Productivity Improvement of Some Rice Varieties (*Oryza Sativa* L.) by Using Growth Promoter Supplement Foliar Application.

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ABSTRACT:

This investigation was carried out during 2021 and 2022 seasons at the farm of Rice section, Sakha Agriculture Research station, Kafr El-Sheikh Egypt, to study the effect of growth promoter foliar application on studied characteristics of some rice cultivars. A split-plot design in randomized complete block with three replications was used where Growth Promoter (control, 0.7, 1.4, and 2.1 ml/L) were arranged in main plots, while rice cultivars namely; Sakha101,Sakha 104,Giza 178 and Egyptian Yasmine were assigned in sub-plots. The results reveled that, there were a highly significant differences between the concentrations of growth catalyst and rice cultivars for all the studied traits. The concentrations of Growth Promoter increased the yield and it components remarkably increased. The highest foliar concentration (2.10 ml/L) recorded the peak values of the studied traits compared to control treatment in both seasons. Sakha 101 and Giza 178 rice cultivars gave the highest yield traits compared to the rest rice cultivars. The best combination which recorded the highest rice grain yield when Sakha 101 rice cultivar foliated with growth promoter by 2.10 ml/L in both studied seasons, respectively. A relative field efficiency (RFE) kg kg^{-1} recorded the ceiling grain yield when growth promoter foliated at the concentration of 2.10 ml/L for Sakha 101 rice cultivar which produced 12.580 kg kg^{-1}followed by 8.042 kg kg^{-1} for Sakha 104. Herein, it conclude that, foliar application of growth promoter supplement by the concentration of (2.1ml/L) achieved productivity of grain yield for the two rice varieties Sakha 101 and Giza 178 under experimental condition.

Keywords*:* Rice varieties; grain yield; Growth promoter supplement and Relative field efficiency.

INTRODUCTION

Rice is cultivated in 114 countries globally and is a crucial grain crop, upon which half of the world's population relies Gutaker *et al*., (2020). However, vitamin and mineral deficiencies affect half of the global population, leading to significant health issues and even deaths among children (World Food Program 2015). Developed nations have implemented fortification programs to address these deficiencies, but the same programs are not affordable in poor countries.

Bio-stimulants are organic substances, like amino acids, hormones, plant extracts, seaweeds, that are utilized with plants to enhance feeding efficiency, crop fineness and tolerance to abiotic stresses. These substances can be sprayed directly on plants or added to the soil regardless of their nutrient content Dujaqrdin *et al* .,(2015). Potassium is another vital element for plants, as it plays roles in regulating cellular osmosis, stomata function, and activating enzymes responsible for nitrogen metabolism and energy production in plants Havlin *et al*.,(2015) and Jothi *et al*.,(2019).

Plants naturally contain amino acids, which combine to form proteins and several peptide compounds. These amino acids contribute to plant growth, improvement of yield quality, and reduced fertilizer use. Spraying amino acids on leaves can enhance plant growth and amino acid synthesis, essentially during critical growth periods Dewettinck *et al* .,(2008) and Raupeliene, (2015). Bread yeast is an environmentally friendly, highly effective and inexpensive source of bio-stimulation Xi, *et al*., (2019). It contains many nutrients like nitrogen, potassium, phosphorous, zinc, iron, sodium and silicon, as well as growth regulators like auxins and cytokinin. The amino acids and vitamins in baker's yeast, like B1 and B6, activate cell division in plants and improve the quantity and quality of the crop Dewedar *et al*.,(2016).

Several factors result in fertilizer losses and low fertilizer efficacy, including immobilization, de-nitrification, leaching, soil fixation, and volatilization. Using appropriate fertilizer application techniques can enhance nutrient use efficiency, promoting soil fertility restoration, nutrient preservation, and sustainable rice crop production (Swamy *et al* .,2020). In regions with heavy rainfall like the Konkan region, chemical fertilizer leaching losses are significant. In such cases, foliar delivery of nutrients through growth promoter supplement might be the most suitable option.

Generally, growth promoter supplement are produced as a normal or synthetic compound substances composed of hormones or precursors of plant hormones. When properly applied to crops, it acts directly on physiological processes that supply benefits for growth and development and/or responses to water stress, salinity and toxic elements, like toxic aluminum Du Jardin (2012) and Couto *et al.,* (2012). These products, which variance from traditional fertilizers of nitrogen, phosphorous and potassium, may contain in their formula a variety of organic compounds, like seaweed extracts, humic acids, amino acids, vitamins, ascorbic acid, and other chemicals, which may differ according to their manufacturer Yaronskaya *et al*., (2006). Bio-stimulants supply a prospect new way to adjust and/or modify physiological processes in plants to stimulate growth, relieve stress-induced restrictions, and increase productivity. The effects of bio-stimulants are still not obvious. It can act on plant productivity as a direct response of the plants or soil to the application of the bio-stimulant or an indirect response to the bio-stimulant on the soil and plant microbiome with sequent effects on plant productivity Yakhin *et al.,* (2017), the objectives of the current study were: (1) to study the effect of growth promoter supplement (Viusid Agro) to enhance growth, agronomic traits to increase grain yield in rice (2) to study the relationship between grain yield and other traits in the studied rice varieties .

MATERIALS AND METHODS

This experiment was carried out at the Experimental Farm of the Sakha Rice Research Department, Kafr El-Sheikh, Egypt (31°05′17″N 30°56′44″E, 7 meters high) through the 2021 and 2022 seasons. Monthly maximum and minimum temperature (C^{o}), relative humidity % and wind velocity (Km/h) at RRTC Sakha, Kafr EL Skeikh province during 2019 and 2020 seasons are shown in Table (1).Soil properties for both seasons are shown in Table 2.

Plant material:

The plant material used for this study consisted of four rice genotypes: Sakha 101, Sakha 104, Giza 178, and Egyptian Yasmine., as shown in Table 3.

Experimental design and treatments:

A split-plot design in a randomized complete block arrangement with three replications for all treatments was involved. Assigned different concentrations of Viusid Agro (growth promoter supplement), including a treatment without spraying (0.0) as control , as well as concentrations of 0.70 ml/L, 1.40 ml/L, and 2.10 ml/L, with a total water amount of 250 liters per hectare were distributed in main plots. The rice varieties (Sakha 101, Sakha 104, Giza 178, and E. yasmine) were located in the sub-plots. Sowing performed on May 1st during the 2021 and 2022 seasons, and the rice varieties were transplanted as thirty-day-old seedlings in ten rows that were 5 meters long, with individual plants spaced 20 x 20 cm apart. The growth promoter (Viusid Agro) supplement was applied through foliar spraying three times, specifically during the maximum tillering, panicle initiation, and booting stages. The composition of Viusid Agro can be found in Table 4.

