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Research Article

EVALUATION OF RICE VARIETIES AND ITS ESTABLISHMENT METHOD IN RICE - WHEAT SYSTEM

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Abstract: A field experiment was conducted at JNKVV, College of Agricultural farmer field, Rewa (M.P.), during *Kharif* 2015-16 and 2016-17 in split plot design with three method of sowing/planting *i.e.*, M_1- Direct Sowing, M_2- LEHI, M_3- System of rice intensification assigned in main plot and four rice varieties *i.e.* V_1- Pusa Sugandha-1, V_2- Danteshwari, V_3- Pusa Sugandha- 5, V4- Narendra- 97 laid in sub plot. The most suitable sowing method was M_3 - system of rice intensification produced significantly higher No. of tiller m^{-2}, No. of panicle m^{-2}, No. of filled grains $panicle^{-1}$, weight of grain $panicle^{-1}$ resulted maximum grain yield (42.00 and 44.18 qha^{-1}) over rest method of sowing; thereafter LEHI and SRI in sequence for grain yield were noticed during experimentation. Similarly, V_2 performed significantly higher No. of filled grain $panicle^{-1}$, weight of grains $panicle^{-1}$, grain and straw yield over rest of varieties except V_1 was given closed performance to the V_2. Moreover maximum returns also get from the V_1 gave highest B: C ratio (2.65) with combination of M_3 during experimentation and proved its superiority over other for Kymore Plateau of M.P. However, the second best variety was Pusasugandha-1 during both years.

Keywords: Rice, SRI, Variety

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Introduction

Rice (*Oryza sativa L.*) cultivation is of immense importance to food security of Asia, where more than 90% of global rice is produced and consumed. In India rice is cultivated area 44.11 and 43.38 million hectare with the production of 105.48 and 104.32 MT and its productivity of 2391 and 2404 kg ha^{-1} during 2014-15 and 2015-16 [1]. Rice-Wheat cropping systems are widely adopted by the farmer due to stable production and less labour requirement [8]. But continuous adoption of these cropping system had led to the problem of specific weeds, reduced soil fertility in specific root zone, development of soil sickness and infestation of similar kind of pest which ultimately resulted in decline the efficiency and productivity of system [6 & 9]. The impressive growth is mainly sowing to wide adaptation of high yielding semi-dwarf varieties, increased use of chemical fertilizers and improved package of cultural practices. Direct-seeded rice (DSR) is a feasible alternative to conventional puddled transplanted rice with good potential to save water, reduce labour requirement, mitigate green-house gas (GHG) emission and adapt to climatic risks. The yields are comparable with transplanted rice if crop is properly managed. In recent years, efforts have been made in promoting the DSR technology by various organizations. It reduces overall water requirement of rice crop. Wet (low land) cultivation system is prevalent in areas where adequate water supply is assured either through rainfall or irrigation or both. System of Rice Intensification (SRI) encourages rice plant to grow healthy with large root volume, profuse and strong tillers, non-lodging, big panicle, more and well filled panicles and higher grain weight and resists insects because it allows rice to grow naturally. Tillering is greatly increased, 30 tillers per plant are fairly easy to achieve, 50 tillers $plant^{-1}$ are quite attainable and with really good use of SRI, individual plants can have 100 fertile tillers or even more. It showed a dramatic improvement in rice productivity and produced two fold more yield *i.e.*, radically different from traditional ways of growing rice. In the SRI, changed practices with lower inputs lead to increase in yield up to 7-8 tha^{-1}, about double the present world average of 3.8 tha^{-1} [10].

