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Enhancing the performance of direct seeded basmati rice through seed priming and nitrogen management

Gulshan Mahajan[1], Japinder Singh[2] and Neerja Sharma[3]
Punjab Agricultural University, Ludhiana – 141004, India

ABSTRACT

Field experiment was conducted at Punjab Agricultural University Ludhiana to enhance the performance of dry direct seeded basmati rice with 20 treatment combination in split plot design viz. five nitrogen levels and timing in main plots [0, 40 kg ha^{-1}(2 and 3 splits), 60 kg ha^{-1} (2 and 3 splits)] and four seed priming treatments (control, osmohardening, water hardening and hydropriming).The direct seeded Pusa Basmati 1121 responded upto 60 kg ha^{-1} of N applied in 3 splits (21, 42 and 63 days after sowing) and resulting higher grain yield, milled and head rice recovery%, KLAC and elongation ratio than 40 kg ha^{-1} of N application applied in 2 or 3 splits. Crop with hydropriming gave superior performance as compared to other seed priming treatments. Highest grain yield of Pusa Basmati 1121 was obtained with hydropriming at 60 kg ha^{-1} of N application applied in 3 splits.

Key words: *aerobic rice, emergence count, milling and cooking quality, N splits*

Looming water crisis and labour shortage during rice transplanting time is prompting a search for production system that uses less labour and water to produce rice. Recent research indicates higher crop water and labour productivity from dry-direct seeded rice (DSR) compared to puddle transplanted rice particularly in the Philippines, Malaysia and Thailand (Pandey and Velasco 2005). In Punjab earlier attempts to grow DSR has not been very successful due to poor germination, uneven crop stand, high weed infestation and yield penalty. Recently in Punjab, farmers have shown more interest on cultivation of dry direct seeded rice especially for cultivar Pusa Basmati 1121. Information on enhancing the performance of direct seeded rice through seed priming which could promote early vigour and better establishment in dry direct seeded rice is lacking. On account of high plant population in DSR, N requirement for Pusa Basmati 1121 may differ from transplanted rice (33 plants m-^{2}). For cultivation of transplanted crop of Pusa Basmati 1121, 40 kg ha^{-1} in 2 splits (21 and 42 days after transplanting) has been recommended for state. It was hypothesised that N requirement of direct seeded Pusa Basmati 1121 at different growth stages can be met by increasing the number of splits and dose of N. Quality of harvested basmati rice has also not been addressed in relation to seed priming and different N management practices in dry DSR. Hence, there is need to evaluate and identify invigoration technique and N management practices for enhancing the performance of direct seeded basmati rice. The experiment was carried out at the experimental farm of the Punjab Agricultural University, India during the wet season of 2010 using cultivar Pusa Basmati 1121. The farm is located in north western part of Indo-Gangetic Plain at 30^{0} 56' N, 75^{0} 52' E . The experiment was conducted in split plot design with 20 treatment combination viz. five nitrogen rate and timing in main plots [0, 40 kg ha^{-1}(2 and 3 splits), 60 kg ha^{-1} (2 and 3 splits)] and four seed priming treatments (control, osmohardening, water hardening and hydropriming). For 2 splits (2S), N was applied at 21 and 42 days after sowing; for 3 splits (3S), N was applied at 21, 42 and 63 days after sowing. For water hardening treatment seeds were soaked in tap water at room temperature for 24 h, dried back and cycle is repeated once. For osmo-hardening treatment, seeds were hardened with KCl 2% following the procedure for water hardening. For hydro priming treatment, seeds were soaked in aerated distilled water for 48 h. At harvest of the crop, grain yield of rice was measured at 14% grain moisture content. Five hills were selected randomly from each plot at harvest for measuring agronomic parameters including number of panicle m-2, spikelet sterility% and filled grains panicle^{-1}. Milling and cooking characteristics were evaluated by following the standard protocol of IRRI. Results (Table 1) revealed that highest grain yield (4.6 t ha^{-1}) was obtained with 60 kg ha^{-1} nitrogen applied in 3 splits and it was significantly higher than all other N treatments. Increasing splits with 40 kg ha^{-1} of N application had no influence on grain yield. However, increasing splits (2s to 3s) with 60 kg ha^{-1} of N application resulted in significantly higher grain yield than 2 splits. Increase in grain yield in response to 60 kg ha^{-1} of N in 3 splits was attributed to higher panicle m-2 and grain panicle-1 as compared to 40 kg ha^{-1} of N applied in either 2 or 3 splits. Our results are in line with earlier study of Mahajan and Timsina (2011), who revealed that direct seeded rice require more N as compared to transplanted rice. Grain yield with hydropriming, water hardening and osmohardening treatment increased to the extent of 18, 10 and 7 % respectively as compared to control (non-primed). Higher grain yield in hydropriming treatment was attributed to higher emergence (Table 1) leading to more panicle m^{-2} as compared to other seed priming treatments. Interaction between N and seed priming treatments (Table 2) revealed that hydropriming supplemented with 60 kg ha^{-1} N application gave highest yield (5 t ha^{-1}) among all the treatment combination. Grain yield did not vary with hydropriming treatment supplemented with 40 kg ha^{-1} N applied in 2 splits and without priming treatment supplemented with 60 kg ha^{-1} N applied in 3 splits. Interestingly, hydropriming with 40 kg ha^{-1} of N in 3 splits resulted significantly higher grain yield than without priming with 60 kg ha^{-1} of N application applied in 3 splits. Seed priming treatments had no influence on milling characteristics; however