All practices for rice culture followed the recommendations of RRTC (2020). Data were collected from 25 randomly chosen plants from each replication, and mean values were utilized for statistical analysis.

This study contained, fourteen morphological, yield and yield component traits, including days to heading, plant height, flag leaf area, flag leaf angle, chlorophyll content (SPAD), number of panicles per square meter, panicle length, panicle weight, number of filled grains per panicle, seed set percentage, 1000-grain weight, grain yield, harvest index, and relative field efficiency (RFE), following the guidelines provided by the Standard Evaluation System (SES) of IRRI (2008).

Relative Field Efficiency (RFE) (KgKg^{-1}) :

The relative field efficiency which could be defined as the yield improvement due to the amount of growth promoter supplement foliar application and measured according to the following equation (Ali, 2011).

R F E (KgKg^{-1}) = (Grain yield of treatment – Grain yield of un-treatment)/ Amount of stimulator sprayed sprayed ha^{-1}

All acquired data were statistically analyzed according to the method analysis of variance (ANOVA) for the split -plot design by Gomez and Gomez (1984), using COSTAT statistical package. Least Significant of Difference (LSD) method was used to detect the differences between treatment means at 5 % level of probability as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

The data presented in Table 5 clearly demonstrate significant differences in growth characteristics when comparing different concentrations of the growth promoter supplement Viusid Agro, as well as different rice varieties. The interaction between Viusid Agro concentrations and rice varieties also had a notable impact on these growth traits. Specifically, days to 50% heading, plant height, flag leaf angle, flag leaf area and chlorophyll content were significantly influenced by the foliar concentrations of Viusid Agro during both seasons. As the dose of Viusid Agro application increased, there was a gradual increase in the number of days to 50% heading, plant height, flag leaf area, flag leaf angle and chlorophyll content in both seasons. The greatest values for these growth traits were observed when Viusid Agro was applied at a concentration of 2.10 ml/L, while the lowest values were obtained a concentration of 0.70 ml/L in both seasons.

The increase in chlorophyll content can be attributed presence of higher levels of amino acids in the treated plants. Amino acids support an increase in chlorophyll content, which in turn improves many growth traits (Awad *et al*., 2007). Moreover, Viusid Agro helps in the utilization of complex carbohydrates, resulting in homogenous protoplasm formation and increased plant organ sizes. It also adjust the action of cytokinins, which leads to an increase in meristematic cell divisions, which affects the size of plant growth positively (Havlin *et al*., 1999).

Additionally, significant effects were occurred between rice varieties in terms of days to 50% heading, plant height, flag leaf angle, flag leaf area and chlorophyll content. Sakha 104 showed the shortest heading time, Sakha 101 had the shortest stature and high chlorophyll content, and Giza 178 showed a desirable flag-leaf angle. These results highlight the critical role played by bio-stimulants, especially Viusid Agro, in the growth and development of rice plants.

These results are consistent with previous research conducted on several plant species (El-Zohiri and Asfour, 2009), which support our results .Goss (1973) also highlights the effect of amino acids positively on growth, stating that they can avail as a source of carbon and energy when carbohydrates are imperfect in plant. This process involves the release of ammonia and organic acids from amino acids, which then enter the Kerb's cycle to release energy through respiration. Therefore, Viusid Agro positively influenced the morpho-physiological and productive indicators of rice cultivation.

Data in Table (6) show the interaction effect between Viusid Agro treatments and each rice variety on growth characteristics, the results indicate that growth characters were significantly influenced by the concentrations of Viusid Agro and rice genotypes tested through both seasons (combined data). For the days to 50% heading, the rice variety Sakha 104 exhibited a desirable value of 98.67 days without addition of Viusid Agro during both seasons. In contrast, the rice variety E. yasmine recorded undesirable values of 114.00 days when sprayed with 2.10 ml/L of Viusid Agro during both seasons, as shown in Table 6 and Fig. 1.

Moreover, plant height was highly affected by the addition of Viusid Agro and rice varieties during both seasons. The rice variety Sakha 101 achieved a desirable plant height value of 97.33 cm without applying Viusid Agro during both seasons. Furthermore, the undesirable value for plant height was obtained at 125.83 cm when the rice variety Sakha 104 was treated with 2.10 ml/L of Viusid Agro via foliar application during both seasons.

In terms of flag leaf area, the application of Viusid Agro at a rate of 2.10 ml/L had the highest recorded value (60.71 cm^2) during two seasons. On the contrary, the control treatment without spraying Viusid Agro on the rice variety Sakha 101 had the lowest value (32.56 cm^2) during the same period. These findings are consistent with studies conducted by Kandil *et al*. (2016) and Mirtaleb *et al.* (2021), which mentioned that spraying bio-stimulants increases the dry matter and stimulates the activity of enzymes responsible for the synthesis of protein, carbohydrates and dry matter. This has a positive effect on the grain yield and its weight. Foliar spraying with amino acids over the vegetative growth stage increases vegetative and root growth due to its role as bio-stimulants that encourage the growth of leaves and roots. Also, spraying amino acids and potassium on rice plants influenced vital processes.

Regarding flag leaf angle, the interaction between Viusid Agro and rice varieties significantly influenced the flag leaf angle in all the two seasons. The highest values were obtained with the application of 2.10 ml/L

Viusid Agro on the rice variety Sakha 101 (33.970). Conversely, the effects of abiotic stress.

Rice variety Giza 178 showed the narrowest flag leaf angle (20.75°) when Viusid Agro was not applied. These findings align with the research conducted by Talha *et al*. (2020), which demonstrated that foliar spraying of growth promoter supplements twice during specific growth stages enhances growth characteristics, leaf area index, photosynthetic efficiency and grain yield.

The amino acids found in Viusid Agro have various roles in plants, including promoting plant growth and yield and helping plants deal with the harmful effects of abiotic stress. They also adjust ion transport, the opening of stomata and influence synthesis and activity of the enzymes and gene expression (Rai, 2002).

Overall, the flag leaf area and angle are influenced by the application of Viusid Agro and the choice of rice variety. The use of Viusid Agro, particularly at a rate of 2.10 ml/L, generally resulted in increased flag leaf area and angle values. Similarly, the presence of amino acids in Viusid Agro contributes to desirable plant growth characteristics and helps mitigate the harmful effects of abiotic stress.

