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IMPACT OF NITROGEN LEVELS AND APPLICATION METHODS ON RIPENING PROCESS AND KERNEL DEVELOPMENT IN FINE RICE

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The impact of different nitrogen rates and application methods on ripening process and kernel development in fine rice was assessed. The results indicated that the rate of occurrence of abortive, opaque and sterile kernels was significantly influenced with N2 level (80 kg ha-t), The rate of occurrence of normal kernels increased significantly with N2 level. Application method M2 (point placement) resulted in decreased occurrence of abortive, opaque and sterile kernels compared with broadcast method.

Key words: fine rice, kernel development, nitrogen levels and application methods, ripening process

INTRODUCTION

Rice is one of the principal food crops and a good source of earning foreign exchange. Rice also provides livelihood to rural population of developing regions in the world. Among the various factors limiting yield and causing deterioration in quality, poor grain filling is considered very important. Various types of abnormal kernels develop during ripening process. This may be due to poor photogenic activity and translocation system of plants. The ill-ripening not only affects the milling recovery but also the consumers preference. Inferior quality of rice also lowers its value in the international market. Appropriate N level and its proper management are advocated to improve grain filling and kernel development in rice. Consequently the present study was designed to see the effect of different nitrogen levels and application methods on ripening process and kernel development of rice with the objective to discourage the occurrence of kernel abnormalities and to enhance the rate of normal translucent kernels.

MATERIALS AND METHODS

Impact of N rates and its application methods on ripening process and kernel development in fine rice was studied through field experiments during 1996 and 1997. The soil was sandy-clay loam, having total N 0.049%, available phosphorus 6.55 ppm and available potassium 167.50 ppm. The trial was conducted according to split plot design with a net plot size of 2x3 m. The treatments included four nitrogen levels Le. 0, 40, 80 and 120 kg N ha' and two application methods viz. broadcast (M1) and point placement M2 as main plot treatments and as subplot treatments, respectively. Point placement method of nitrogen application involved placement of urea (wrapped in tissue paper) manually in the center of four hills in alternate rows. The placement depth was kept at 10 cm below ground level by a simple device made with an iron rod. Twenty-five days old seedlings were transplanted in a puddled field during the 1st week of July maintaining a row to row and plant to plant distance of 20x20 cm with one seedling per hill.

All agronomic practices were kept 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. Various types of kernels were separated, counted, averaged and expressed in percent. Data were statistically analyzed and mean values were compared at 0.05P (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Abortive Kernels Panicle-ti The data pertaining to abortive kernels panicle-! are given in Table 1. Abortive kernels are those in which fertilization does not take place at the development stage of kernel. It is evident from the data that the occurrence of abortive kernels was significantly affected by different nitrogen application methods and nitrogen levels in both the years of trial. In application method M2 (point placement), less abortiveness may be attributed to slow release of nitrogen ensuring its availability for longer period of time. In 1996, occurrence of abortiveness tended to decrease in nitrogen level N2 (2.73%) but increased in nitrogen level's NI, NO and N3 in an ascending order. In 1997, reduced abortiveness was observed in nitrogen levels NI and N2. The minimum abortiveness in N2 might be due to increased photosynthetic activity and translocation

Table 1. Effect of different nitrogen application methods and nitrogen levels on qualitative traits of fine rice (Basmati-385)

Treatments	Abortive kernels (%) 1996	1997	Opaque kernels (%) 1996	1997	Sterile kernels(%) 1996	1997	Normal kernels (%) 1996	1997
A. Application methods								
Ml= Broadcast	3.49a	3.57a	15.17a	15.29a	6.65a	7.14a	74.67b	74.01b
M2= Point placement	3.39b	3A3b	14.61b	14.84b	6A5b	6A5b	6.79b	75.53a
B. Nitrogen levels (kg ba-')								
NO=O	3.67b	3.68b	18.08a	18.10a	7.14b	7.60b	71.10d	70.61d
Nl=40	3.00c	3.00c	15.06b	14.79c	5.86c	6.33c	76.07b	75.87b
N2=80	2.73d	2.90c	11A4c	12.12d	5.25d	5.59d	80.53a	79.11a
N3=120	4.37a	4.42a	15.00b	15.24b	7.93a	8.34a	72.69c	71.98c

Means followed by different letters in a column are significantly different at 0.05P.

rates resulting in lesser occurrence of abortive kernels.

