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Performance of GNV 1089 Rice Variety for Yield and Water Productivity under Direct Seeded Rice in Upper Krishna Command Area

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ABSTRACT

Paddy is the major crop growing in upper krishna project command area. The growing of long duration rice varieties consumes more irrigation water than short duration varieties which lead to soil salinization and water scarcity problem among tail end farmers. Hence, ICAR-Krishi Vigyan Kendra, Yadgir conducted two years field trials on assessment of different varieties under different sowing methods during 2018 and 2019 *kharif* seasons. The design consist five genotypes viz, GNV 1089 (V1), RNR 15048 (V2), BPT 5204 (V3), GGV-05-01 (V4) and SIRI 1253 (V5) as main plot and different sowing methods *viz.,* traditional transplanting rice (TTR) and direct seeded rice (DSR) as sub plot. A spilt plot design was used at different cluster villages at selected farmer's field. The observations on crop yield and quantity of water applied were recorded. The pooled data of two seasons showed that, highest average grain yield 6184 kg/ha was recorded in GNV 1089 (V1) followed by GGV-05-01 (V4) and lowest average grain yield 5524 kg/ha in V3. The highest water productivity was recorded in GNV 1089 (5.90 kg/ha/mm) under DSR and least was in BPT 5204 (4.30 kg/ha/mm). The study revealed that, more crop yield and water productivity can be achieved in short duration variety under DSR method. The highest B:C ratio (2.76) was recorded under GNV 1089 (V1) of DSR and lowest B:C ratio (1.30) under SIRI 1253 (V5) of TTR over rest of the treatments. There was a significant difference in B:C ratio of 1.46 under TTR over DSR method. The farmers were satisfied with GNV 1089 crop performance due to its early harvest and less consumption of irrigation water. Growing of GNV 1089 under DSR method in command area will reduces the water scarcity problem and increase the farm income by using less crop inputs.

Key Words: DSR, Traditional transplanting, Paddy, Water productivity, Irrigation.

INTRODUCTION

Rice is the world's most stable food crop and a primary source of food for more than half of the world's population and in India it contributes about 45 per cent of the total production and helps to sustain sufficiency food in the country (Kaur *et al,* 2013; Sandhu and Dhaliwal, 2016). Upper Krishna Project (UKP) is the prestigious irrigation project having irrigating potential of 6.22 lakh ha area and irrigating major crops like paddy (30 %), cotton (20 %), chilli (7 %) and sunflower (5 %) during the season. The sixty five percent of the net irrigated area in the district is irrigated by UKP through canal irrigation and 60 per cent of the irrigated area is under paddy-paddy cropping system. The judicious use of land and water for crop production in command area not only increased crop yield but also minimizes the use of crop inputs and thereby increases the farm income (Kumar and Ladha, 2011). However, due to lack of technical knowledge on use of water and getting sufficient water at main and sub canal in command area, the upper end farmers will get more water than the tail end farmers. This causes the water scarcity problem among tail end farmers in *kharif*

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seasons itself. In addition to this, cultivation of 140 to 150 day long duration rice varieties also one of the major causes for use of more water in UKP area. The water productivity of long duration varieties is very less and use of excess water creates problems of rise in ground water table (GWT) to near the soil surface which causes 30 to 35 percent of crop loss during cropping season. With uncertainty over the release of water and owing to deficit rainfall during *kharif* season also farmers were could not able to get sufficient water irrigation (Mallikarjun *et al*, 2014). Therefore, in order to create awareness on equal water use in both upper and tail end farmers, there is more scope for introduction of cultivation of short duration paddy variety. This short duration rice varieties uses less crop water use as compared to long duration varieties and uses less crop inputs like pesticides and fertilizers.