Data presented in Table 7 shows that the effect of Viusid Agro and the different rice genotypes, as well as their interaction, on various traits related to panicle formation in rice plants. These traits include of panicles number /m², panicle length, panicle weight and the number of filled grains / panicle. The results from Table 7 indicate that spraying Viusid Agro on rice plants significantly affects these panicle traits during both seasons. The greatest values for these traits were observed when the foliar application concentration was 2.10 ml/L, compared to the other treatments and the control.

Additionally, Table 7 shows significant differences between the rice varieties for panicle traits, with the Sakha 101 and E. yasmine varieties displaying the best values. Previous studies (Rodrigues *et al*., 2003; Talha *et al.*, 2020) they reported that the increase in rice yield observed with foliar Viusid Agro is mainly due to an increase in the number of productive tillers and the total number of tillers /m².

Results in Table 8 and Fig. 2 indicated that effect of the interaction between levels of Viusid Agro and rice genotypes on panicle characters. The results showed that panicle weight, panicle length, panicles/m² and the number of filled grains/ panicle were significantly affected by the levels of Viusid Agro and rice genotypes through the two seasons (combined data). The results indicated that the foliar application of 2.10 ml/L for plants of the rice variety Sakha101 gave the greatest values for number of panicle/ m2 (520.38), and the cultivar E. yasmine recorded the desired values for the length of panicle, the weight of panicle, and the number of filled grains/ panicle. (30.05 cm, 6.95 and 217.83 grains), respectively. While the lowest values for the number of panicles/m² were recorded in rice cultivar E. yasmine without foliar spraying of Viusid Agro (289.67). The rice varieties Giza 178, Sakha 104, and Sakha 101 gave undesirable values (3.82 g, 22.07cm, 137.50 grains) for the weight of the panicle, the length of the panicle, and the number of filled grains/ panicle with control treatment through the two seasons. These results mentioned that Viusid Agro play a critical role in growth of rice plant.

Data presented in Table 9 explained the effect of several concentrations of Viusid Agro on seed traits such as, seed set (%), grain yield (t/ha^{-1}) 1000-grain weight (g), and harvest index (%) of rice genotypes as well as, their interaction.

Results exhibited that seed set (%), 1000 grain weight (g), grain yield (t/ha) and harvest index (%) were significantly influenced by Viusid Agro treatments through the two seasons and the pooled data. The application of Viusid Agro at a rate of 2.10 ml/L increased the percentage of seed set, weight of 1000 grains, grain yield (ton/ha) and harvest index% by applying Viusid Agro during the two seasons compared to the control treatment. Albion (2000) and Johansson (2008) report that fertilizers, amino acids form organic sources with minerals resulting in increased of nutrients availability by plants.

Also, our data in the Table 9 cleared that there were significantly effects between the genotypes of rice on the yield traits. The rice genotypes Sakha 104, Sakha 101, and Giza 178 gave the highest yield and their components traits values through the two seasons. While, the E. yasmin variety gave the unwanted values for the two traits, seed set ratio and grain yield (ton/ha). Sakha 101 and Giza 178 gave the lowest values for 1000 grain weight and harvest index during the two seasons.

It has desirable effect on efficient carbon metabolism, organic content and mineral compounds, biomass accumulation, the pigments, including chlorophyll, and increasing the outputs of the photosynthesis process of proteins and carbohydrates, and maintains integrity of cell walls and plasma from the plant.

Additionally, its importance in increasing endogenous oxygen, it increases the extension of the cell wall and therefore the elongation of the stem. This result similar with what was reported when spraying the atonic on two genotypes of hybrid rice, and that the foliar spraying with the bio-stimulant Taravertavant (Tar) led to an increase in the biological yield, grain yield and weight of 1000-grain (g) and then improvement the biological yield (Banful and Attivor 2017)

Results presented in Table 10 exhibited how the interaction between different rice genotypes and Viusid Agro concentrations affected the yield and its attributed traits. Results indicated that factors such as seed set percentage, weight of 1000 grains, grain yield (ton/ha), and harvest index were significantly influenced by Viusid Agro concentrations and the varieties of rice during all the two seasons .Table 10 and Figure 3 provide a visual representation of these effects. For instance, the highest seed set% value of 97.31% was achieved with a foliar application of 1.40 ml/L of Viusid Agro on the Sakha 104 variety during both seasons. Conversely, the lowest seed set% value of 83.46% was recorded for the E. Yasmin variety without any spraying during both seasons, as presented in Table 10 and Figure 3.

Weight of 1000- grain was also significantly affected by levels of Viusid Agro and rice varieties during both seasons. The desired 1000-grain weight value of 30.26g was attained with the foliar application of Viusid Agro on the Sakha 101 rice variety throughout both seasons. Conversely, the undesired 1000-grain weight value of 20.69g was observed for the Giza 178 rice variety in the control treatment during both seasons, as shown in Table 10 and Figure 3.

Moreover, the interaction effect of foliar usage of Viusid Agro treatments on grain yield (t/ha) for various rice varieties during the 2021 and 2022 seasons was examined. The results indicated that a foliar application rate of 2.10 ml/fed resulted in desirable grain yields of 12.057 and 12.019 t/ha for the Giza 178 and Sakha 101 varieties, respectively, in both seasons. In contrast, the E. Yasmin variety yielded an undesirable grain yield value of 8.946 t/ha without any foliar application during both seasons, as shown in Table 10 and Figure 3. The inclusion of potassium phosphate spray in Viusid Agro played a vital role in increasing grain yield. Potassium effectively controlled and enhanced the physiological functions of the plants, extended the grain-filling period and increased yield components and biological yield, resulting in higher grain production. These findings align with the research conducted by Jothi *et al.*, (2019) and Rekani (2020) on the effects of potassium spraying on rice plants. Additionally, increasing in grain yield may be attributed to the growth regulator in the spray, which enhances the tolerance of rice varieties to adapt to changing environmental and climatic conditions, as demonstrated in Table 1.