Opaque Kernels: 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 significantly influenced by application method in both the years of trial. Less frequency of occurrence of opaque kernels was observed in application method M2 (point placement) compared with Ml (broadcast). Nitrogen levels also caused a significant impact in both the years of experimentation. In 1996, lower percentage of opaque kernels was recorded in nitrogen level N2 (11.44%) than those with nitrogen levels NI (15.06%) and N3 (15.00%), both being statistically equal. In control, still higher percentage of opaque kernels (18.08) was observed. In 1997, minimum opaqueness was noted in nitrogen level N2, which tended to increase with nitrogen levels NI, N2 and NO in an ascending order. Minimum opaqueness in nitrogen level N2 might be attributed to optimum supply of N facilitating continuous translocation of carbohydrates to the panicles and thereby decrease the occurrence of opaque kernels.

Spikelet Sterility: Sterile spikelets are those which remain unfilled due to non-fertilization. The sterility may occur due to genetic make up and environmental stress such as low solar radiation, low or high temperature, strong winds, drought and soil salinity. In addition, nutritional stress and certain physiological disturbances due to sudden fluctuation in temperature during the period of fertilization may cause sterility. Data regarding spikelet sterility as affected by level and method of nitrogen application are given in Table 1. Lower percentage of sterile spikelets was observed in application method M2 compared with Ml in both the years of study. Spikelet sterility was the lowest in N2 nitrogen level, It increased both at lower and higher levels of N in both the years of trial. Decreased occurrence of sterility with M2 may be due to less losses of N in the form of run off and ammonia volatilization. Lower spikelet sterility observed with N2 might be due to optimum vegetative growth, whereas higher sterility in N3 nitrogen level may be attributed to higher vegetative growth manifested with higher number of tillers per hill, panicle bearing tillers per hill and longer panicles.

Normal Kernels: Normal kernels are those which during the ripening process and development do not stop gaining weight and attain normal dimensions due to normal starch compaction. The data presented in Table 1 showed that M2 produced more normal kernels (75.53 and 74.77%) than Ml (74.67 and 74.01%) during 1996 and 1997 alike. Nitrogen level N2 produced more normal kernels (80.53%) in 1996 than others. The values for other treatments in descending order were NI (76.07%), N3 (72.69%) and NO (71.10%). Similar trend was observed in 1997. These results are supported by the findings of

Sen and Pandey (1990) who reported 186 filled spikelets per panicle with broadcast method and 222 with point placement (10 cm-depth). Reddy (1986), Maskina *et al.* (1987), Marazi *et al.(1993)* and Daniel and Wahab (1994) reported a linear increase in filled grains per panicle with graded levels of nitrogen.

REFERENCES

Daniel, KV. and K Wahab. 1994. Levels and time of nitrogen in semi-dry rice. Madras Agri. J. 81(6):357-358.

Marazi, AR., G.M. Khan, KN. Singh and AS. Bali. 1993. Response of rice to different levels of nitrogen and water regimes in Kashmir Valley. Ind. J. Agri. Sci. 63(11):726-727.

Maskina, M.S., Y. Singh and B. Singh. 1987. Response of new rice varieties to nitrogen. IRRN. 12(4):8-9.

Reddy, D.S. 1986. Effect of nitrogen and. plant population on yield and yield components of Jaya rice under recommended irrigation practice. Madras Agri. J. 73(6):321-324.

Sen, A and B.K Pandey. 1990. Effect on rice of placement depth of urea super granules. IRRN. 15(4):18.

Steel, R.G.D. and J.H. Torrie. 1984. Principles and Procedures of Statistics. McGraw **Hill** Book Co. Inc., New York.