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Effect of Time and Methods of Nitrogen and Potassium Application at Different Growth Stages on Hybrid 1 and Giza 178 Rice Cultivare.

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TWO FIELD experiments were carried out at the experimental farm of Rice Research & Training Centre, Sakha, Kafrelsheikh, Egypt to study the effect of nitrogen and potassium fertilization on growth characters, yield and its components of Hybrid rice1 and Giza 178 rice cultivar. The experimental design was a split split plot design with four replicates, the main plots were assigned to rice cultivar, methods of nitrogen application treatments which were randomly distributed in sub plots as N1 1/2 basal +1/4 at Mid Tillering (MT) +1/4 at Late Boating (LB) and N2 (1/2 basal +1/4 at Mid Tillering + 2% sprayed at (LB) time and methods of potassium application were arranged in the sub sub plot and assigned as (*K1*) 1/2 basal +1/2 as top dressing (TD) at L.B, (*K2*) 1/2 basal+1/4 TD at PI+1/4 TD at L.B, (*K3*) 1/2 basal +2 % foliar at PI +1/4 TD at LB, (*K4*) 1/2 basal+1/4 TD at PI+ 2% foliar at LB, (*K5*) 1/2 basal + 2 %foliar at PI + 2 % foliar at LB.

The obtained results could be summarized as follows: In both seasons the data showed that Hybrid rice1 recorded the highest values in number of tiller/m^2, number of panicle/m^2, number of filled grain/panicle, 1000 grain weight, straw yield and grain yield compared with Giza 178 rice cultivar. Giza 178 recorded significant increase in the flag leaf area, total chlorophyll content. Times and methods of nitrogen application as N2 caused significant increase in the flag leaf area and total chlorophyll content in both seasons and straw yield in the second season only, while N1 treatment gave significant increase in number of tillers /hill and number of panicles /hill in both seasons, while number of filled grains /panicle, grain yield (ton/fed) in 2008 season, Times and methods of potassium application caused significant effect in both seasons on plant height, total chlorophyll content, Number of filled grains. $panicle^{-1}$, 1000-grain weight, grain and straw yields ton/fed^{-1}.

We can concluded that Hybride1 rice cultivar when treated with nitrogen as $^1/_2$ of the dose as basal $+^1/_4$ at MT $+^1/_4$ at late boating stage (LB) and potassium application either as$1/_2$ dose as basal $+^1/_4$ as foliar at PI (2% of K_2O) $+^1/_4$ as TD at LB stage or as$1/_2$ dose as basal $+^1/_4$ as

TD at PI+ $^{1}/_{4}$ as foliar at LB stage (2%of K_2O) achieved the highest values of most studied characters and grain yield ton.fed$^{-1.}$

Keywords: Time and methods of nitrogen, Potassium application, Growth stage, Inbred & hybrid rice Cultivar.

Rice is considered one of the major food and export crop in Egypt and it is an important food crop for half of the world's population. In Egypt, total rice productivity in 2009 was 6.15 million tons which was sufficient for local consumption and export. (Economic Sector, Ministry of Agriculture and Soil Reclamation, 2009).

Yield potentials of high-yielding varieties have clear effect. Increasing efforts have been placed on the development and use of hybrid rice is one way to improve rice yield by exploiting the hetrosis in F1 hybrid, which has yield about 20 % higher than inbred rice cultivars, (Abo Youssif *et al.,* 2005 and Gorgy, 2007), Hybrid Rice had significantly higher values for the yield attributes number of panicles /hill, panicle weight, number of filled grains/panicle, 1000 grain weight and yield than inbred rice (Singh *et al.,* 2004; Krishanakumar *et al.,* 2005; Mohamed, 2006; Rahman *et al.,* 2007 and Zayed *et al.,* 2007a).

The nutrition is one of the important factors to increase rice grain yield, especially nitrogen. Nitrogen plays an effective role in plant growth. The nitrogen deficiency in Egyptian soils is one of the most limiting factors for rice production, under the condition of fertilizer expansive and less affects yield of rice so, appropriate method of application needs to be determined to enhance productivity. Nitrogen absorbed at later growth stages is used to produce more grain than straw (Yoshida, 1981). Several studies reported yield and its attributes were significantly affected by nitrogen application in splits (Manzoor *et al.,* 2006 and Sahoo *et al.,* 1990) .

Potassium is the third essential element for plant nutrition after N and P. Potassium is linked with all phenomena of plant physiology viz, photosynthesis or respiration, metabolism of fats, carbohydrates and nitrogenous compound, enzyme activation, cell elongation and water use efficiency (Ghoshi *et al.,* 1995).

Rice *(Oryza sativa* L.*)* requires potassium through its growth period but with varying intensity. Acute shortage of potassium during critical period of growth affects the yield of the crop. It is now believed that Potassium application for rice were studied by Surendran (2005), Patil *et al.* (2006), Awan *et al.* (2007), Pandey *et al.* (2007), Zayed *et al.* (2007b) and Manzoor (2008). They reported that adding potassium fertilizers into more doses including foliar applications had an important role in enhancing vegetative growth and improving grain yield. Similar results reported by Velayautham *et al.* (1992), Poonam *et al.* (1993), Ghoshi *et al.* (1995), Devasenapathy (1997), Thakur *et al.* (1999), Meena *et al.* (2003), Natarajan *et al.* (2004), Ramteke *et al.* (2004) and Zayed *et al.* (2006)

they found that rice crop performed better when splitting application of potassium was followed over one dose as basal application. Also, they reported that potassium splitting either as 50% basal + 25% at tillering stage + 25% at panicle initiation (PI) were the most effective splits. Whereas, they significantly increased rice growth, all yield attributes and grain yield.

Cao *et al.* (2004) stated that potassium application as 70% basal + 30% panicle dressing significantly increased seed setting, number of filled grains, 1000-grain weight and grain yield of rice crop.

