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Studies on the Effect of Foliar Fertilizer Application in Combination with Conventional Fertilizers on Rice Production

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ABSTRACT

Improving Productivity and increasing farmer income through reducing the production inputs is the main challenge for rice grower. A field experiment was conducted at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt in order to evaluate the effects of foliar application of NPK at different growth stages on productivity and nutrients uptake by rice variety Sakha108 under transplanting condition during the summer season of the years 2017 and 2018. Urea (46.5% N), super phosphate (15% P_2O_5), potassium sulphate (50% K_2O) and complex water soluble fertilizer NPK (28:28:28) were used as the nutrient sources for the experimental treatments. The treatments were as follow: T1 = Recommended urea, super phosphate, potassium sulphate (control), T2 = 2/3 NPK urea, super phosphate, potassium sulphate as basal + foliar spray of NPK (28:28:28), 2.5 kg ha^{-1} at mid tillering MT., T3 = 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at panicle initiation PI., T4 = 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPk (28 :28 :28) 2.5 kg ha^{-1} at flowering FL., T5 = 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at MT+ PI., T6= 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at MT + FL., T7= 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at PI + FL. and T8= 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at MT + PI + FL. The data was recorded for the following characteristics: chlorophyll content (SPAD value), flowering date (day), plant height (cm), number of panicles m^{-2}, panicle length (cm), panicle weight (g), 1000-grain weight (g), number of filled grains $panicle^{-1}$, number of unfilled grains $panicle^{-1,}$ grain yield (t ha^{-1}), straw yield (t ha^{-1}), harvest index (HI), and N.P,K uptake (kg ha^{-1}). The NPK treatments had a significant effect on all studied characteristics in both seasons. T5 and T8 recorded the highest values of most studied characteristics in both seasons. Gross return and net returns were highest with T8= 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at MT + PI + FL, followed by T5 = 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at MT+ PI. compared to other treatments .

Keywords: Oryza sativa, nitrogen, phosphorus, potassium, compound fertilizer, grain yield.

INTRODUCTION

Rice crop is one of the major cereal crops in Egypt. Under limited natural resources in Egypt such as arable land and irrigation water, improving rice productivity per unit area is the main goal of rice research. Adequate supply of essential nutrients is a key factor to enhance rice productivity. Hasewaga *et al*. (2000) reported that foliar fertilizers have significant influences of growth and rice paddy yield. Lin and Zhu (2000) studied the effect of regent foliar application on rice growth and yield. Their results showed that foliar application of fertilizers at flowering stage enhanced rice productivity. Latha and Nadanassababady (2003) indicated that foliar fertilization is an important method as it facilitates easy and rapid.

Ahamad and Jabeen (2005) indicated that foliar nutrition generally increases the grain yield as well as decreases the amount of fertilizers which applied as soil application. Ali *et al.* (2005) reported that foliar spray increased the metabolic activity of plant. Girma *et al*. (2007) found that foliar application is a visible economic way to increase nutrients uptake. Fageria *et al.* (2009) also reported that crops respond to soil applied fertilizers in five to six days, while the response is faster (48 hours) in foliar application.

Foliar application increase nutrients uptake at critical growth stages and resulted in enhanced physiological activity leading to increase yield (Kundu and Sarkar, 2009). Alam *et al*. (2010) opined that foliar application could be considered only as a supplement to soil application of N Bhuyan *et al.* (2012) reported that foliar application of N at late growth stages reduced sterility per cent and increased thousand grain weight and yield.

Jagathijothi *et al*. (2012) reported that foliar nutrients increase the photosynthetic rate and carbohydrate translocation and in turn increased the dry matter production. They have also found that the combined application of NPK sources with foliar spray enhanced the growth of rice. Chaurasia *et al.* (2005) found maximum plant height, number of branches plant-1, fruit length, yield, net profit and maximum B: C ratio by 5 foliar sprays of water soluble liquid fertilizers, 19:09:19 followed by NPK 19:19:19.