Furthermore, harvest index was significantly affected by Viusid Agro levels and rice varieties during both seasons. The highest harvest index value of 55.32% was achieved with a foliar application rate of 2.10 ml/fed of Viusid Agro on the Giza 178 variety during both seasons. Conversely, the lowest harvest index values of 43.43% were recorded for the Sakha 101 variety without any Viusid Agro spraying (control) throughout both seasons, as presented in Table 10 and Figure 3. This can be attributed to bio-stimulants acting as a positive growth regulator or carbon metabolism enhancer. When applied these bio-stimulants in small amounts, enhance plant growth and yield, so influencing the quantity and quality of crops, as described by Basak (2008). The application of foliar stimuli resulted in a significant increase in the percentage of harvest index. In addition, stimulants that have humic substances in their composition can improve feeding efficiency and enhance crop quality, as suggested by Canellas *et al.* (2015).

kg-1, was achieved Table (11).When spraying Viusid Agro (1.40 ml/L) on the Sakha 101 variety, resulting in field efficiency of 12.580 kg kg^{-1}. This was followed by spraying the same amount on Sakha 104, resulting in an agronomic efficiency of 8.042 kg kg-1, which outperformed the control treatment. The spraying of 1.40 ml/L of Viusid Agro was found to have many benefits such as improving crop nutrition, decreasing plant stress, and being cost-effective due to its rapid absorption and transportation, as well as making crops more tolerant to drought, diseases and less harmful to the environment (Al-juthery and Sahar, 2019).

CONCLUSION

In conclusion, this study highlights the importance of foliar spraying with Viusid Agro in improving the important plant characteristics like SPAD chlorophyll content, plant height, and grain yield/ ha. The spraying treatments with 1.40 ml/L and 2.10 ml/L achieved the highest average values for main plant characteristics including the number of panicles per square meter and grain yield, as well as the weight of 1000 grains for the rice varieties Sakha 101 and Giza 178. Overall, the highest relative field efficiency was observed with the spraying of Viusid Agro at rate 1.40 ml/L with the rice variety Sakha 101.

REFERENCES

Albion. 2000: What exactly are the Metal sate products? Plant Nutr. Newsl., 1, 1–4.

Ali, N.S. 2011: Fertilizers technologies and uses. Baghdad University. College of Agriculture.

Al-juthery, H.W.A., Sahar F.S. 2019: icronutrients foliar application onjerusalem artichoke, Al-Qadisiyah Journal For Agriculture Sciences, 9(1) 156-164.

Awad, M.M., Abd El-Hameed, A.M., Shall, Z.S. 2007: Effect of glycine, lysine and nitrogen fertilizer rates on growth, yield and chemical composition of potato. J Agric Sci Mansoura Univ.; 32(10):8541-8551.

Banful, B.K., Attivor, D. 2017: Growth and yield response of two hybrid rice cultivars to Atonik plant growth regulator in a Tropical environment. Environment, Earth and Ecology, 1(1).

Basak, A. 2008: Biostimulators–definitions, classification and legislation. Biostimulators Mod Agric Gen Asp, 7-17.

Canellas, L.P., Olivares, F.L., Aguiar, N.O., Jones, D.L., Nebbioso, A., Mazzei, P., Piccolo, A. 2015: Humic and fulvicacids as biostimulants in horticulture. Scientiahorticulturae. 196:15-27.

Couto, C.A., Peixoto, C.P., Vieira, E.L., Carvalho, E.V., Peixoto, V.A.B. 2012: Action by kinetin, indolbutyric acid and acid gibberellic in sunflower emergence under stress by aluminum. Communication Scientiae. 3: 206-209.

Dewedar, G.A., Ibrahim, E.A. 2016: Effect of Foliar Application of Yeast on Yield and Seed Quality of Some Rice Cultivars.J. Plant Production, MansouraUniv., Vol. 7(6): 593 – 601.

Dewettinck, K., Van Bockstaele, F., Kuhne, B., Van de Walle, D., Courtens, T.M., Gellynck, X. 2008: Nutritional value of bread: Influence of processing,food interaction and consumer perception. J. Cereal. Sci., vol. 48, pp. 243-257

Du Jardin, P. 2012: The science of plant biostimulants—A bibliographic analysis, Ad hoc Study Report..Brussels: European Commission.

DuJardin, P.D. 2015: A review: Plant biostimulants: Definition, concept, maincategories and regulation. ScientiaHorticulturae 196: 3–14.

El-Zohiri, S.S.M., Asfour, Y.M. 2009: Effect of some organic compounds on growth and productivity of some potato cultivars. Annals of Agric Sci Moshtohor. 2009;47(3):403 -415.

FAO, 2009: The state of food insecurity in the world 2009. FAO available at ftp://ftp.fao.org/docrep/fao/012/i0876e/i0876e.pdf.

Gomez, K.N., Gomez, A.A. 1984: Statistical procedures for agricultural research. John Wiley and Sons, New York, 2nd ed., 68 p.

Goss, J.A. 1973: Amino acid synthesis and metabolism. In Physiology of. Plants and their cells. Pergamon Press, Inc., New York;. p.202. Doi: http://dx.doi.org/10.1016/ B978-0-08-017036-7.50013-1.

Gutaker, R.M., Groen, S.C., Bellis, E.S., Choi, J.Y., Pires, I.S., Bocinsky, R.K., Oliveira, M.M. 2020: Genomic history and ecology of the geographic spreadof rice. Nature Plants, 6(5), 492-502.

Havlin, J.L., Beaton, J.D., Tisdale, S.L., Nelson, W.L. 2005: Soil fertility and fertilizers, in an introduction to nutrient management, 6thed. Prentic Hall, New Jersey. USA. PP 199-218.

Havlin, J.L., Beaton, J.D., Tisdale, S.L., Nelson, W.L. 1999: Soil Fertilityand Fertilizers and Introduction. To Nutrient management. 6th Edn. New Jersey, USA. pp. 540.

IRRI, 2008: Standard Evaluation System for rice 3rd Edition, Int. Rice Testing Programm.

Jardin, P.D. 2015: Plant biostimulants: Definition, concept, main categories and regulation. Scientia Horticulturae. ;196:3-14.

Johansson, A. 2008: Conversations on chelation and mineral nutrition. Aust. J. Grape Wine Res., 583, 53–56.

Johnson, A.A., Kyriacou, B., Callahan, D.L., Carruthers, L., Stangoulis, J., Lombi, E., Tester, M. 2011: Constitutive over expression of the OsNAS gene family reveals single gene strategies for effective iron- and zinc-biofortification of rice endosperm. PLoS ONE 6(9):e24476.

Jothi, M., Keerthana, P., Gomathi, S., Priya, B., Ramesh, T., Rathika, S. 2019: Effect of foliar spray of potassium on rice undersodicsoil.ThePharma Innovation Journa. 8(8): 244-247.

Kandil, A.A., Sharief, A.E.M., Seadh, S.E., Altai, D.S.K. 2016: Role of humic acid and amino acids in limiting loss of nitrogen fertilizer and increasing productivity of some wheat cultivars grown under newly reclaimed sandy soil. Int. J. Adv. Res. Biol. Sci, 3(4), 123-136.