It has therefore become important to know the amount, time and methods application of nitrogen and potassium for hybrid compared with inbred rice varieties.

At later growth stage of hybrid rice the plant canopy has a huge tillers and leaves, the application of nutrients as granules could be ineffective might be some of them can't reach to soil easily and the plants can not absorb this nutrients through the root beside its efficiency that will be decreased.

Hence the present investigation aimed, to find out the best way to apply nitrogen and potassium at later growth stage for Egyptian hybrid and inbred rice.

Material and Methods

Tow field experiments were carried out at the experimental farm of the Rice Research and Training Center (RRTC), Sakha, Kafrelsheikh, Egypt, during two successive rice seasons of 2007 and 2008 to study the response of hybrid1 and Giza 178 inbred variety to nitrogen and potassium splitting at different growth stages, the total dose of both nitrogen and potassium were 60 kg N.fed^{-1} and 24 kg K_2O. fed^{-1}, respectively, these doses were splitted as the following treatments:

Nitrogen treatments
N1- 1/2 basal +1/4 at Mid Tillering (MT) +1/4 at Late Boating (LB)
N2- 1/2 basal +1/4 at MT + 2% sprayed at LB.

Potassium treatments
K1- 1/2 basal+ 1/2 as Top Dressing (TD) at Late Boating (LB),
K2- 1/2 basal+ 1/4 as TD at Panicle initiation (PI) + 1/4 T.D at LB,
K3- 1/2 basal+ 1/4 as TD at PI+ 2 % as foliar at LB,
K4- 1/2 basal+ 2 % as foliar at PI+ 1/4 as TD at LB,
K5- 1/2 basal+ 2 %foliar at PI+ 2 % foliar at LB

The experimental design was a split split plot design with four replicates, The main plots received the rice varieties and nitrogen treatments were assigned to sub plots while potassium treatments were located in sub- sub plots. The size of sub plot was 15 m^2 (3 x 5 m).

The seed of rice cv. Hybrid 1 and Giza 178 at rate of 15 and 60 kg. fed^{-1}, respectively, all seed were soaked in water for 24 hr then drained and incubated for 48 hr; seeds were uniformly broadcast in the nursery on 14^{th} and 16^{th} may of 2007 and 2008 seasons, respectively. The other cultural practices of inbred and hybrid rice cultivation were applied as according to the recommendations of Rice Research and Training Center. The experimental soil was fertilized with 15.5 kg P_2O_5 fed^{-1} in form of calcium super phosphate (15.5% P_2O_5) during the soil preparation. Seedling were carefully pulled from the nursery after 30 days from sowing and transferred to the permanent field. Seedling were handling transplanted in hills 20x20 cm apart between hills and rows at the rate of 2 seedlings/hill for hybrid 1 and 3-4 seedlings/hill for Giza178 in all experiments in both seasons. The herbicide Saturn 50% at the rate of 2L/feddan was used for controlling weeds. Nitrogen was used in form urea 46.6% N and potassium was used in form of potassium sulphate (48 $\%k_2o$). Nitrogen and potassium were applied as mentioned before according to the used treatments.

The previous crop was wheat in both seasons of study, soil sample were taken from the experimental sites at the depth of 0-30 cm from the soil surface and subjected to chemical analysis. The chemical properties of the experimental sites in both seasons are presented in Table 1.

TABLE 1. Some chemical properties of the soil in the experimental sites in 2007 and 2008 Mineral seasons.

Characters	**Seasons**	
	2007	**2008**
Texture	clay	clay
pH	7.9	8.2
E.C. (ds/m)	1.89	2.2
Organic matter content (%)	1.6	1.58
Available nitrogen (ppm)	19.2	18.9
Available phosphorus (ppm)	16.3	16.7
Available potassium (ppm)	359	368

Studied characters

Total chlorophyll content (SPAD value)

Ten leaves were randomly taken from each sub-sub plot to determine chlorophyll content by using SPAD meter (Minolta model SPAD 501) at complete heading stage.

Flag leaf area (cm^2)

From each sub-sub plot ten flag leaves were randomly taken from the main Culm to estimate each area at complete heading stage by using leaf area meter (Model LI 3000A).

Plant height (cm)

Average of plant height (Pl. H) of five random rice plants from each sub-sub plot were measured from soil surface up to the top of rice plant at harvesting time.

Number of tiller / hill

As a number of tillers per hill for mean ten hills randomly taken from each plot at harvesting time.

Yield and its components

Number of panicle/ hill as a number of panicle per hill for mean ten hills randomly taken from each plot at harvesting time, ten main panicles were randomly taken from each plot to calculate number of filled grains/panicle, weight of 1000-grain, according to Juliano (1971) and Khush *et al.* (1979). Guarded area of 10 m^2, in each plot, was manually harvested, and then air dried for about four days and biological yield was recorded, then, mechanically threshed. Grain yield was recorded and adjusted to 14% moisture content. Grain and straw yields were recorded as tons/fed. All the collected data were statistically analyzed, according to Gomez & Gomez (1984) and differences among treatment means were compared, using D.M.R.T., according to Duncan (1955).

Results and Discussion

Plant height, total chlorophyll content and flag leaf area

Data presented in Table 2 show the response of Egyptian hybrid1 and Giza 178 rice cultivar to nitrogen and potassium splitting at different growth stages. Data indicated that Giza 178 recorded significantly increases in the chlorophyll content; flag leaf area and plant height compared with hybrid 1, the chlorophyll content and flag leaf area were significantly affected by time and methods of nitrogen application in both seasons.

Application of nitrogen as **1/2** basal +**1/4** at mid tillering (MT) + 2**%** N as foliar application at Late Boating (LB) recorded the highest values in total chlorophyll content and flag leaf area in the both seasons under study.

