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Effect of nitrogen and phosphorus on yield and quality of scented rice cv. Pusa Basmati-1

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Abstract

A field experiment was conducted at Agronomy, Research Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during the *kharif* season of 2011 to evaluate the effect of nitrogen and phosphorous on yield and quality of scented rice cv. Pusa Basmati-1. The experiment was conducted in randomized block design with three replication. The sixteen treatments consisting of 4 nitrogen levels (N_0, N_{40}, N_{80}, N_{120}) and 4 phosphorus level (P_0, P_{20}, P_{40} and P_{60}). The soil of the experiment site was silty loam in texture having pH-8.2, organic carbon 0.36% available nitrogen 161.5 kg ha^{-1}, available phosphorus 14.5 kg ha^{-1} and available potash 295 kg ha^{-1}. The crop received recommended agronomic practices. All the growth and yield attributes increased significantly with increase in nitrogen level up to 80 kg N ha^{-1} though the highest value were recorded with 120 kg N ha^{-1}. The highest grain yield of 27.62 q ha^{-1} was recorded with 120 kg N ha^{-1} which was at par with 80 kg N ha^{-1} and significantly better over control and 40 kg N ha^{-1} showing an increase of 0.38, 3.88 and 7.25 q ha^{-1} over 80, 40, 0 kg N ha^{-1}, respectively. Application of phosphorus resulted increase in all the growth and yield attributes significantly with increase in dose of phosphorus up to 40 kg P_2O_5 ha^{-1} only. The maximum grain yield of 28.78 q ha^{-1} was recorded with application of 40 kg P_2O_5 showing an increase of 23.46 and 47.58 per cent over, 20 kg P_2O_5 ha^{-1} and control respectively. Nitrogen and Phosphorus levels failed to influence the quality parameter of scented rice such as hulling percentage, kernel length, kernel breadth, L: B ratio, KLAC, water absorptions during cooking, amylose and protein content significantly.

Keywords: Nitrogen, phosphorus, yield and scented rice

1. Introduction

Rice (Oryza sativa L.) is the world's single most important crop and a primary food source for half of the world's population. A total of 49% calories consumed by the human population come from rice, wheat, and maize, where 23% are provided by rice, 17% by wheat and 9% by maize. Among the rice varieties scented or Basmati rice occupies a prime position on account of its extra-long, super fine, slender grains, pleasant & exquisite aroma, fine cooking quality, sweet taste, soft texture, maximum length & breadth ratio and greater elongation after cooking with softness of cooked rice. Basmati word has been derived from two Sanskrit words (vas-aroma) and (May up-ingrained or present from beginning). Among various volatile compounds found in rice, responsible for its aroma 2- acetylel-pyrroline (2-AP) is the most important. The basmati is a globally reputed as aromatic group of rice, having three distinct quality feature, pleasant aroma, super-fine grain (>6.5 mm long) along with extreme kernel elongation and soft texture of cooked rice. Phosphorus being major nutrient stimulants for early root growth and development helping by their establishment of seedling quickly by Mahaskar *et.al.* (2005) [5]. Phosphorus gives rapid and vigours start to plant, strengthen straw and decrease lodging tendency and improves the quality of food grains. The response of nitrogen and phosphorus varies with variation in their doses, therefore balanced use of nitrogen and phosphorus is required to utilize higher production potential of scented rice. Basmati rice is characterized by extra-long slender grain, pleasant and distinct aroma, and soft and fluffy texture of the cooked rice by Nagaraju *et al.* (2002) [6]. As rice is consumed as whole grain, quality parameters such as appearance in terms of grain shape and size, along with its cooking and eating qualities, play a critical role in consumer prefer-ence. Raychaudhari (1992) [7] stated that in ancient India, rice was distinguished into three kinds according to hardness, color, flavor, and size of grain. Preferences for grain size and shape vary with consumers as some ethnic groups prefer short bold grains, while medium and long slender grains are preferred by others.

