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Effect of Split Application Of Nitrogen Fertilizer On Growth And Yield Of Hybrid Rice (GRH1).

[1]Sahar Youseftabar, [2]Allahyar Fallah, [3]Jahanfar Daneshiyan

[1]Young Researchers Club, Iran Islamic Azad University, sari Branch, sari, Iran
[2]Faculty member, rice research institut amol, iran
[3]Faculty member, agricultural research,iran

Abstract: A field trial to Effect of split application of nitrogen fertilizer on growth and yield of hybrid rice(GRH1). comprising of 2 treatment's ,nitrogen fertilizer at 100,200 and 300 kg/ha was main plot and spilt application at 3 levelT1=(1/2basal-1/2mid tillering),T2=(1/3basal-1/3mid tillaring-1/3panicle initation) and T3=(1/4basal-1/4 mid tillering-1/4panicle initation-1/4 flowering) as sub plot.using randomized complete block desing (RCBD)with 3 replication in rice research in stitute of iran-departy of mazandaran (amol) in 2006 cropping season.the results showed that growth parameter, 1000-grain wight, filled grain and grain yield increased significantly with nitrogen fertilizer.effect of different split application N-fertilizer were significantly on this parameter, increase split application decrease in growth parameter but 1000-grain wight, filled grain and grain yield increase with increase split application.study intraction effect of treatment's revealed that all the tparameter's increased significantly with an application of 300 kg/ha N-fertilizer at different stage.

Key word: hybrid rice-nitrogen-spilt application-growth parameter.

INTRODUACTION

Rice occupies an important place in cereal crops (Irshad *et al*, 2000). introduction of hybrid rice is an important step towards augmentation of rice yield.hybrid rice about 15-20% more than the promising high-yielding commercial varities.earlier studies reveal that guality of rice (Chaturvedi, 2005). Nitrogen (N) is an essential nutrient of rice production, but excessive N application would lead to increased production cost and negative effects of blocking agricultural sustainable development such as environmental pollution and rice quality decline (Cheng *et al*, 2011). Nitrogen is the main nutrient associated with yield, Its availability promotes crop growth and tillering, finally determining the number of panicles and spikelets during the early panicle formation stage. This nutrient also provides sink during the late panicle formation stage (Hirzel *et al*, 2011). some of the promising N management techniques in clued split application ,rate and timing of N rate critical for optimum rice grain yield (Doberman and fair hurst, 2000). so it is essential to find out the optimum rate of nitrogen application for efficient ultlization of this element by the plants for better yield. the rice hybrid often benefit in rough and whole grain when N is top-dressed at the panicle emergence (early heading) growth stage (walker, 2006). Nitrogen contributes to spikelet production during the early panicle formation stage, and contributes to sink size by decreasing the number of degenerated spikelets and increasing hull size during the late panicle formation stage. Nitrogen contributes to carbohydrate accumulation in culms and leaf sheaths during the preheading stage and in grain during the grain-filling stage by being a fertilization to prevent the occurrence of N deficiencies, as well as to prevent overfertilization, which contributes to increased lodging, poor grain filling due to mutual shading, and increased severity and incidence of diseases (Ghanbari-Malidareh-2011). Rice tillering is an important agronomic trait for grain production and the number of tillers is dynamic and adjustable, Although moderate tillering contributes greatly to rice yields, excessive tillering leads to high tiller abortion, poor grain setting, and small panicle size and ultimately reduces grain yield (Liu *et al*, 2011). top dressing of N at heading helped the plants to maintain a high photosynthesis rate, with a subsequent significant increase of grain-filling rate, grain-filling duration, and higher percentage of filled grains, compared with basal application or top dressing of N at tillering (Wei *et al*, 2011). it is important that rice breeders consider selecting genotypes with high efficiency in remobilizing N from vegetative parts to the grain or genotypes with high grain protein concentration. Increase grain yield can be attributed to an increase in the number of grains per panicle (Ghanbari-Malidareh-2011). (irshad *et al*, 2000) suggested that for getting maximum yield at least some nitrogen must be applied at tillering stage along with that applied at transplanting.