The increase in the previously mentioned characters by the application of N could be attributed to the increase in cell division and elongation and also to role of N in chlorophyll biosynthesis.

As for the effect of potassium application methods data in the same table revealed that all potassium treatments showed significant differences in plant height, total chlorophyll content, and flag leaf area in both seasons under study. The results revealed that adding K3, (1/2 B + **1/4** as TD at PI+ 2 **%** as foliar at LB) and K4 (**1/2** B + 2 **%** as foliar at PI+ **1/4** as TD at LB) potassium treatments recorded the highest values in plant height and flag leaf area, while, K2,(**1/2** B +**1/4** as TD at (PI)+ **1/4** TD at LB) potassium treatment recorded the highest values in total chlorophyll content, Similar results were recorded by Mutanal *et al.* (1997), Meena *et al.* (2003), Surendran (2005), Gobi *et al.* (2006), Zayed *et al.*

(2006), Zayed *et al.* (2007b) and Manzoor (2008), on the other hand the K5,($^1/_2$ B + 2 % foliar at PI+ 2 % foliar at LB) potassium treatments was among of treatments which recorded the lowest values in total chlorophyll content, flag leaf area and plant height, Similar results were recorded by Meena *et al.* (2003).

TABLE 2. Plant height, total chlorophyll content and flag leaf area of Egyptian Hybrid 1 and Giza 178 rice varieties as affected by time and methods of both N and K application in 2007 and 2008 seasons.

Factors	PL.H (cm)		Total chlorophyll SPAD		Flag leaf area(cm^2)	
	2007	**2008**	**2007**	**2008**	**2007**	**2008**
Egyptian varieties (A) :						
V1, hybrid1	107.40a	108.30 a	41.49 b	40.85 b	34.37 b	34.4 b
V2, Giza 178	96.10b	96.90 b	48.25 a	48.19 a	39.82 a	39.5 a
F- test	**	**	**	**	**	**
Time and methods of N apllication (B):						
N1, $^1/_2$ B +$^1/_4$ as TD at MT +$^1/_4$ as TD at LB	101.35	102.30	44.41b	44.06 b	36.43 b	35.9 b
N2, $^1/_2$ Bl +$^1/_4$ as TD at MT + 2% foliar at LB	102.05	103.00	45.33 a	44.98 a	37.76 a	38.0 a
F- test	Ns	Ns	*	*	**	**
Time and methods of K apllication (C):						
K1, $^1/_2$ B + $^1/_2$ as TD at LB	97.30 d	98.29 d	46.38 b	45.76 b	34.35 b	36.3 c
K2, $^1/_2$ B +$^1/_4$ as TD at (PI)+ $^1/_4$ TD at LB	99.90 c	100.79 c	48.27 a	48.19 a	33.19 b	37.3 b
K3, $^1/_2$ B + $^1/_4$ as TD at PI+ 2 % as foliar at LB	105.40 a	106,30 a	42.46 d	41.97 d	36.89 a	38.3 a
K4, $^1/_2$ B + 2 % as foliar at PI+ $^1/_4$ as TD at LB	105.00 a	105,90 a	44.12 c	43.86 c	35.84 a	38.0 a
K5, $^1/_2$ B + 2 %foliar at PI+ 2 % foliar at LB	101.00 b	101.89 b	43.11 cd	42.79 cd	31.58 c	34.7 d
F-test	**	**	**	**	**	**

B, MT, LB and TD namely**,** Basal, Mid Tillering, Late Boating and Top dressing**, *, **** and NS indicate $p<0.05$, $p<0.01$ and not significant, respectively. Means of each column designated by the same latter are not significantly different at 5% level using Duncan's multiple range test.

Number of tiller/ hill

Performance of Egyptian Hybrid1 and Giza 178 rice varieties, as influenced by various time and methods of nitrogen and potassium application on number of tillers/hill in 2007 and 2008 seasons are presented in Table 3.

Data indicated that Egyptian Hybrid1 recorded highest significant increasing in the number of tillers/hill compared with Giza 178, the number of tillers/hill were significantly affected by time and methods of Nitrogen application in both seasons.

TABLE 3. Number of tillers and panicles / hill of Egyptian Hybrid 1 and Giza 178 rice varieties as affected by time and methods of both N and K application in 2007 and 2008 seasons.

Factors	No. of tillers/hill		No. of panicles /hill	
	2007	2008	2007	2008
Varieties (A) :				
V1, hybrid1	22.83 a	23.99 a	22.44 a	23.80 a
V2, Giza 178	21.72 b	17.78 b	20.32 b	17.59 b
F- test	**	**	**	**
Time and methods of N apllication (B):				
N1, $^1/_2$ B +$^1/_4$ as TD at MT +$^1/_4$ as TD at LB	22.88 a	22.52 a	22.17 a	22.33 a
N2, $^1/_2$ Bl +$^1/_4$ as TD at MT + 2% foliar at LB	21.68 b	19.25 b	20.19 b	19.06 b
F- test	**	**	**	**
Time and methods of K apllication (C):				
K1, $^1/_2$ B + $^1/_2$ as TD at LB	22.52	22.66	21.47	21.51
K2, $^1/_2$ B +$^1/_4$ as TD at (PI)+ $^1/_4$ TD at LB	22.00	22.41	21.46	21.29
K3, $^1/_2$ B + $^1/_4$ as TD at PI+ 2 % as foliar at LB	22.01	22.13	21.02	21.60
K4, $^1/_2$ B + 2 % as foliar at PI+ $^1/_4$ as TD at LB	22.14	22.56	21.07	21.50
K5, $^1/_2$ B + 2 %foliar at PI+ 2 % foliar at LB	22.73	22.65	21.88	22.27
F-test	Ns	Ns	Ns	Ns

B, MT, LB and TD namely, Basal, Mid Tillering, Late Boating and Top dressing, *, ** and NS indicate $p<0.05$, $p<0.01$ and not significant, respectively. Means of each column designated by the same latter are not significantly different at 5% level using Duncan's multiple range test.