2. Materials and methods

The experimental site falls under subtropical sub humid zone in Indo-gangatic plains having alluvial calcareous soil. It lies between 24.40-26.56o North latitude and 82.12o-83.980 East longitude with an altitude of about 113m from mean sea level. The meteorological observations viz., weekly distribution of rainfall, maximum and minimum temperature, relative humidity, wind velocity, mean evaporation rate and sun shine hours recorded during crop season. The composite soil sample was taken by mixing samples of different depth (up to 60 cm) and places with the help of soil augur and was analyses for its physical and chemical characteristics. The soil was silt loam in texture, slightly alkaline in reaction, low in organic carbon and available nitrogen, medium in phosphorus and potassium. The scientific name of this variety is IFT-10364. Its height is 85-95 cm, matures in 135 days and average yield is 45 q ha-1. Transplanting of rice seedling in experimental field was done manually by using 25 days old seedlings. Two to three seedling hill- 1 were transplanted at a spacing of 20 × 10 cm. After making individual experimental unit, the amount of N and P was applied as per treatment through urea and single super phosphate. One third dose of nitrogen and total phosphorous was applied as basal application before puddling and incorporated in the soil. Remaining dose of nitrogen was applied as top dressing in two equal splits each at tillering and panicle initiation stages. A uniform dose of 60 kg K2O ha-1 through muriate of potash and 25 kg zinc sulphate ha-1 was applied as basal before puddling. Harvesting was done as per maturity of the individual plot. The crop was harvested with the help of sickles when 85% panicles had ripened. The grains were subjected to hard enough, containing about 20% moisture.

2.1 Quality studies of scented rice

Hulling percentage, 100g cleaned paddy sample was weighed and dehulled in laboratory by Dehusking Machine (laboratory) rice sheller. Make INDOSAW. The weight of hulled rice was determined and hulling recovery was calculated by dividing the weight of hulled rice by total weight of raw paddy sample and multiplying by 100. Kernel length, Breadth and L: B ratio, ten randomly selected whole kernels of rice were taken and length of each grain was measured by placing on a micro scale. Breadth of each grain was measured using a vernier calipers. The average of 10 such observation was taken for final reading of length and breadth of rice kernels. The L: B ratio was calculated by dividing the average length by the average breadth of rice kernel. Kernel length after cooking, it is expansion of rice in longitudinal direction after cooking at 82^0C for 45 minutes and it was measured. Water absorption during cooking (ml/ 100g), 2g rice sample was taken into a large test tube containing 10 ml distilled water. The rice was cooked by placing the test tube in water both at 77^0C for 35 minutes. The contents of the test tube were transferred into a glass funnel, lines with filter paper and flitted on a filtration flask and the volume of unabsorbed water recorded by using mild vacuum and measured. The amount of water absorbed by sample was determined by subtracting and unabsorbed water volume from the original volume of water added (10ml). Adopted water uptake on cooking (ml/100g rice) was calculated by multiplying the absorbed water volume by 50.The amylase content in grain was estimated by the method suggested by Juliano (1979) [4]. Protein content of rice was determined in laboratory to ascertain N content by Kjendahal method (AOAC, 1980) [1]. Protein content (%) was calculated by multiplying N content of the grain by the factor 6.25.

3. Result and Discussion

The hulling percentage was not affected significantly by nitrogen levels. Though maximum hulling of 67.96 per cent was recorded with 120 kg N ha^{-1} which was 4.63 higher than N_0 (control). This may be attributed to the fact that higher levels of nitrogen might have reduced the thicknes of testa and tegmen layers (husk) and increased the hulling percentage. Similar finding was also reported by Subhash *et al.* (2005) [11]. Kernel length was not affected significantly by nitrogen levels. Through maximum kernel length of 7.91mm was recorded with 120 N ha^{-1} which was 0.22 mm higher than N_0 (control). This may be attributed to higher levels of nitrogen resulted increase in N uptake and its diversion towards sink grain and resulted increase in length of kernel. Similar finding have also reported by Jadhav *et al.* (2003) [3] and Gautam *et al.* (2005) [2]. Kernel breadth and length breadth ratio was not affected significantly by nitrogen levels. This may be attributes to fact that nitrogen application failed to influence cell differentiation at early stage of seed development. Similar finding was also reported by Subhash *et al.* (2005) [11], Singh and Verma (2006) [10]. KLAC was not affected significantly by nitrogen levels. Though maximum KLAC was recorded with 120 kg N ha^{-1} which was 0.88mm higher than N_0 (control). This may be attributed to the fact than the elongation in kernel after cooking was increased in the same ratio. The result are the agreement with those of Gautam *et al.* (2005) [2] and Subhash *et al.* (2005) [11]. Water absorption during cooking was not affected significantly by nitrogen levels. Though maximum water absorption during cooking was recorded with 120 kg N ha^{-1} which was 9.24 ml/100mg higher than N_0 control. This may be attributed to high levels of nitrogen increased the nutrient uptake *vis-à-vis* N and K content in grains which increased the water absorption during cooking. Similar finding was also reported by Singh and Thakur (2007) [9] and Sharma *et al.* (2012) [8]. Amylase & protein content in grain was not affected significantly by Nitrogen levels. This may be attributed to the fact that various physiological processes responsible for conversion of carbohydrate to amylase and protein were not affected with various Nitrogen levels. Similar finding was also reported by Singh and Thakur (2007) [9] and Tiwari *et al.* (2015) [12].