Kauffman, G.L., Kneivel, D.P., Watschke, T.L. 2007: Effects of a biostimulant on the heat tolerance associated with photosynthetic capacity, membrane thermostability, and polyphenol production of perennial ryegrass. Crop Science. 47:261-267.

Mirtaleb, S.H., Niknejad, Y., Fallah, H. 2021: Foliar spray of amino acids and potassic fertilizer improves the nutritional quality of rice. Journal of Plant Nutrition, 44(14), 2029-2041.

Rai V.K., 2002: Role of amino acids in plant responses to stresses. Biologia Plantarum, , 45, 481–487.

Raupeliene, A. 2015: Effect of foliar application of amino acids on the photosynthetic indicators and yield of winter wheat. Proceedings of the 7th International Scientific Conference Rural Development,AleksaanadrasStulginskis University, Lithuania.

Rekani, S.I. 2020: Effect of foliar application of potassium on growth and yield of submergence rice grown in calcareous Soil. International Journal of Agriculture Innovations and Research, 9, 97-101.

Rodrigues, F.Á., Vale, F.X., Datnoff, L.E., Prabhu, A.S., Korndörfer, G.H. 2003: Effect of rice growth stages and silicon on sheath blight development. Phytopathology 93: 256-261.

RRTC, 2020: National Rice Research Program: Final results of 2019 growing season. Sakha, Egypt.

Snedecor, G.W., Cochran, W.G. 1980: Statistical Methods, 7th Ed., Ames, IA: The Iowa State University Press.

Swamy, G.V.V.S.N., Sairam, M, Shankar, T., Maitra, S., Mohapatra, S., Sahu, S. 2020: Various approaches for nutrient management in rice (Oryza sativa L.). Agro Economist - An International Journal.;7(2):123-127.

Talha, I.A., Gomma, M.A., Nada, A.M., Dalia, Tabl, M. 2020: Enhancement the Productivity of some Rice Varieties by Using Some Growth Promoter Supplements. Alexandria Science Exchange Journal, Vol. 41, No.4.

World Food Programme, 2015: Types of malnutrition. http://www.wfp.org/ hunger/malnutrition/types.

Xi, Qin, Lai, W., Cui, Y., Wu, H., Zhao, T. 2019: Effect of yeast extract on seedling growth promotion and soil improvement in afforestation in asemiarid chestnut soil area. Forasts, 10, 76.

Yakhin, O.I., Lubyanov, A.A., Yakhin, I.A., Brown, P.H. 2017: Biostimulants in plant science: A global perspective. Frontiers in Plant Science.;7(2049):1-32.

Yaronskaya, E., Vershilovskaya, I., Poers, Y., Alawady, A.E., Averina, N., Grimm, B. 2006: Cytokinin effects on therapy role biosynthesis and photosynthetic activity in barley seedlings. Plant.;224:700-709.

Table 1: Monthly maximum and minimum temperature (C°), relative humidity % and wind velocity (Km/h) at RRTC Sakha, Kafr EL Skeikh province during 2019 and 2020 seasons.

Month	2021 season					2022 season				
	Temperature (C⁰)		Relative Humidity (%)		Wind Velocity(Km/h)	Temperature (C⁰)		Relative Humidity (%)		Wind Velocity (Km/h)
	Max	Min	7.30	13.00		Max	Min	7.30	13.00	
May	32.48	24.75	73.68	42.74	99.23	30.00	21.82	78.38	44.13	100.58
June	32.14	25.52	80.40	50.23	110.76	33.04	25.74	82.57	50.50	89.30
July	34.89	27.84	85.13	50.45	96.03	33.33	25.57	64.55	77.26	107.67
August	35.68	28.27	85.37	48.28	83.53	34.59	26.02	77.67	68.12	102.97
Sept.	32.55	25.03	84.13	49.57	96.70	32.99	25.97	88.87	55.97	96.67
Oct.	28.5	22.3	76.50	61.20	80.23	28.75	20.79	91.26	56.77	84.97

Table 2: Mechanical and chemical soil analysis of the experimental site during 2021 and 2022 seasons.

Soil analysis	2021	2022
Mechanical analysis		
Clay %	61.70	62.83
Silt %	29.10	30.30
Sand %	10.50	10.87
Texture class	Clayey	Clayey
Chemical analysis		
Organic matter%	1.52	1.55
E.C. Ds/m	2.00	2.03
PH	8.11	8.15
Total N ppm	462	465
Available P ppm	14.5	15.8
Available K ppm	380	382
Available Zn ppm	1.00	1.10

Table 3: Pedigree and origin of rice varieties used in 2021 and 2022 seasons.

No.	Entry.	Pedigree	Origin
1	Sakha 101	Giza 176 / Milyang 79	Egypt
2	Sakha 104	GZ4096/ GZ4100	Egypt
3	Giza 178	Giza 175/Milyang 49	Egypt
4	Egyptian Yasmine	IR262/KD ML-105	IRRI

Table 4: Chemical components (%) of Viusid agro (Growth promoter supplement) used in 2021 and 2022 seasons.

	Viusid Agro	Concentration.
1	Potassium phosphate	5.00%
2	Malic acid	4.60%
3	Glucosamine	4.60%
4	Arginine	4.15%
5	Glycine	2.35%
6	Ascorbic acid	1.15%
7	Calcium pantothenate (ppm)	0.115
8	Pyridoxal (ppm)	0.225
9	Folic acid (ppm)	0.05
10	Cyanocobalamin (ppm)	0.0005
11	Monoammonium glycyrrizinate (ppm)	0.23
12	Zinc sulphate (ppm)	0.115

Table 5: Effect the different concentrations of Viusid Agro of rice varieties and their interaction on days to 50%heading, plant height, flag leaf area, flag leaf angle and chlorophyll content during 2021 and 2022 seasons combined data.