Application of nitrogen as 1/2 B +1/4 at MT+1/4 at LB recorded the highest values in number of tillers/hill in both seasons.

Regarding the effect of time and methods of potassium application data in the same table show that all potassium treatments did not recorded any significant effect on number of tillers/hill in both seasons under study. Similar results were reported by Manzoor *et al.* (2006).

Yield attributes

Performance of Egyptian Hybrid1 and Giza 178 rice varieties, as influenced by various time and methods of nitrogen and potassium application on number of panicles/hill in 2007 and 2008 seasons are presented in Table 3.

Data pointed that Egyptian Hybrid1 recorded significantly increase in the number of panicles /hill compared with Giza 178; the number of panicles /hill was significantly affected by time and methods of nitrogen application in both seasons.

Application of Nitrogen as $^1/_2$ B +$^1/_4$ at MT+$^1/_4$ at LB recorded the highest values in number of panicles /hill in both seasons.

As For the effect of time and methods of potassium application data in the same table show that all potassium treatments did not recorded any significant effect on number of panicles /hill in both seasons under study**.** Similar results were reported by Manzoor *et al.* (2006).

Data in Table 4 show that Performance of Egyptian Hybrid1 and Giza 178 rice varieties, as influenced by various time and methods of nitrogen and potassium application on number of filled grains/panicle and 1000 grain weight in 2007 and 2008 seasons.

TABLE 4. Number of filled grains /panicle and 1000 grain weight (gm) of Egyptian hybrid 1 and Giza 178 rice varieties as affected by time and methods of both N and K application in 2007 and 2008 seasons.

Factors	No. of filled grains/ panicle		1000 grain weight (gm)	
	2007	2008	2007	2008
Egyptian varieties (A) :				
V1, Hybrid1	177.4a	191.8 a	24.57 a	25.53 a
V2, Giza 178	166.1b	152.8 b	20.91 b	21.51 b
F- test	**	**	*	**
Time and methods of N apllication (B):				
N1, $^1/_2$ B +$^1/_4$ as TD at MT +$^1/_4$ as TD at LB	171.4	174.5 a	22.70	23.45
N2, $^1/_2$ Bl +$^1/_4$ as TD at MT + 2% foliar at LB	172.5	170.5 b	22.78	23.59
F- test	Ns	**	Ns	Ns
Time and methods of K apllication (C):				
K1, $^1/_2$ B + $^1/_2$ as TD at LB	167.3 d	158.8 d	22.94	23.05 d
K2, $^1/_2$ B +$^1/_4$ as TD at (PI)+ $^1/_4$ TD at LB	169.9 c	180.4 b	22.88	23.60 b
K3, $^1/_2$ B + $^1/_4$ as TD at PI+ 2 % as foliar at LB	170.9 b	176.4 c	22.57	23.40 c
K4, $^1/_2$ B + 2 % as foliar at PI+ $^1/_4$ as TD at LB	175.1a	161.2 d	22.66	24.04 a
K5, $^1/_2$ B + 2 %foliar at PI+ 2 % foliar at LB	175.4 a	184.6 a	22.63	23.50 bc
F-test	**	**	Ns	**

B, MT, LB and TD namely, Basal, Mid Tillering, Late Boating and Top dressing, *, ** and NS indicate $p<0.05$, $p<0.01$ and not significant, respectively. Means of each column designated by the same latter are not significantly different at 5% level using Duncan's multiple range test.

Data recorded that Egyptian Hybrid1 recorded significantly increase in the number of filled grains / panicle and 1000 grains weight compared with Giza 178 in both seasons, the number of filled grains /panicle were significantly affected by time and methods of Nitrogen application in 2008 season only, Application of Nitrogen as $^{1}/_{2}$ B +$^{1}/_{4}$ at MT+$^{1}/_{4}$ at LB recorded the highest values in number of filled grains /panicle in 2008 season, while 1000 grain weight did not significantly affect by the tow nitrogen treatments under study (Table 4). Similar results were reported by Manzoor *et al*. (2006).

Split application of potassium had a significantly effect on yield attributes of Egyptian Hybrid1 and Giza 178 rice varieties (Table 4). The results revealed that number of filled grains /panicle gave highest values in plots which received potassium treatment K5 as $^{1}/_{2}$ B + 2 %foliar at PI+ 2 % foliar at LB, while 1000 grain weight reached to the maximum value when rice received potassium treatment K4 as $^{1}/_{2}$ B +2 % as foliar at PI+$^{1}/_{4}$ as TD at LB in 2008 season.

The application of both N and K as basal lied to increase number of tillers (especially effective tillers), while the application of the two elements at PI increase number of spikelets/ panicle and the application of both N and K at late booting increase the photosynthesis at filling period consequently increase 1000 grain weight. Similar results were observed by Devasenathy (1997), Surendran (2005) and Zayed *et al.* (2007b).

Grain and straw yield

Grain yield of Giza 178 and Egyptian Hybrid1 rice varieties as affected by time and methods of nitrogen and potassium application in 2007 and 2008 seasons are presented in Table 5. Data indicated that hybrid 1 surpassed significantly inbred rice (Giza 178) in grain yield. This is holding true in the two seasons under study.

Data in the same table showed that time and methods of nitrogen application had a significant effect in 2008 season only.

Splitting nitrogen application as $^{1}/_{2}$ B +$^{1}/_{4}$ at MT +$^{1}/_{4}$ at LB (N1) recorded the highest values of grain yield compared with other methods of N-application. Moreover the second N- treatment ($1/_{2}$ B +$^{1}/_{4}$ at MT + 2% foliar at LB) caused a significant increase in straw yield in 2008 season, while in the first season the grain and straw yields were not significant.