Rani *et al.* (2014) studied foliar fertilizers application effects on growth, yield, economics and nutrient uptake of rice. NPK 19:19:19 was used at the rate of 2.5 kg ha^{-1} at active tillering and panicle initiation stages. The results indicated that combined application of fertilizers recommended doses with foliar spray of NPK 19:19:19 increased significantly grain yield. They found also that foliar application of NPK two times at the rate of 2.5 kg ha^{-1} produced the highest values of both gross returns and net returns.

Studies conducted in wetland rice by Surya (2015) found higher grain and straw yield by flag leaf nutrition with 0.5 per cent KNO_3 and it was on a par with 19:19:19 complex.

The primary objective of this study is to study the impact of foliar application of NPK on growth and productivity of Sakha108 newly Egyptian rice variety.

MATERIALS AND METHODS

A field experiment was designed and conducted at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt in order to evaluate the effects of foliar application of NPK at different growth stages on rice productivity and NPK uptake by rice variety Sakha108 under transplanting condition. The experiment was conducted during the summer season of the years 2017 and 2018.The experimental site lies between

31°5′17″ North latitude and 30°56′44″ East longitude at an altitude of 8 m from mean sea level. The previous crop was wheat in both seasons.

The physico-chemical properties of the soil of the experimental site are given in Table 1.

Table 1. Soil mechanical and chemical properties of the experimental site.

Soil characteristics	Seasons 2017	2018
Soil texture (%)	Clayey	
clay %	57.00	54.00
Sand %	11.00	11.00
Silt %	32.00	35.00
pH (1: 2.5 water suspension)	8.05	8.2
EC (dSm-1)	2.0	2.05
Organic matter	1.65	1.50
Available P mg Kg^{-1}	14.00	12.00
Available NH_4 mg Kg^{-1}	13.5	12.60
Available NO_3 mg Kg^{-1}	10.0	11.80
Available K mg Kg^{-1}	366	350
Cations (meq/L.)		
Ca+ +	7.20	6.00
Mg+ +	2.60	1.50
Na+	12.00	13.00
K+	0.50	0.50
Anions (meq/L.)		
HCO3-	5.60	5.00
Cl-	14.00	14.00
$SO4^{--}$	2.70	2.00
$CO3^{--}$	0.00	0.00

The selected rice variety was Sakha108 released from Rice Research & Training Center, Field Crops Research Institute, Agriculture Research Center, Egypt. It is non-lodging, short stature variety with about 130-135 days duration. The grains are short (Japonica type) and the variety is resistant to blast.

Urea (46.5% N), super phosphate (15% P_2O_5), potassium sulphate (50% K_2O) and complex paste water soluble fertilizer NPK (28:28:28) were used as the nutrient sources for the experimental treatments. NPK was used at the rate of 2.5 kg of the past per hectare (dissolved in 500 L). The treatments were as follow:

T1 = Recommended urea (165 kg N ha^{-1}), super phosphate (36 kg P_2O_5 ha^{-1}), potassium sulphate (58 kg K_2O ha^{-1}) (control)

T2 = 2/3 NPK urea, super phosphate, potassium sulphate as basal + foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at mid tillering MT.

T3 = 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at panicle initiation PI.

T4 = 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK at(28:28:28) 2.5 kg ha^{-1} flowering FL.

T5 = 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at MT+ PI.

T6= 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at MT + FL.

T7= 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at PI + FL.

T8= 2/3 NPK urea, super phosphate, potassium sulphate as basal + Foliar spray of NPK (28:28:28) 2.5 kg ha^{-1} at MT + PI + FL.

The field experiments were laid out in a Randomized Complete Block Design with four replications. The plot size was 12 m2 (3 X 4 m). The experimental area was ploughed twice and well leveled. The nursery bed was sown on 1st and 5th of May in the both season respectively. 27-day old seedlings were used at 20 X 20 cm transplanting spacing. The crop was harvested at full maturity. The border and sampling rows were harvested separately. 10 m2 of each plot was harvested and the weight of grain and straw were recorded.

