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Response of Rice Crop to Nitrogen Fertilizer Rates with Foliar Application with a Mixture of Potassium and Zinc on Growth and Yield

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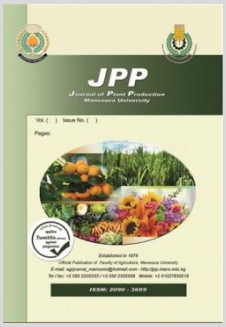

ABSTRACT

Two field experiments were conducted at Sakha Agricultural Research Station,Kafr El-Sheikh Governorate , Egypt, during 2018 and 2019 seasons.to to investigate the effect of different proportions of nitrogen rates with foliar potassium and Zinc their combined effect on growth and yield components .The treatments i.e.,45kgN/fad ,60kgN/fad,45Kg N/fad+spray with 2% K_2O,45Kg N/fad+spray with 2 % Zn, 45Kg N/fad+spray with 1% K_2O+1%Zn, 60 kg N/fad+spray with 2 % K_2O and 60 kg N/fad + spray with 2 % Zn, 60kg N/fad+spray with 1% K_2O+1%Zn .The used variety was Sakha 107.The experiments were performed in Randomized Complete Block Design with four replications.The collected data include physiological traits, yield attributes yields and grain quality characteristics. The main obtained results are summarized as following all mistuned traits were significantly and pristinely responded to tested nitrogen treatment combined with foliar spray of K_2O, Zn mixture in both study seasons .The highest means of dry matter, leaf area index ,crop growth rate, net assimilation rate , panicle number/m^2, panicle length, panicle weight,filled grains numbers/panicle ,1000 grain weight. Grain, and biological yields and grain content of carbohydrates,crude protein and amylase were produced when rice plants received 60kgN/fad.+ mixture spray of K_2O,Zn at 1% for each.The grain quality showed the same pattern of above mentioned traits. It could be concluded that high growth, yield attributes, grain yield and grain quality traits, as well as physiological parameters could be approached by apply 60kg N/fad along with foliar spray of K_2O, Zn mixture twice at 15 and 30 days after transplanting

Keywords: Rice, Yield, Nitrogen rates ,Potassium, Zinc, physiological parameters

INTRODUCTION

Rice (*Oryza sativa L.*) is the most important cereal crop after wheat in Egypt. It is a staple food for nearly one half of the world population since most of them live in developing countries. Moreover, it is a very important cereal crop in Egypt for local consumption. In Egypt the total rice cultivated area is about 1.17 million fed which produce about 8.76 million tons of paddy rice (RRTC, 2019). Nitrogen is one of the most important plant nutrients and plays a vital role in plant photosynthesis and biomass production. Increasing panicle numbers per unit area is the main factor of yield increment as a result of nitrogen application (Bindra *et al*., 2000; Laroo and Shivay 2011). Nitrogen is the most important and yield-limiting nutrient in rice production worldwide (Lin *et al*., 2006). Potassium (K) is one of the three essential macronutrients required in large amounts for plant growth. This versatility of K nutrition is well documented in enhancing yield and quality of rice (Srivastava and Singh, 2007). Potassium is naked for the activity of several enzymes, including those of energy metabolism and protein synthesis (White and Karley, 2010). It plays an essential part in the formation of starch and in the production and translocation of sugars, and is thus of special value to carbohydrate-rich crops, and influences tillering or branching of plant and size and weight of grain. Zinc is one of the most important essential micronutrients required for plant growth. It acts as an activator of several enzymes in plants and is directly involved in the biosynthesis of growth substances such as auxin which is involved in plant growth and cell division. Where, zinc represented in all six enzyme classes (oxides reeducates, trans ferases, hydrolases, lyases, isomerizes and ligases (Auld, 2001).Additionally, Zn also, a part of several other enzymes such as superoxide dismutase and catalyze, which prevents oxidative stress in plant cells (Shehata *et al*., 2009). The main objective of the present study is to investigate the effect of different proportions of nitrogen and potassium and zinc and their combined effect on growth and yield components of rice .