Traditional Transplanted Rice (TPR) has been increasingly replaced by Direct-Seeded Rice (DSR) because of its low water and labour requirements (Le Xu, *et al,* 2019) and puddling is done by extensive tillage in standing water (>300 mm), which creates impervious layer 10-15cm below soil surface and consumes more than 30 percent of irrigation water (Singh *et al,* 2012). The use of short duration varieties along with DSR sowing technique minimizes the expenditure without effecting on their crop yield and increases the farm income. On the face of global water scarcity and escalating labour rates, when the future of rice production is under threat, direct seeded rice (DSR) offers an attractive alternative. Despite controversies, if properly managed, comparable yield may be obtained from DSR compared with transplanting system. The main advantage of cultivation of short duration crop along with DSR method is that, getting high income with less water use or with minimum use of crop inputs during crop growth period. The DSR method reduces the cost of production, conserves irrigation water, controls soil erosion and weeds, and also increases the quantity of organic matter in the soil (Yadahalli and Kammar, 2017, Verma *et al,* 2016). Introduction of technologies to minimize intense water use and increase water productivity in command area will enhance the crop yield and reduces the water scarcity problems among the farmers and it helps the farmers to get more income (Mahantashivayogayya *et al,* 2016). University of Agriculture Science, Raichur developed a 125 day short duration rice variety namely GNV-1089. In order to popularize this variety in UKP, it needs to be assessed it's suitable in UKP in comparison with existing long duration rice varieties under DSR method. The present study was under taken to assess GNV-1089 rice variety for its water productivity in comparison with long duration paddy varieties under DSR in UKP command area.

MATERIALS AND METHODS

The present study was conducted to assess GNV-1089 paddy variety at selected farmers field during 2018 and 2019 *kharif* season at cluster blocks of ICAR-KVK Yadgir (Karnataka). The details of rice verities and sowing methods were chosen during testing period are presented in Table 1. The farmers were selected based on their personal interest that was ready to adopt new technologies in their field. The trials were conducted at five locations with twelve technological options. Farmers were guided for use of DSR seed drill during both the *kharif* seasons of 2018 and 2019.

Table 1. Detail of selected rice varieties and sowing methods.

Treatments Detail	
Main Plot: Varieties (V)	
V1	GNV 1089
V2	RNR 15048
V3	BPT 5204
V4	GGV 05-01
V5	SIRI 1253
Sub plot: Sowing Methods (S)	
S1	Traditional Transplanting Rice (TTR)
S2	Direct Seeded Rice (DSR)

Irrigation Scheduling and Parshall flume

The irrigation scheduling was adopted and one cusec capacity parshall flume was installed at demonstrated field to quantify the quantity of irrigation water supplied to each treatment. The observations on quantity of water supplied to each treatment were recorded at each irrigation stages using standard procedure of parshall flume. The quantity of water used and crop yield was used to calculated water productivity of each treatment.

Data Collection

Yield parameters were recorded on harvesting stages during both the *kharif* seasons. Grain yield obtained from each net plot area of each treatment was used for calculating the grain and straw yield/ ha. The water productivity was calculated based on quantity of water used and economic yield obtained. The benefit cost ratio was worked out by grass returns and cost of cultivation.

RESULTS AND DISCUSSIONS

Yield and yield attributing characters

Among the genotypes significantly higher grain yield 6134 and 6235 (kg/ha) was recorded in V1 (GNV-1089) during 2018 and 2019, respectively over rest of the varieties. The pooled data revealed that, significantly higher average grain yield (6184 kg/ha) was recorded in V1 and lowest average grain yield (5524 kg/ha) was recorded under (V3) BPT 5204 (Table 2). Pooled indicated that, significantly higher straw yield (6630 kg/ha) was recorded under V1 and lowest (6010 kg/ha) was recorded in V3. Among sowing methods, there was no significant difference in economic grain and straw yield. The similar results were commemorating with the findings of **(Singh, 2018, Yadahalli and Kammar, 2017,** Anand *et al,* 2018), Masthana reddy *et al* (2017) and Kumar *et al* (2016). The yield gap between DSR and traditional transplanting gap was reduced by appropriate management practices, suitable soil properties and climatic stresses management. There was no significant difference in the interaction effects.