MATERIALS AND METHODS

In order to investigate the Effect of split application of nitrogen fertilizer on growth and yield of hybrid rice(GRH1) an experimental desing in rice research in stitute of iran-departy of mazandaran (amol) in 2006

Corresponding Author: Sahar Youseftabar, Young Researchers Club, Iran Islamic Azad University, sari Branch, sari, Iran
Tel:+989113134083; E-mail: Sahar_yoseftabar@yahoo.com

cropping season.nitrogen fertilizer at 100,200 and 300 kg/ha was main plot and spilt application at 3 level (1/2basal -1/2mid tillering) ,(1/3basal-1/3mid tillaring-1/3panicle initation) and (1/4basal-1/4 mid tillering-1/4panicle initation-1/4 flowering) as sub plot.using randomized complete block desing(RCBD) with 3 replication. the soil was clay loam and slightly acidic (PH=6.91) with total N 0.13.1% and organic matter (OM)29%. Hybrid rice (GRH1) variety was transplanted at spacing plots of 20cm×20cm. chimical herbicides were employed aginst different weeds during the course of study. plots received identical cultural treatments in terms of ploughing, cultivation seed rate , P and K fertilizes and disease control. the plot size was kept as 3×4 meter.the measurement of morphological characters such as plant height,tiller number,stem dry weight and total dry weight were taken in the maximum tillering, flowering and harvesting stages. At physiological maturity stage 10 main stem were selected and measured yield component for each plot.yeild of each plot with harvesting of $5m^2$ and adjusted with 14% grain humidity and changed to hectare.The data were analysed following analysis by SAS software. the duncan's multiple range tests was used to compare the means at 5% of significant.

RESULTS AND DISCUSSION

The results showed that the fertilizer treatment had significant effect on plant growth parameter at different growth stages. this parameter increased significantly with increased nitrogen fertilizer. The analysis of variance showed significant responses of plant hight , Number of tillers $hill^{-1}$, Dry matter of stem $hill^{-1}$ and total Dry matter accumulation $hill^{-1}$ to increase Nitrogen fertilizer. Interesting in compariso to 100 and 200 kg/ha level application of higher N-fertilizer 300 kg/ha showed a positive respond to application of high nitrogen hybrid cultivar. plant hight, Number of tillers $hill^{-1}$ and total Dry matter accumulation increased when application of higher dose of nitrogen fertilizer (300 kg/ha) (table1). However the effect of different split application N fertilizer on this parameter was also significant,but increase split application decrease in this parameter (table2). The interaction of rate and split application of nitrogen fertilizer was significant on this parameter at three stage, tillering, flowering and harvesting (table3)

Rate and timing of N fertilizer are critical for optimum rice grain yield.nitrogen increases plant height, tiller number, leaf size (Dobermann and fairhurst, 2000). Hybrid rice produced in india on high PH8.4 vertisol had higher N uptake and higher grain yields when 120kg Nha^{-1} was split-applied as urea at basal,tillering,panicle initiation and flowering growth stages compared with the some N rate equally split between basal,tillering,and panicle initiation application (walker *et al*, 2006).

Plant height reveals the overall vegetative growth of the crop in response to variuse management practices. It was found that application of N fertilizers increased the plant height significantly. the longest plant height at 3 stage tillering –flowering-harvesting was 86-112.33 and 114.66 cm respectively with the application of 300 kg/ha N-fertilizer with different split aplication, so shortest panicle was 66.57-95.66-106.1 respectively in tillering –flowering-harvesting stage (table 3). (Irshad *et al*, 2000) showed that the Plant height was significantly increased by nitrogen application. (Dastan *et al* 2012) report that the plant height significant effect under nitrogen treatment in 5% probability level. (Islam *et al*, 2009) showed that the effect of split application of N fertilizer on plant height appeared to be consideable at 65 and 90 DAT, while it was statistically negligible at the maturity. the increase in plant height in response to application of N fertilizers is probably due to enhanced availability of nitrogen which enhanced more leaf earea resulating in higher photo assimilates and there by resulted in more dry matter accumulation (Chaturvedi, 2005).