MATERIALS AND METHODS

The present work was carried out at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, Egypt, during the two summer seasons of 2018 and 2019. The aim was to study the effect of nitrogen fertilizer rates *i.e*. 45and 60 kg N/fad and foliar spray with 2% K_20, as well as some of macronutrients mixture of (K_2O,Zn)using concentration at 1%and 2% for each element on growth, yield, yield components . The experiments were laid out in a randomized complete block design with four replications in both seasons. The treatments were as follows:

1-45kg N/fad.
2-60kg N/fad.
3-45Kg N/fad. + spray with 2 % K_2O.
4-45Kg N/fad. + spray with 2 % Zn.

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5-45Kg N/fad. + spray with 1% K_2O+1%Zn**.**mixture
6-60 kg N/fad. + spray with 2 % K_2O**.**
7-60 kg N/fad. + spray with 2 % Zn.
8-60kg N/fad. + spray with 1% K_2O+1%Zn**.** mixture

Rice grain (Sakha 107cultivar) were sown on nursery at the rate of 60kg/fad and were soaked in water for 24h, then drained and incubated for 48h to motivate and enhance germination percentage. Per-germinated seeds were manually broadcasted on 1st May in both seasons. In wet leveled plots, 30 day old seedlings were manually transplanted. Spacing's were given 20 cm X 20 cm. Nitrogen as urea(46% N) at the rates of 97.83and 130.43 kg fad^{-1} was applied for all treatments in two splits, two third as a basal application and incorporated into the soil then the soil was immediately flooded. Full dose of phosphorus as a single superphosphate(15.5%P_2O_5) was applied as a basal dose at the time of final land preparation and incorporated well into the soil. Plot area was 20 m^2 (4m wide long). Some mechanical and chemical properties of the experimental site are shown in Table (1) and were done according to Ryan *et al.* (1996).

Foliar application of potassium and zinc mixture was sprayed two times, 15 and 30days after transplanting (DAT), the volume of water was 200 liter/fad.,(0.5 liter/plot),0.5% wetting agent of tween 20 was used. Agricultural practices were practiced according to the methods being adopted for growing rice in the Egypt.

Table1. Some mechanical and chemical characteristics of the used soil in season 2018 and 2019.

Tested characteristics	Value 2018	Value 2019
Piratical size distribution		
Sand %	35.0	27.3
Silt %	32.8	27.64
Clay %	32.2	45.06
Texture class	Clayey	Clayey
PH (1:2.5 soil water suspension)	8.2	8.10
Ec_e(soil paste extracted at 25c ds.m^{-1})	2.5	2.58
OM (organic matter) %	1.73	1.65
Available potassium (ppm)	305	320
Soluble cations, meq.l^{-1}(soil paste):		
Ca^{++}	5.2	5.4
Mg^{++}	2.1	2.2
K^+	1.73	1.81
Na^+	11.58	12.49
Soluble anoins, meq.l^{-1}(soil paste):		
CO_3^{--}	-	-
HCO_3^-	3.52	3.69
Cl^-	15.27	16.44
SO_4^{--}	1.82	1.77

A- Growth analysis and attributes:-

The analysis various relived Plant samples were randomly taken at 45 DAT) and the beginning of stem elongation (60 DAT). Dry matter accumulation (g)/m^2, leaf area index, crop growth rate (CGR), in g/m^2/week and net assimilation rate (NAR), in g/m^2 /week were recorded. Plant samples were taken from the area (40x40cm) were randomly taken from the outer rows of each experimental plot at the beginning of tillering . Plants were separated into leaves, stems and panicles, then dried at 105°C in a ventilated oven to a constant weight. Leaf area / plant (cm^2) at 45 and 60 DAT were estimated by using leaf area meatier apparatus. LAI expresses the ratio of leaf surface to the ground area occupied by the crop. Crop growth rate(CGR):The increase of plant dry matter per unit of ground area in unit of time and net assimilation rate (NAR):the increase of plant dry matter per unit of assimilatory material per unit of time were determined according to Watson (1952) as the following formulae:

$$CGR = (W_2 - W_1) / (t_2 - t_1) \text{ in } (g/ m^2 / week)$$

$$NAR = (W_2 - W_1)(\log_e A_2 - \log_e A_1) / (A_2 - A_1)(t_2 - t_1) \text{ in } (g/m^2/week)$$