Water consumption and Water productivity

Water is the main input for paddy production all over the world. The judicious use of water in paddy production could enhance water use efficiency and helps to bring more area under irrigation. The results of water consumed and water productivity of selected rice variety and sowing method is presented in Table 3. Among the genotypes pooled data of water consumption showed that, significant more water (1305 mm) was consumed by BPT 5204 (V3) as compared to rest of the varieties and less water use (1048 mm) was recorded under V1 (GNV 1089). Significantly higher water productivity (5.90 kg/ha/mm) was noticed under GNV 1089 followed by RNR 15048 (4.63 kg/ha/ mm), GGV 05-01 (4.37 kg/ha/mm) and least was in BPT 5204 (4.23 kg/ha/ mm). The results clearly indicated that, V1 (GNV 1089) is short duration variety and matures 25 days early to long duration variety. The early maturity character of V1 leads to less water use consumption and higher water productivity. Always medium and long duration varieties mature at 135 to 150 which consume more water for grain yield production. Among the sowing methods, the results indicated that, there was 14 to 20 per cent water can be saved through DSR method over traditional transplanting rice (TTR) method which helps to achieve more water productivity. The combination of cultivation of short duration rice variety with DSR methods helps to save 25 to 30 percent of irrigation water without affecting the economic yield of rice. Many studies shows that apart from higher economic returns, DSR crops are faster and easier to plant, less labour intensive and consume less water (Bhushan *et al,* 2007 and Jehangir *et al,* 2005), conducive to mechanisation, generally flower earlier leading to shorter crop duration and mature 7–10 days earlier and have less methane emissions (Balasubramanian and Hill, 2002) than transplanted rice. In DSR culture, water use efficiency and productivity may increase if appropriate soil types from levelled land were selected.

Table 2. Grain and straw yield of rice varieties under Traditional Transplanting Rice (TTR) and Direct Seeded Rice (DSR) during 2018 and 2019.

	Grain Yield (Kg/ha)			Straw Yield (Kg/ha)		
Main Plot: Varieties	2018	2019	Pooled	2018	2019	Pooled
V1	6,134	6,235	6,184	6,493	6,766	6,630
V2	5,722	5,604	5,663	5,886	6,134	6,010
V3	5,530	5,519	5,524	5,888	6,135	6,012
V4	5,805	5,721	5,763	6,163	6,422	6,293
V5	5,702	5,462	5,582	5,936	6,186	6,061
Se(m)	5.12	6.94	6.01	5.84	6.03	5.94
CD @ 5%	16.94	22.99	19.92	19.35	19.98	19.67
Sub Plot: Sowing Methods						
S1	5,768	5,750	5,759	6,077	6,332	6,204
S2	5,789	5,666	5,728	6,070	6,325	6,197
Se(m)	9.10	7.76	8.37	7.75	7.99	7.87
CD @ 5%	N/A	24.75	26.72	N/A	N/A	N/A

Legends: *GNV 1089 (V1), RNR 15048 (V2), BPT 5204 (V3), GGV-05-01 (V4) and SIRI 1253 (V5), S1: Traditional transplanting rice, S2: Direct seeded rice*

Economics of rice genotypes and sowing methods:

Cost economics is the ultimate key to identify successful technology. The highest B:C ratio (2.76) was recorded under V1(GNV 1089) of DSR and lowest B:C ratio (1.30) under V5 (SIRI 1253) of TTR over rest of the treatments. There was a significant difference in B:C ratio of 1.46 under TTR over DSR methods. This may be due to fact that, growing of paddy nursery and transplanting requires additional cost of Rs.4000 per acre leads to lowest B:C ratio in TTR. Adaptation of DSR method not only saves money but also saves crop inputs like irrigation water (30 %), seeds (50 %), fertilizer (10 %) and pesticides (10 %). The saving of crop inputs could enhance the higher B:C ratio in DSR method. DSR saved sufficient number of laborers' required for transplanting of paddy, thus, a big relief for the large hue and cry over labour shortage during the transplanting season (**Swain et al, 2017**). Further irrigations to the tune of 30 to 40 per cent were saved in DSR over the normal planted rice which is quite a satisfactory answer to the ever decreasing water table of the state.