The hulling percentage was not affected significant by phosphorus levels. Though maximum hulling of 66.14 per cent was recorded with 60 kg P_2O_5 ha^{-1} which was 1.16 per cent higher than P_0 (control). This may be attributed to higher levels of phosphorus might have reduced the thickness of testa and tegman (husk) and increased the hulling percentage. Kernel length was not affected significantly by phosphorus levels through maximum kernel length of 7.83 mm was recorded with 60 kg P_2O_5 ha^{-1} which was 0.06 mm higher than P_0 (control). This may be attributed to higher levels of phosphorus resulted increase in P_2O_5 uptake and its diversion towards sink grain and increase length of kernel. Kernel breadth and length breadth ratio was affected significantly by phosphorus levels. This may be attributed to fact that phosphorus application failed to influence cell differentiation at early stage of seed development. KLAC was not affected significantly by phosphorus levels. Though maximum KLAC was recorded with 60 kg P_2O_5 ha^{-1} which was 0.88mm higher than P_0 (control). This may be attributed to the fact than the elongation in kernel after cooking was increased at the same ratio. Water absorption during cooking was not affected significantly by phosphorus levels. Though maximum water absorption during cooking was recorded with 60 kg P_2O_5 ha^{-1} which was 2.31ml/100mg higher than P_0 control. This may be attributed to high levels of phosphorus increased the nutrient uptake *vis-à-vis* P and K content in grains which increased the water absorption during cooking. Amylose & protein content in grain was not affected significantly by Phosphorus levels. This may be attributed to the fact that various physiological processes responsible for conversion of carbohydrate to amylase and protein were not affected with various Phosphorus levels.

Table 1: Effect of nitrogen and phosphorus on different quality parameters

Treatment	Hulling percentage (%)	Kernel length (mm)	Kernel breadth (mm)	L:B ratio	KLAC (mm)	Water absorption during cooking (ml/100)	Amylose content (%)	Protein content (%)
Nitrogen (kg ha^{-1})								
N_0	63.33	7.69	1.80	4.32	12.03	196.39	21.21	7.73
N_{40}	64.65	7.79	1.81	4.32	12.28	199.03	21.65	8.15
N_{80}	66.31	7.84	1.85	4.26	12.59	202.33	22.21	8.24
N_{120}	67.96	7.91	1.86	4.32	12.91	205.63	22.76	8.34
SEm±	2.03	0.17	0.06	0.18	0.39	4.05	0.68	0.24
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
Phosphorus (P_2O_5 kg ha^{-1})								
P_0	64.98	7.77	1.81	4.34	12.34	199.69	21.76	7.70
P_{20}	65.31	7.80	1.82	4.29	12.40	200.35	21.87	8.18
P_{40}	65.81	7.82	1.83	4.31	12.50	201.34	22.04	8.25
P_{60}	66.14	7.83	1.85	4.27	12.56	202.00	22.15	8.33
SEm±	2.03	0.17	0.06	0.18	0.39	4.05	0.68	0.24
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS

4. Conclusions

Nitrogen and Phosphorus levels failed to influence the quality parameter of scented rice such as hulling percentage, kernel length, kernel breadth, L: B ratio, KLAC, water absorptions during cooking, amylose and protein content significantly. Thus, it may be concluded that Pusa Basmati-1 may be fertilized with 80 kg N and 40 kg P_2O_5 $ha^{-1}$for achieving maximum yield, quality and net return.

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