Main effect	Days to 50% heading (day)			Plant height (cm)			Flag leaf area (cm²)			Flag leaf angle (°)			Chlorophyll content (SPAD)		
	2021	2022	Comb.	2021	2022	Comb.	2021	2022	Comb.	2021	2022	Comb.	2021	2022	Comb.
Viusid Agro Concentrations (C)															
Control	104.50	103.00	103.75	104.10	105.79	104.94	42.62	43.61	43.12	23.85	23.37	23.61	38.77	39.46	39.12
0.70 ml /L	105.67	104.67	105.16	113.72	113.64	113.68	49.80	50.66	50.23	26.45	26.55	26.50	40.12	40.24	40.18
1.40 ml/L	107.42	106.83	107.13	115.78	116.85	116.31	54.03	54.49	54.26	27.87	28.23	28.05	41.42	40.79	41.11
2.10 ml /L	108.91	108.08	108.50	117.45	118.07	117.76	54.78	55.33	55.06	29.06	30.12	29.59	41.84	41.50	41.67
LSD 0.05	0.558	0.492	0.322	1.380	0.589	0.771	0.779	0.887	0.829	0.738	0.761	0.626	0.354	0.545	0.317
Rice Varieties (V)															
Sakha 101	109.75	108.25	109.00	100.84	102.48	101.66	39.46	40.65	40.05	30.43	30.71	30.57	41.64	42.60	42.12
Sakha 104	101.58	100.58	101.08	119.27	121.22	120.24	53.76	54.85	54.31	27.56	27.20	27.39	39.27	39.28	39.28
Giza 178	102.75	102.16	102.45	111.92	111.32	111.62	52.96	53.32	53.14	21.87	21.63	21.75	40.62	40.31	40.47
E. yasmine	112.42	111.58	112.00	119.01	119.33	119.17	55.05	55.27	55.16	27.37	28.73	28.04	40.63	39.79	40.21
LSD 0.05	0.486	0.506	0.347	1.480	0.726	0.949	0.604	0.963	0.623	0.517	0.629	0.423	0.313	0.687	0.361
Interaction															
C x V	NS	NS	*	*	*	*	*	*	*	*	*	*	NS	NS	NS

Table 7: Effect the different doses of Viusid Agro of rice varieties and their interaction on number of panicles/ m², panicle length (cm), panicle weight (g), number of filled grains/ plant during 2021 and 2022 seasons (combined data).

Main effect	Number of panicles/ m²			Panicle length (cm)			Panicle weight (g)			Number of filled grains/ plant		
	2021	2022	Comb.	2021	2022	Comb.	2021	2022	Comb.	2021	2022	Comb.
Viusid Agro Concentrations (C)												
Control	361.54	379.77	370.65	24.07	24.34	24.20	4.37	4.51	4.44	150.45	151.47	150.96
0.70 ml /L	396.81	408.54	402.67	24.95	24.84	24.89	4.80	4.83	4.82	159.30	161.25	160.28
1.40 ml/L	437.25	443.23	440.24	25.63	25.90	25.76	5.06	5.22	5.15	169.46	171.81	170.63
2.10 ml /L	453.46	476.29	464.88	26.03	26.11	26.07	5.34	5.47	5.40	177.07	179.26	178.16
LSD 0.05	16.735	9.26	7.08	0.348	0.431	0.335	0.073	0.106	0.064	1.636	1.978	1.661
Rice Varieties (V)												

Sakha 101	460.20	494.79	477.50	25.17	25.53	25.35	4.45	4.59	4.53	145.35	147.94	146.65
Sakha 104	408.88	420.46	414.67	23.76	23.73	23.75	4.28	4.39	4.34	145.58	147.60	146.59
Giza 178	431.65	442.44	437.04	22.80	22.98	22.89	4.31	4.38	4.35	171.43	172.16	171.80
E. yasmine	348.33	350.15	349.24	28.93	28.95	28.94	6.53	6.66	6.60	193.91	196.08	195.00
LSD 0.05	10.896	12.09	7.595	0.304	0.273	0.222	0.096	0.064	0.065	1.195	1.435	0.895
Interaction												
C x V	*	*	*	*	*	*	*	*	*	*	*	*

Table 9: Effect of the different concentrations of Viusid Agro on rice varieties and their interaction on seed set %, 1000-grain weight (g), grain yield t/ha. and harvest index (%) during 2021 and 2022 seasons (combined data).

Main effect	Seed set %			1000-grain weight (g)			Grain yield t/ha.			Harvest index (%)		
	2021	2022	Comb.	2021	2022	Comb.	2021	2022	Comb.	2021	2022	Comb.
Viusid Agro concentrations (C)												
Control	88.56	88.68	88.66	25.49	25.73	25.61	9.572	9.624	9.625	46.00	47.02	46.51
0.70 ml /L	92.18	92.62	92.41	26.41	26.67	26.54	9.994	10.022	10.010	48.95	49.35	49.15
1.40 ml/L	93.37	93.65	93.40	27.24	27.27	27.26	10.620	10.812	10.717	52.07	52.27	52.17
2.10 ml /L	93.81	93.22	93.53	27.81	27.86	27.83	11.595	11.541	11.569	53.06	53.21	53.14
LSD 0.05	1.194	0.771	0.829	0.227	0.192	0.193	0.171	0.117	0.126	0.776	0.929	0.619
Rice Varieties (V)												
Sakha 101	93.41	93.87	93.65	29.42	29.40	29.42	10.831	10.912	10.872	48.80	48.86	48.84
Sakha 104	94.75	94.40	94.57	27.89	28.26	28.07	10.591	10.603	10.596	48.92	48.91	48.92
Giza 178	90.65	90.67	90.60	21.51	21.63	21.57	10.748	10.812	10.767	52.44	53.58	53.01
E. yasmine	89.11	89.23	89.17	28.14	28.24	28.20	9.651	9.725	9.681	49.91	50.49	50.20
LSD 0.05	0.698	0.480	0.449	0.143	0.139	0.088	0.129	0.112	0.092	0.796	0.741	0.536
Interaction												
C x V	*	*	*	*	*	*	*	*	*	*	*	*

3

Table 6: The effect of the interaction between growth promoter supplement and rice varieties on days to heading (day), plant height (cm), flag leaf area (cm^2) and flag leaf angle (°) for combined data.

Viusid Agro Concentrations (C)	Rice Varieties (V)	Days to 50% heading (day)	Plant height (cm)	Flag leaf area (cm^2)	Flag leaf angle (°)
		Comb.	Comb.	Comb.	Comb.
Control	Sakha 101	106.83	97.33	32.56	25.80
	Sakha 104	98.67	112.51	46.53	23.08
	Giza 178	100.00	105.37	47.84	20.75
	E. yasmine	109.50	104.58	45.54	24.81
0.70 ml/L	Sakha 101	107.33	101.24	41.55	30.52
	Sakha 104	100.33	119.32	54.48	26.40
	Giza 178	101.83	111.58	50.79	21.73
	E. yasmine	111.17	122.58	54.12	27.33
1.40 ml/L	Sakha 101	109.83	103.63	42.69	32.00
	Sakha 104	101.67	123.33	57.22	29.80
	Giza 178	103.67	114.09	56.86	21.97
	E. yasmine	113.33	124.20	60.29	28.44
2.10 ml/L	Sakha 101	112.00	104.45	43.43	33.97
	Sakha 104	103.66	125.83	59.02	30.25
	Giza 178	104.33	115.44	57.06	22.55
	E. yasmine	114.00	125.33	60.71	31.60
LSD 0.05		0.695	1.898	1.246	0.845

Table 8: The effect of the interaction between doses of Viusid Agro and rice varieties on number of panicles/ plant, panicle length, panicle weight (g) for combined data.

