain weight in 2003 and 2004 seasons were significantly affected by the interaction between tested genotypes of rice and Zn sulphate applications.

4- There were a significant differences interaction between Zn sulphate treatments and N levels or tested rice varieties on hulling, milling and heading rice percentages in both seasons.

5- The interaction among the three factors studied were significant on crop growth rate in both seasons.

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GENERAL CONCLUSION

Giza 177 Cv. was the earliest variety while Shakha 101 Cv. Was the latest and Salha 104 Cv. Was in-between.

Sakha 104 Cv. Surpassed the other varieties in vegetative growth as well as biological yield. Sakha 101 Cv. recorded the highest values of panicles characters, No. of panicles / hill grain yield (t/ha) and harvest index. Difference between Sakha 101 and Sakha 104 in some traits was insignificant.

Giza 177 Cv. recorded the highest values of 1000-grain weight, hulling, milling and heading rice percentages.

Appling of 220 kg N/ha gave the highest values of most growth characters, grain yield and its components and latest heading and grain quality. The difference between 165 and 220 kg N/ha in most cases was insignificant.

Adding 220 kg N/ha with soil or foliar application of $ZnSO_4$ produced the best results for grain yield (t/ha) and good quality of Sakha 101 Cv. of rice crop.

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الملخص العربى

أجريت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بإيتاى البارود – محافظة البحيرة – مركز البحوث الزراعية خلال صيف موسمى ٢٠٠٣ و٢٠٠٤ وذلك بهدف دراسة تأثير معدلات مختلفة من التسميد النيتروجيتى وطرق اضافة الزنك على بعض الصفات المورفولوحية والفسيولوجية والمحصول ومكوناته وبعض الصفات التكنولوجية للحبوب فى بعض اصناف الارز المصرية (جيزة ١٧٧وسخا ١٠١وسخا ١٠٤).

استخدم تصميم القطع المنشقة مرتين فى ٤ مكررات حيث وزعت اصناف الارز عشوائيا فى القطع الرئيسية بينما وزعت المعاملات السمادية للنيتروجين فى القطع المنشقة الاولى حيث كانت مستويات السماد النيتروجينى المختلفة من سماد اليوريا (٤٦,٥% أزوت) بالمعدلات الآتية (صفر و ١١٠ و ١٦٥ و ٢٢٠ كجم وحدة ازوت/الهكتار).

بينما وضعت شتلات الارز المعاملة بالطرق المختلفة لاضافة الزنك (النقع والاضافة الارضية والرش) فى القطع المنشقة الثانية والتى كانت مساحتها ١٥ م^{٢} (٣ × ٥م) وكانت معاملات الزنك فى المشتل كالآتى: النقع وفيها تم نقع التقاوى فى محلول كبريتات الزنك (١% كبريتات زنك) لمدة ٢٤ ساعة بينما طريقة الاضافة الارضية لكبريتات الزنك حيث اضيفت كمية الزنك الموصى بها (٢٢ كجم/هكتار) نثرا بعد تسوية المشتل وقبل بدار التقاوى بنصف ساعة اما طريقة الرش للزنك فقد تم رش المشتل بعد عمر ٢٠ يوم من الزراعة وقبل نقل الشتلات بعشرة أيام وذلك بمحلول كبريتات الزنك بتركيز ١%.

وتم زراعة الحبوب نثرا فى كلا موسمى الزراعة فى ٢٠ مايو بمعدل ١٤٤ كجم/هكتار وذلك فى مشتل مساحته ٥٢٥ م٢ /هكتار وتم نقل الشتلات الى الارض المستديمة عند عمر ٣٠ يوم وتم اضافة الاسمدة للمشتل حسب التوصيات الفنية

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لـــزراعة المـــشتل. واســـتخدم طـــريقة الشتل اليدوى المنتظم فى سطور فى الأرض المستديمة وذلك على مسافات ٢٠×٢٠ سم بين السطور وبين الجور.

وفيما يلى الصفات التى تم دراستها فى كلا موسمى الدراسة:

أولاً- الصفات الفسيولوجية والمورفولوجية :

١- طـــول النبـــات :

كـــان هـــناك فـــروقاً معنوية بين الأصناف حيث كان الصنف سخا ١٠٤ هو أطول الأصناف ثم يليه الصنف جيزة ١٧٧ ثم يليه الصنف سخا ١٠١ وذلك لاختلاف طبيعة نمو هذه الأصناف المختلفة مورفولوجياً.

