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Response of Maize to Different Application Methods and Rates of Fulvic Acid and Zn under Soil Affected by Salinity Conditions

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Maize, fulvic acid, Zinc, application methods, yield, components.

ABSTRACT

Two field experiments were conducted at the Experimental Farm, Faculty of Agriculture, Saba Basha, Alexandria University, Alexandria Governorate, Egypt, during of 2021 and 2022 seasons to investigate the effect of different methods and rates of fulvic acid (FA) and Zn on yield and its components of maize. In both seasons, the two filed experiments were set up in a randomized complete block design (RCBD) with three replications. The treatments were as follows; The control treatment (T1), soil application of FA at the rate of 12 kg/ha at 30 and 45 DAS (T2), soil application of Zn at the rate of 12 kg Zinc sulphate/ha at 30 and 45 days (T3), spraying of FA at the rate of 1.2 kg/ha at 40 and 50 days (T4), spraying of Zn at the rate of 1.2 kg/ha at 40 and 50 days (T5), soil application of FA and Zn at the rate of 12 kg/ha at 30 and 45 days (T6), spraying of FA and Zn at 40 and 50 days (T7), soil application of FA and spraying of Zn (T8), and soil application of Zn at 35 and 45 days and spraying of FA at the rate of 1.2 kg/ha at 40 and 50 days (T9 in both seasons. The results showed that soil application of Zn at 35 and 45 days and spraying of FA at 40 and 50 DAS (T9) gave the highest mean values of yield and its components of yellow hybrid of maize followed by soil application of FA and spraying of Zn (T8) which gave the same trend while the control treatment recorded the lowest mean values of the studied characters of maize in both seasons under this study conditions.

INTRODUCTION

Maize is among the most significant cereal crops, notably in Egypt, where much focus has been placed on increasing overall output, especially if it is used to make bread. Agronomic approaches such as bio-organic and/or inorganic fertilizers, irrigation, and novel hybrids are applied in the recently recovered desert land. In Egypt, maize is grown on roughly 0.8 million hectares (ha), with an average yield of 1.6 tonnes/ha (FAO, 2020).

Micronutrient deficits, such as a shortage of zinc (Zn), are a major constraint on agricultural output, particularly in alkaline calcareous soils. As a result, Zn is frequently used in macronutrient fertilisers to boost crop quality and yield (Khalilv *et al*., 2012). The use of Zn fertiliser can boost plant growth, blooming, and biomass output. In this way, Ehsanullah

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et al. (2015) reported that the rise in grains number/cob, grain number/row, grain number/ear, grain yield and yield components was significantly enhanced by the application of Zn. Also, Wasaya *et al.* (2017) showed a significant increase in yield characters and yield of maize with the application of zinc. Increasing amounts of Zn boosts maize growth and yield (Singh *et al*., 2020). The establishment of the reproductive organs of maize plants is influenced by Zn fertilizing during the early stages of growth. Foliar zinc fertilisers can completely restore the physiological efficiency of plants that have been deficient in zinc shortage (Ivanov *et al.*, 2021; Rahouma *et al*., 2021). The nitrogen at 150 kg/ha + Zn at 15 kg/ha yields the highest grain number/ear, grain number/row, 100- grain weight, stover, and biological yields/ha, followed by the nitrogen at 150 kg/ha + Zn at 15 kg/ha yields the highest grain number/ear, grain number/row, test weight, grain, stover, and biological yields/ha. Among all the treatments used, the lowest ones were identified in the control group (Singh *et al*., 2021).

FA or HA application significantly reduced the effects of drought by preserving chlorophyll content and gas exchange, possibly through increased antioxidant enzyme (superoxide dismutase (SOD), peroxidase (POD), and catalase (CAT)) activities and proline. These beneficial effects resulted in increased plant growth and allometry, as well as grain yield. It is worth noting that FA treatment boosted crop performance under well-watered situations. As a result, FA can be used to increase crop production in normal and stressful conditions (Chen *et al*., 2004; Rahmat *et al*., 2010; Anjum *et al*., 2011; Rahouma *et al*., 2021). In addition, humic acid reduces water evaporation, boosts yield/yield components, improves water retention, and increases soil water holding capacity (Kamran *et al*., 2014). Under water stress, the injection of 14.4 kg/ha of humic acid enhanced maize growth and grain production (Gomaa *et al*., 2015 and Kandil *et al.*, 2020). Fulvic acid boosted production, components, and quality under salinity-affected soil conditions (Kandil *et al*., 2020). Both humic acid and zinc applications have significantly improved Pioneer 3084 maize plant growth, grain yield, and yield attributes. The best results have been recorded with 15 kg humic acid/ ha as soil application combined with the spraying of 9 ml/ l zinc as spraying (Rahouma *et al*., 2021).

