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Response of crop geometry and nitrogen management on growth and yield of hybrid rice under partially reclaimed Sodic condition

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Rice is major crop in *kharif* season on northern part of country. Crop geometry and nitrogen management is the key factor for rice cultivation and it response better when hybrid rice were grown with appropriate management practices. Keeping these things in mind, on-farm trials were undertaken on farmer's field in participatory manners to workout best crop geometry and suitable nitrogen dose for higher production of hybrid rice under partially reclaimed sodic soil condition during *kharif* 2010 and 2011. Trials were conducted in five villages of the district with 06 treatments, comprising 03 crop geometry (15X15cm, 20X10cm and 20X15cm) and 03 nitrogen levels (100, 120 & 150 kg N/ha) in a farmers' participatory mode. All the growth and yield attributing characters were maximum with wider crop geometry of 20X15cm and minimum with closer crop geometry of 15X15cm, however, the grain yield showed non-significant difference. The growth, yield attributes, grains and straw yields were increased significantly with increased levels of nitrogen during both years. The highest gross return of Rs. 87,228 per ha was recorded with 150 Kg N/ha in conjunction with crop geometry of 20X10cm followed by the spacing of 20X15cm alongwith 150 kg N/ha. Crop should be transplanted at closer crop geometry of 20X10cm and fertilized with same amount of nitrogen (*ie* 150 kg /ha) those recommended for neutral soils.

Keyword: Crop geometry, hybrid rice, nitrogen management, reclaimed soil

1. Introduction

Rice is the widely grown cereal crop of world, forms the staple diet of 2.7 billion people. Rice is grown in 114 countries across the world on an area about 150 million hectares with annual production of over 525 million tonnes, constituting nearly 11 per cent of the world's cultivated land (Rai, 2006) [4]. More than 90 per cent of the world's rice is produced and consumed in Asia where it is an integral part of culture and tradition. Rice occupies a pivotal place in Indian agriculture and it provides 48% caloric requirement for more than 70% of Indians. The yield level of high yielding varieties is plateauing in recent year. To meet the demand of increasing population and maintain this self-sufficiency the present production level need to be increased up to 140 million tonnes by 2025 which can be achieved only by increasing the rice production by over 2 million tonnes per year in coming decade (Anonymous, 2005) [1]. This has to be done against the backdrop of declining natural resource base such as land, water, labour and other inputs and without adversely affecting the quality of environment.

There is an urgent need to adopt some innovative

technologies to break the yield ceiling in rice. Among the available technological options to enhance rice production and productivity, hybrid rice is the most practically feasible and readily adoptable technology. Hybrid rice have a convincing yield advantage of at least 1.0 tonne per hectare more than the highest yielding inbred cultivars with similar maturity duration. Hybrid vigour in rice can be profitably used to increase its productivity by 14-18% over the available best varieties in India (Siddiq, 1993) [6]. More than 80 % of the total hybrid rice area is in eastern Indian states like Uttar Pradesh, Jharkhand, Bihar, Chhattisgarh, with some little area in states like Madhya Pradesh, Assam, Punjab and Haryana. As rice is a key source of livelihood in eastern India, a considerable increase in yield through this technology will have a major impact on household food and nutritional security, income generation, besides an economic impact in the region.

Appropriate agronomic management is a pre-requisite to exploit the full potential of a hybrid for different location and regions, sometimes even for different hybrids. Specific package of practices need to be developed to realize the full genetic potential of hybrids. Among the various cultural practices nutrient management and crop geometry are most important for yield maximization (Siddiq, 2001) [7]. The cost of hybrid rice seed is expensive and hence there is a need to use the seed rationally without affecting the yield. However, ideal plant geometry has also to be adopted for getting optimum plant stand in the field which results in higher yield. The yield potential is not fully exploited mainly due to inadequate plant population. Plant geometry play an important role in yield maximization of rice (Siddiqui *et al.*, 1999) [8]. Nutrient management also plays a significant role in enhancing yield of hybrid rice. In order to get highest yields farmers resorted to excess use of chemical nitrogenous fertilizers which affects badly both the soil and crops with nutrient toxicity leading to higher production costs and environmental degradations. Since not much work has been done in partially reclaimed sodic soil conditions, the present on-farm trials were undertaken on farmer's field in participatory manners to workout best crop geometry and suitable nitrogen dose for higher production of hybrid rice under partially reclaimed sodic soil condition.

