Pak. J. Agri. Sci. Vol. 34(1-4), , 1997

IMPACT OF NPK RATES AND N-APPLICATION TECHNIQUES ON RIPENING PROCESS AND DEVELOPMENT Of PANICLE STRUCTURE IN FINE RICE

M. Asif, F.M. ChaudhrVt~. Saeed & N. Akbar
Department of Agronomy, Univef$ity of Agriculture, Faisalabad

The impact of NPK rates and N-application techniques on ripening process and development of panicle structure in fine rice was assessed. The results indicated that the rate of occurrence of abortive, opaque and chalky kernels was significantly decreased, whereas the rate of occurrence of normal kernels significantly increased with NPK level F_2 (130-67 -67 kg ha') and N-application technique N_3 (1/3 N at transplanting + 1/3 N at tillering and 1/3 N at panicle initiation). Both the ripening process and panicle structure considerably improved due to decline in occurrence of abnormal/chalky kernels.

Key words: fine rice, impact of NPK rates, N-application techniques, panicle structure

INTRODUCTION

Rice is one of the principal food crops and a good source of earning foreign exchange and livelihood of rural population of developing regions in the world. Among the various factors limiting yield and causing deterioration in qualitY, poor grain filling is a major constraint. Various types of abnormal kernels develop during ripening process and kernel development. This may be due to poor photosynthetic activity and translocating system of plants. The ill-ripening and chalkiness not only affect the milling recovery but also the consumers preference. Inferior quality of rice also lowers its value in the international market. Appropriate NPK level, their timely application and proper management of nitrogen are said to affect grain filling and kernel development in rice.

The present investigation was, therefore, designed to see the effect of different NPK levels and split application of nitrogen on ripening process and kernel development of rice with the objective to discourage the occurrence of kernel abnormalities and to enhance the rate of occurrence of normal translucent kernels.

MATERIALS AND METHODS

Impact of NPK rates and N-application techniques on ripening process and development of panicle structure in fine rice was studied through field experiments during 1995 and 1996. The soil was sandy clay loam having total N 0.037%, available phosphorus and potassium, 5 and 178 ppm, respectively. The trial was conducted according to a split plot design with a net plot size of 2x 3 m. The treatments included 3 NPK levels i.e. 60-0-0, 130-67-67 and 180-90-90 kg ha' as main plot treatments and 3 N application techniques i.e. all N at transplanting; 1/2 N at transplanting + 1/2 N at tillering; 1/3 N at transplanting + 1/3 N at tillering + 1/3 N at panicle initiation as subplot treatments. Twenty-five days old seedlings were transplanted in a puddled field during the 1st week of July maintaining row to row and plant to plant distance of 20 x 20 cm with one seedling per hill. All agronomic practices were kept normal and uniform. Twenty plants were selected at random for recording data on various types of abnormal kernels. Abortive and opaque kernels were determined by passing light through them. The panicles were held in front of a source of light. Various types of chalky/normal kernels were separated, counted, averaged and expressed in percent. Data were statistically analyzed and mean values were compared at 5% level of probability (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Abortive Kernels Panicle: The data pertaining to abortive kernels panicle' are given in Table 1. Abortive kernels are those in which fertilization does not take place but the development of kernels starts slowly which discontinues at early development stage of kernel. It is evident from the data that occurrence of abortive kernels was significantly affected by different NPK levels in 1996. However, abortive kernels showed non-significant response to NPK levels in 1995.

The decreased abortiveness obtained in NPK level F_2 (130-67-67 kg ha') might be due to balanced NPK supply for the optimum development of spikelets in this treatment. The other reason might be less lodging as compared to higher NPK level (180-90-90 kg ha") which resulted in maximum kernel abortiveness. Nitrogen application techniques significantly influenced the occurrence of abortive kernels during both the years of trial. Treatment N_3 (1/3 N at transplanting + 1/3 N at tillering + 1/3 N at panicle initiation) produced the minimum abortive kernels as

Table 1. Effect of different NPK [illegible] structure in fine rice

Treatments	[illegible] (%)		Opaque [illegible] (%)		Chalky kernels ([illegible])		[illegible] (%)	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NPK levels ([illegible]$^{-1}$)								
F_1 ([illegible])	6.4	4.4b	9.24a	[illegible]	43.5a	42.0a	[illegible]	[illegible]
F_2 ([illegible])	[illegible]	4.4b	[illegible]	[illegible]	[illegible]	[illegible]	73.3	[illegible]
[illegible] ([illegible])	8.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71.3	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.26	4.61	[illegible]	3.27
N-[illegible]								
N_1: All N at transplanting	[illegible]	[illegible]	[illegible]	[illegible]	36.5	[illegible]	70.4	[illegible]
N_2: 1/2 N at transplanting + 1/2 N at tillering	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	32.7ab	71.1	71.3
N_3: **1/3 N at transplanting + 1/3 N at tillering + 1/3 N at panicle** initiation	5.7b	4.3b	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71.1
[illegible]	1.62	[illegible]	[illegible]	[illegible]	[illegible]	2.73	[illegible]	[illegible]

[illegible] = Non-[illegible] in a [illegible] 0.05 [illegible].

compared to N, (all N at transplanting) or N_2 (1/2 N at transplanting + 1/2 N at tillering). The minimum abortive kernels in N_3 might be due to increased photosynthetic activity and translocation rates resulting in lesser occurrence of abortive kernels. The other reason could be the higher sterility (data not shown) in this treatment which ameliorated the severe competition among the growing kernels for carbohydrates. These findings are in line with those of Khan and Chaudhry (1995) who stated that when hard competition occurs at sterility stage, remaining spikelets are in a better position to survive at abortive stage and vice versa.