Nitrogen fertilizer application increased significantly number of tillers in three stage(table 1).the use of 300 kg/ha nitrogen fertilizer prouduced maximum number of tillers than all other treatments during different growth stage in hybrid rice GRH1. significant difference in tiller production $hill^{-1}$ was observed due to split application of N-fertilizer, increase split application decrease the number of tillers per hill (table 2). Application of all nitrogen at transplanting or delaying some of it till panicle emergence resulted in statistically minimum number of tillers per hill (Irshad *et al*, 2000). the analysis of interaction effect of rate and spilt application nitrogen fertilizer showed that the maximum number of tiller was 19.86 at tillering stage and 16.33 at flowering stage and14 At harvesting stage(table3).the minium of tiller number was was 13.66 at tillering stage and 8.66 at flowering stage and 9.83 At harvesting stage (table3). Availability of nitrogen throughout the growth stages might be responsible for the better performance.the Number of tillers per unit area was the same at maturity, while it differed at tillering and flowering and harvesting stage. Number of stalk(total tillers/hill)was associated to nitrogen rates($p<0.01$),the incraese in number of stalk,provided by the increasing nitrogen rates,contributed to increase in number of leaves,which could have caused shading,decreasing the area of active photosythesis and diminishing the production of carbohydrates (Ghanbari-malidarreh, 2011). Panicle number is influenced by the number of tillers that develop during the vegetative stage (De Datta,1981). Number of tillers per unit area is the most important component of yield. more the number of tillers, especially fertile tillers, the more will be the yield. More number of tillers/m^2 due to the more availability of nitrogen that played a vital role in cell division (Chaturvedi , 2005).

Dry matter of stem per hill significantly with N-fertilizer application in rice at all growth stages of the crop (table 2). the data presented in table 2 revealed a statistically significant increase due to 300 kg/ha nitrogen fertilizer. the maximum number of tiller was 232.93 at tillering stage and 757.5 at flowering and significantly highest dry-matter accumulation 898.03 was obtained 300kg/ha nitrogen fertilizer at 4 stage application in harvesting stage(table3). the minium of tiller number was 146.6 at tillering stage and 341.25 at flowering stage and 699.62 At harvesting stage(table3). (Islam *et al*, 2009) showed that the effect of split application of nitrogen fertilizer was statistically significant on the dry matter(DM)of root,stem and leaves as well as total dry matter at three growth stage.the highest DM of root/hill,stem/hill and leaves/hill was found where three equal split application of nitrogen was done(T4).Total Dry matter per hill had significant effect under rate of Nitrogen fertilizer treatment (table 2).the analysis of data showed that application 300 kg/ha nitrogen fertilizer compariso to 100 and 200 kg/ha increase total dry matter per hill significantly. increase split appication nitrogen fertilizer at tillering and flowering stage decrease total matter. the maximum of Total Dry matter per hillwas 443.39 at tillering stage and 998.76 at flowering stage and 1969.06 At harvesting stage(table3).the minium of Total Dry matter per hill was 298.9 at tillering stage and 542.82 at flowering stage and 1499.84 At harvesting stage (table3). (chaturvedi,2005) reported that dry matter accumulation increased significantly with N-fertilizer application in rice at all growth stages of the crop.Nitrogen is one of the essential nutrient elements to plant and it is know that multiple mechanisms are employed by the plant to adapt to the change of nitrogen of nitrogen environment (zhang and forde, 1998).

Hybrid rice usally has large panicles and there-for greater sink size.it might be necessary to apply N at flowering for hybrid rice (peng *et al*, 1998). Nitrogen applied at flowering increased flag leaf N content significantly for hybrid rice.this increase was also observed for the rest of the leaves besides the flag leaf.rubisco (ribulose-1,5-bisphosphate carboxylase/oxygenase)content of the flag leaves was higher for the plants that received N at flowering.a close correlation existed between photosynthetic rate and leaf N concentration of the flag leaves.N applied at flowering enhanced the photosynthetic rate of flag leaves (peng *et al*, 1998).

