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Original Research Article

Impact of Double-Transplanting (Sanda) on Yield and Profitability of Rice in Eastern Uttar Pradesh

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A B S T R A C T

A field experiment was conducted during the wet season of 2018 and 2019 at Crop Research Station, Masodha, Uttar Pradesh to assess the performance of high-yielding varieties of rice (Oryza sativa L.) under double-transplanting (Sanda) method in rice. The experiment consists of 2 treatment combinations, viz. 2 plant stand establishment methods (normal transplanting and double transplanting) in main plots and 2 rice varieties 'NDR 2064' and 'Sambha Mahsuri-Sub 1' in subplots. The increase in grain yield was owing to increase in number of EBT/m2, sterility%, grain panicle weight and 1,000 grain weight. The average yield of NDR 2065 and Sambha Mahsuri-Sub 1 grown under Sanda planting was 6.2 & 5.7t/ha, about 16.98 & 12.87% higher than that of Normal planting. The yield of rice was 5.3 and 5.05t/ha under Normal transplanting, respectively. Cost of rice cultivation (Rs. 35,306 & 42,408) under Sandaplanting is lower than the Normal planting (Rs. 42,408 & 42,788), The technology of Sanda gave higher grass return of NDR 2065 Rs. 84,320 & Sambha Mahsuri-Sub 1, Rs. 89,775/ha with a normal planting grass return of Rs. 72,080 (NDR 2065)& 79,538(Sambha Mahsuri-Sub 1)/ha. and additional net return of Rs.49,014 & 54,431/ha as compared to Normal transplanting Rs. 29,672 & 36,750 (NDR 2065& Sambha Mahsuri-Sub 1).

Keywords

Double transplanting, Sanda, Economics, Gross return, Variety, Yield

Introduction

More than 90% of the world's rice is grown and consumed in Asia, where 60% of the calories are consumed by 3 billion Asians (Khush, 1997). India is one of the world's largest producers of white rice, accounting for 20 % of all world rice production. Rice is the major crop in Uttar Pradesh and is grown in about 5.90 mha which comprises of 13.5% of total rice in India. Uttar Pradesh has favourable and suitable climate, vast areas of fertile soils, sunshine and adequate water resources. The state ranks 3rd in the country in production of rice. The major area under lowland and flood prone is located in eastern part of Uttar Pradesh. While a major cause of rice yields appears to be the uncertainty about the availability of water in the rainfed fields, even the yields of irrigated rice are low.

However, very little progress seems to made on technology development for rainfed rice which constitute nearly 70% or rice hectare in U.P. Indian farming was largely based on indigenous technical knowledge of the farmers. Indigenous knowledge is the knowledge of indigenous people inhabiting different geographical region of the world with their own language, culture, tradition, belief, folklore, rites and rituals (Chhetry and Belbahri, 2009). Indigenous Technical Knowledge (ITKs) (Talukdar *et al.*, 2012). Traditional farming consists of technologies developed by farmers over decades of adjusting farming systems to local agro climatic and social conditions (Venkata Ramaiah and Rama Raju, 2004). Double step transplanting referred as kaiam is followed in Siddharth Nagar for establishment of crop of the traditional tall scented rice cultivar Kalanamak in rainfed lowland areas. Singh *et al.*, (2005) enumerated potential benefits of the practice over normal transplanting as saving of seeds, staggered use of labor, protection from lodging, increased number of grains per panicle, larger panicles and about ten days of advanced maturity. farmers practice a system of double transplanting of rice, locally known as Sanda to avoid crop failure from submergence. One-month old seedlings are transferred to another field with dense transplanting, and then re-transplanted to the main after the risk of flash flood is over. Scientists argue that the system would have lower yield and higher costs, This practice helps in producing healthy and taller seedlings that can easily overcome the adverse situation like high water depth at the time of transplanting (Rautaray, 2007; Ashim et al., 2010). In some flood-prone areas, farmers practice double transplanting (even triple transplanting) to produce taller seedlings for transplanting in standing water at the beginning of the season (India and Bangladesh) or to rejuvenate seedlings while waiting for the floodwater to recede to levels that can allow transplanting in the main field, proper management of seedlings in nurseries or after transplanting in the field (Ram et al., 2010). It is also said that double transplanted rice produce more yield than normal transplanting with same aged seedlings (Ziagua, 2000; Satapathy, 2015).