A large number of varieties have been released for cultivation by private and government sector to enhance its productivity. Hence, it is essential to compare the productivity of these high yielding varieties under agro-climatic condition of rice growing belt of the state. Keeping in view of above points the study "Evaluation of different rice varieties and its establishment method in rice wheat system" is being done during two consecutive year experimentation.

material and methods

The field experiments were laid out at farmer's field during two consecutive year of *Kharif* 2015-16 and 2016-17 in split plot design assigned three methods of sowing/planting *i.e.* M_1- Direct Sowing, M_2- LEHI, M_3- System of rice intensification in main plot and four rice varieties *i.e.* V_1- Pusa Sugandha-1, V_2- Danteshwari, V_3- Pusa Sugandha- 5, V_4- Narendra- 97 laid in sub plot replicated in four times at College of Agricultural, JNKVV, Rewa [M.P.]. The field preparation was started after the harvest of *rabi* crop (Wheat), the field was cultivated by tractor mounted cultivator. With the onset of monsoon, the field was flooded and puddled twice by paddy puddler. For nursery rising: Wet bed method was adopted. Separate nursery beds were prepared for four varieties by cultivating twice by tractor mounted cultivator. The area of nursery bed was ten percent of the total area to be transplanted. Fifty grams of seed was sown per metre square area for nursery. A frequent light irrigation was practiced throughout the seedling stage for keeping the field moist. The 21 days old-seedlings were transplanted in well puddled main field. Two seedlings per hill were transplanted manually. The spacing was kept 25 cm between rows and 25 cm between hills. The treatment for sowing on different method adopted in main plot was taken in to consideration is as follow:

1. **Direct seeding:** Seed were sown in line with space of 20 cm row to row. (each row having 3.5 m length)
2. **LEHI method:** Seeds were soaked in the water for 24 hour after that water soaked seeds are wrapped in moist gunny bag with proper moisture.

These seeds were sprouted within two days and sprouted seeds were used for sowing in puddled condition. (spacing 25 cm x 10 cm).

3. **SRI methodology:** Young and single seedling of 21 days age was planted it ensure high tillering with profuse root growth. Planting has to be done in a square pattern at 25 cm x 25 cm spacing.

Table-1 Plant height (cm) and Number of tillers m-2 as influenced by sowing methods and varieties of rice under rice- wheat cropping system (mean data of 2015-16 and 2016-17)

Treatments	Plant height (cm) DAS/DAT	Number of tillers m^{-2} DAS/DAT
A. Main plot		
Methods of sowing		
M_1: Direct seeded	100.66	279.37
M_2: LEHI	98.00	299.69
M_3: SRI	95.65	363.92
SEm±	0.30	3.04
CD (P=0.05)	0.91	9.125
B. Sub plot		
Varieties		
V_1: Pusa sugandha-1	108.00	317.88
V_2: Danteshwari	86.75	325.92
V_3: Pusa sugandha-5	92.25	311.36
V_4: Narendra-97	105.42	302.13
SEm±	1.42	2.72
CD (P=0.05)	4.27	8.17

Under Nutrient management/Fertilizer Application, Nitrogen was applied through urea in three split doses. Half dose of N was given as basal at the time of transplanting; remaining half dose of N was applied in two equal doses as top dressing at tillering and panicle initiation stage of the crop, respectively. Phosphorous and potash was applied through DAP and Muriate of potash, respectively as basal dose in individual plots before the transplanting. A uniform dose of 60 kg P_2O_5 + 40 kg K_2O and 25 kg Zinc ha^{-1} was applied in all plots through DAP, MOP and Zinc sulphate. The Field was dominated by weeds as *Echinochloa crusgalli, Commelina benghalensis, Eclipta alba* and *Cyperus iria* were controlled by use of chemical Butachlor at 2 and 3 days after Sowing and planting. The data recorded on different observations were tabulated and analyzed statistically by using the techniques of analysis of variance (ANOVA) as suggested by [4]. Critical difference at 0.05 probability level was worked out to compare the treatments when 'F' test was found significant.