Regarding the effect of potassium application methods on grain and straw yield in the two seasons in Table 5 the presented data indicated that grain and straw yield were significantly affected by the time and method of potassium application in both seasons. K2, (**$^{1}/_{2}$** B +**$^{1}/_{4}$** as TD at (PI) + **$^{1}/_{4}$** TD at LB) achieved the highest values in the first season in both grain and straw yield, without significant differences with K3 and K4. Moreover in the second season K3 treatment recorded the highest value for grain also for straw yield but significant differences with K3 and K4.

TABLE 5. Grain and straw yield ton. fed^{-1} of Egyptian Hybrid 1 and Giza 178 rice varieties as affected by time and method of N and K application in 2007 and 2008 seasons.

Factors	Grain yield		Straw yield	
	2007	2008	2007	2008
Egyptian Varieties (A) :				
V1, Hybrid1	4.37 a	4.98 a	5.57 a	6.68 a
V2, Giza 178	4.16 b	3.70 b	5.30 b	5.31b
F- test	**	**	**	**
Time and methods of N apllication (B):				
N1, $^1/_2$ B +$^1/_4$ as TD at MT +$^1/_4$ as TD at LB	4.23	4.41 a	5.51	5.96b
N2, $^1/_2$ Bl +$^1/_4$ as TD at MT + 2% foliar at LB	4.21	4.27 b	5.36	6.03 a
F- test	NS	**	NS	**
Time and methods of K apllication (C):				
K1, $^1/_2$ B + $^1/_2$ as TD at LB	4.19 b	4.27 d	5.34 b	5.88 b
K2, $^1/_2$ B +$^1/_4$ as TD at (PI)+ $^1/_4$ TD at LB	4.39 a	4.34 c	5.6 a	5.92 b
K3, $^1/_2$ B + $^1/_4$ as TD at PI+ 2 % as foliar at LB	4.30 ab	4.45 a	5.48 ab	6.08 a
K4, $^1/_2$ B + 2 % as foliar at PI+ $^1/_4$ as TD at LB	4.30 ab	4.40 b	5.47 ab	6.05 a
K5, $^1/_2$ B + 2 %foliar at PI+ 2 % foliar at LB	4.14 b	4.25 d	5.28 b	6.04 a
F-test	*	**	*	**
Interaction:				
Ax B	*	**	*	Ns
A x C	*	**	*	**
B x C	Ns	*	Ns	NS
Ax B X C	Ns	*	NS	NS

B, MT, LB and TD namely, Basal, Mid Tillering, Late Boating and Top dressing, *, ** and NS indicate $p<0.05$, $p<0.01$ and not significant, respectively. Means of each column designated by the same latter are not significantly different at 5% level using Duncan's multiple range test.

This results might be owing to the continuous supply of potassium to the rice plant during growth stage which increased translocation of carbohydrates from stems, leafs and other storage organs to grains, leading to high sink capacity and higher grain yield. Similar results was obtained by Poonam *et al.* (1993), Jandran *et al.* (2000), *et al.* (2003), Zayed *et al.* (2006 Meena), Nagarathna & Prakasha (2007) and Mashmann *et al.* (2010).

Data in Table 6 show that significant differences were observed between both N treatments and rice varieties in both season, treatment of splitting nitrogen as 1/2 basal+1/4 at P.I +1/4 at L.B with hybrid1 rice variety recorded the highest value of grain yield in both season.

TABLE 6. Grain yield ton. fed^{-1} as affected by the interaction between rice varieties and the time and methods of nitrogen application in 2007 and 2008 seasons.

Factor	Rice varieties			
	2007		2008	
N- apllication time	Hybrid1	Giza 178	Hybrid1	Giza 178
N1, $^1/_2$ B +$^1/_4$ as TD at MT +$^1/_4$ as TD at LB	4.56 a	4.09 b	5.07 a	4.89 b
N2, $^1/_2$ Bl +$^1/_4$ as TD at MT + 2% foliar at LB	4.19 b	4.23 b	3.75 c	3.65 c

B, MT and LB namely**,** Basal, Mid Tillering and Late Boating. Means of each column designated by the same latter are not significantly different at 5% level using Duncan's multiple range test.

Data in Table 7 show that significant differences were recorded between time and methods of potassium application and the two tested varieties in both season, Data revealed that time and methods of potassium application as K4 $^1/_2$ B + 2 % as foliar at PI+ $^1/_4$ as TD at LB stage or K3, $^1/_2$ B + $^1/_4$ as TD at PI+ 2 % as foliar at LB for hybrid 1 rice variety gave the greatest value of grain yield in both seasons.

TABLE 7. Grain yield ton. fed^{-1} as affected by the interaction between time and methods of potassium application and rice varieties in 2007 and 2008 seasons.

Factor	Rice Varieties			
	2007		2008	
K- methods and times (C):	**Hybrid1**	**Giza 178**	**Hybrid1**	**Giza 178**
K1, $^1/_2$ B + $^1/_2$ as TD at LB	4.29 bc	4.1cd	4.8 c	3.75 def
K2, $^1/_2$ B +$^1/_4$ as TD at (PI)+ $^1/_4$ TD at LB	4.38 ab	4.41 ab	4.8 c	3.88 d
K3, $^1/_2$ B + $^1/_4$ as TD at PI+ 2 % as foliar at LB	4.36 ab	4.25 bcd	5.1 ab	3.8 de
K4, $^1/_2$ B + 2 % as foliar at PI+ $^1/_4$ as TD at LB	4.59 a	4.01d	5.27 a	3.54 f
K5, $^1/_2$ B + 2 %foliar at PI+ 2 % foliar at LB	4.25 bc	4.04 cd	4.94 bc	3.56 ef

B, PI, LB and TD namely, Basal, panicle initiation, Late Boating and Top dressing, Means of each column designated by the same latter are not significantly different at 5% level using Duncan's multiple range test.