CONCLUSION

The growing of GNV 1089 rice variety under DSR method recorded significantly higher water productivity over rest of the verities under TTR with less quantity of irrigation water consumed. The adopted farmers were satisfied and expressed their positive opinion on cultivation of GNV-1089 as compared long duration verities like BPT 5204. The cultivation of GNV 1089 under DSR method minimizes the water logged and soil salinity problems by using less irrigation water during crop growing period and it will increase the irrigation potential in command area. The higher B:C ratio (2.70) was achieved in GNV 1089 rice variety than BPT-1504, RNR-15048, GGV-05-01 and SIRI 1253. Hence, the farmers in UKP command area can adopt cultivation of GNV-1089 under DSR method instead of growing longer duration variety like BPT-1504 which will enhance their income by reducing high crop inputs. Hence, it is concluded that cultivation of GNV-1089 under DSR is the alternate to growing of long duration variety under TTR during *kharif* season for rice cultivating in UKP command area.

Table 3. Water consumed (mm) by rice variety during crop growth period under Traditional Transplanting Rice (TTR) and Direct Seeded Rice (DSR).

Main Plot: Varieties	Water Used during crop growth period (mm)			Water Productivity (Kg/ha mm)		
	2018	2019	Pooled	2018	2019	Pooled
V1	1027	1068	1048	5.97	5.84	5.90
V2	1200	1248	1224	4.77	4.49	4.63
V3	1280	1331	1305	4.32	4.15	4.23
V4	1240	1290	1265	4.68	4.44	4.56
V5	1252	1302	1277	4.55	4.19	4.37
Se(m)	2.40	2.07	2.30	0.01	0.01	0.01
CD @ 5%	7.94	6.85	7.63	0.05	0.03	0.04
Sub Plot: Sowing Methods						
S1	1,221	1,218	1,220	4.25	4.41	4.33
S2	1,083	1,074	1,079	5.47	5.32	5.40
Se(m)	1.60	1.29	1.45	0.02	0.01	0.02
CD @ 5%	5.11	4.13	4.64	0.06	0.04	0.05

Legends: *GNV 1089 (V1), RNR 15048 (V2), BPT 5204 (V3), GGV-05-01 (V4) and SIRI 1253 (V5), S1: Traditional transplanting rice, S2: Direct seeded rice*

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Table 4. Economics of Traditional Transplanting Rice (TTR) and Direct Seeded Rice (DSR) under selected rice varieties (Pooled data).

Sr. No.	Parameter	Traditional Transplanting Rice					Direct Seeded Rice				
		V1	V2	V3	V4	V5	V1	V2	V3	V4	V5
1	Seed	1500	1650	1673	1658	1620	816	812	898	816	881
2	Fertilizer cost	15875	17462	17701	17549	17145	12500	13560	13750	13628	13500
3	Herbicide and Pesticide	7800	8580	8697	8623	8424	6924	6933	7616	6968	7478
4	Land Preparation	2500	2750	2788	2764	2700	2456	2256	2702	2267	2652
5	Puddling	5000	5500	5575	5528	5400	-	-		-	-
6	Nursery rising and transplanting	6750	7425	7526	7462	7290	-	-		-	-
7	Fertiliser, Pesticide and Weedcide application	3750	4125	4181	4146	4050	4212	4325	4633	4347	4549
8	Irrigation	2500	2750	2788	2764	2700	1525	1600	1523	1608	1647
9	Harvest and transportation	5250	5775	5854	5804	5670	5781	5925	6359	5955	6243
10	Total Expenditure	50925	56017	56781	56297	54999	34214	35411	37481	35588	36951
11	Crop Yield	6115	6141	5120	5925	4750	6298	6325	5273	6253	4892
12	Grass returns	91725	92115	76800	88875	71250	94470	94875	79095	93795	73380
13	Net Returns	40800	36098	20019	32578	16251	60256	59464	41614	58207	36429
14	B:C Ratio	1.80	1.64	1.35	1.58	1.30	2.76	2.68	2.11	2.64	1.99

Legends: GNV 1089 (V1), RNR 15048 (V2), BPT 5204 (V3), GGV-05-01 (V4) and SIRI 1253 (V5), S1: Traditional transplanting rice, S2: Direct seeded rice

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