Where:-

$(A_2 - A_1)$ = differences in leaf area between two successive samples in m^2.
$(W_2 - W_1)$ = differences in dry matter accumulation of whole plants between two successive samples in (g).
$(t_2 - t_1)$ = Number of days between two successive samples (in week).
Log_e = Natural logarithm.

I-Yield analysis and attributes:-

Harvesting took place at 28/8 and 4/9 in the first and second seasons, respectively. At harvest time, one meter square were randomly taken from the central rows in each plot to determine grain and straw yields The crop of each plot was separately harvested at full maturity. Plant samples were collected from each plot for data collection on plant growth characters and yield components. Ten panicle/plot were randomly uprooted before harvesting in order to collect the following data: Total number of panicle /m^2 , panicle length (cm), panicle weight (g), number of grains/ panicle, number of filled / panicle .Data on grain and straw yield/plot were recorded on a plot basis after drying in the sun maintaining 14% moisture, threshing, winnowing and finally converted into fad. The biological yield (grain + straw) was measured and harvest index (HI) was calculated using the following :-

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield(grain + straw)}} \times 100$$

II- Chemical composition:-

At 60 days after sowing (DAT) leaves samples were taken to determine Chlorophyll a, Chlorophyll b and carotenoids concentrations as mg/g fresh weight of leaves were extracted. Leaves samples (0.5 g) were homogenized with acetone (90%v/v), filtered and make up to a final volume of 50 mL. Chlorophyll concentrations were calculated spectrophotometerically from the absorbance of extract at 663.2 ,646.8 and 470 nm. The amounts of photosynthetic pigments were quantified using the following formula:-

$$\text{chl.a} = (12.25A663.2 - 2.79A646.8)$$
$$\text{chl.b} = (21.21A646.8 - 5.1A663.2)$$
$$\text{car.} = (1000A470 - 1.8\text{chl. b}/198)$$

According to Lichtenthaler (1987). Rice grain samples (150 g for each) were taken randomly; samples were cleaned and dehulled with an experimental Steak huller machine and polished in Satake miller and tested according to standard evaluation system of IRRI (2007). Protein content was determined for brown rice, according to the standard Micro-Kjeldahl method. Then, the estimated nitrogen content was multiplied by a factor of 5.95 to obtain crude protein content. Amylose content was estimated by the simplified procedure reported by Juliano (1971) and Gelatinization temperature was recorded according to Little *et al*. (1958).

III- Statistical analysis:

All collected data were subjected to analysis of variance according to Gomez and Gomez (1984). All

statistical analysis was performed using analysis of variance technique by means of CoStat computer software package (CoStat, Ver. 6.311., 2005). The least significant differences (LSD at 0.05) was used to compare the treatment means.

RESULTS AND DISCUSSION

I-Growth and growth analysis:-

a – Growth: -

Results in Table 2 indicated that all growth traits under study *i.e* . dry matter accumulation (g/m^2) at 45 and 60 days after transplanting (DAT) as well as leaf area index were significant by affected by investigated treatments. Increasing nitrogen fertilizer from 45 up to 60kg N/fad gradually increased all growth traits under study. Gewaily *et al.*(2018) reported that treated rice plants with (0 to 220 kg N ha^{-1}) increased all growth characters compared to zero nitrogen application (control). The results showed that the maximum values of such studied traits were scored from plant received 60 kg N/fad and foliar sprayed with 1% (K_2O+ Zn) followed by adding 60kg N/fad with Z at 2% significant differences between such two treatments. This fending may be referred to the role of potassium and zinc mixture (K_2O+Zn) as foliar application for reduce soil dressing of nitrogen fertilizers by 15 kg N ha^{-1} which reduce costs and environmental pollution. In this connection,. Fergany (2018)stated that it can be concluded that application of zinc foliar application at the level of 600ppm, on rice exhibited the highest values of grain, straw, biological especially K_2O and Zn act either as metal components of various enzymes or as functional, structural, or regulatory cofactors. Thus, they are associated with saccharine metabolism, photosynthesis, nucleic acid, lipid metabolism and protein synthesis. He added that, zinc is an essential micronutrient for synthesis of auxin, cell division and the maintenance of membrane structure and function. Zinc also plays at higher concentrations has retarded the growth and development of plants by interfering with certain important metabolic processes.

