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Growth and Yield Attributes of Direct Seeded Aerobic Rice (*Oryza sativa* L.) as Influenced by Seed Rate and Varieties

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A B S T R A C T

The present investigation was conducted during *kharif* season of 2014 at N.E. Borlaug Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) to optimizing the seed rate of hybrid and high yielding varieties of rice under direct seeded aerobic condition. Treatments were tested in a split plot design with three replications keeping varieties in main-plots and seed rates in sub-plots. Hybrid varieties DRRH 3 and PAC 837 performed better with the grain yields of 4620 kg/ha and 4554 kg/ha respectively as compared to high yielding varieties of PD 16 (4408 kg/ha). Among the different seed rates tested, seed rate of 35 kg/ha yielded more (4829 kg/ha) as compared to other seed rates. More yield and profit from direct seeded aerobic rice can be obtained from hybrid rice varieties with seed rate of 35 kg/ha under *tarai* condition of Uttarakhand, India.

Introduction

Rice is the most important and widely cultivated crop in the world. Asia is the home of rice as more than two billion people are getting 60-70 per cent of their energy requirement from rice and its derived products (Rekha *et al*., 2015). Rice crop is grown by many ways depending upon resource availability, though transplanting which is being done after puddling the field is common practice in most of irrigated areas in the world. Due to resource constraints, especially water and labourers, direct seeding under dry condition is now emerging new trend in rice cultivation. Direct-seeding of rice has the potential to provide several benefits to farmers and the environment over conventional practices of puddling and transplanting. Direct seeding (both wet and dry) avoids nursery raising, seedling uprooting, puddling and transplanting, and thus reduces the labour requirement. According to IRRI scientists, aerobic rice is a production system of rice in which especially developed "aerobic rice" varieties are grown in well-drained, non-puddled, and saturated soils (Bouman and Lampayan, 2009). To realize the maximum possible benefits of rice crop and to obtain higher yield, it is essential to adopt recommended package of agronomic practices for successful cultivation of rice. Among the various cultural practices seed rate and selection of variety are most important for

yield maximization. Improved high yielding and hybrid varieties contribute one of the major components of modern rice production technology (Prasad, 2004). The cost of hybrid rice seed is expensive and hence there is a need to use the seed rationally without affecting the yield. Suitable rice variety with optimum seed rate is significantly desirable to utilize available natural resources efficiently to getting maximum yield. Therefore, considering the above harden facts, the present investigation entitled "Growth and yield attributes of direct seeded aerobic rice (*Oryza sativa* L.) As influenced by seed rate and varieties" was carried out.

Materials and Methods

An experiment was conducted during the *kharif* season of 2014 at N. E. Borlaug Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, District Udham Singh Nagar, Uttarakhand. The experimental site falls in sub-humid and subtropical climatic zone and situated in *tarai* belt of Shivalik range of foot hills of Himalayas. Geographically it is located at 29^0N latitude and 79.29^0E longitude and an altitude of 243.84 meter above mean sea level. Soil of experimental field was silt loam in texture. It is of alluvial origin and is classified as *Auic Hapludoll* (Deshpande *et al*., 1971). The chemical analysis of upper 20 cm soil showed that it was high in organic carbon (0.92%), low in available N (232 kg/ha), medium in available phosphorus (21kg/ha), potassium (212 kg/ha) and slightly alkaline in soil reaction (pH: 7.7). the experiment was laid out in spilt-plot design keeping varieties viz. DRRH 3, PAC 837 (Hybrids) and PD 16 (High yielding variety) in main plots and seed rates (15, 25, 35 and 45 kg ha^{-1}) in sub-plots with three replications. Normal crop husbandry practices were followed for successful raising of the crop. The data obtained were subjected to statistical analysis and were tested at five per cent level of significance to interpret the treatment differences as suggested by Gomez and Gomez (2010).

Results and Discussion

Growth Attributes

The data pertaining to growth attribute of hybrid and high yielding varieties at harvest is presented in table 1. The variety PAC 837 recorded significantly higher plant height at maturity, respectively than all other varieties. The variety DRRH 3 recorded lowest plant height. Seed rates had non-significant effect on plant height. However, little bit taller plants were recorded with seed rate 45 kg/ha which might be due to more competition for light at higher plant population Reddy and Reddy, 2010also reported that plant height increases with increase in plant population. However, Hossain *et al.,* (2008) reported that variation in plant height of different varieties might be due to the difference in their genetic makeup. Maximum number of shoots/m^2 was recorded with DRRH 3 (309) and lowest was with PD 16 (284) at maturity. It might be due to better tillering of DRRH 3 and PAC 837. Numbers of shoots/m^2 were increased with increasing the seed rates up to 35 kg/ha. Varieties with seed rate 35 kg/ha recorded maximum numbers of shoot/m^2 at maturity (321). Increase in number of tillers up to from 15 kg to 35 kg seed rate might be attributed to achievement of optimum plant population under higher seed rates. Highest plant dry matter was recorded in variety DRRH 3 (929 g/m^2) which was significantly higher than all other varieties while lowest dry matter accumulation was recorded with variety PD 16 (900 g/m^2). Significantly higher plant dry matter was produced with seed rate 35 kg/ha (956 g/m^2) which was at par with seed rate 45 kg/ha (933 g/m^2), however, lowest dry matter accumulation was recorded with seed rate of