Data in Table 8 show that there is no significant differences were detected among treatments between both N and K in 2007 growing season, while, in 2008 season a significant effect was achieved. The best combination between both N and potassium treatments, N1 treatment with either K3 (1/2 B + 1/4 as TD at PI+ 2 % as foliar at LB) or K4 (1/2 B + 2 % as foliar at PI+ 1/4 as TD at LB) produced the highest grain yield.

TABLE 8. Grain yield ton.fed^{-1} as affected by the interaction between time and method of nitrogen and potassium application in 2007 and 2008 seasons.

Factor	N- apllication time			
	2007		2008	
K- methods and times (C):	N1	N2	N1	N2
K1, 1/2 B + 1/2 as TD at LB	4.29	4.09	4.37ab	4.17 b
K2, 1/2 B +1/4 as TD at (PI)+ 1/4 TD at LB	4.38	4.40	4.39 ab.	4.29 ab
K3, 1/2 B + 1/4 as TD at PI+ 2 % as foliar at LB	4.37	4.24	4.5 a	4.4 ab
K4, 1/2 B + 2 % as foliar at PI+ 1/4 as TD at LB	4.32	4.27	4.47 a	4.34 ab
K5, 1/2 B + 2 %foliar at PI+ 2 % foliar at LB	4.26	4.03	4.33 ab	4.17 b
	Ns	Ns		

B, PI, LB and TD namely**,** Basal, panicle initiation, Late Boating and Top dressing**,** Means of each column designated by the same latter are not significantly different at 5% level using Duncan's multiple range test.

Data in Table 9 showed that interaction among rice varieties, nitrogen application and potassium application methods in 2007 growing season was not significant while, in 2008 growing season highly significant differences were recorded. The best combination was rice variety (Hybrid1) combined with N1 (1/2 B +1/4 as TD at MT +1/4 as TD at LB) with K4 (1/2 B + 2 % as foliar at PI+ 1/4 as TD at LB stage) which gave the greatest grain yield.

TABLE 9. Grain yield ton. fed^{-1} as affected by the interaction between time and method of nitrogen and potassium application and rice varieties in 2007 and 2008 seasons.

Factor	2007				2008			
	Hybrid 1		Giza 178		Hybrid 1		Giza 178	
	N- apllication time							
K- methods and times (C):	N1	N2	N1	N2	N1	N2	N1	N2
K1	4.63	3.95	3.96	4.23	4.92 bc	4.68 c	3.83 d-f	3.67 d-f
K2	4.5	4.26	4.27	4.54	4.87 bc	4.73 c	3.91 d	3.85 de
K3	4.5	4.22	4.24	4.26	5.19 ab	5.02 bc	3.82 d-f	3.78 d-f
K4	4.74	4.43	3.9	4.11	5.38 a	5.16 ab	3.56 d-f	3.52 ef
K5	4.44	4.07	4.08	3.99	5.02 bc	4.87 bc	3.65 d-f	3.47 f
	Ns	Ns	Ns	Ns				

B, PI, LB and TD namely**,** Basal, panicle initiation, Late Boating and Top dressing**,** Means of each column designated by the same latter are not significantly different at 5% level using Duncan's multiple range test.

Conclusion

From the previous data it could be concluded that the application of nitrogen as 1/2 of the dose as basal +1/4 as TD at Mid. T +1/4 as TD at late boating stage (LB), applied potassium fertilizer as either 1/2 dose as basal +1/4 as foliar at PI

(2%of K_2O) +1/4 as TD at LB stage or 1/2 dose as basal +1/4 as TD at PI + 1/4 as foliar (2%of K_2O) at LB stage for Egyptian Hybrid1 rice variety gave the highest grain yield.

References

Abo Youssef, M., Draz, A. and El-Mowafi, H. (2005) The effect of sowing date and GA_3 doses of the parental lines of SK2058H on hybrid rice seed production under Egyptian conditions. *Egypt. J. Agric. Res.* **83**(5B), 323-331.

Awan, T., Manzoor, Z., Safdar, E. and Ahmed, M. (2007) Yield response of rice to dynamic use of potassium in traditional rice growing area of Punjab. *Pak. J. Agric. Sci.* **44**(1), 130-134.

Cao, W., Ding, Y.F., Zhijun, Ji. Wang, Q.S. Hung, P.S. and Zhe, R.H. (2004) Effect of potassium fertilizer application rates on plant potassium accumulation and grain quality of Japonica rice. *Scientia Agriculture Sinica*, **37** (10), 1444-1450.

Devasenapathy, P. (1997) Split application of potassium in rice. *Madras Agricultural J.* **84** (5), 265-266.

Duncan, B. (1955) Multiple Ranges and Multiple F. *Test. Biometrics,***11,** 1-42.

Economic Sector (2009) Ministry of Agriculture and Soil Reclamation.

Ghoshi, S.K., Pal, S. and Mukhopad Hyay, A.K. (1995) Split application of potassium to maximize its efficiency on yield of high yielding rice. *Ind. Agricutlurist,* **39** (4), 259-264.

Gobi, R., Pandian, J. and Kanaka, S. (2006) Evaluation of stand establishment methods and split application of N and K for hybrid rice (CORH 2). *Crop Res. Hisar***. 23**(3), 275-278.

Gomez, K. and Gomez, A. (1984) *"Statistical Procedures of Agricultural Research".* John Wiley and Sons. Inc., New York, U.S.A.

Gorgy, R.N. (2007) Effect of balanced fertilizers on productivity of hybrid and inbred rice varieties *J. Agric. Res. Kafrelsheikh Univ.* **33** (1), 101 – 122.