At present as mentioned earlier the practice double transplanting or two-step transplanting is prevalent in Ballia, Gazipur, Azamgarh, Mau, Jounpur, Varanasi and Siddharth Nagar (Uttar Pradesh), Central Bihar, and Chhattisgarh in India, Bangladesh and Eastern Nepal.

For double transplanting or locally known as "Sunda planting" of Ballia, Gazipur, Azamgarh, Mau, Jounpur and Varanasi rice in rice grown areas, nursery period of seedling should not be extended beyond 7 weeks. It should be of 3 + 3 weeks or 3 + 4 weeks. All double transplanting performed better as compared to single transplanting.

Materials and Methods

Experiment were conducted during WS 2018 and 2019 at Crop Research Station, Masodha, which is situated at 26.47^{0}N (latitude), 82.12 $^{\circ}$E (longitude) and 113 m (altitude). The soil is sandy loam low in organic carbon. It is rich in potassium, medium in phosphorus and possesses good water holding capacity. The rice variety NDR 2065 and Sambha Mahsuri-Sub 1 was used as test variety. The nursery of NDR 2065 and Sambha Mahsuri-Sub 1 was sown in 4th week of May every year. After 25 days, seedlings from primary nursery were uprooted and closely transplanted (8cm × 8 cm) in bunches of 8 to 10 seedlings/hill in the secondary nursery for double transplanting. The seedlings from secondary and normal nursery were up rooted at age of 25 and 60 days, respectively, and transplanted in the field with one seedlings at a spacing of 15 cm

× 15 cm in last week of July during both the years. The second time transplanted rice is cared for in the same manner of normal transplanting, in Split plot design with five replication in 20m^2 plot size, variety specific agronomic practices were raise the crop. Recommended dose of fertilizer 120:60:60: 25 kg N: P: K: and $ZnSO_4$/ha. Half of the dose of N and full dose of P: K and $ZnSO_4$ were applied basal, while remaining N were top-dressed in 2 equal splits–at tillering and panicle initiation stage. Data were recorded at different crop-growth stages and statistically analyzed. The data recorded on days to 50% flowering, plant height, panicle length, panicle weight, EBT/m^2, total grain/panicle, total biological yield, harvest index, grain yield (t/ha.) and test weight (g 1000 seeds). The data on grain yield of each plot were recorded separately by threshing the harvested NDR 2065 and Sambha Mahsuri-Sub 1 on tarpaulin followed by proper sun drying and winnowing.

Results and Discussion

The data presented in Table 1 to 4 reveled that results with double transplanting, (Sanda) were significantly superior over normal transplanting. Seedlings obtained from nursery under double (Sanda) transplanting had dwarf plant height, high panicle length, low sterility %, high number of EBT/m2, high test weight, high panicle weight. The better health of seedlings under double transplanting leads to quick establishment in main field and early production of effective tillers. The double transplanting system is an efficient method of rice establishment compared to the single transplanting system. The cost of rice production would be lower in the double (Sanda) transplanted systems. Weeding and the pesticide/fungicide use in the Sanda plot and Normal planting thereby reduce the cost of inter-cultural operations.