The objective of this manuscript was to see how different application techniques of fulvic acid (FA) and zinc (Zn), as well as their combination, affected maize production and yield components.

MATERIALS AND METHODS

Two field experiments were conducted at the experimental farm, the Faculty of Agriculture, Saba Basha, Alexandria University, Alexandria Governorate, Egypt, during the summer seasons of 2021 and 2022 to determine the effect of different application methods of fulvic acid (FA) and zinc (Zn), as well as their interaction, on yield and its components of maize cv (SC 2066) under the soil as affected by salts.

Table 1 shows the physical and chemical parameters of the experimental soil, which were determined using the method outlined by Page *et al*. (1982).

In the first and second seasons of this study, Egyptian clover (*Trifoluim alexandrinum* L.) was the previous crop.

A randomized complete block design (RCBD) was used for the experiment. Whereas the treatments applied in the three replicates are as follows:

1- The control (untreated) (T1),
2- soil application of FA at the rate of 12 kg/ha at 30 and 45 days after sowing=DAS (T2),
3- soil application of Zn at the rate of 12 kg Zinc sulphate/ha at 30 and 45 DAS (T3),
4- spraying of FA at the rate of 1.2 kg/ha at 40 and 50 DAS (T4),

5- spraying of Zn at the rate of 1.2 kg/ha at 40 and 50 DAS (T5),
6- soil application of FA and Zn at the rate of 12 kg/ha at 30 and 45 days (T6),
7- spraying of FA and Zn at the rate of 1.2 kg/ha at 40 and 50 DAS (T7),
8- soil application of FA at the rate of 12 kg/ha and spraying of Zn (T8) at the rate of 1.2 kg/ha, and
9- soil application of Zn at 35 and 45 DAS and spraying of FA at 40 and 50 DAS (T9).

Each plot size was 10.5 m^2 including 5 ridges each 3.00 m in length and 0.70 m in width. Sowing takes place in the summer seasons of 2021 and 2022, respectively. The field was sprayed with herbicides (Stomp 50% at the rate of 3.6 l/ha and Gisaprim at the rate of 1.8 kg/ha) after sowing and then irrigated on the same day .

The seeds were planted at the rate of 2 seeds/hill. The space between hills was 25 cm. Hilles were made on the north side of each ridge and thinned to one plant/hill before the first irrigation. maize hybrids grains were gained from Misr High Tech International Seed Co. which was obtained from the Ministry of Agriculture and Land Reclamation, Egypt.

Table 1. Soil Physical and chemical properties of experimental sites in both seasons.

Soil properties	Seasons	
	2020	2021
A- Mechanical analysis		
Sand	14.50	14.70
Silt	42.10	42.10
Clay	43.40	43.20
Soil texture	Clay loam	Clay loam
B- Chemical properties		
pH (1:1)	8.20	8.30
EC (1:1) dS/m	4.30	4.25
1- Soluble cations (1:2)		
K^+	1.40	1.45
Ca^{++}	9.00	10.00
Mg^{++}	11.30	11.50
Na^+	13.60	13.80
2- Soluble anions (1:2)		
CO^-_3+ HCO^-_3	2.80	2.90
CL^-	19.70	19.80
SO^-_4	12.80	13.50
Calcium carbonate (%)	6.70	6.90
Total nitrogen (%)	1.10	1.20
Available P (mg/kg)	3.70	3.60
Organic matter (%)	1.50	1.60

Phosphorus fertilizer was added at a rate of 480 kg/ha calcium superphosphate (12.5% P_2O_5) just before sowing. Mineral nitrogen fertilizer at the rate (288 kg N/ha) was in the form of urea (46 % N) and applied at two equal doses the first one after thinning before the first irrigation and the second dose done before the second irrigation.

At harvest time, ear length (cm), number of rows/ear, number of grains/row, number of grains/ear, 100- grain weight (g), biological yield, grain yield (t/ha), straw yield (t/ha) and harvest index (%) were measured from the two middle ridges of each plot in both seasons

Data obtained was analyzed using the appropriate method of statistical analysis of variance as described by Gomez and Gomez (1984). The treatment means were compared using the least significant differences test (LSD) at a 5% level of probability. All the statistical analyses were done using CoStat 6.311 (2005) computer software package.