Viusid Agro concentrations (C)	Rice Varieties (V)	Number of panicles/ plant	Panicle length (cm)	Panicle weight (g)	Number of filled grains/ panicle
		Comb.	Comb.	Comb.	Comb.
Control	Sakha 101	440.42	24.67	3.86	137.50
	Sakha 104	380.58	22.92	3.82	138.01
	Giza 178	371.96	22.07	4.13	161.83
	E. yasmine	289.67	27.17	5.95	166.50
0.70 ml/L	Sakha 101	452.08	25.05	4.21	140.77
	Sakha 104	407.50	23.00	4.18	143.67
	Giza 178	430.42	22.88	4.26	164.33
	E. yasmine	320.72	28.65	6.62	192.33
1.40 ml/L	Sakha 101	496.66	25.78	4.80	152.17
	Sakha 104	428.54	24.19	4.43	151.83
	Giza 178	462.71	23.18	4.48	175.20
	E. yasmine	373.04	29.90	6.87	203.33
2.10 ml/L	Sakha 101	520.83	25.90	5.23	156.15
	Sakha 104	442.04	24.88	4.93	152.83
	Giza 178	483.08	23.45	4.51	185.83
	E. yasmine	413.54	30.05	6.95	217.83
LSD 0.05		15.190	0.444	0.131	1.790

Table 10: The effect of the interaction between doses of Viusid Agro and rice varieties on seed set (%), 1000-grain weight (g), grain yield t/ha. and harvest index (%) for combined data.

Viusid Agro Concentrations (C)	Rice Varieties (V)	Seed set (%)	1000-grain weight (g)	Grain yield t/ha.	Harvest index (%)
		Comb.	Comb.	Comb.	Comb.
Control	Sakha 101	91.53	27.99	9.955	43.43
	Sakha 104	90.50	26.50	9.731	43.61
	Giza 178	89.15	20.69	9.860	51.06
	E. yasmine	83.46	27.28	8.946	47.95
0.70 ml/L	Sakha 101	92.71	29.31	10.324	48.31
	Sakha 104	96.80	27.49	10.153	47.09
	Giza 178	90.12	21.16	10.222	51.28
	E. yasmine	89.94	28.22	9.336	49.92
1.40 ml/L	Sakha 101	93.33	30.10	9.337	51.21
	Sakha 104	97.31	28.27	10.857	52.24
	Giza 178	92.19	22.10	10.929	54.38
	E. yasmine	90.77	28.56	9.891	50.85
2.10 ml/L	Sakha 101	97.05	30.26	12.019	52.41
	Sakha 104	93.64	30.04	11.643	52.74
	Giza 178	90.94	22.33	12.057	55.32
	E. yasmine	92.50	28.72	10.555	52.07
LSD 0.05		0.899	0.177	0.186	1.073

Table 11: The effect of spraying Viusid Agro on the relative field efficiency (kg kg^{-1}).

Viusid Agro concentrations	Rice Varieties (V)	Relative Field Efficiency
		Comb.
Control	Sakha 101	0.00
	Sakha 104	0.00
	Giza 178	0.00
	E.Yasmin	0.00
0.70 ml/L	Sakha 101	5.269
	Sakha 104	6.019
	Giza 178	5.167
	E.Yasmin	5.576
1.40 ml/L	Sakha 101	12.580
	Sakha 104	8.042
	Giza 178	7.632
	E.Yasmin	6.756
2.10 ml/L	Sakha 101	7.368
	Sakha 104	6.826
	Giza 178	7.844
	E.Yasmin	5.745

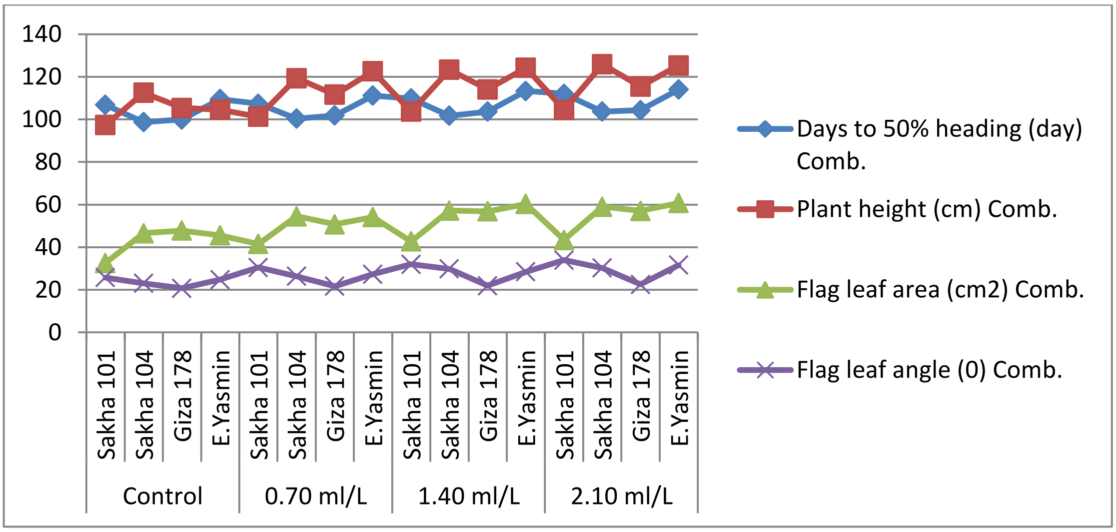

Figure 1: Illustrate Interaction effects of concentrations of Viusid Agro treatments days to 50% heading, plant height, flag leaf area and flag leaf angle of the rice varieties during two seasons (combined data).