15 kg/ha (860 g/m^2). The dry matter accumulation increased with increasing seed rate up to 35 kg/ha and thereafter decline at 45 kg/ha seed rate. However, the decline was marginal between 35 and 45 kg seed rates.

Yield attributing characters

The data of yield contributing characters *viz* number of panicle/m^2, panicle weight, test weight and sterility per cent are presented in table 1. Different varieties did not have significant bearing on the number of panicle/m^2. However, the maximum number of panicle/m^2 (306) was obtained with variety DRRH 3 compared to PAC 837 (305) and PD 16 (300). The total numbers of panicle/m^2 were 273, 293, 331 and 319 at 15, 25, 35 and 45 kg/ha seed rates respectively. Aslam *et al.,* (2002) also reported the influence of seed rate on panicle population. The data related to filled grains panicle^{-1} is presented in figure 1. More number of grains per panicle was obtained with variety PAC 837 over rest two varieties Among different seed rates, seed rate of 25 kg/ha recorded higher number of grains per panicle Lowest number of grains per panicle was recorded with 35 kg/ha and 45 kg/ha seed rate. More grain per panicle at lower seed rate was due to less competition among the plants for light, moisture and for nutrient compared with those at high seed rate. The mutual competition among plants at high seed rate decreased the grains per panicle (Angiras and Sharma, 2000). In case of panicle weight, varieties did not show any significant effect. However, maximum panicle weight was obtained with variety PAC 837 (1.66 g) which was equal to DRRH 3 (1.66 g) and lowest with variety PD 16 (1.65 g). However, the effect of different seed rates on panicle weight was significant and it was observed that seed rate 25 kg/ha had significantly higher panicle weight (1.73 g) than all the other seed rates except 15 kg/ha (1.71 g) which were at par with each other and seed rate 35 kg/ha (1.60) and 45 kg/ha (1.60 g) were also at par with each other. The effect of different varieties on sterility percent was found significant. The variety DRRH 3 (19.69%) had significantly lower sterility percent than that of all the other varieties and higher sterility percent was found in PD 16 (22.71%). Dawadi and Chaudhary (2013) also reported variation in sterility percent of different rice verities. There was no significant effect of seed rate on sterility percent. However, slightly higher sterility percentage was obtained with the 45 kg/ha seed rate (21.76%) than that of all the other seed rates and lowest with 35 kg/ha (21.38%). Similar result was reported by Pridashry *et al.,* (2000). Significantly higher test weight was recorded with PD 16 (25.36 g) followed by PAC 837 (24.35g). Varietal difference in seed rate is also reported by Jayanti *et al.,* (2015). Among the different seed rates, 15 kg/ha had recorded significantly higher 1000 grain weight (23.94 g) which was at par with seed rate 25 kg/ha (23.84 g). Lowest 1000 grain weight was recorded with seed rate 45 kg/ha (23.61 g) which also at par with 35 kg/ha (23.64 g). Higher 1000 grain weight might due to more productive tillers, more filling of starch in grains and better grain development (Anonymous, 2009).