Yield and contributing characters

The yields contributing characters like plant height, panicle length, EBT/m^2 and sterility% obtained over the years under normal transplanting as well as Sanda transplanting. Days to 50% flowering recorded of sanda (87) NDR 2065 and (107) Sambha Mahsuri-Sub 1, against normal planting (93, 116,) plant height recorded an average of Sanda (93 & 82 cm) and normal planting (128 & 102). EBT/m2 was recorded of Sanda (328 &331) against normal planting (258.5 & 289.3). Biological yield recorded an average of Sanda (19.2, 16.6 t/ha) against an average of (17.9, 16.4 t/ha) in normal planting. Grain yield in Sanda planting recorded an average of (6.2 & 5.7 t/ha) against a potential yield of 6.4 & 6.0 t/ha. Normal planting recorded an average yield of (5.3 & 5.05 t/ha). Yield increase percentage over normal planting (16.88 & 12.87%). There was a difference between harvest index (%) of Sanda and normal planting were recording a harvest index of average from (34.7 & 36.2%) Sanda, (27.6 & 30.4%) normal planting (Table 1). clearly Sanda planting the superiority over normal planting, respectively.

Extension, technology gap and technology index

The extension gap 0.9 & 0.65t/ha during the period of study for the adoption of improved agricultural production to reverse the trend of wide extension gap (Table 2).

The technology gap is the difference or gap between the Sanda yield and potential yield and it was varies. The trend of technology gap 0.2 & 0.3 t/ha, technology index 3.1 & 5.0%, against an average of normal planting 17.18 &15.83%.

Table.1 Impact of Sanda and normal transplanting of rice, yield and contributing characters

	2018				2019				Mean				increase over normal TP	
	NDR 2065		Sambha Mahsuri-Sub 1		NDR 2065		Sambha Mahsuri-Sub 1		NDR 2065		Sambha Mahsuri-Sub 1			
	Normal	Sanda	Normal	Sanda	Normal	Sanda	Normal	Sanda	Normal	Sanda	Normal	Sanda	NDR 2065	Sambha Mahsuri-Sub 1
Days to 50% flowering	92	88	115	106	94	86	117	108	93	87	116	107	-6.45	-7.76
Plant Height (m)	126	90	99	78	130	95	105	85	128	93	102	82	-27.34	-19.60
Panicle length (cm)	26.8	28.2	26.9	27.4	26.6	28.4	25.8	27.6	26.7	28.3	26.4	27.5	+5.99	+4.17
EBT/m2	285	326	302	333	301	329	305	329	293	328	304	331	+11.94	+8.88
Panicle weight (g)	3.1	3.96	2.2	2.5	3.3	3.8	2.4	2.9	3.2	3.88	2.3	2.7	+21.25	+17.39
Total grain/panicle (no.)	256.8	275.2	290.2	301.4	260.2	278.2	288.4	305.6	258.5	276.7	289.3	303.5	+7.04	+4.91
Total biological yield (t/ha.)	18.8	17.6	16.4	15.6	19.6	18.2	16.8	15.9	19.2	17.9	16.6	15.8	-9.38	-4.81
Sterility %	14.6	4.6	9.8	3.8	15.8	5.4	10.2	5.6	15.2	5.0	10.0	4.7	-67.2	-53.00
Test Weight (g)	26.8	27.4	16.2	17.4	26.9	27.5	16.5	17.8	26.8	27.5	16.4	17.6	+2.61	+7.31
Harvest Index	27.6	34.7	29.9	35.2	27.6	34.6	30.9	37.1	27.6	34.7	30.4	36.2	+25.72	+19.07
Yield (t/ha.)	5.2	6.1	4.9	5.5	5.4	6.3	5.2	5.9	5.3	6.2	5.05	5.7	+16.98	+12.87

Table.2 Impact of extension gap, technology gap, technology index Sanda and normal transplanting of rice