The data was recorded for the following characteristics: chlorophyll content (SPAD value), flowering date (day), plant height (cm), number of panicles m-2, panicle length (cm), panicle weight (g), 1000-grain weight (g), number of filled grains panicle-1, number of unfilled grains panicle-1, grain yield (t ha-1), straw yield (t ha-1), harvest index (HI), and N.P,K uptake (kg ha-1).

From the experiment beginning to ending, costs in US $ of each treatment were recorded carefully and classified into fixed and variable costs. Fixed costs included land preparation, seed, pesticides, human labors, gas and harvest at the prevailing market prices. Variable costs were identified by assessing market price of different fertilizers as well as human labors for fertilizers application. Gross return for each treatment was calculated by summing the value of grain (US $ ha-1) at the prevailing market price. Net return was calculated by subtracting total cost from gross return (US $ ha-1).

Analysis of variance technique was used for the statistical analysis of the studied characteristics. The experimental design was Randomized Complete Block Design. Duncan's Multiple Range Test was used for mean values comparison.

RESULTS AND DISCUSSION

The results of chlorophyll content (SPAD value), flowering date (day) and the plant height at harvest are presented in the Table 2. The chlorophyll content (SPAD value) was varied significantly with different treatments. T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) recorded the highest values of chlorophyll content followed by T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) and T1 (Recommended NKP) without any significant differences among them. This increase might be due to the balanced nutrient supply at different growth stages viz., mid tillering, panicle initiation and flowering stages.

Considering the effect of NPK treatments on flowering date, there were no significant differences among the different treatments. The perusal of the data showed that foliar fertilizers have significant influences of plant height at harvest. The plant height was significantly higher with T1 (Recommended NKP) followed by T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) andT5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.).The foliar application of NPK at different growth stages might have increased the plant height due to the fact that excess nutrient to rice might help for cell elongation and increase photosynthetic rate .

Table 2. Chlorophyll content (SPAD value), flowering date (day) and plant height (cm) at harvest as affected by different treatments in 2017 and 2018 seasons.

Characteristics	Chlorophyll content (SPAD value)		Flowering date (day)		Plant height (cm)	
	2017	2018	2017	2018	2017	2018
T1. Recommended NPK	42.78	43.15	111.8	111.9	99.0	99.5
T2. 2/3 basal + Foliar at MT	40.93	41.55	109.7	109.3	93.5	93.5
T3. 2/3 basal + Foliar at PI	40.63	41.38	110.5	110.0	93.8	93.8
T4. 2/3 basal + Foliar at FL	41.70	41.35	110.7	110.5	93.8	93.7
T5. 2/3 basal + Foliar at MT+ PI	43.33	44.32	110.8	110.5	98.4	98.8
T6. 2/3 basal + Foliar at MT + FL	40.95	41.43	110.5	110.3	95.8	96.8
T7. 2/3 basal + Foliar at PI + FL	41.68	41.83	110.3	110.5	96.5	97.3
T8. 2/3 basal + Foliar at MT + PI + FL	43.38	44.45	110.5	110.0	98.8	99.3
$L.S.D._{0.05}$	2.06	2.13	-	-	4.6	5.1
F Test	**	*	NS	NS	*	*

Number of panicles m^{-2} at harvest, panicle length (cm) and panicle weight (g) as influenced by different treatment is presented in Table 3.

Maximum number of panicles per meter square was found in T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) which was at par with T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) and T1 (Recommended NKP) and significantly superior over rest of the treatments.The NPK nutrients applied as foliar spray at different growth stages might have resulted in the rapid availability and uptake of those nutrients leading to faster crop response compared to soil application which increased significantly number of panicles per unit area.Similar results have been reported by Hasewaga *et al*. (2000), Fageria *et al*. (2009) and Jagathjothi *et al*. (2012).

The effects of NPK treatments on panicle weight were observed to be significant. T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) recorded the heaviest panicles followed by T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.). T2 (2/3 basal + Foliar at MT) recorded the lightest panicles and it was on a par with T3 (2/3 basal + Foliar at PI). Similar findings were also reported by Hasewaga *et al*. (2000), Fageria *et al*. (2009) and Jagathjothi *et al*. (2012).