Table 1. Emergence count (No.) and yield contributing characteristics in relation to seed priming and N management

Treatments	Emergence count (10 days after sowing)	Panicles m^{-2}	Filled grains panicle^{-1}	1000 grain weight (g)	Spikelet sterility (%)
N Rate (kg ha^{-1}) and timing					
Control	116	251	58	24.4	24.0
N_{40} (2S)	118	274	61	25.7	21.0
N_{40} (3S)	115	276	62	26.0	21.5
N_{60} (2S)	118	285	63	26.2	21.6
N_{60} (3S)	118	299	69	25.6	22.4
LSD (0.05)	NS	22	5	NS	NS
Seed priming					
Control (No priming)	103	265	60	25.2	25.0
Osmohardening	115	271	62	25.5	22.3
Water hardening	121	280	62	25.7	21.9
Hydropriming	130	291	67	25.9	19.4
LSD (0.05)	11	17	4	NS	2.2

2S: Two equal splits (21 and 42 days after sowing); 3S Three equal splits (21,42 and 63 days after sowing)

Table 2. Grain yield (t ha^{-1}) in relation to seed priming and N management

	Control (No priming)	Osmo-hardening	Water hardening	Hydro-priming	Mean
Control	3.3	3.4	3.5	3.6	3.5
N_{40} (2S)	3.7	4.1	4.2	4.5	4.1
N_{40} (3S)	3.7	4.3	4.4	4.6	4.3
N_{60} (2S)	4.0	4.2	4.3	4.7	4.3
N_{60} (3S)	4.3	4.5	4.6	5.0	4.6
Mean	3.8	4.1	4.2	4.5	
LSD (0.05)	N rates and timing : 1.5; Seed priming: 1.1; N rates and timing x seed priming : 2.5				

2S: Two equal splits (21 and 42 days after sowing); 3S Three equal splits (21,42 and 63 days after sowing)

Table 3. Milling and cooking characteristics in relation to seed priming and N management

Treatments	Milled rice recovery (%)	Head rice recovery (%)	Chalkiness (%)	Amylose content (%)	KLAC (mm)	Elongation ratio
N Rate (kg ha^{-1}) and timing						
Control	67.0	45.8	8.2	22.6	16.9	1.87
N_{40} (2S)	67.1	46.1	7.5	22.5	16.9	1.83
N_{40} (3S)	67.3	46.8	6.4	22.1	17.1	1.86
N_{60} (2S)	67.5	47.6	5.7	21.4	17.1	1.91
N_{60} (3S)	68.4	47.7	5.6	21.3	17.4	1.93
LSD (0.05)	0.6	0.6	0.3	0.2	0.2	0.04
Seed priming						
Control (No priming)	67.2	46.5	6.8	21.8	16.9	1.83
Osmohardening	67.4	46.7	6.7	21.9	17.1	1.88
Water hardening	67.5	46.9	6.6	21.8	17.1	1.90
Hydropriming	67.8	47.2	6.5	22.2	17.3	1.91
LSD (0.05)	NS	NS	NS	NS	0.1	0.03

2S: Two equal splits (21 and 42 days after sowing); 3S Three equal splits (21,42 and 63 days after sowing)

milling characteristics were influenced significantly with N levels and timings (Table 3). Milled rice recovery was highest (68.4%) with 60 kg N ha^{-1} applied in 3 splits. Head rice recovery was higher with 60 kg ha^{-1} of N application than 40 kg ha^{-1} of N application and no difference between splits was observed at 60 kg ha^{-1} of N application. Chalkiness did not vary between different splits at 60 kg ha^{-1} of N application, however found significantly lower than 40 kg ha^{-1} of N application applied in 2 or 3 splits. Amylose content was lower at 60 kg ha^{-1} than 40 kg ha^{-1} of N application. Kernel length after cooking (KLAC) and elongation was highest at 60 kg ha^{-1} of N application applied in 3 splits and found significantly higher than 40 kg ha^{-1} of N application applied in 2 or 3 splits. KLAC and elongation ratio was highest with hydropriming among all the seed priming treatments. Our results are in conformity with earlier study of Farooq *et al.* (2006) revealed that grain yield and quality characteristics of basmati rice improved with seed priming.

REFERENCES

Farooq M, Basra SMA, Tabassum R and Afzal I 2006. Enhancing the performance of direct seeded fine rice by seed priming. Plant Production Science 9:446-456.

Mahajan G and Timsina J 2011. Effect of nitrogen rates and weed control methods on weeds abundance and yield of direct-seeded rice. Archives of Agronomy and Soil Science 57: 239–250.

Pandey S and Velasco L 2005. Trends in crop establishment methods in Asia and research issues. In “Rice Is Life: Scientific Perspectives for the 21st Century” (K. Toriyama, K. L. Heong, and B. Hardy, Eds.), pp. 178–181. International Rice Research Institute, Los Ban˜ os, Philippines and Japan International Research Center for Agricultural Sciences, Tsukuba, Japan.