كمـــا وجـــد زيـــادة معنوية فى طول النبات بزيادة التسميد النيتروجينى حتى المستوى ١٦٥ كيلو جرام / هكتار. أما بالنسبة لطرق إضافة الزنك لم يكن هناك أثراً معنوياً لها على هذه الصفة.

٢- مساحة ورقة العلم :

تأثرت صفة مساحة ورقة العلم معنوياً بالأصناف حيث وجد أن الصنف سخا ١٠١ كـــان أكبر الأصناف فى صفة مساحة ورقة العلم بينما وجد أنه ليس هناك فرقاً بـــين الـــصنفين جيـــزة ١٧٧ وسخا ١٠٤ فى هذه الصفة ، وبالنسبة لتأثير النيتروجين لـــوحظ أن هـــناك تأثيراً معنوياً على هذه الصفة وذلك بإضافة النيتروجين حتى معدل ١٦٥ كجـــم / هكتار وقد لوحظ أن هناك تأثيراً معنوياً لطرق إضافة الزنك على صفة مـــساحة ورقـــة العلـــم حـــيث كانت طريقة النقع هى أقل الطرق بالنسبة لهذه الصفة والطرق الأخرى ليس هناك فرق ملحوظاً بينهما.

٣- معدل النمو :

لقـــد أظهرت النتائج المتحصل عليها أن للأصناف تأثيراً ملحوظاً حيث سجل الـــصنف سخا ١٠٤ أعلى معدل نمو بينما كان أقل معدل نمو فى الصنف جيزة ١٧٧ أمـــا الـــصنف ســـخا ١٠١ كان متوسطاً فى معدل النمو. وأوضحت النتائج أن إضافة

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النيتـــروجين حتى معدل ٢٢٠ كجم / هكتار قد أعطت زيادة ملحوظة فى صفة معدل الـــنمو. وأظهـــرت النتائج المتحصل عليها بالنسبة لطرق إضافة الزنك أنه كان هناك تأثيـــراً معنوياً على هذه الصفة حيث طريقة الرش هى أعلى الطرق فى معدل النمو ثم يلـــيها طـــريقة الإضافة الأرضية بينما طريقة النقع كانت أقل الطرق فى صفة معدل النمو.

٤- عدد الأيام حتى تاريخ الطرد :

لقد أظهرت النتائج أن أطول الأصناف فى الفترة من تاريخ نقع البذور وحتى تـــاريخ التزهير هو الصنف سخا ١٠١ ثم يليه الصنف سخا ١٠٤ وبينما الصنف جيزة ١٧٧ هـــو أقـــل الأصناف فى هذه الفترة حتى التزهير. وكما لوحظ أنه بزيادة التسميد النيتروجينى إلى ٢٢٠ كجم / هكتار أدى إلى زيادة عدد أيام التزهير بغض النظر عن الأصـــناف ، وبالنسبة لتأثير طرق إضافة الزنك وجد أن هناك تأثيراً ملحوظاً لطريقتى الإضـــافة الأرضـــية والرش فى زيادة عدد أيام التزهير بينما طريقة النقع كانت أقلهم تأثيراً.

٥- نسبة المجموع الخضرى إلى المجموع الجذرى فى مرحلة الطرد:

وجـــد أنـــه ليس هناك فرقاً معنوياً بين الصنف جيزة ١٧٧ وسخا ١٠١ بينما سجل الصنف سخا ١٠٤ أعلى قيمة فى هذه الصفة وذلك فى موسمى الزراعة. ووجد أن النيتـــروجين لـــيس لـــه تأثيـــراً ملحوظاً على هذه الصفة وذلك فى كلا الموسمين. وبالنـــسبة لطـــرق إضافة الزنك وجد أنه ليس هناك تأثيراً ملحوظاً بين طريقتى النقع والـــرش بينما طريقة الإضافة الأرضية أعطت تأثيراً معنوياً ملحوظاً على هذه الصفة بالمقارنة بطرق الإضافة الأخرى.