Panicle length was affected significantly by various treatments in both seasons. The longest panicles were recorded by T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) which was at par with T1 (Recommended NKP) and T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) and significantly superior other treatments.

Table 3. Number of panicles m^{-2} at harvest, panicle length (cm) and panicle weight (g) as affected by different treatments in 2017 and 2018 seasons.

Characteristics	Panicles No. m^{-2}		Panicle weight (g)		Panicle length (cm)	
	2017	2018	2017	2018	2017	2018
T1. Recommended NPK	625.3	632.5	3.81	3.91	21.48	21.78
T2. 2/3 basal + Foliar at MT	437.5	450.0	3.19	3.20	17.95	18.10
T3. 2/3 basal + Foliar at PI	445.3	463.8	3.33	3.36	19.13	18.93
T4. 2/3 basal + Foliar at FL	455.0	468.8	3.53	3.53	19.43	19.80
T5. 2/3 basal + Foliar at MT+ PI	643.0	653.8	4.08	4.21	21.28	22.03
T6. 2/3 basal + Foliar at MT + FL	500.3	587.5	3.92	3.81	20.38	20.08
T7. 2/3 basal + Foliar at PI + FL	495.6	556.3	3.84	3.92	18.83	19.70
T8. 2/3 basal + Foliar at MT + PI + FL	645.3	656.3	4.17	4.28	22.03	22.53
$L.S.D._{0.05}$	42.3	45.3	0.20	0.21	1.01	1.11
F Test	**	**	**	**	**	**

1000-grain weight (g), No. of filled grains $panicle^{-1}$ and No. of unfilled grains $panicle^{-1}$ as affected by different treatments in 2017 and 2018 seasons are presented in Table 4.

The effect of various treatments on 1000-grain weight was observed to be significant. Foliar application of NPK increased 1000-grain weight over T1 (Recommended NKP). T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) recorded the highest values and it was at par with T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.). Under NPK foliar application treatments, NPK nutrients were continuouslyavailable at different growth stages (mid tillering, panicle initiation and flowering). This might have increased the grain filling as well as grain weight).Lin and Zhu (2000) reported similar trend.

Number of filled grain per panicle was affected significantly by different treatments in both seasons. T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) and T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) recorded the highest number of filled grain per panicle followed by T1 (Recommended NKP) without any significant differences among them. Foliar application of NPK at different growth stages may increase the availability of those nutrients which might increase the absorption and the translocation of nutrients to the rice grain. Similar trend has been reported by Jagathjothi *et al*. (2012).

Different NPK treatments affected significantly number of unfilled grain per panicle. Generally, foliar application of NPK at any of the growth stages in combined with two third of NPK as basal application decreased significantly number of unfilled grain per panicle. T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) and T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) recorded the lowest number of unfilled grain per panicle.

Table 4. 1000-grain weight (g), No. of filled grains panicle-1 and No. of unfilled grains panicle-1 as affected by different treatments in 2017 and 2018 seasons.

Characteristics	1000-grain weight (g)		No. of filled grains panicle^{-1}		No. of unfilled grains panicle^{-1}	
	2017	2018	2017	2018	2017	2018
T1. Recommended NPK	22.68	22.70	119.30	120.65	10.25	11.33
T2. 2/3 basal + Foliar at MT	23.05	23.95	95.69	98.31	8.75	9.09
T3. 2/3 basal + Foliar at PI	23.28	23.73	97.19	101.04	8.91	9.28
T4. 2/3 basal + Foliar at FL	23.45	23.45	99.34	102.03	9.10	9.38
T5. 2/3 basal + Foliar at MT+ PI	24.63	24.72	122.56	124.66	5.43	5.54
T6. 2/3 basal + Foliar at MT + FL	23.40	23.65	108.25	112.31	7.08	6.94
T7. 2/3 basal + Foliar at PI + FL	23.68	23.70	107.46	108.75	7.09	6.89
T8. 2/3 basal + Foliar at MT + PI + FL	24.73	24.98	122.98	125.13	5.45	5.56
L.S.D.$_{0.05}$	1.98	2.01	11.12	13.11	1.02	1.12
F Test	**	**	*	*	**	**

Table 5 presented the effects of different NPK treatments on grain and straw yield as well as harvest index in the two seasons.