Juliano, B. (1971) Amplified assay for milled rice amylose cereal. *Sci. Today,* (16) 334-338**,** 340-360.

Khush, G., Parle, C. and Delacruze, N. (1979) Rice grain quality evaluation and improvement at IRRI Proc. Workshop on Chemical Aspect of Rice Grain Quality.

Krishnakumar, S., Nagarajan, R., Natarajan, S., Jawahar, D. and Pandian, B. (2005) NPK fertilizers for hybrid rice, (*Oryza sativa* L.) productivity in Alfisols of Southern Districts of Tamil Nadu. *Asian J. Plant Sci*. **4**(6), 574-576.

Manzoor, Z., Ali, R.I., Awan, T.H., Khaled, N. and Mushtaq Ahmad (2006) Appropriate time of nitrogen Application to fine rice, *Oryza sativa*. *J. Agric. Res.* **44**(4)261-267.

Manzoor, Z., Awan, T., Ahmed, M., Akhter, M. and Faiz, F. (2008) Effect of split application of potash on yield and yield related traits of basmati rice. *J. Anim. Pl. Sci.* **18**(4), 120-124.

Mashmann, E., Slaton, N., Corwright, R. and Norman, J. (2010) Rate and timing of potassium fertilization and fungicide influence rice yield and stem rot. *Agron. J.* **102** (2), 163-170.

Meena, S., Singh, S. and Shivary, Y.S. (2003) Response of hybrid rice (*Oryza sativa* L.) to nitrogen and potassium application in sandy clay-loam soils. *Indian J. of Agric. Sci.*, **73** (1), 8-11.

Mohamed, M. (2006) Effect of some agricultural treatments on yield of hybrid rice. *M. Sc. Thesis,* Agron. Dept., Fac. Agric., Al-Azhar Univ., Cairo, Egypt.

Mutanal, S., Kumar, P., Josh, V. and Hannon, N. (1997) Effect of split application of potassium on grain yield of paddy in Transplanted condition. *Karnataka J. Agric. Sci.* **10** (2), 298-301 .

Nagarathna, T. and Prakasha, H. (2007) Synchronization of potassium supply in rice hybrids. *Environment and Ecology*, **25**(34), 967-968.

Natarajan, S., Arivazhagan, K. and Surendran, U. (2004) Effect of split application of different potassic fertilizers on yield and nutrient uptake by rice cv PY5. *J. of Ecobiology*, **16** (3),175-180.

Pandey, N., Verma, K., Anurag, A. and Tripathi, S. (2007) Integrated nutrient management in transplanted hyrid rice (*Oryza sativa* L.). *Indian J. Agron.* **52**(1), 49-51.

Patil, D., Thiyyagajan, K. and Patil, P. (2006) Evaluated of six parameters model of generation mean analysis in thermo-sensitive genic males sterile lines of two line hybrid rice (*Oryza sativa* L.). Plant Archieves, **6**(1), 139-143.

Poonam, A., Sharma, I.P. and Srivastava, V.C. (1993) Rate and time of potassium application in transplanted rice. *J. Res. Birsa. Agric. Univ.* **5** (2) 171-172.

Rahman, M.H. Ali and Khatun, M.M. (2007) Effect of different levels of nitrogen on growth and yield of transplant aman rice CV BRRI Jhan 32. *International J. Sustainable Crop Production*, **2** (1), 28-34.

Ramteke, J.R., Powar, M.S., Yadav, S.L. and Gedam, V.B. (2004) Effect of time of application of phosphorus and potassium on the yield and nutrient uptake of rice hybrids. *J. Maharashtra Agric. Univ.* **29** (2), 242-243.

Sahoo, N. C., Mishra, B. K. and Mohanty, J. P. (1990) Response of aged seedlings of transplanted rice to split application of nitrogen. *Orissa J. Agric. Res.* **3**(10),13-17

Singh,T., Shivay,Y.S. and Singh, S. (2004) Effect of date of transplanting and nitrogen on productivity and nitrogen use indices in hybrid and non-hybrid aromatic rice. Division of Agronomy, Indian Agricultural Research Institute, New Delhi, India *Acta-Agronomica-Hungarica*, **52** (3), 245-252.

Surendran (2005) Split application of Muriate of potash and sulphate of potash on Growth, yield attributes, uptake and availability of Nutrients in low land Rice CV. PY-5. *The Journal Agricultural Science*, **1** (2), 42-48.

Thakur, D.S., Patel, S.R. and Ageshwarlal, N. (1999) Effect of split application of potassium with FYM on rice (*Oryza sativa* L.). **44** (2), 301-303.

Velayauthan, A., Velayudham, K. and Balasubramanian, R. (1992) Effect of split application of potassium to lowland rice on NPK uptake and yield. *Orissa J. Agric. Res.* **5** (3), 162-165.

Yoshida, S. (1981) Fundamentals of rice crop science. IRRI. Lose banose, Philippine.

Zayed, B., El-Gouhary, A., El-Ekhtyar, A. and Sedeek, S. (2006) Response of Giza 177 and SK2034H hybrid rice to potassium splitting. 1st *Field Crops Conf.*, August 22-24, Giza, Egypt, pp. 407-414.

Zayed, B., El-Keredy, M., Abd Allah, A. and El-Khoby, W. (2007a) Growth and grain yield of hybrid and traditional rice as affected by splitting nitrogen under saline soil conditions. *J. Agric. Res. Kafrelsheik Univ.* **33**(4), 787-806.

Zayed, B., Shehata, S., El-Khoby, W. and Khafaga, E. (2007b) Rice and water productivity as affected by irrigation intervals and potassium splitting under newly reclaimed saline soil. *J. Agric. Res. Kafrelsheikh Univ.* **33**(4), 807-823.