Table 2. Mean of dry matter(g/m^2), leaf area index , crop growth rate(g/m^2/week) and net assimilation rate (g/m^2/week) as affected by nitrogen rate and foliar spraying with mixture of potassium and zinc for rice during 2018 and 2019 seasons.

Treatments	Dry matter		Leaf area index		Crop growth rate	Net assimilation rate
	45 days	60 days	45 days	60 days	45-60 days	45-60 days
				2018 season		
1-45kg N/fad	334.05	440.95	3.483	3.653	49.88	323.72
2-60kg N/fad	384.95	554.33	4.088	4.199	79.04	524.04
3-45Kg N/fad + spray with 2 % K_2O	354.53	463.69	3.524	3.666	50.94	331.11
4-45Kg N/fad + spray with 2 % Zn	367.09	480.34	3.562	3.733	52.85	345.64
5-45Kg N/fad + spray with 1% K_2O+1%Zn	378.93	495.11	3.646	3.773	54.21	355.62
6-60 kg N/fad + spray with 2 % K_2O	402.25	573.73	4.117	4.274	80.02	533.73
7-60 kg N/fad + spray with 2 % Zn	417.00	594.50	4.315	4.306	82.83	553.30
8-60kg N/fad + spray with 1% K_2O+1%Zn	440.05	625.90	4.455	4.386	86.72	586.23
LSD 0.05	16.01	15.06	0.23	0.28	4.92	18.00
				2019 season		
1-45kg N/fad.	400.86	509.14	3.459	3.729	50.53	330.47
2-60kg N/fad.	461.94	635.22	4.178	4.356	80.86	538.53
3-45Kg N/fad. + spray with 2 % K_2O.	425.44	544.43	3.528	3.894	55.52	365.32
4-45Kg N/fad. + spray with 2 % Zn.	440.51	564.42	3.723	3.911	57.82	381.03
5-45Kg N/fad. + spray with 1% K_2O+1%Zn.	454.72	582.13	3.887	3.992	59.45	394.15
6-60 kg N/fad. + spray with 2 % K_2O.	482.70	662.48	4.259	4.396	83.89	560.39
7-60 kg N/fad. + spray with 2 % Zn.	500.40	686.60	4.362	4.466	86.89	581.29
8-60kg N/fad. + spray with 1% K_2O+1%Zn.	518.06	709.12	4.493	4.516	89.16	606.29
LSD 0.05	11.82	12.63	0.42	0.56	4.40	15.89