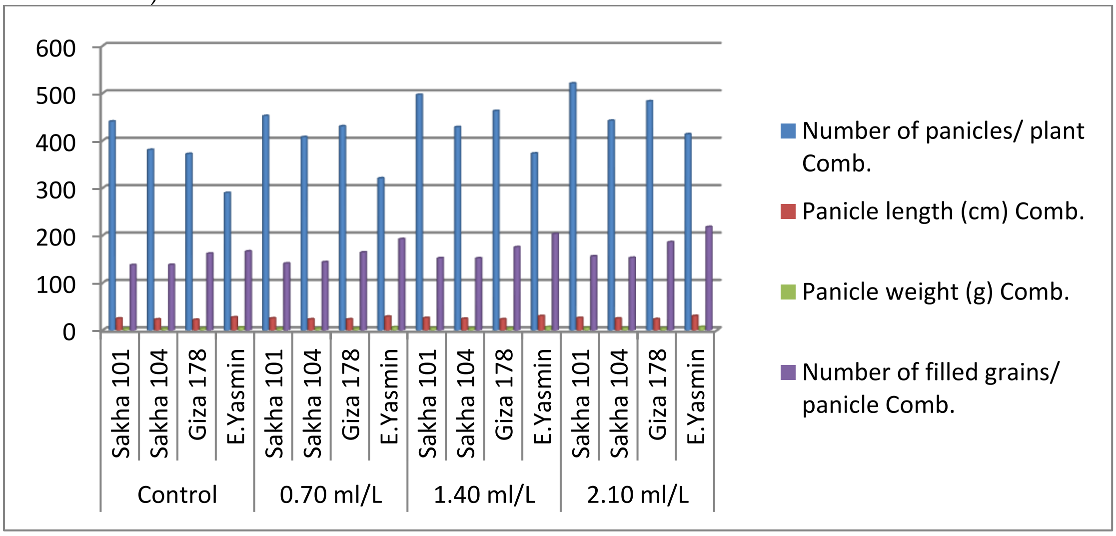

Figure 2: Illustrate interaction effects of concentrations of Viusid Agro treatments on number of panicles/m², panicle length, panicle weight and number of filled grains/ panicle of the rice varieties during two seasons (combined data).

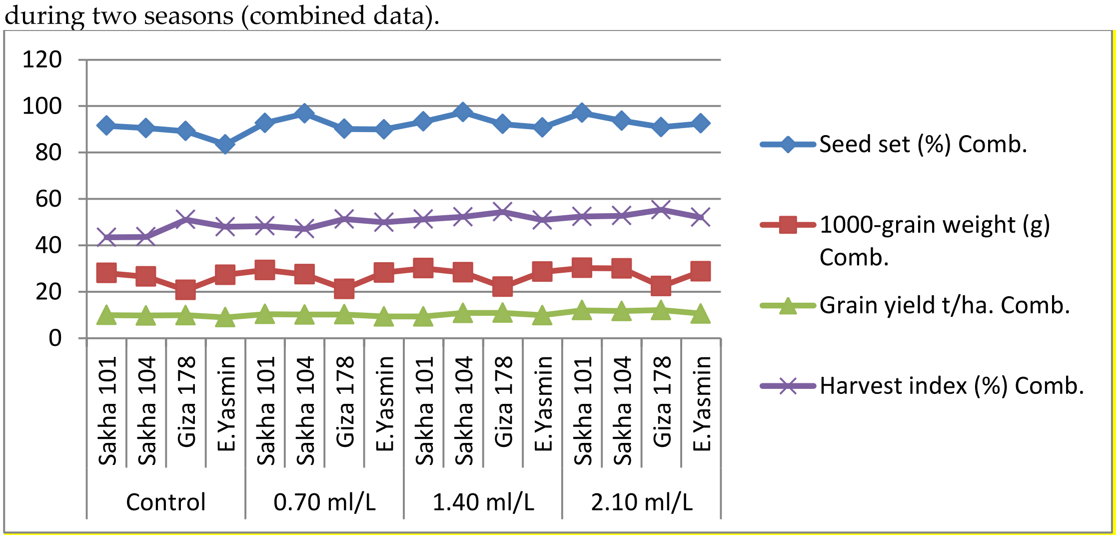

Figure 3: Illustrate the interaction effects of concentrations of Viusid Agro treatments on seed set%, 1000-grain weight, grain yield t/ha and harvest index% of the rice varieties during two seasons (combined data).

تحسين إنتاجية بعض أصناف الأرز باستخدام الرش بمحفزات النمو

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الملخص العربي:

اجريت التجربة فى موسمي الزراعه 2021 و2022م بالمزرعة البحثية لقسم بحوث الأرز –محطة البحوث الزراعية سخا كفر الشيخ –مصر وذلك لدراسة تأثير الرش بتركيزات مختلفة من محفز النمو على صفات المحصول ومكوناته لبعض اصناف الارز. تم استخدام تصميم القطع المنشقة مره واحده فى ثلاث مكررات بحيث تم وضع تركيزات الرش بمحفز النمو (كنترول و0.7 و 1.4 و 2.1 مل / لتر) فى القطع الرئيسية بينما تم ترتيب الاصناف فى القطع الشقية. أظهرت النتائج وجود فروق معنوية بين الرش بتركيزات مختلفة من محفز النمو واصناف الارز المختلفة فى كلا موسمي الدراسه. سجل التركيز 2.1 مل / لتر أفضل القيم لجميع الصفاتللمحصول ومكوناتة بالمقارنة بمعامله الكنترول. وأظهرت النتائج أيضا وجود فروق معنوية بين أصناف الأرز حيث أعطي الصنف سخا 101 والصنف جيزة 178 أفضل القيم المرغوبة للصفات المحصولية مقارنة بالصنفين الاخرين. وبالنسبة لتأثير التفاعل بين تركيزات منظم النمو وأصناف الأرز حققت معاملة الرش بتركيز 2.1 مل/ لتر علي الصنف سخا 101 أفضل القيم المرغوبة لصفات والمحصول ومكوناته. وسجلت الكفاءة الحقلية النسبية للرش بمشجع النمو أعلى القيم مع الصنف سخا 101 المعامل بالتركيز الأعلى (2.1 مل/ لتر) حيث بلغت القيمة 12.580 كجم يليه الصنف سخا 104 بنفس المعدل وكانت القيمة (8.042) كجم/ كجم . لذلك تشير الدراسة الى أنة يمكن زيادة إنتاجية محصول الأرز بالرش بمشجع النمو بمعدل2.1 مل / لتر ماء للأصناف سخا 101 وجيزة 178 تحت ظروف الدراسة .

الكلمات الاسترشادية: اصناف الارز, محصول الحبوب, محفز النمو والكفاءة الحقلية النسبية.