The effect of NPK treatments had significant effect on grain yield of Sakha108 rice variety in tow seasons. T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) recorded highest grain yield followed byT5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) and T1 (Recommended NKP) without any significant differences among them. The lowest grain yield was registered by T2 (2/3 basal + Foliar at MT). The increase in grain yield by utilization of foliar application of NPK might be attributed to balance supply of NPK,enhance more intense chlorophyll synthesis and more sufficient translocation of assimilates to production parts. Hasewaga *et al*. (2000), Fageria *et al*. and (2009)Jagathjothi *et al*. (2012) indicated that foliar application of NPK at different growth stages increased rice grain yield.

The NPK treatments had a significant effect on straw yield rice in both seasons. T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) produced the highest straw yield followed by T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.), T1 (Recommended NKP) and T4 (2/3 basal + Foliar at FL) without any significant differences among them. Higher straw yield might be due to increased plant height and more number of tillers for the above mentioned treatments.The NPK supplied through foliar application might have resulted in the rapid availability and uptake of nutrients leading to faster crop response which increase the dry matter production as well as straw yield.Similar trend has been reported by Fageria *et al*. and (2009)Jagathjothi *et al*. (2012).

Harvest index was affected significantly by different NPK treatments. T1 (Recommended NKP), T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) and T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) produced the highest values of harvest index.

Table 5. Grain yield (t ha-1), Straw yield (t ha-1) and Harvest Index (HI) as affected by different treatments in 2017 and 2018 seasons.

Characteristics	Grain yield (t ha^{-1})		Straw yield (t ha^{-1})		HI	
	2017	2018	2017	2018	2017	2018
T1. Recommended NPK	12.12	12.26	15.29	15.17	0.4422	0.4470
T2. 2/3 basal + Foliar at MT	9.95	9.69	14.23	14.22	0.4115	0.4053
T3. 2/3 basal + Foliar at PI	10.11	10.02	14.22	14.50	0.4155	0.4086
T4. 2/3 basal + Foliar at FL	10.76	10.15	15.41	15.11	0.4112	0.4018
T5. 2/3 basal + Foliar at MT+ PI	12.21	12.61	15.53	15.63	0.4402	0.4465
T6. 2/3 basal + Foliar at MT + FL	11.02	11.13	14.66	14.76	0.4292	0.4299
T7. 2/3 basal + Foliar at PI + FL	11.13	11.24	14.76	14.76	0.4299	0.4321
T8. 2/3 basal + Foliar at MT + PI + FL	12.27	12.79	15.21	15.36	0.4465	0.4544
L.S.D.$_{0.05}$	1.01	1.11	0.51	0.55	0.0221	0.0236
F Test	**	**	**	*	*	*

The nitrogen, phosphorus and potassium uptakes by rice grain at harvest are presented in Table 6.NPK nutrients had significant effects on N uptake (kg ha^{-1}). T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) recorded significantly higher nitrogen uptake, followed by T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) followed by T1 (Recommended NKP).Phosphorus uptake by rice grain (kg ha^{-1}) was affected significantly by the studied treatments in both seasons. T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) and T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.) recorded the highest values of phosphorus uptake without any significant differences between them.Different treatments had significant effects on potassium uptake (kg ha^{-1}). T8 (2/3 NPK as basal + Foliar spray of NPK at MT + PI + FL.) recorded significantly higher potassium uptake followed by T5 (2/3 NPK as basal + Foliar spray of NPK at MT+ PI.). Foliar application of NPK at different growth stages increased both grain yield and the absorption of those nutrients and might have resulted in the increased uptake of N, P and K by rice grains. The increase in NPK uptake with foliar application of NPK at different growth stages could be attributed also to reduce losses of nutrient and enhance fertilizer use efficiency.