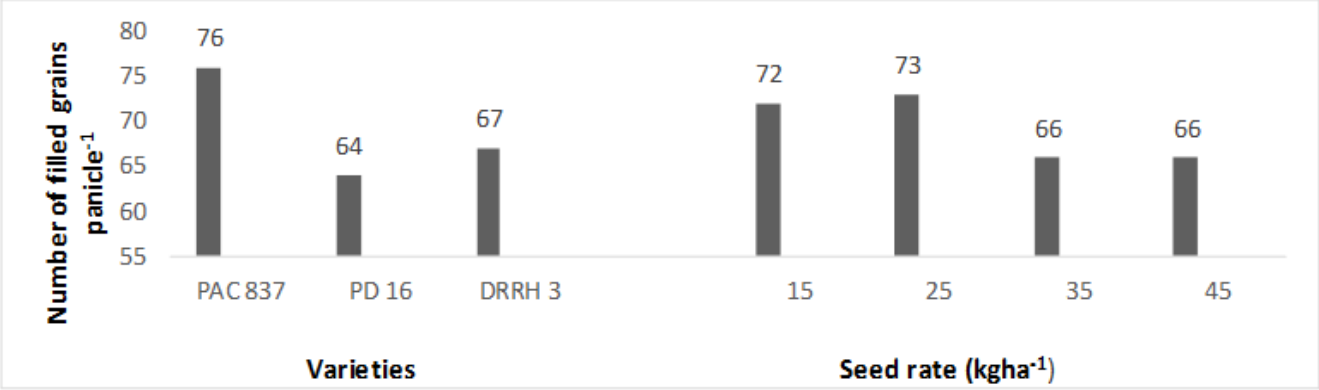
Yield

Different varieties had non-significant effect on grain yield in this investigation (Table 1). Variety DRRH 3 recorded maximum grain yield (4620 kg/ha) than all other varieties followed by PAC 837 (4554 kg/ha) and PD 16 (4408 kg/ha). Higher yield might be due to more number of shoots/m^2, panicle/m^2, panicle weight, test weight and finally less sterility percentage. There was significant variation in grain yields due to different seed rates.

Table.1 Effect of varieties and seed rate on growth parameters, yield attributes, yield and harvest index of aerobic rice

Treatment	Plant height (cm)	Shoots m^{-2}	Dry matter (gm^{-2})	Panicles m^{-2}	Panicle weight (g)	Sterility (%)	Test weight (g)	Grain yield ($kg\ ha^{-1}$)	Biological yield ($kg\ ha^{-1}$)	Harvest Index (%)
Varieties										
PAC 837	107	298	917	305	1.66	21.41	24.35	4554	9581	47.53
PD 16	104	284	900	300	1.65	22.71	25.36	4408	9260	47.62
DRRH 3	101	309	929	306	1.66	19.69	21.58	4620	9747	47.25
S.E.m ±	1.10	1.99	4.13	2.5	0.01	0.28	0.06	63	212	0.4
C.D. (5%)	3.50	7.80	12.61	NS	NS	1.10	0.22	NS	NS	NS
Seed rate ($kg\ ha^{-1}$)										
15	103	294	860	273	1.71	21.54	23.94	4209	8838	47.47
25	103	289	900	293	1.73	21.73	23.84	4491	9476	47.19
35	104	321	956	331	1.60	21.38	23.65	4829	10127	47.68
45	105	285	933	319	1.60	21.76	23.61	4581	9680	47.32
S.E.m ±	0.83	2.75	8.87	2.7	0.04	0.18	0.09	66	264	0.4
C.D. (5%)	NS	8.18	26.93	7.9	0.11	NS	0.27	198	785	NS

Fig.1 Number of filled grains $panicle^{-1}$ as influenced by varieties and seed rate of aerobic rice



Among the different seed rates, significantly higher grain yield was obtained with 35 kg/ha (4829 kg/ha) than all other seed rates However, lower grain yield was obtained with seed rate of 15 kg/ha (4209 kg/ha). Grain yield obtained with seed rate 25 kg/ha (4491 kg/ha) and 45 kg/ha (4581 kg/ha) was *at par* with each other. Optimum seed rate also provide better space for leaf growth for better light interception and higher dry matter accumulation which might have resulted in higher grain yield. This was also supported by (Ling *et al.* 2011). Interaction effect was non-significant for grain yield. Rice varieties did not influence the biological yield significantly. However, the maximum biological yield was observed with DRRH 3 (9747 kg/ha) while the lowest was noted with PD 16 (9260 kg/ha).

Among the seed rates, 35 kg/ha seed rate recorded significantly higher biological yield (10127 kg/ha) than all the other varieties which was at par with 45 kg/ha (9780 kg/ha). Lower biological yield recorded with seed rate of 15 kg/ha (8838 kg/ha). With regard to biological yield, it was increased with increase in seed rate up to 35 kg/ha and after that decreased. Variation in biological yield might be due to variation in growth and yield attributing characters. Similar results regarding reduction in biological yield were also reported by Tohiduzzaman (2011). Effect of different varieties on harvest index was found to be non-significant. The highest harvest index was observed in PD 16 (47.62), followed by PAC 837 (47.53). However, lowest HI was recorded with variety DRRH 3 (47.25). Different seed rates also had a non-significant influence on harvest index. However, highest and lowest harvest index were recorded with seed rate of 35 kg/ha (47.68) and 25 kg/ha (47.19), respectively.

In conclusion, based on above results it could be concluded that hybrid rice variety DRRH 3 and PAC 837 were performed better under aerobic condition as compared to high yielding varieties of PD 16 with the seed rate of 35 kg/ha for the *tarai* region of Uttarakhand, India.

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