٦- عمق الجذر عند الطرد:

وجـــد أنـــه لـــيس هناك تأثيراً ملحوظاً بين الأصناف فى كلا الموسمين بينما بإضـــافة النيتروجين لم يحدث أية تأثير ملحوظ له فى الموسم الأول. بينما فى الموسم

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الثانـــى وجـــد أن له تأثيراً حيث بزيادة النيتروجين حتى ٢٢٠ كجم / هكتار أدى إلى تقلـــيل عمق الجذر. بينما لا يوجد تأثيراً لطرق إضافة الزنك على جميع الأصناف فى كلا موسمى الزراعة على هذه الصفة.

ثانياً – المحصول ومكوناته :

١ – طول الدالية (سم):

أظهـــرت النتائج أن هناك فروقاً معنوية بين الأصناف حيث وجد أن الصنف ســـخا ١٠١ هو أطول الأصناف فى صفة طول الدالية ثم يليه الصنف سخا ١٠٤ وأن الصنف جيزة ١٧٧ هو أقصر الأصناف فى هذه الصفة وذلك فى موسمى الدراسة.

ووجـــد أنه بإضافة النيتروجين حتى ١٦٥ كجم / هكتار أعطى زيادة ملحوظة فـــى طول السنبلة فى الموسمين كما وجد أن جميع طرق إضافة الزنك ليس لها تأثيراً ملحوظاً فى كلا موسمى الدراسة على هذه الصفة.

٢ – وزن الدالية (جم):

أوضـــحت الدراســـة أنـــه هـــناك تأثيراً ملحوظاً على صفة وزن الدالية بين الأصـــناف حيث كان الصنف سخا ١٠١ هو أعلى الأصناف حيث سجل ٣,٥٣ جم و ٣,٨٩ جـــم على التوالى فى الموسمين بينما لم تظهر فروقاً معنوية بين الصنفين جيزة ١٧٧ ، سخا ١٠٤ فى كلا الموسمين. وبالنسبة للنيتروجين وجد أن هناك زيادة معنوية فى وزن الدالية بإضافة النيتروجين حتى مستوى ١٦٥ كجم / الهكتار كما لم توجد أى تأثيـــرات معـــنوية نتيجة طرق إضافة عنصر الزنك على هذه الصفة فى كلا موسمى الدراسة.

٣ – عدد الحبوب الممتلئة بالدالية :

أظهـــرت النـــتائج المتحصل عليها أنه هناك تأثيراً معنوياً بين الأصناف حيث ســـجل الـــصنف سخا ١٠١ أعلى الأصناف ثم يليه الصنف سخا ١٠٤ ثم جيزة ١٧٧

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ووجـــد أن إضافة النيتروجين عند مستوى ١٦٥ كجم/الهكتار أعطى زيادة معنوية فى الموســـمين حيث أعطى ٩٦,٢٢ ، ١٢٧,١٣ حبة على التوالى فى الموسمين وأنه ليس هـــناك تأثيراً معنوياً نتيجة لزيادة النيتروجين حتى ٢٢٠ كجم/هكتار أما بالنسبة لطرق إضـــافة الـــزنك وجـــد أنه هناك زيادة معنوية نتيجة للإضافة الأرضية حيث أعطت ٩٤,٤٩ ، ١١١,٧٨ حـــبة فى الموسمين على التوالى وتليها طريقة الرش بينما طريقة النقع أعطت أقل عدد حبوب ممتلئة بالسنبلة.

٤- عدد الداليات فى الجورة :

لوحظ من خلال الدراسة أنه يوجد هناك تأثيراً معنوياً بين الأصناف على هذه الـــصفة حـــيث أعطى الصنف سخا ١٠١ أعلى عدد للداليات فى الجورة يليه الصنف ســـخا ١٠٤ بيـــنما كـــان الصنف جيزة ١٧٧ أقل الأصناف عدداً للداليات بالجورة فى موســـمى الدراسة. وبالنسبة للنيتروجين وجد أنه بزيادة التسميد النيتروجينى حتى ٢٢٠ كجـــم / هكتار أدى ذلك إلى وجود زيادة معنوية ملحوظة على هذه الصفة وذلك خلال موســـمى الدراسة. أما بالنسبة لطرق إضافة الزنك وجد أنه ليس لها تأثير معنوياً على هذه الصفة فى كلا موسمى الدراسة.