RESULTS AND DISCUSSION

The results presented in **Tables (2 and 3)** showed the significant influence of soil and spraying of Zn and FA and their combination on grain yield, straw yield, biological yield, ear length, number of grains/row, number of grains/ear and 100- grain weight except for harvest index (HI %) during 2021 and 2022 seasons.

The results in Tables (2 and 3) showed the significant effect of soil and spraying of Zn or FA on yield and its components, whereas soil application of Zn at 35 and 45 days and spraying of FA at 40 and 50 DAS (T9) recorded the highest values of grain yield (6.05 and 5.77 t/ha), straw yield (8.85 and 8.10 t/ha), biological yield (14.90 and 13.87 t/ha), ear length (24.67 and 25.33 cm), number of grains/row (45.33 and 46.33), number of grains/ear (545.33 and 550.33), and 100- grain weigh (52.67 and 52.67 g) followed by soil addition of FA and spraying of Zn (T8), while the lowest ones were given with the control treatment in both seasons.

The increase in the value of yield attributes could be recognized as the increase in plant dry matter. An increase in yield and its components may be due to the role of Zn and FA for plant growth such as the increasing which observed in previous growth characters also cleared by Karrimi *et al.* (2018) observed that Zn with its prominent role in several physiological and enzymatic activities of the plant system, not only involves the conversion of carbohydrates, protein, and chlorophyll synthesis but also induces many catalytic functions of the plant. In this respect, Wasaya *et al*. (2017) detected a significant increase in yield parameters and yield of maize with the use of zinc. Also, Krishnaraj *et al.* (2020) mentioned that an increment in the above growth characters due to Zn application can be attributed to improved plant growth and enhancement in photosynthetic and other metabolic activities, which led to an increase in various plant metabolites responsible for cell division and cell elongation due to optimal nutrient availability, as well as accelerated growth of the internodal portion with higher synthesizing of growth hormones such as IAA and metabolizing gibberellic acid. Furthermore, amino acids, vitamins, microelements, and hormones are all biochemical fulvic acids, and all of these compounds may induce cell division, root development, and absorption of nutrients, as well as improve plant anti-stress capabilities, and hence encourage crop growth and production (Qin and Leskovar, 2020).

Fulvic acids, on the other hand, have been shown to boost mineral intake, promote root length, and raise the fresh and dry weights of agricultural plants (Chen *et al.,* 2004). According to Yang *et al*. (2017), fulvic acid (FA) includes several nutritional ingredients that are good for enhancing crop yields as well as the physicochemical and biological environment of the soil. These results are in the same trend as those reported by Khalilv *et al*. (2012); Naeem *et al.* (2015); Moradi *et al.* (2017); Yang *et al.* (2017); Kandil *et a*l. (2020); Rahouma *et al*. (2021) who indicated that using Zn or FA increased yield and yield components.

Table 2. Effect of soil and spraying of Zn, and FA on maize yield in both seasons.

Treatment	Grain yield (t/ha)		Straw yield (t/ha)		Biological yield (t/ha)		Harvest index (HI%)	
	2021	2022	2021	2022	2021	2022	2021	2022
T1	3.57 f	3.23 e	5.27 f	4.97 e	8.84	8.20	40.38	39.39
T2	3.93 f	3.88 d	6.27 e	5.52 d	10.20	9.40	38.53	41.28
T3	4.70 de	4.57 c	7.50 cd	6.17 c	12.20	10.74	38.52	42.55
T4	4.63 e	4.50 c	7.43 d	6.10 c	12.06	10.60	38.39	42.45
T5	4.93 cde	4.63 c	7.73 bcd	6.57 c	12.66	11.20	38.94	41.34
T6	5.28 bc	5.07 bc	8.00 bc	7.27 b	13.28	12.34	39.76	41.09
T7	5.16 bcd	5.03 bc	7.89 bcd	7.33 b	13.05	12.36	39.54	40.70
T8	5.50 b	5.23 ab	8.07 b	7.77 ab	13.57	13.00	40.53	40.23
T9	6.05 a	5.77 a	8.85 a	8.10 a	14.90	13.87	40.60	41.60
$LSD_{0.05}$	0.49	0.57	0.52	0.53	0.97	0.95	ns	ns

Table 3. Effect of soil and spraying of Zn, and FA on maize yield components in both seasons.