Table 6. N, P and K uptake (kg ha-1) as affected by different treatments in 2017 and 2018 seasons.

Characteristics	N uptake (kg ha^{-1})		P uptake (kg ha^{-1})		K uptake (kg ha^{-1})	
	2017	2018	2017	2018	2017	2018
T1. Recommended NPK	115.67	113.61	25.62	27.01	43.91	45.85
T2. 2/3 basal + Foliar at MT	101.39	98.61	19.83	18.96	32.57	33.32
T3. 2/3 basal + Foliar at PI	98.02	95.52	20.86	19.36	33.72	34.11
T4. 2/3 basal + Foliar at FL	97.66	96.55	22.06	21.10	34.71	35.78
T5. 2/3 basal + Foliar at MT+ PI	127.50	123.60	30.39	30.86	50.54	52.12
T6. 2/3 basal + Foliar at MT + FL	104.16	102.42	20.15	21.42	35.54	35.98
T7. 2/3 basal + Foliar at PI + FL	106.47	103.77	21.34	22.06	37.28	36.95
T8. 2/3 basal + Foliar at MT + PI + FL	128.56	124.32	30.78	31.30	52.44	54.98
$L.S.D._{0.05}$	12.24	14.34	3.33	3.45	4.45	5.03
F Test	**	**	**	**	**	**

Gross and net returns showed significant difference among the different treatments(Table 7).It was observed that the maximum variable and total costs were involved in control (recommended NPK). Application of two third of the recommended doses of NPK combined with foliar application of NPK once at flowering or at panicle initiation or at mid tilliring recorded the lowest values of variable and total costs. Due to the differences of fertilizers' costs among the eight treatments, the total cost of production was varied. The gross and net returns were found to be the maximum with T8 (2/3 basal + Foliar at MT + PI + FL) which was slightly higher than T5 (2/3 basal + Foliar at MT+ PI) and T1 (Recommended NPK). The lowest gross and net profits were obtained from T2 (2/3 basal + Foliar at FL) and T3 (2/3 basal + Foliar at PI) due to its lowest grain yield.

Table7. Economic analysis ofdifferent treatments in 2017 and 2018 seasons.

Treatments	Fixed cost $	Variable cost $	Total cost $	Grain yield (t ha-1)	Gross return $	Net Return $
			2017			
T1. Recommended NPK	1257.04	194.42	1451.46	12.12	2731.27	1279.80
T2. 2/3 basal + Foliar at MT	1257.04	127.38	1384.42	9.95	2242.25	857.83
T3. 2/3 basal + Foliar at PI	1257.04	127.38	1384.42	10.11	2278.31	893.89
T4. 2/3 basal + Foliar at FL	1257.04	127.38	1384.42	10.76	2424.79	1040.37
T5. 2/3 basal + Foliar at MT+ PI	1257.04	138.11	1395.15	12.21	2751.55	1356.40
T6. 2/3 basal + Foliar at MT + FL	1257.04	138.11	1395.15	11.02	2483.38	1088.23
T7. 2/3 basal + Foliar at PI + FL	1257.04	138.11	1395.15	11.13	2508.17	1113.02
T8. 2/3 basal + Foliar at MT + PI + FL	1257.04	148.83	1405.88	12.27	2765.07	1359.19
			2018			
T1. Recommended NPK	1257.04	243.03	1500.07	12.26	2935.49	1435.42
T2. 2/3 basal + Foliar at MT	1257.04	159.23	1416.27	9.69	2320.14	903.87
T3. 2/3 basal + Foliar at PI	1257.04	159.23	1416.27	10.02	2399.15	982.89
T4. 2/3 basal + Foliar at FL	1257.04	159.23	1416.27	10.15	2430.28	1014.01
T5. 2/3 basal + Foliar at MT+ PI	1257.04	172.63	1429.68	12.61	3019.30	1589.62
T6. 2/3 basal + Foliar at MT + FL	1257.04	172.63	1429.68	11.13	2664.93	1235.25
T7. 2/3 basal + Foliar at PI + FL	1257.04	172.63	1429.68	11.24	2691.27	1261.59
T8. 2/3 basal + Foliar at MT + PI + FL	1257.04	186.04	1443.08	12.79	3062.39	1619.31