Result and Discussion

Planting Method

During the present study, the planting methods had significantly influences the growth and yield attributing characters of paddy and M_3- system of rice intensification produced higher No. of tiller m^{-2}, No. of panicle m^{-2}, No. of filled grains $panicle^{-1}$, weight of grains $panicle^{-1}$ and harvest index over M_1. While, test weight numerically shown non-significant effect between the treatments was highest with M_3 during both year of experimentation. Moreover, M_2 was also performed and significant effect showed over M_1 and placed in second position in aforesaid characters. For all the reason may be that proper temperature, photoperiod as well as sunlight and sufficient period were available to complete the active vegetative growth phase of crop plant reported by [5]. While, the average tiller (369.92 m^{-2}) in M_3 than M_2 and M_1 were higher due to the transplanting (SRI) in M_3 enables optimal spacing and good spacing can increase tiller and paddy yield over poor spacing or other planting methods. Proper spacing is said to ensure good water management [11]. The more number of filled grains (97.37 $panicle^{-1}$), weight of grains over M_2 and M_1 had sufficient time spent on M_3 with adequate spacing, more plant stand, tiller & panicle per stand will resulting higher yield (43.09 qha^{-1}). However, M_2 also was given significant effect over M_1 and produced in secondary line grain yield (38.15 qha^{-1}) during the experiment. The SRI method (M_3) recorded the higher average yield because of the planting distance, ensure air circulation, water and light which are basic factor necessary for photosynthesis [2]. This is in agreement with report by IRRI (1984). The maximum yield of grain and straw under SRI may be due to the maximum plant growth parameters by maximum translocation of photosynthates [14]. The unfilled grains/ panicle significantly less in M_3 than M_2 & M_1, respectively. Significantly heavier panicle were noted under M_3 (1.72 gm) as against M_1 (1.01 gm). Heavier grains were significantly obtained under M_3 as compared to M_1. The increase in grain yield due to M_3 over M_1 was 57.14%. The maximum yield of grain and straw under M_3 may be due to maximum plant growth parameter resulting in higher value of yield attributes character as maximum translocation of photosynthesis toward sink, show senescence and higher rate of transport of dry matter from source during grain filling period [15].

Performance of varieties

The early duration rice variety V_4 and V_3 and medium duration V_2 and late duration V_1 differed markedly in growth pattern and V_1 attained greater height (108 cm) than rest of varieties except V_4 as has attained numerically closed with V_1 during experiment. The number of tiller increased successively with advancement in growth of crop and significantly affected by V_2 as difference in term of No. of tiller m^{-2} (325.92 cm). V_1 has non-significant difference for those character and touch closed to stated variety. Further, the V_1 has larger panicle which has a positive correlation with the No. of grain $plant^{-1}$ and ultimately on grain yield of crop as important yield attributing character influenced the yield directly. The lowest number of tillers m^{-2} was produced by V_4. Consequent upon the superiority in growth parameter of rice varieties, V_2 over V_1, V_3 and V_4 resulted in production of superior yield attributes as Number of panicle (325.92 m^{-2}), Number of filled grains (76.585$panicle^{-1}$), Weight of grain $panicle^{-1}$ (1.56g), Test weight (25.62 g) and finally produced grain (41.31qha^{-1}) and Straw yield (92.75 qha^{-1}). However, variety V_1 had given closed performance to V_2 by producing yield over rest of treatments. The cumulative effect of superior growth and yield attributes were finally reflected in term of higher grain and straw yield also reported by [7]. The difference in grain yield of the varieties maybe explained on the basis of different in duration *i.e.* earlier variety contain lower yield. Thus V_2 gave (8.8 %) more grain yield over V_3 and (42%) over V_4 with development of more tiller and yield attributing character to produce superior yield. Similar result is close agreement with [13]. The straw yield also showed significant difference during the investigation, V_1 (92.31qha^{-1}) had the significant effect over V_4. Straw yield of rice is directly related to growth parameters, *viz*; plant height and number of tillers per unit area and these growth parameters were superior in rice variety V_2 may be responsible for differences in straw yield [13]. The higher harvest index is result to greater partitioning of photosynthesis toward the production of straw rather than grain yield [3].