***,**and not significant indicate at0.05and 0.01 probability levels respectively**

b- Growth analysis:-

Table (2) shows the means crop growth rate (CGR) and net assimilation rate (NAR) at (45-60 DAT) period. It was observed that there were significant difference in CGR and NAR values among the two nitrogen levels (45 and 60 kg N fad^{-1}) and their combinations with foliar spraying with 2% K_2O and Zn mixture (K_2O+Zn). It was noticed that CGR and NAR values increased gradually with increasing nitrogen level from 45up to 60kg N fad^{-1}. Such finding could be attributed to the accumulation of dry matter or photosynthesis compounds with increasing nitrogen fertilizer level The benefit role of nitrogen treat a attributed to encouraging photosynthesis, plant metabolism and development. In addition, applying nitrogen to enhance anabolism against catabolism producing high net assimilation rate as it was observed. Zinc application had positive impact on rice crop physiological parameters since it might be increased the formalin of Indol acetic acid resulted which accelerate rice growth, cell division, cell elongation and plant organ development releasing high dry matter large leaf area per soil unit area as well as net assimilation rate .At the sometime, the rate of potassium is well known where it is useful for enhancing growth, photosynthesis and plant metabolism process and elevating the nutrient uptake Mohiti *et al.*, (2015). In addition, the maximum values of CGR and NAR at (45-60 DAT) were obtained from plants treated with 60 kg N fad^{-1} and foliar spraying with2% Zn plus followed by plants received 60 kg N fad^{-1} with insignificant differences between such two treatments. Such finding may due to the positive effect of potassium and zinc mixture 1%(K_2O+Zn) as foliar spray. A gradual increase of zinc concentration was observed with the increasing Zn levels from 1% to 2%. In this connection, Myat Yadanar *et al.* (2018)reported that macronutrients play a great role in plant growth as a result of affecting many physiological processes in plant life. With respect foliar

spraying of K_2O, Venkategowda Ramegowda *et al*. (2014). Found similar results.

ll-Yield and yield components :-

Regarding the influence of fertilization application on number of panicles m^2 at harvest was indicated in Table 3 were significantly affected by different proportions of nitrogen and foliar spray with potassium and zinc on the number of panicles

Increasing nitrogen fertilizer level from 45 up to 60kg N/fad. Significantly increased number of panicles/ m^{-2}.It can be noticed that applying 60kg N/fad. increased panicle length, panicle weight ,number grain /panicle and grain yield with 22.1,42.75,42.0, 16.8 and 20.05% respectively. Myat Yadanar *et al*.,2018)stated that fertilizing rice plants with 85kg N/ha increased number of panicles $hill^{-1}$, number of grains and grain yield. The maximum grain yield was observed from the present recommended rate85 kg N ha^{-1} treatment. In this treatment, plants were able to produce high panicle numbers and filled grains percentages. Minimum grain yield was achieved at control. Among the treatments, the highest percentage of grain yield increase(41.65%) was resulted from 85 kg N ha^{-1} treatment. They added that, nitrogen application can be increasingly effected some traits such as dry matter, panicle length, panicle number per square meter which are correlated with grain yield.

Table 3. means of yield attributes of rice as affected by different levels of nitrogen fertilizer and foliar spray by K_2O and Zn plus mixture in 2018/2019 seasons .

Treatments	No. of panicle's /m^2		Panical length (cm)		Panicle weight (g)		No.of grain /panicle		No.of filled grain	
	2018	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**
1-45kg /fad	326.15	358.77	13.62	14.97	2.58	2.43	92.9	96.0.	84.5	83.5
2-60kg N/fad	419.05	460.96	19.73	20.47	2.82	2.73	104.7	103.3	94.8	95.9
3-45Kg N/fad + spray with 2 % K_2O	345.05	379.56	15.08	15.62	2.64	2.51	95.1	98.4	88.4	84.9
4-45Kg N/fad + spray with 2 % Zn	358.90	394.79	15.94	16.37	2.72	2.59	99.2	101.3	87.9	86.7
5-45Kg N/fad + spray with 1% K_2O+1%Zn	383.75	422.13	16.82	17.09	2.81	2.64	100.4	105.4	86.3	89.0
6-60 kg N/fad + spray with 2 % K_2O	437.35	481.09	20.05	21.38	2.91	2.94	112.8	108.6	88.0	89.5
7-60 kg N/fad + spray with 2 % Zn	451.85	497.04	21.18	22.04	3.08	2.98	114.1	110.3	87.6	89.5
8-60kg N/fad + spray with 1% K_2O+1%Zn	473.50	520.85	22.69	22.77	3.17	3.09	117.6	112.8	90.8	98.7
LSD 0.05	3.72	4.09	1.35	1.29	0.26	0.38	5.17	5.29	5.7	5.3