٥- المحصول البيولوجى بالطن / هكتار:

وجـــد أن هناك زيادة معنوية بين الأصناف حيث وجد أن أعلى الأصناف هو الـــصنف ســـخا ١٠٤ حيث أعطى ٢٨,٩١ ، ٢٧,٠٨ طن / هكتار فى كلا الموسمين علـــى التوالـــى ثم يليه الصنف سخا ١٠١ بينما الصنف جيزة ١٧٧ كان اقلهم فى هذه الـــصفة. وبالنسبة للنيتروجين وجد أن هناك تأثيراً معنوياً ملحوظاً بإضافة النيتروجين مـــن صـــفر حتى ٢٢٠ كجم / هكتار على جميع الأصناف فى كلا موسمى الدراسة. وبالنـــسبة لطـــرق إضافة الزنك وجد أن هناك تأثيراً معنوياً ملحوظاً لطريقة الإضافة الأرضية حيث أنها أعلى الطرق ثم يليها طريقة الرش ثم يليها طريقة النقع.

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٦- محصول الحبوب بالطن / هكتار:

وجد من خلال الدراسة أن هناك زيادة معنوية بين الأصناف فى هذه الصفة حيث سجل الصنف سخا ١٠١ أعلى الأصناف حيث أعطى ٨,٨٩ ، ٨,٦٤ طن / هكتار فى الموسمين على التوالى ثم يليه الصنف سخا ١٠٤ بينما كان الصنف جيزة ١٧٧ هو أقل الأصناف فى هذه الصفة – وبالنسبة للنيتروجين وجد أن هناك زيادة معنوية فى هذه الصفة بإضافة النيتروجين من صفر حتى ٢٢٠ كجم / هكتار فى كلا موسمى الدراسة. أما بالنسبة لطرق إضافة الزنك فقد أظهرت النتائج المتحصل عليها أن هناك تأثيراً معنوياً ملحوظاً حيث أعطت طريقة الإضافة الأرضية أعلى قيمة فى هذه الصفة حيث أعطت ٨,٢١ ، ٨,٣٤ طن / هكتار فى كلا موسمى الدراسة على التوالى ثم يليها طريقة الرش بينما كانت طريقة النقع هى أقل طريقة فى هذه الصفة.

٧- دليل الحصاد :

أظهرت الدراسة أن هناك زيادة معنوية بين الأصناف حيث كان الصنف سخا ١٠١ هو أعلى الأصناف حيث أعطى ٠,٣٩ ، ٠,٣٩٦ فى كلا موسمى الدراسة على التوالى بينما الصنف سخا ١٠٤ ، جيزة ١٧٧ لا يوجد فرق معنوى بينهما. بينما أوضحت الدراسة أنه يوجد هناك تأثيراً معنوياً بإضافة النيتروجين حتى ١٦٥ كجم / هكتار أدى إلى زيادة قيمة معامل الحصاد فى الموسمين ووجد أنه ما بين مستوى نيتروجين ١٦٥ ، ٢٢٠ كجم / هكتار لا يوجد تأثيراً معنوياً ملحوظاً.

وبالنسبة لطرق إضافة الزنك وجد أن هناك زيادة معنوية حيث كان أعلى طريقة هى الإضافة الأرضية والرش وذلك بالمقارنة بالنقع حيث كانت أقل قيمة عندها فى الموسمين.

٨- وزن الألف حبة (جم):

تأثير وزن الألف حبة معنوياً بالأصناف فقد سجل الصنف جيزة ١٧٧ أعلى المتوسطات حيث أعطى ٢٨,٧ ، ٢٨,٣٠ جم فى كلا موسمى الدراسة ثم يليه الصنف

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سخا ١٠٤ بينما كان الصنف سخا ١٠١ هو أقل الأصناف فى هذه الصفة. كذلك تأثرت هذه الصفة معنوياً بإضافة النيتروجين حتى ١٦٥ كجم / هكتار حيث لا يوجد فرقاً بين ١٦٥ ، ٢٢٠ كجم / هكتار. وبالنسبة لطرق إضافة الزنك كان لها تأثيراً معنوياً حيث كانت طريقة الإضافة الأرضية هى أعلى الطرق وليس هناك فرقاً بين طريقتى النقع والرش فى كلا موسمى الدراسة.