Treatment	Ear length (cm)		Number of grains/row		Number of grains/ear		100- grain weight (g)	
	2021	2022	2021	2022	2021	2022	2021	2022
T1	17.67 e	18.30 e	30.33 d	28.00 f	348.67 e	335.00 d	38.00 g	37.00 f
T2	19.33 d	19.67 de	34.67 c	35.33 e	421.67 d	410.67 c	42.00 f	41.67 e
T3	19.20 d	19.17 de	40.67	41.00 d	488.00 bc	475.00b	44.67 cde	44.17 cde
T4	19.50 d	18.90 de	43.00 ab	42.00 cd	521.67 abc	528.00 a	43.33 def	44.33 cde
T5	19.67 d	20.17 d	42.67 ab	41.67 cd	529.33 abc	519.67 a	45.33 cd	46.17 bc
T6	21.67 c	22.00 bc	42.67 ab	42.33 cd	488.00 bc	521.67 a	42.67ef	43.67 de
T7	22.00 bc	21.67 c	40.67 b	44.33 bc	529.67 ab	535.33 a	46.33 bc	46.17 bcd
T8	23.17 b	23.33 b	45.00 a	47.33 a	531.67 ab	550.67 a	48.50 b	48.17 b
T9	24.67 a	25.33 a	45.33 a	46.33 ab	545.33 a	550.33 a	52.67 a	52.67 a
LSD 0.05	1.45	1.46	3.65	2.72	48.12	38.86	2.46	2.80

- The control (T1), soil application of FA at the rate of 12 kg/ha at 30 and 45 days (T2), soil application of Zn at the rate of 12 kg Zinc sulphate/ha at 30 and 45 DAS (T3), spraying of FA at the rate of 1.2 kg/ha at 40 and 50 DAS (T4), spraying of Zn at the rate of 1.2 kg/ha at 40 and 50 DAS (T5), soil application of FA and Zn at the rate of 12 kg/ha at 30 and 45 days (T6), spraying of FA and Zn at 40 and 50 days (T7), soil application of FA and spraying of Zn (T8), and soil application of Zn at 35 and 45 days and spraying of FA at 40 and 50 DAS (T9).
- Ns: no significant difference at 0.05 level of probability.

CONCLUSION:

From the result of these two growing seasons field's study, it was concluded that yield, its components of maize crop increased with treated yellow SC 2066 hybrid with soil application of Zn at 35 and 45 DAS at the rate of 12 kg/ha and spraying of FA at 40 and 50 days after sowing (DAS) (T9) at the rate of 1.2 kg/ha or soil application of FA and spraying of Zn (T8), under study conditions at Alexandria Governorate, Egypt.

REFERENCES

Anjum, S. A., Wang, L., Farooq, M., Xue, L., and Ali, S. (2011). Fulvic acid application improves the maize performance under well-watered and drought conditions. Journal of Agronomy and Crop Science, 197(6), 409-417.

Atiyeh, R. M., Lee, S., Edwards, C. A., Arancon, N. Q., and Metzger, J. D. (2002). The influence of humic acids derived from earthworm-processed organic wastes on plant growth. Bioresource Technology, 84(1), 7-14.

Chen, Y., Nobili, M. D., and Aviad, T. (2004). Stimulatory effects of humic substances on plant growth. In: Magdoft F., Ray R. (eds): Soil Organic Matter in Sustainable Agriculture, 103-129.

CoStat-Cohort Software (2005). CoStat User Manual, version 3 Cohort Tucson, Arizona, USA.

Ehsanullah, A., Tariq, M.A., Randhawa, A.S., Anjum, M., Nadeem, M., Naeem, M., 2015. Exploring the Role of Zinc in Maize (Zea mays L.) through Soil and Spraying. Universal Journal of Agricultural Research, 3(3), 69–75.

FAO (2020). Maize, cultivated area and production. Food and Agriculture Organization of the United Nation, 2019. http://www.fao.org/faostat/en/#data/QCL

Gomaa, M. A., Radwan, F. I., Rehab, I. F., Kandil, E. E., & Abd El-Kowy, A. R. M. (2015). Response of maize to compost and a-mycorrhizal under condition of water stress. *International Journal of Environment*, 4(4), 271-277.

Gomez, K.A and Gomez A.A. (1984). Statistical Procedures in Agricultural Research. 2nd edition. Wiley, NewYork.

Ivanov, K., Vasilev, A., Mitkov, A., Nguyen, N., and Tonev, T. (2021). Application of Zn-containing foliar fertilisers for recovery of the grain productivity potential of Zn-deficient maize plants. Italian Journal of Agronomy, 16(2),1-9.