	NDR 2065				Mean		Sambha Mahsuri-Sub 1				Mean	
	Normal	Sanda	Normal	Sanda	Normal	Sanda	Normal	Sanda	Normal	Sanda	Normal	Sanda
	2018	2018	2019	2019			2018	2018	2019	2019		
Potential Yield (t/ha.)	6.4	6.4	6.4	6.4	6.4	6.4	6.0	6.0	6.0	6.0	6.0	6.0
Grain Yield t/ha	5.2	6.1	5.4	6.3	5.3	6.2	4.9	5.5	5.2	5.9	5.05	5.7
Extension gap (t/ha)	-	0.9	-	0.9	-	0.9	-	0.6	-	0.7	-	0.65
Technology gap (t/ha)	1.2	0.3	1.0	0.1	1.1	0.2	1.1	0.5	0.8	0.1	0.95	0.3
Technology index	18.75	4.68	15.62	1.56	17.18	3.1	18.33	8.33	13.33	1.7	15.83	5.0

Table.3 Cost of cultivation Sanda and normal transplanting of rice

	Sanda	**Normal**	**Sanda**	**Normal**	**Sanda**	**Normal**	**Sanda**	**Normal**	**Sanda NDR 2065**	**Normal**	**Sanda Sambha Mahsuri-Sub 1**	**Normal**
Cosy of Seed	144	1440	180	1800	160	1600	200	2000	152	1520	190	1900
Seedling raising	222	1025	222	1025	310	1275	310	1275	266	1150	266	1150
First close transplanting	1500	0	1500	0	1750	0	1750	0	1625	0	1625	0
Main rice crop 1 ha.	19000	25000	19000	25000	20050	27000	20050	27000	19525	26000	19525	26000
Post harverst	13225	13225	13225	13225	14250	14250	14250	14250	13738	13738	13738	13738
Total cost	**34091**	**40690**	**34127**	**41050**	**36520**	**44125**	**36560**	**44525**	**35306**	**42408**	**35344**	**42788**

Table.4 Impact of economics Sanda and normal transplanting of rice

	NDR 2065				**Mean**		**Sambha Mahsuri-Sub 1**				**Mean**	
	Normal	**Sanda**	**Normal**	**Sanda**	**Normal**	**Sanda**	**Normal**	**Sanda**	**Normal**	**Sanda**	**Normal**	**Sanda**
	2018	**2018**	**2019**	**2019**			**2018**	**2018**	**2019**	**2019**		
Yield q/ha.	52.00	61.00	54.00	63.00	53.00	62.00	49.00	55.00	52.00	59.00	50.50	57.00
Sale price of grain (MSP) (Rs./qt)	1360	1360	1360	1360	1360	1360	1575	1575	1575	1575	1575	1575
Gross expenditure (Rs./ha)	40690	34091	44125	36520	42408	35306	41050	34127	44525	35306	42788	35344
Gross returns (Rs./ha)	70720	82960	73440	85680	72080	84320	77175	86625	81900	92925	79538	89775
Extra returns	30030	48869	29315	49160	29672	49014	36125	52498	37375	57619	36750	54431

Economics

The inputs and outputs price were taken for calculating cost of cultivation and net returns (Table 3). The investment on production by adopting Sanda technology with a mean value of Rs. 49014 & 54431/ha against normal planting (Rs.29675 & 36750).

In conclusion, Sanda method planting requires less quantity of seeds 4kg/ha. then 40kg/ha. normal planting. escapes early stage drought during seedling and vegetative growth, it is easy to maintain closely transplanted in small area with less quantity of irrigation which save water, less number of irrigations (1 or 2) while transplanted rice needs 5-6 irrigations to complete its life-cycle. Helps farmers to grow rice even under initial drought, because they can manage small Sanda plots with less water. Thus area coverage under rice is more, in turn, increase farm produce employment and income, less due to false smut and BLB robust/stout plants. Bears more no. of tillers/hill, all tillers bear panicles, panicles are heavy, the grain are fully filled and test weight high, hence more yield.

Sanda method is a option under condition of delayed rain as its offers an excellent strategy to avoid impact of early crop growth stage drought. Further, its save ground water reduces cost of cultivation and ensure high profit.

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