ثالثاً – الصفات التكنولوجية للحبوب :

١ – نسبة التقشير :

تأثرت هذه الصفة معنوياً بالأصناف حيث كان الصنف جيزة ١٧٧ هو أعلى الأصناف فى نسبة التقشير يليه الصنف سخا ١٠٤ بينما كان الصنف سخا ١٠١ هو أقل الأصناف فى هذه الصفة. ولاحظ أن هناك تأثيراً معنوياً بإضافة النيتروجين حتى المستوى ١٦٥ كجم/هكتار بزيادة نسبة التقشير بغض النظر عن تأثير الأصناف كما وجد أنه ليس هناك تأثيراً معنوياً بين المستوى ١٦٥ ، ٢٢٠ كجم / هكتار فى الموسمين كما لم تظهر أى تأثيرات معنوية نتيجة لطرق إضافة عنصر الزنك فى كلا موسمى الدراسة.

٢ – نسبة التبييض :

وجد أن هذه الصفة تأثرت معنوياً بالأصناف حيث وجد أن الصنف جيزة ١٧٧ هو أعلى الأصناف فى نسبة التبييض ثم يليه الصنف سخا ١٠٤ بينما كان الصنف سخا ١٠١ هو أقل الأصناف فى نسبة التبييض.

وأوضحت الدراسة أنه هناك زيادة معنوية فى نسبة التبييض بإضافة النيتروجين من مستوى صفر حتى ٢٢٠ كجم / هكتار. وأن مستوى النيتروجين ٢٢٠ كجم / هكتار أعطى أعلى قيمة فى نسبة التبييض حيث أعطى ٧٢,٨٤% ، ٧٢,٨٥% فى الموسمين على التوالى. بينما أظهرت النتائج أنه ليس هناك تأثيراً مختلفاً بين النقع والطريقتين الأخريين.

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٣- نسبة الحبوب الكاملة :

وجد من خلال الدراسة أن هناك زيادة معنوية بين الأصناف فى هذه الصفة حيث وجد أن الصنف جيزة ١٧٧ هو أعلى الأصناف فى هذه الصفة ثم يليه الصنف سخا ١٠١ بينما كان الصنف سخا ١٠٤ هو أقل الأصناف فى هذه الصفة كما أوضحت النتائج أيضاً أنه بزيادة النيتروجين إلى ١٦٥ كجم / هكتار أدى إلى زيادة صفة نسبة الحبوب الكاملة فى الموسمين وأنه ليس هناك تأثيراً معنوياً بين مستوى صفر حتى ١١٠ كجم / هكتار كما لم يظهر أى فرقاً معنوياً بين معدل ١٦٥ ، ٢٢٠ كجم / هكتار حيث كان أفضل المعدلات هو ١٦٥ كجم / هكتار حيث أعطى أعلى نسبة حبوب كاملة.

بالنسبة لطرق إضافة الزنك قد تأثرت هذه الصفة معنوياً حيث أعطت طريقة الإضافة الأرضية أعلى نسبة حبوب كاملة يليها طريقة الرش وأن طريقة النقع أعطت أقل نسبة حبوب كاملة.

تأثير التفاعلات :

١- بعض الصفات المدروسة تأثرت معنوياً بالتفاعل بين مستويات النيتروجين والأصناف المختبرة وهذه الصفات هى: طول النبات ، عمق الجذور عند الطرد ، وعدد الداليات بالجورة ، وزن الـ ١٠٠٠ حبة فى الموسم الأول ٢٠٠٣ . ومساحة ورقة العلم ومعدل النمو وتاريخ الطرد ونسبة المجموع الخضرى للمجموع الجذرى عند الطرد والمحصول البيولوجى ومحصول الحبوب بالطن / هكتار فى كلا الموسمين ٢٠٠٣ ، ٢٠٠٤ .