Table 1: Effect of crop geometry and nitrogen levels on growth characters of hybrid rice under partially reclaimed sodic condition (pooled data of 2010 & 2011)

Treatment	Plant height (cm)	Total tillers/m^2	Effective tillers/m^2	LAI at 60 DAT	Dry matter at harvest (g/m^2)
Crop geometry					
15X15cm	85.29	347.12	287.86	6.42	698.21
20X10cm	88.18	354.05	304.20	6.94	732.00
20X15cm	91.04	360.83	324.20	7.10	784.94
CD (p=0.05)	3.17	20.86	16.36	0.34	41.57
Nitrogen level (kg/ha)					
100	88.42	367.15	299.02	7.18	775.16
120	91.73	394.81	304.39	7.67	814.34
150	94.48	408.14	316.57	7.94	845.00
CD (p=0.05)	3.13	26.94	14.03	0.63	61.18

Table 2: Effect of crop geometry and nitrogen levels on yield attributing characters and yield of hybrid rice under partially reclaimed sodic condition (pooled data of 2010 & 2011)

Treatment	Grains/ panicle	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index	Nitrogen uptake (kg/ha)
Crop geometry						
15X15cm	172.47	22.14	58.20	79.69	43.2	96.96
20X10cm	186.33	22.51	62.73	75.89	44.1	105.48
20X15cm	195.03	23.18	60.21	70.45	45.3	100.28
CD (p=0.05)	9.84	NS	NS	6.16	NS	6.70
Nitrogen level (kg/ha)						
100	172.13	21.87	58.90	66.08	45.2	99.02
120	187.56	23.84	60.28	68.41	47.2	107.64
150	195.53	25.26	65.04	72.79	48.5	118.96
CD (p=0.05)	7.87	1.39	3.05	2.66	1.5	8.65

Materials and Methods

The on-farm trial was conducted during rainy season at farmer's field in District Mau during *kharif* season of 2010 & 2011. Five farmers of village Pilkhi, block Ratanpura were selected where the field was reclaimed with the help of gypsum @ 4.0 t/ha. The soil was partially reclaimed sodic condition with pH 8.1, organic carbon 0.24%, electrical conductivity 0.32 dS/m and 149.8, 14.7 and 206.2 kg/ha available N, P and K respectively. The experiment constituted of 06 treatments, comprising 03 crop geometry (15X15cm, 20X10cm and 20X15cm) and 03 nitrogen levels (100, 120 & 150 kg N/ha) during both the years were evaluated in randomized block design having three replications. Nitrogen was applied as per treatment in three doses, one-half as basal, one-fourth as top dressed at early tillering and remaining at panicle initiation stage. The recommended dose of other fertilizers was 60, 60, 40 kg P_2O_5, K_2O, $ZnSO_4$ per ha respectively were applied as basal during both the years. Rice hybrid variety NDRH-2 of 21 days old seedlings was transplanted keeping one plant per hill under puddled condition. The crop was raised under irrigated condition and all the recommended cultural practices were also adopted as per need of crop.

Results and Discussion

All the growth and yield attributing characters were maximum with wider crop geometry of 20X15cm and minimum with closer crop geometry of 15X15cm. Higher growth and yield attributing characters were recorded with wider crop geometry of 20X15cm might be due to more availability of resources for development of individual plant. As a result of better partitioning of photosynthates from source to sink and less competition for resources, development of yield attributes was better under wider crop geometry. Grain yield did not differ much due to crop geometry, however, closer crop geometry of 20X10cm spacing registered more grain yield (2.52 q/ha) than that of with wider crop geometry of 20X15cm, because of higher plant population under former treatment in spite of better growth and yield attributing characters under the later treatment (Table 1). Nayak *et al.* (2003) [3] and Rajarathinam and Balasubramanian (1999) [5] reported significantly higher yield of hybrid rice with adoption of closer spacing of 20X10cm and 15X15cm than with wider crop geometry of 20X15cm.

Each successive increase in nitrogen significantly increased the plant height, effective tillers/m^2, grains/panicle, grain and straw yields. On an average of two years the strategy of applying the recommended dose of nitrogen (150 kg/ha) proved superior over the lower doses of nitrogen

in terms of all the growth and yield attributing characters under partially reclaimed soil. Nitrogen application at 150 kg/ha recorded significant increase in plant height, number of effective panicle/m^2 and number of grains/panicle over subsequent level of Nitrogen. Favourable effects of N application on the growth and yield attributes further got reflected on the grain and straw yields. The grains and straw yields were increased significantly with increased levels of nitrogen during pooled data of both years (Table 1). These results are in close conformity to the findings of Dai *et al.* (2006) [2]. Though the interaction effect were found non-significant between nitrogen levels and crop geometry with respect to all the characters under studies. Among the different combinations, the highest gross monetary return of Rs. 87,228 per ha was recorded with 150 Kg N/ha in conjunction with crop geometry of 20X10cm followed by the spacing of 20X15cm alongwith 150 kg N/ha. This combination was also recorded maximum net return and benefit-cost ratio (Rs. 54,894 and 1.70) respectively.

It may be concluded that for achieving maximum yield and net return from hybrid rice (NDRH-2) under partially reclaimed sodic condition, the crop should be transplanted at closer crop geometry of 20X10cm and fertilized with same amount of nitrogen (*ie* 150 kg /ha) those recommended for neutral soils.

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