Table 1: Effect of rate of N-fertilizer on morphophysiological parameters of hybrid rice at different stages

teatment	Plant hight (cm)			n.of tiller hill^{-1}			Dry matter of stem hill^{-1} (gr)			Total dry matter hill^{-1} (gr)		
	T stage	F stage	D stage	T stage	F stage	D stage	T stage	F stage	D stage	T stage	F stage	D stage
N1 100kg/ha	70.22 c	101.81b	106.77b	15.22b	10.23c	10.66ab	162.1c	134.82b	738.2 a	282.76c	729.31b	1753.01b
N2 200kg/ha	75.00 b	105.24b	111.77a	16.77ab	11.77b	11.22a	179.69b	154.07b	817.75a	326.87b	761.55b	1701.19b
N3 300kg/ha	80.33 a	109.73a	114.66a	18.33a	14.55a	12.38b	210.72a	205.00a	954.93a	394.02a	994.85a	2036.22a

*Means separation in columns fllowed by the same letter(s) are not significantly different at P≤0.05

Table 2: Effect of spilt application of N-fertilizer on morphophysiological parameters of hybrid rice at different stages

teatment	Plant hight (cm)			n.of tiller hill^{-1}			Dry matter of stem hill^{-1} (gr)			Total dry matter hill^{-1} (gr)		
	T stage	F stage	D stage	T stage	F stage	D stage	T stage	F stage	D stage	T stage	F stage	D stage
T1= 2spilt application	384.02 a	105.22 a	111.44ab	183.33 a	13.11 a	11.25a	3.30a	204.38 a	736.53 b	81.01 a	958.01 a	1721.7 b
T2= 3spilt application	339.64 b	107.22 a	112.88a	147.20 b	12.55 a	12.00a	2.43b	156.32 b	861.46 a	78.21 b	804.26 b	1905.4 a
T3= 4spilt application	294.51 c	104.00 a	108.88b	120.68 c	10.88 b	11.02a	2.00c	132.2b	773.53 b	72.43 c	723.44 b	1823.1 a

*Means separation in columns fllowed by the same letter(s) are not significantly different at P≤0.05.

Table 3: Introduction effect of rate and split application of N-fertilizer on morphophysiological parameters of hybrid rice at different stages.

teatment	Plant hight (cm)			n.of tiller hill-1			Dry matter of stem hill-1 (gr)			Total dry matter hill-1 (gr)		
	T stage	F stage	D stage	T stage	F stage	D stage	T stage	F stage	D stage	T stage	F stage	D stage
N1T1	71.33bc	102.33b	107.33b	16.33c	11.33d	11.83bc	162.3de	498.13d	735.83de	316.87b	864.37bc	1571.66bc
N1T2	68.66c	101.66b	106.5b	15.57d	10.66d	10.75c	162.73d	465.42de	841.94b	301.04bc	688.33d	1783.88ab
N1T3	66.57cd	95.66c	106.1bc	13.66de	8.66e	11.41bc	161.66d	422.92e	801.03c	289.97c	635.21de	1702.06b

N2T1	82.66a b	108.33 ab	114.66 a	18.46b	11.66c d	10.5c	221.8a b	605.33 c	830.62 bc	429.71 ab	903.88 b	1561.24 bc
N2T2	71.81b c	104b	112.65 ab	14.00d e	12.66d	11.66 bc	146.6e	575.8c d	822.71 bc	291.17 bc	837.92 c	1745.42 ab
N2T3	70.60b c	102.66 bc	108.12 b	15.66d	11.00d	9.83d e	170.66 c	341.25 f	699.92 e	317.35 bc	542.82 e	1499.84 c
N3T1	86.00a	112.88 a	116.66 a	19.86a	16.33a	11.75 bc	213.16 b	757.5a	744.58 d	425.54 ab	998.76 a	1589.16 bc
N3T2	77.66b	112.33 ab	114.66 ab	18.46b	14.33b	13.58 b	232.93 a	602.56 c	849.16 b	443.39 a	886.51 bc	1798.32 ab
N3T3	77.1b	111.00 ab	112.66 ab	16.66c	13.00c	14.00 a	186.06 c	709.58 b	898.03 a	368.96 b	992.28 b	1969.06 a