Effect of Planting Method and Different Varieties on Economics of Rice

Cost of cultivation under the influence of planting method with different varieties have been revealed [Table-3] that cost of cultivation Rs. 53945 ha^{-1} was maximum in combination of M_3V_4 followed by M_2V_4, M_3V_3 and least cost was recorded under the treatment of M_1V_1 during investigation. The net monetary return Rs. 85545 ha^{-1} was maximum in M_3V_2 followed by Rs. 82702 ha^{-1} in M_3V_3 and least return get Rs. 40283 ha^{-1} in M_1V_4, , respectively. In economically, M_3V_2 (2.65) effect was higher but near about over M_3V_3 (2.58) and M_3V_1 (2.57) were better combination found over all the treatments.

Conclusion

The most suitable sowing method M_3 - system of rice intensification produced significantly resulted maximum grain yield (42.00 and 44.18 qha^{-1}) over rest method of sowing; thereafter LEHI and SRI in sequence for grain yield were noticed during experimentation. Similarly, V_2 performed significantly higher grain and straw yield over rest of varieties except V_1 was given closed performance to the V_2. Moreover maximum returns also get from the V_1 gave highest B: C ratio (2.65) with combination of M_3 during experimentation.

Application of research All the methods were taken into the research experiment are conventional v/s innovative system being used as per rural area's suitability. On economically level, these methods used into experimental research conducted.

Table-2 Yield and Yield attribute characters as influenced by sowing methods and varieties of rice under rice- wheat cropping system (mean data of 2015-16 and 2016-17)

Treatments	Number of panicle m^{-2}	Panicle length (cm)	Number of filled grains $panicle^{-1}$	Weight of grain $panicle^{-1}$ (g)	Test weight (g)	Grain yield (qha^{-1})	Straw yield (qha^{-1})	Harvest index (%)
A. Main plot								
Methods of sowing								
M_1: Direct seeded	279.37	22.66	54.06	0.99	23.84	27.42	69.85	13.96
M_2: LEHI	299.69	22.70	64.31	1.34	23.75	38.15	90.86	15.31
M_3: SRI	363.92	22.84	97.37	1.69	24.01	43.09	98.70	15.27
SEm±	3.04	0.35	1.23	0.07	0.51	1.33	3.46	0.32
CD (P=0.05)	9.125	NS	3.70	0.21	1.54	3.98	10.40	0.96
B. Sub plot								
Varieties								
V_1: Pusa sugandha-1	317.88	23.91	74.54	1.35	24.67	37.95	92.31	14.63
V_2: Danteshwari	325.92	22.35	76.58	1.56	25.62	41.31	92.75	15.61
V_3: Pusa sugandha-5	311.36	21.01	70.54	1.30	23.08	36.04	85.04	14.77
V_4: Narendra-97	302.13	23.68	65.41	1.14	22.08	29.58	75.78	14.38
SEm±	2.725	0.38	1.45	0.05	0.66	1.51	2.25	0.30
CD (P=0.05)	8.175	1.14	4.36	0.16	1.99	4.52	6.74	0.92

Table-3 Economic evaluation influenced by different method and varieties of rice under rice- wheat cropping system (mean data of 2015-16 and 2016-17)

Treatment	Rice grain equivalent yield qha^{-1}	Total Cost of cultivation ($Rs.ha^{-1}$)	Gross Return ($Rs.ha^{-1}$)	Net Return($Rs.ha^{-1}$)	B:C Ratio
M_1V_1	58.23	43863	93167	49304	2.12
M_1V_2	66.01	46474	105624	59149	2.27
M_1V_3	62.35	47309	99765	52456	2.11
M_1V_4	55.24	48099	88383	40283	1.83
M_2V_1	71.81	48639	114901	66261	2.36
M_2V_2	79.59	50918	127346	76428	2.50
M_2V_3	76.32	51850	122120	70269	2.35
M_2V_4	71.67	53776	114671	60894	2.13
M_3V_1	80.14	49566	128219	78652	2.57
M_3V_2	85.81	51758	137303	85545	2.65
M_3V_3	84.70	52816	135519	82702	2.58
M_3V_4	79.59	53945	127347	73401	2.36

Research Category: Agronomic response and their economics.

Abbreviations: qha-1- Quintal per hectare, %- Percentage, v/s- versus, g- gram.

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