CONCLUSION

This study concluded that, basal application of 2/3 of recommended doses of urea, super phosphate, potassium sulphate in combined with foliar spray of NPK (28:28:28) either at mid tillering + panicle initiation + flowering or at mid tillering + panicle initiation increase rice yield by when compared with traditional method .From the economic analysis results, the combination of traditional fertilizers (urea, super phosphate and potassium sulphate) with complex water soluble fertilizer NPK (28:28:28) could be used to uplift the net return of Sakha108 cultivation.That help to increase farmer income .Huge amount of fertilizers can be saved with following foliar application methods for second addition of fertilizer .In this prospective , more studies are under way to investigate rice productivity under traditional and foliar spray with the second dose of fertilizer .

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دراسة تاثير الإضافة الورقية للاسمده مع الإضافة التقليديه علي انتاجية محصول الارز

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تم إجراء تجربة حقلية في المزرعة التجريبية بمحطة البحوث الزراعية بسخا، كفرالشيخ، مصر من أجل تقييم الاضافة الورقية للسماد المركب NPK في مراحل النمو المختلفة على إنتاجية الأرز وامتصاص الـ NPK بواسطة صنف الأرز سخا108 خلال عامي 2017 و 2018. تم استخدام اليوريا (46.5% N)،سوبرالفوسفات(15% P_2O_5)، كبريتات البوتاسيوم(50% K_2O) والأسمدة القابلة للذوبان في الماء NPK (28:28:28). كانت المعاملات على النحو التالي م1: السماد الموصي به من اليوريا والسوبر فوسفات وسلفات البوتاسيوم (معاملة المقارنة)، م2: 3/2 كمية السماد الموصي به + رش NPK المركب عند مرحلة التزهير، م3: 3/2 كمية السماد الموصي به + رش NPK المركب عند مرحلة بزوخ السنبلة، م4: 3/2 كمية السماد الموصي به + رش NPK المركب عند مرحلة منتصف التفريع، م5: 3/2 كمية السماد الموصي به + رش NPK المركب عند مرحلتي منتصف التفريع وبزوخ السنبلة ، م6: 3/2 كمية السماد الموصي به + رش NPK المركب عند مرحلتي منتصف التفريع والتزهير ، م7: 3/2 كمية السماد الموصي به + رش NPK المركب عند مرحلتي بزوخ السنبلة والتزهير، م8: 3/2 كمية السماد الموصي به + رش NPK المركب عند مراحل منتصف التفريع وبزوخ السنبلة والتزهير. تم تسجيل البيانات للخصائص التالية: محتوى الكلوروفيل (SPAD)، تاريخ التزهير (اليوم) ،ارتفاع النبات (سم) ،عدد الفروع م^2 ،طول السنبلة (سم) ،وزن السنبلة (ج) ، وزن 1000 حبة (ج)، عدد الحبوب الممتلئة في السنبلة، عدد الحبوب غير الممتلئة في السنبلة، محصول الحبوب (طن للهكتار)،محصول القش (طن للهكتار)، دليل الحصاد، معدل امتصاص الحبوب لكلا من النيتروجين والفسفور والبوتاسيوم بالاضافة الي التقييم الاقتصادي. كان للمعاملات المختلفة تأثير كبير على جميع الخصائص المدروسة في كلا الموسمين. سجلت المعاملة رقم 5 ورقم 8 أعلى القيم لمعظم الخصائص المدروسة في كلا الموسمين. أشار التحليل الاقتصادي إلى أن استخدام الأسمدة التقليدية (اليوريا، السوبر فوسفات وكبريتات البوتاسيوم) مقترنًا بالإضافة الورقية للأسمدة المركبة القابلة للذوبان في الماء NPK (28:28:28) ثلاث مرات زيادة في صافي العائد لزراعة الصنف سخا108.