Kamran, A., Shad, K. K., Farmanullah, K., Abdul, Q., Muhammad, S., and Muhammad, Z. (2014). Phenology, yield and yield components of maize as affected by humic acid and nitrogen. Journal of Agricultural Science (Toronto), 6(7), 286-293.

Kandil, E. E., Abdelsalam, N. R., Aziz, A. A. A. E., Ali, H. M., and Siddiqui, M. H. (2020). Efficacy of nanofertilizer, fulvic acid and boron fertilizer on sugar beet (Beta vulgaris L.) yield and quality. *Sugar Technology*, 22(5), 782-791.

Kandil, E. E., Abdelsalam, N. R., Mansour, M. A., Ali, H. M., and Siddiqui, M. H. (2020). Potentials of organic manure and potassium forms on maize (Zea mays L.) growth and production. Scientific Reports, 10(1), 1-11.

Karrimi, A. S., Reddy, A. P. K., Babazoi, F., and Kohistani, T. (2018). Growth, yield and post-harvest soil available nutrients in sweet corn (Zea mays L.) as influenced by zinc and iron nutrition. Journal of Pharmacognosy and Phytochemistry, 7(4), 2372-2374.

Khalilv, A., E. Behrouzyar, Yarnia, M, Khoii, F.R., Mogaddam, M., and Safarzadeh V.M.N. (2012). The effect of methanol and some micro-macronutrients spraying on maize (*Zea mays* L.) maternal plant on some of morphophysiological characteristics in a subsequent generation. *International Journal of Agronomy and Plant Production*, 3 (12): 618-624.

Krishnaraj, M., Senthil, K., Shanmugasundaram, R., Prabhaharan, J., & Subramanian, E. (2020). Effect of chelated iron and zinc application on growth and productivity of maize (Zea mays L.) in subtropical climate. *Journal of Pharmacognosy and Phytochemistry*, 9(6), 1212-6.

Moradi, P., Pasari, B., and Fayyaz, F. (2017). The effects of fulvic acid application on seed and oil yield of safflower cultivars. *Journal of Central European Agriculture*, 18(3).

Naeem, M. (2015). Exploring the role of zinc in maize (Zea mays L.) through soil and spraying. *Universal Journal of Agricultural Research*, 3(3), 69-75.

Page, A. L., Miller, R. H., and Keeney, D. R. (1982). Methods of Soil Analysis, Part 2, Agron. Monogr, ASA and SSSA, Madison.

Qin, K., and Leskovar, D. I. (2020). Humic substances improve vegetable seedling quality and post-transplant yield performance under stress conditions. *Agriculture,* 10(7), 254.

Rahmat, U., Rashid, K. A. Khan, M. S., and Ozturk, E. (2010). Impact of humic acid and chemical fertilizer application on growth and grain yield of rainfed wheat (Truticum aestivum, L.). *Pakistan Journal Agricultural Research,* 23 N (3-4):113-121.

Rahouma, M. A., and Mahmud, A. (2021). Maize Growth and Yield Response to Different rates of humic Acid and Zinc. *Alexandria Science Exchange Journal,* 42(4), 823-829.

Singh, H., Singh, V., Singh, S., & Khanna, R. (2020). Response of maize (Zea mays L.) to foliar application of Zinc and Boron. *Indian Journal of Agronomy,* 65(4), 489-492.

Singh, J., Partap, R., Singh, A., and Kumar, N. (2021). Effect of nitrogen and zinc on growth and yield of maize (*Zea mays* L.). *International Journal of Bio-Resource and Stress Management,* 12(3):1-8.

Wasaya, A., Shahzad Shabir, M., Hussain, M., Ansar, M., Aziz, A., Hassan, W., and Ahmad, I. (2017). Spraying of zinc and boron improved the productivity and net returns of maize grown under rainfed conditions of Pothwar plateau. *Journal of Soil Science and Plant Nutrition,* 17(1), 33-45.

Yang, W., Li, P., Guo, S., Fan, B., Song, R., Zhang, J., and Yu, J. (2017). Compensating effect of fulvic acid and super-absorbent polymer on leaf gas exchange and water use efficiency of maize under moderate water deficit conditions. *Plant Growth Regulation,* 83(3), 351-360.