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تأثير طرق ومواعيد إضافة النيتروجين والبوتاسيوم عند مراحل نمو مختلفة لصنفى الأرز هجين ١ وجيزة ١٧٨

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أجريت تجربتان حقليتان بمزرعة مركز البحوث والتدريب فى الأرز بسخا – كفر الشيخ خلال موسمى ٢٠٠٧ و٢٠٠٨ لدراسة تأثير طرق إضافة النيتروجين والبوتاسيوم عند مراحل نمو مختلفة لصنفى الأرز هجين مصرى ١ والصنف جيزة ١٧٨ حيث استخدمت معاملتين من السماد النيتروجينى وهى عبارة عن:

١- نصف الجرعة على الشراقى + ٢٥٪ عند مرحلة التفريع المتوسط + ٢٥٪ عند مرحلة الحمل المتأخرة (الحبلان) N1.

٢- نصف الجرعة على الشراقى + ٢٥٪ عند مرحلة التفريع المتوسط + ٢٥٪ رش ورقى بتركيز ٢٪ عند مرحلة الحمل المتأخرة) N2، واستخدم السماد النيتروجينى بمعدل ٦٠ كجم ن/ فدان وقد استخدم السماد البوتاسى بمعدل ٢٤ كجم بو٢أ / فدان أضيف نصف المعدل (٥٠٪) على الشراقى لجميع القطع التجريبية الخاصة بمعاملات البوتاسيوم وتم إضافة النصف الأخر(٥٠٪) على النحو التالى :

١. ٥٠٪ إضافة أرضية عند مرحلة الحمل المتأخرة k1.
٢. ٢٥ ٪ عند مرحلة بداية تكوين الدالية+ ٢٥٪عند مرحلة الحمل المتأخرة k2
٣. ٢٥ ٪ عند مرحلة بداية تكوين الدالية + ٢٥٪ رش ورقى بتركيز ٢٪ عند مرحلة الحمل المتأخرة k3
٤. ٢٥٪ رش ورقى بتركيز ٢٪ عند مرحلة بداية تكوين الدالية + ٢٥٪ عند مرحلة الحمل المتأخرة k4
٥. ٢٥٪ رش ورقى بتركيز ٢٪ عند مرحلة بداية تكوين الدالية + ٢٥٪ رش ورقى بتركيز ٢٪ عند مرحلة الحمل المتأخر k5

وقد استخدم معدل التقاوى ٦٠ و١٥ كجم/ فدان لكل من صنفى الأرز جيزة ١٧٨ وهجين١على التوالى مع استخدام طريقة الشتل اليدوى فى الزراعة على مسافات ٢٠x٢٠ سم بين الجور على ان تحتوى كل جورة على ٣-٤ نباتات بالنسبة لصنف جيزة ١٧٨ وعلى نباتين بكل جور للهجين ١. ووزعت المعاملات فى تصميم القطع المنشقة مرتين حيث وزعت الأصناف فى القطع الرئيسية ووزعت معاملات التسميد النيتروجينى فى القطع الشقية ووزعت معاملات التسميد البوتاسى فى القطع تحت الشقية وتتلخص أهم النتائج المتحصل عليها فيما يلى :

تفوق الهجين ١ فى ارتفاع النبات وعدد الأشطاء/م^2 وعدد الداليات /م^2 وعدد الحبوب الممتلئة ووزن الألف حبة ومحصول الحبوب ومحصول القش فى كلا موسمى الزراعة وقد سجل جيزة ١٧٨ أعلى القيم فى محتوى الكلوروفيل ومساحة الورقة العلم . وقد أظهرت الدراسة أن معاملة النيتروجين N1 سجلت تفوق معنوى فى صفات عدد الأشطاء/م^2 وعدد الداليات /م^2 فى كلا موسمى الدراسة كما أظهرت زيادة معنوية فى صفات عدد الحبوب الممتلئة /سنبلة وصفة محصول الحبوب (طن/فدان) وذلك فى موسم ٢٠٠٨ فقط. وسجلت معاملة النيتروجين N2 تحسن معنوى فى صفات محتوى النيتروجين الكلى ومساحة الورقة العلم فى موسمى ٢٠٠٧ و٢٠٠٨ وأظهرت زيادة معنوية فى صفة محصول القش (طن /فدان) فى الموسم الثانى من الدراسة . ومن نتائج كلا الموسمين يتضح أن إضافة معاملة البوتاسيوم K4 أعطت زيادة معنوية فى صفات ارتفاع النبات ومساحة الورقة العلم فى كلا موسمى الدراسة ،كما سجلت تلك المعاملة تحسن معنوى فى عدد الحبوب الممتلئة/ سنبلة فى الموسم الأول ، ووزن الألف حبة فى

الموسم الثانى ، وسجلت كلا من K3 و K4 زيادة معنوية ملحوظة فى صفتى محصول الحبوب (طن/فدان) ومحصول القش (طن/فدان) فى كلا الموسمين .ومن نتائج البحث انه إضافة النيتروجين (٢/١ الجرعة على الشراقى + ٤/١ عند مرحلة التفريع المتوسط + ٤/١ عند مرحلة الحمل المتأخرة) وإضافة البوتاسيوم اما كنصف الكمية على الشراقى مع إضافة النصف الباقى بنسبة ٢٥٪ رش ورقى بتركيز ٢٪ عند مرحلة بداية تكوين السنبلة + ٢٥٪ عند مرحلة الحمل المتأخرة أو إضافة البوتاسيوم (كنصف الكمية على الشراقى و٢٥٪ نثرا بتركيز ٢٪ عند مرحلة بداية تكوين السنبلة و٢٥٪ رش ورقى بتركيز ٢٪ عند مرحلة الحمل المتأخرة) لصنف الأرز هجين مصرى ١ فقد أعطت أعلى القيم فى محصول الحبوب.