Treatments	1000grain weight (g)		Grain yield (ton/fad^1)		Biological yield (ton/fad^1)		Harvest index(%)	
	2018	2019	2018	2019	2018	2019	2018	2019
1-45kg /fad.	16.67	15.42	3.173	3.225	6.994	6.810	45.36	47.36
2-60kg N/fad.	18.67	17.73	3.955	4.052	7.478	7.397	52.89	54.78
3-45Kg N/fad. + spray with 2 % K_2O.	17.26	15.98	3.265	3.328	7.153	7.025	45.65	47.37
4-45Kg N/fad. + spray with 2 % Zn.	18.09	16.45	3.321	3.425	7.269	7.071	45.69	48.44
5-45Kg N/fad. + spray with 1% K_2O+1%Zn.	18.75	16.84	3.462	3.623	7.540	7.181	45.92	49.76
6-60 kg N/fad. + spray with 2 % K_2O.	19.34	17.91	4.107	4.157	7.726	7.563	53.16	54.96
7-60 kg N/fad. + spray with 2 % Zn.	20.18	18.92	4.257	4.237	7.984	7.699	53.32	55.03
8-60kg N/fad. + spray with 1% K_2O+1%Zn.	20.52	19.32	4.216	4.271	7.986	7.745	53.36	55.15
LSD 0.05	2.04	1.83	0.335	0.375	0.451	0.466	NS	NS

***,**and not significant indicate at0.05and 0.01 probability levels respectively**

Results in Table 3 indicated that the highest main values of panicle length, panicle weight ,number of grains /panicle and grain yield were gained from plants received 60 kg N/fad and sprayed with K_2O+Zn 1% mixture compared to adding 45kg N/fad with insignificant difference between such two treatments. Furthermore, nitrogen rates along foliar spray with mixture from K and Zn had positive effect in improved plant vigor during vegetative growth stages that enabled plants to produce more tiller buds, particularly the bearing tillers as high assimilates existence and available energy. improving rice growth by nitrogen rates along foliar spray with mixture from K and Zn accelerated cell division and along resulted in long panicle and tall plant relieving the stunt appearance induced by nitrogen rates favorable effect on rice growth reflected on yield characteristics as seen in Table 3.Referring to nitrogen rates along foliar spray with mixture from K and Zn on rice yield, the yields significantly varied owing to fertility treatments in both seasons Table 3 the high pattern of its components associated nitrogen levels were efficient in comparable rate with the tested rice cultivar of Sakha107 ,since it is short duration cultivar (125 days). It this respect EL-Shimaa *et al*.2019) found that the maximum panicle length, panicle weight ,number of grains /panicle and grain yield was achieved by spraying rice plants with 60 mg/L Zn under adding 60kg /N. It can observed that the effect between plants treated with 60kg N/fed and foliar spray with K_2O and Zn 1% mixture compared to plants received 45 kg N/fad were significant. Meanwhile, a significant effect was observed between such first treatment and adding 45kgN/fad plus foliar spray with K_2O and Zn 1%mixture .These results role in tryptophan synthesis which is a precursor of IAA which reflected on grain yield and its components. Fergany 2018)concluded that application of thrice zinc foliar application at the level of 600ppm, on rice exhibited the highest values of grain, straw biological yields as well as most of yield attributes and nitrogen physiological parameters. Data in Table 3 indicated that grain and biological yields with significant differences between such two treatments. While harvest index(%)not significant differences between such two treatments. Gewaily *et.al* 2018) reported that application of appropriate levels of N fertilizers is one of important factor to increase N use efficiency by rice cultivars. Improve of N use efficiency can be achieved through optimum N application rates. The results of this study indicated that the increased nitrogen rates up to 220 kg N ha^{-1} significantly enhanced the grain yield and the yield

components. Agronomic efficiency varied significantly among rice genotypes. The optimum N application rates for newly released Egyptian rice genotypes is not only essential for producing higher rice yield, but also for improving soil fertility

4-Chemical analysis :-

a-Total chlorophyll of leaves:

Results in Table 4 indicated that chlorophyll a and b are the major pigments for the absorption of light energy and synthesis of both pigments requires the total chlorophyll of leaves at 60 DAT was significantly increased with increasing nitrogen rates from 45 up to 60 kg N/fad. In this respect, Young-Ju Song *et al.* (2012)on rice plant, reported that the increase of chlorophyll formation with increasing nitrogen levels might be due to the role of concentrations fluctuated over the experimental time.