٢- تأثرت معنوياً صفات طول النبات ومساحة ورقة العلم وعمق الجذور عند الطرد وعدد الداليات بالجورة فى الموسم الأول ٢٠٠٣ وصفات معدل النمو ، المحصول البيولوجى ، الحبوب بالطن للهكتار فى الموسمين ٢٠٠٣ ، ٢٠٠٤ بالتفاعل بين مستويات النيتروجين وطرق إضافة كبريتات الزنك.

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٣- صـــفات معـــدل النمو فى الموسم الأول ٢٠٠٣ ، ونسبة المجموع الخضرى للمجمـــوع الجـــذرى عـــند الطرد والمحصول البيولوجى ومحصول الحبوب بـــالطن / هكـــتار ، ووزن الـــــ ١٠٠٠ حـــبة تأثـــرت معنوياً بالتفاعل بين الأصناف المختبرة فى الأرز وطرق إضافة كبريتات الزنك.

- كمـــا وجـــدت اختلافات معنوية بين طرق إضافة كبريتات الزنك وأصناف الأرز المختبرة أو معدلات السماد النيتروجينى للصفات التكنولوجية المدروسة للأرز مثل : نسبة التقشير ، ونسبة التبييض ، ونسبة الحبوب الكاملة.

٤- كمـــا وجـــد هـــناك تأثير معنوى للثلاث عوامل المدروسة لصفة معدل النمو لمحصول الأرز فى كلا الموسمين.

ونستنتج من النتائج السابقة الآتى :

١- تفـــوق صـــنف الأرز سخا ١٠١ معنوياً حيث تفوق الصنف فى طول الدالية ووزنهـــا وعدد داليات / جورة ، وعدد الحبوب الممتلئة بالدالية مع أنه متأخر فى الطرد.

٢- مـــستوى ٢٢٠ كجـــم نيتروجين/هكتار أعطى أفضل النتائج لمحصول الأرز ومكـــوناته ولم يوجد فرق معنوى بين المعدلين ١٦٥ ، ٢٢٠ كجم نيتروجين /هكتار لمعظم الصفات فى كلا الموسمين.

٣- زاد محصول الحبوب معنوياً بطريقة إضافة كبريتات الزنك أرضياً ، ولو أن الاختلاف بين هذه الطريقة المكلفة وطريقة الرش الغير مكلفة لم تكن معنوية فى أهم الصفات المدروسة.

٤- توصـــى الدراســـة بـــزراعة الصنف سخا ١٠١ والمسمد بمعدل ٢٢٠ كجم نيتـــروجين / هكـــتار مع إضافة ٢٢ كجم كبريتات زنك / فدان مشتل إضافة أرضية.