Opaque Kernels Panicle: Opaque kernels are those which stop gaining weight by starch accumulation at a little later stage of kernel development. These kernels have overall chalky structure. Occurrence of opaque kernels was considerably influenced during 1995 (Table 1). Treatment F_2 (130-67-67 kg ha^{-1}) resulted into minimum opaque kernels as compared to maximum from F, (60-0-0 kg ha^{-1}) and F_3 (180-90-90 kg ha'). The minimum opaque kernels in NPK level F_2 (130-67-67 kg ha') might be attributed to sufficient availability of plant nutrients at later kernel development stage. These nutrients facilitate the continuous translocation of carbohydrates to the panicles and thus helped decrease the occurrence of opaque kernels.

Nitrogen application technique also showed significant effect on occurrence of opaque kernels in both the years of study (Table 1). Treatment N_3 gave maximum opaqueness which did not differ from N_2 during 1995. Again N_2 did not differ from N, for both years of study. Minimum opaqueness was caused by N,. Increased opaqueness in N_3 might partly be due to longer panicles, more spikelets per panicle which caused severe competition among the spikelets at a later stage of kernel development.

Chalky Kernels: Data regarding chalky kernels are presented in Table 1. It is evident from the data that the occurrence of chalky kernels was affected significantly by different NPK levels in both the years of trial. Chalkiness was reduced significantly in F_2 (130-67-67 kg ha') in 1996. However, the difference between F_2 and F_3 treatments was non-significant in 1995. The maximum chalkiness was obtained in F, (60-0-0 kg ha;'). The minimum chalkiness in F_2 (130-67-67 kg ha^{-1}) might be due to optimum synthesis and translocation of carbohydrates.

N-application technique also influenced significantly the chalkiness in 1996. Minimum chalky kernels were recorded in N_3 (1/3 N at transplanting + 1/3 N at tillering + 1/3 N at panicle initiation) against the maximum in N, (all N at transplanting). The minimum chalkiness in N_3 might be ascribed to more starch availability to the developing kernels during early, middle and later stages of kernel development. Similar observations were recorded by Hoshikawa (1993) who reported that chalky kernels occur when storage of reserve substance is poor at the middle and due to under development of starch grains in the cell because of insufficient transportation of hydrocarbons to the rice kernels.

Normal Kernels: Normal kernels are those kernels which during ripening process and development stage do not stop gaining weight and attain normal dimensions due to normal starch compaction. The data presented in Table 1 showed that occurrence of normal kernels was significantly affected by NPK levels in 1996. However, NPK levels did not influence the occurrence of normal kernels in 1995. N-application technique also did not affect the occurrence of normal kernels during both years of the study. However, more number of normal kernels was recorded in N_3 (1/3 N at transplanting + 1/3 N at tillering + 1/3 N at panicle initiation). Higher normal kernels obtained with F_2 (130-67-67 kg ha') might be due to balanced and adequate~vailability of NPK which helped enhance the physiological function ot plant. The other reason for increased normal kernels in F_2 might be the increased number of primary branches (data not given) in this treatment as the primary branches produce more normal kernels (Malik *et al.,* 1989). Higher normal kernels in N_3 might be due to adequate supply of N through all the vegetative and reproductive stages of plant, particularly at the grain filling stage. Thus, top dressing of N during this period would increase carbon assimilation resulting in increased amount of carbohydrates for grain filling (Wang and Zhang, 1995).

REFERENCES

Hoshikawa, K. 1993. Rice grain texture and grading standard. In Science of the Rice Plant: Morphology, Vol. 1, pp. 383-389. Food and Agriculture Policy Research Centre, TOkyo, Japan.

Khan, M.A. and F.M. Chaudhry. 1995. Ripening process, kernel development of rice as affected by application of gibberellic acid. Pak. J. Sci. Res. 47(3-4); 74-77.

Malik, 5., A .M. Aguilan and B.S. Vergera. 1989. Analysis of rice panicle structure. IRRN. 14(3): 10.

Wang, Y.R. and Y.J. Zhang. 1995. Effect of N during late growth stages of rice in translocation of C'4 and grain yield. Sinyat Sen Univ., Biology Dept., China. IRRN. 20(2): 13.

Steel, R.G.D. and J.H. Torrie. 1984. Principles and Procedures of Statistics. 2nd ed. McGraw Hill Book Co., Singapore.