Table 4. means of chlorophyll (a,b) carotenoids(car) and total photosynthetic pigments as affected by nitrogen rate and foliar spraying with mixture of potassium and zinc for rice during2018 and 2019 seasons

Treatments	2018				2019			
	Cchl a	chl b	car	total	Cchl a	chl b	car	total
45kgN/fad	2.364	1.782	0.526	4.671	2.602	1.998	0.624	2.602
60kgN/fad	2.721	2.242	0.645	5.638	2.990	2.608	0.697	6.295
45kgN/fad+2%K_2O	2.543	1.841	0.565	4.948	2.793	2.103	0.651	5.547
45kgN/fad.+2%Zn	2.651	1.947	0.609	5.206	2.914	2.244	0.673	5.831
45kgN/fad+1%K_2O+1%Zn	2.751	1.997	0.636	5.384	3.021	2.368	0.688	6.077
60kgN/fad+2%K_2O	2.869	2.464	0.760	6.093	3.169	2.798	0.716	6.683
60kgN/fad.+2%Zn	2.981	2.587	0.788	6.394	3.268	2.864	0.748	6.880
60kgN/fad+1%K_2O+1%Zn	3.154	2.674	0.826	6.616	3.496	2.914	0.806	7.216
LSD 0.05	0.143	0.181	0.087	0.255	0.175	0.181	0.103	0.281

***,**and not significant indicate at0.05and 0.01 probability levels respectively.**

B-Grain content of carbohydrates, crude protein and amylase:-

Table 5 show that carbohydrates percentage, crude protein percentage and amylase percentage in rice grains were significantly increased with raising nitrogen rates from 45 up to 60 kg N/fad gradually. Guohui Li *et al* (2018)found that adding 60 kg N/fad. increased significantly protein percentage yield of rice grain compared to control or 30 kg N/fad. The maximum values of protein % (7.98 and 8.69%) of rice grains were gained when plants received 45 kg N/fad foliar spraying bypotassium, Zinc mixture with insignificant difference between such treatment and adding 45 kg N/fad. Such finding due to the role of macronutrients mixture (K_2O + Zn) in protein percentage formation. In this respect Samah. Aamer and Dalia Tabl (2019) reported that foliar spraying of K_2O or Zn and combined application of K_2O+Zn on rice plants obtained positive effect on protein percentage of rice grains with superiority to Zn over the other macronutrients. It can be observed that protein percentage recorded a significant increase when plants treated by 45 kg N/fad and foliar spray with 2% K_2O plus 1% K_2O+ Zn compared to plants received 45 kg N/fad and foliar spraying by 2%K_2O,whereas,insignificant differences was observed between the province first treatment and adding 60 kg N/fad + spray with 2% K_2O. Such results may due to the role ofmacronutrients which affected positively protein percentage formation more than foliar spraying with potassium . Similar results were obtained by Asante *et al.* (2013) it can be noticed that the minimum value of carbohydrates % were obtained from plants received 60 kg N/fad (71.4 and 74.6%) followed by adding 60 kg N/fad and foliar spraying with 1% K_2O+Zn mixture(77.9 and 78.6%). On other hand, the maximum value of Amylase %(27.3 and 27.9%) were gained from plants treated with 60 kg N/fad + spraying with mixture 1% K_2O + Zn followed by plants received 60 kg N/fad (21.9 and 22.7%).. Such results improved that macronutrients mixture play an important role for increasing potassium with Zn mixture whereas K_2O give the reverse effect.