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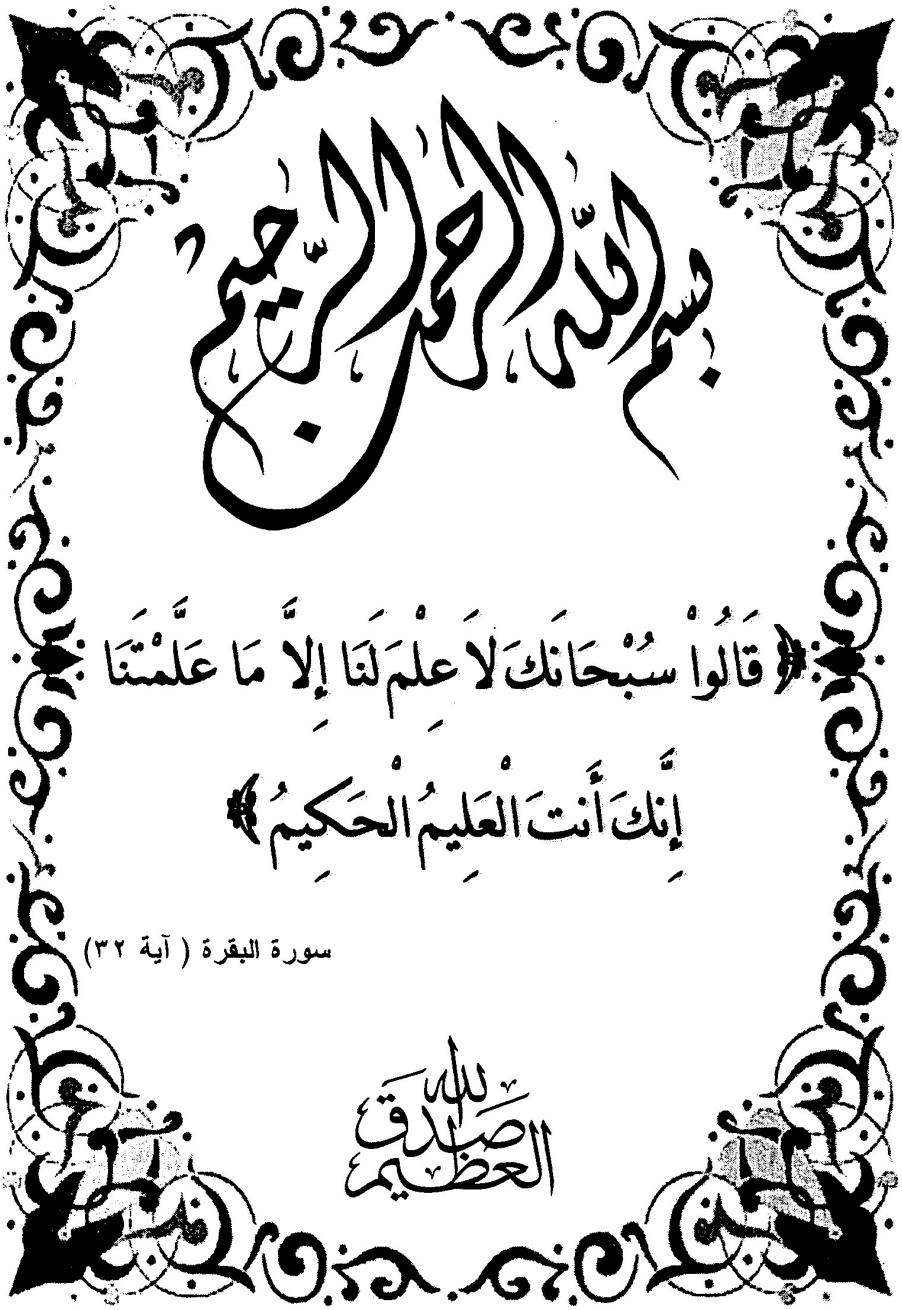

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تأثير مستويات الأزوت وطرق إضافة الزنك على المحصول فى بعض أصناف الأرز

رســـالة مقدمة من

سامى عبد الجواد عبد الفتاح السعدنى

بكالوريوس في العلوم التعاونية الزراعية-المعهد العالي للتعاون الزراعي (١٩٩٨)
استكمال شعبة المحاصيل – كلية الزراعة بمشتهر – جامعة الزقازيق – فرع بنها (٢٠٠٢)

للحصول على

درجة الماجستير فى العلوم الزراعية

(محاصيـــل)

لجنـــة الإشـــراف العلمي :

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أ.د / رجـب عبد الغـنى عبيد .....

رئيس بحوث بمعهد بحوث المحاصيل الحقلية

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قســم المحاصيل

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تأثير مستويات الأزوت وطرق إضافة الزنك على المحصول فى بعض أصناف الأرز

رســـالة مقدمة من

سامى عبد الجواد عبد الفتاح السعدنى

بكالوريوس في العلوم التعاونية الزراعية-المعهد العالي للتعاون الزراعي (١٩٩٨)
استكمال شعبة المحاصيل – كلية الزراعة بمشتهر – جامعة الزقازيق – فرع بنها (٢٠٠٢)

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وقد تمت مناقشة الرسالة والموافقة عليها

لجنة الحكم والمناقشة:

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أ.د / صديق عبد العزيز صديق محيسن .....

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أ.د / رجب عبد الغنى عبيد .....

رئيس بحوث بمعهد بحوث المحاصيل الحقلية

مركز البحوث الزراعية – الجيزة – مصر

تاريخ الموافقة : / / ٢٠٠٧

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رســـالة مقدمة من

سامى عبد الجواد عبد الفتاح السعدنى

بكالوريوس في العلوم التعاونية الزراعية-المعهد العالي للتعاون الزراعي (١٩٩٨)
استكمال شعبة المحاصيل – كلية الزراعة بمشتهر – جامعة الزقازيق – فرع بنها (٢٠٠٢)

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