ARABIC SUMMARY

استجابة الذرة الشامية لطرق الأضافة والمعدلات المختلفة لحامض الفولفيك والزنك تحت ظروف الأرض المتأثرة بالملوحة

محمود عبد العزيز جمعة[1] ، إبراهيم عباس السيد[1] ، جوهرة عبد السلام الصردي[1] ، امل سالم سعيد ابوفليجة[2] ، عصام إسماعيل قنديل[1]

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الذرة الشامية تقع في المركز الثالث من حيث الأهميّة الاقتصادية على مستوى العالم بعد القمح والأرز وتعتبر الغذاء الرئيسي لسكان لعدد كبير من دول العالم، وهي تستخدم بشكل رئيسي في إنتاج دقيق الذرة، وإنتاج زيت الذرة ونشا الذرة، كما تُستخدم كعلف للحيوانات والدواجن، وتدخل أيضاً في الكثير من الصناعات الغذائية وفي إنتاج الوقود الحيوي، والجدير بالذكر أن الذرة الصفراء لها الكثير من الفوائد الصحية بفضل مكوّناتها الغذائية عالية القيمة. وتهدف الدول خاصة مصر وليبيا لزيادة إنتاجية محصول الذرة وتقليل استيراده من الخارج لتوفير العملات الصعبة وتقليل العجز بين الاستهلاك والإنتاج وذلك باختيار الهجن الجديدة عالية الإنتاجية وزيادة انتاجيتها تحت ظروف الأجهاد المائي والأراضي الملحية، لذا أجريت تجارب حقلية خلال موسمي 2021 و 2022 لدراسة تأثير معدلات طرق اضافة مختلفة لحامض الفولفيك والزنك على انتاجية محصول الذرة الشامية في المزرعة البحثية الكلية في تصميم القطاعات العشوائية الكاملة وتضمنت التجربة المعاملات التالية:

1. كنترول (بدون معاملة)
2. الإضافة الأرضية لحامض الفولفيك بمعدل 12 كجم للهكتار على دفعتين30 و45 يوم.
3. الإضافة الأرضية للزنك في صورة سلفات الزنك بمعدل 12 كجم على دفعتين 30 و45 يوم.
4. الرش الورقي لحامض الفولفيك بمعدل نصف كجم للفدان مرتين (40 و50 يوم من الزراعة).
5. الرش الورقي للزنك بمعدل نصف كجم للفدان على مرتين (40 و50 يوم من الزراعة).
6. الإضافة الأرضية لحامض الفولفيك والزنك على دفعتين30 و45 يوم.
7. الرش الورقي لحامض الفولفيك والزنك على مرتين (40 و50 يوم من الزراعة).
8. الإضافة الأرضية لحامض الفولفيك + الرش الورقي الزنك.
9. الإضافة الأرضية للزنك + الرش الورقي لحامض الفولفيك.

الصفات تحت الدراسة:
صفات المحصول ومكوناته: محصول الحبوب (طن/هكتار) – محصول القش(طن/هكتار) – المحصول البيولوجى (طن/فدان) - دليل الحصاد - وزن 100 حبة (جم) – عدد الحبوب/صف – عدد الحبوب/كوز - طول الكوز (سم) - عدد الصفوف/كوز.
وتتلخص أهم النتائج فيما يلي:

- زاد محصول الحبوب ومحصول القش والمحصول البيولوجي ومكونات المحصول زيادة معنوية بإضافة 5 كيلو جرام سلفات زنك إضافة ارضيه مع الرش الورقي بمحلول فولفيك اسيد بمعدل 1.2 كجم للهكتار في عمر 40 ، و 50 يوم من الزراعة (معاملة 9) على باقي المعاملات وتلي تلك المعاملة معاملة رقم (8) وهي الإضافة الأرضية لحامض الفولفيك بمعدل 12 كجم للهكتار على دفعتين في عمر 30 ، 45 يوم مع الرش الورقي للزنك بمعدل 1.2 كيلو جرام للفدان في عمر 40 ، 50 يوم بينما كان معاملة المقارنة أقل المعاملات إنتاجاً للمحصول ومكوناته لهجين الذرة فردي أصفر 2066.

التوصية:

توصي الدراسة بإضافة 5 كجم سلفات زنك للفدان إضافة أرضية مع الرش بحمض الفولفيك في عمر 40 ، 50 يوم بمعدل 1.2 كجم للهكتار او إضافة 5 كجم فولفيك = الرش بمعدل 1.2 كجم سلفات زنك حققت أعلى محصول من الذرة الشامية الصفراء هجين 2066 المنزرع بمنطقة ابيس محافظة الإسكندرية – مصر.