Table 5.mean of carbohydrates %, protein % and Amylase % as affected by nitrogen rate and foliar spraying with mixture of potassium zinc for rice during2018 and 2019 seasons

Treatments	Ccarbohydrate's %		protein		Amylase %	
Seasons	2018	2019	2018	2019	2018	2019
45kgN/fad.	77.9	78.4	6.44	6.76	23.60	24.40
60kgN/fad.	71.4	74.7	7.61	7.41	21.90	22.70
45kgN/fad+2%K_2O.	79.3	80.1	6.73	6.88	24.30	24.80
45kgN/fad. +2%Zn.	81.0	81.1	6.85	6.94	24.96	25.04
45kgN/fad.+1%K_2O+1%Zn	81.7	82.0	6.93	7.36	24.58	25.30
60kgN/fad.+2%K_2O.	74.3	76.2	7.38	8.26	25.19	26.90
60kgN/fad.+2%Zn.	76.1	77.8	7.46	8.42	26.80	27.20
60kgN/fad.+1%K_2O+1%Zn	77.9	77.6	7.98	8.69	27.30	27.80
LSD 0.05	0.87	0.81	0.17	0.23	0.74	0.53

***,**and not significant indicate at0.05and 0.01 probability levels respectively.**

CONCLUSION

In the light of the present results, the maximum values of growth, yield and yield components were obtained from treated rice plants with 45 kg N/fad and foliar spraying by 1% plus (K_2O+ Zn), with insignificant difference compared to adding 60 kg N/fad. So, foliar spray of 2% macronutrients mixture (K_2O+ Zn). Therefore, it is recommended to fertilize rice plants at a rate of 60 kg of nitrogen with twice spraying at the ages of 15 and 30 days of seedlings with potassium and zinc mixed together at a concentration of 1% reduce soil dressing of nitrogen fertilizers from 60 to 45 kg N/fad which reduce costs and environmental pollution.

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استجابة محصول الأرز لمعدلات السماد النيتروجيني والتسميد الورقي بمخلوط من البوتاسيوم والزنك على النمو والمحصول

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أجريت تجربتان حقليتان موسمي 2018، 2019 في مزرعة محطة البحوث الزراعية بسخا لدراسة تأثير معدلات السماد النيتروجيني و الرش الورقي بالبوتاسيوم والزنك علي محصول الأرز لصنف سخا 107والتصميم الإحصائي المتبع هو قطاعات كاملة العشوائية ذو اربع مكررات وكانت المعاملات 1- التسميد بـ 45كجم نيتروجين للفدان ، 2- التسميد بـ 60كجم نيتروجين للفدان ، 3- التسميد بـ 45كجم نيتروجين +الرش الورقي بالبوتاسيوم 2% ، 4- التسميد بـ 45كجم نيتروجين +الرش الورقي بالزنك 2% ، 5- التسميد بـ 45كجم نيتروجين +الرش بمخلوط البوتاسيوم والزنك 1% لكل منهما ، 6- التسميد بـ 60كجم نيتروجين +الرش الورقي بالبوتاسيوم 2% ، 7- التسميد بـ 60كجم نيتروجين +الرش الورقي بالزنك 2% ، 8- التسميد بـ 60كجم نيتروجين +الرش بمخلوط البوتاسيوم والزنك 1% لكل منهما. أوضحت أهم النتائج أن تسميد نباتات الارز بمعدل 60كجم نيتروجين مع الرش الورقي بمخلوط البوتاسيوم والزنك 1%لكل منهما عند أعمار 15 و30يوم من الشتل ادى الى زيادة معنوية في الوزن الجاف/م2 ودليل مساحة الاوراق ومعدل نمو المحصول ومعدل التمثيل الضوئي ومحتوى الاوراق من صبغات التمثيل الضوئي ووزن حبوب الدالية ووزن الـ 1000حبة وعدد الداليات/م2 ووزن الدالية كميه محصول الحبوب والمحصول البيولوجي ومحتوى الحبوب من البروتين الخام والكربوهيدرات ونسبة الاماليوز بالإضافة للصفات الفسيولوجية .ولذا ينصح بتسميد صنف أرز سخا107 بـ 60 كجم نيتروجين مع الرش الورقي بالبوتاسيوم والزنك مرتين عند 15و30يوم من الشتل