*Means separation in columns fllowed by the same letter(s) are not significantly different at P≤0.05

The effect of rate and split application N fertilizer on yield, 1000-grain wight and filled grain was statistically significant(table4,5). the higest yield, 1000-grain wight and filled grain 8697 kg, 26.92 and 162.03 Respectively that were produced when 300 kg/ ha N-fertilizer application in 4 stage,1/4basal-1/4 mid tillering-1/4panicle initation-1/4 flowering (table6) .

Top dressing of N is needed when the crop has a great need for N and when the rate of N uptake is large (Dobermann and fairhurst, 2000). N rate affected the number of grain anf filled grain per panicle only in the first season,the highest N rate negatively affected filled and total grains per panicle in the first season (Hirzel *et al*, 2011). (metwally *et al*, 2011) reported that the analysis of variance showed significant responses of panicle weight,panicle length,number of panicles per hill and 1000-grain weight to N rate,this trend might be due to the role of nitrogen in crop maturation,flowerin and frutiting in cluding seed formation.

Table 4: Effect of rate of N-fertilizer on yield and yield component of hybrid rice at different stages

teatment	Filed grain	1000-grain weight (gr)	Yield (kg/m^2)
N1= 100kg/ha	126.35 c	23.38 b	6989.8 c
N2= 200kg/ha	133.96 b	23.50 b	7690.3 b
N3= 300kg/ha	146.11 a	25.52 a	8611.9 a

*Means separation in columns fllowed by the same letter(s) are not significantly different at P≤0.05.

Table 5: Effect of spilt application of N-fertilizer on yield and yield component of hybrid rice at different stages

teatment	Filled grain	1000-grain weight (gr)	Yield (kg/m^2)
T1= 2spilt application	121.078 c	22.86 c	7702.3 c
T2= 3spilt application	138.77 b	23.94 b	7741.6 b
T3= 4spilt application	146.611 a	25.60 a	7818.1 a

*Means separation in columns fllowed by the same letter(s) are not significantly different at P≤0.05.

Table 6: Introduction effect of rate and split application of N-fertilizer on yield and yield component of hybrid rice at different stages.

teatment	Filled grain	1000-grain weight (gr)	Yield (kg/m^2)
N1T1	114.03de	22.11d	7202 bc
N1T2	132.76c	22.76cd	7020 c
N1T3	132.2c	24.24bc	6447 d
N2T1	117.5d	22.49d	7490 bc
N2T2	138.8bc	23.41cd	7701 b
N2T3	145.53b	25.65ab	7880 b
N3T1	131.7c	23.98cd	8595 ab
N3T2	144.63b	25.67ab	8443 ab
N3T3	162.03a	26.92a	8797 a

*Means separation in columns fllowed by the same letter(s) are not significantly different at P≤0.05.

Conclusions:

According to results of this study,plant height,tiller number,stem dry matter and total dry matter in 3 stage tillering–flowering-harvesting stage were increased by increasing the nitrogen fertilizer.with increase of nitrogen, 1000-grain wieght ,filled grain and yield also increase significat.among the split aplpication of nitrogen fertilizer, two equal split at (1/2basal-1/2mid tillering) produced the highest plant height,tiller number,stem dry matter in 3 stage tillering –flowering-harvesting and four equal split at (1/4basal-1/4 mid

tillering-1/4panicle initation-1/4 flowering) product the highest 1000-grain weight, filled grain, yield and total dry matter in harvesting stage. Growth of rice plant was greatly influenced by different methods of application of nitrogen fertilizer.

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