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Technically performance of alternative crop establishment in rice

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ABSTRACT : Traditionally rice (*Oryza sativa* L.) is transplanted after puddling which requires heavy amount of water and labour and affects the soil health due to dispersion of soil particles, increases soil compaction and make tillage operations difficult in succeeding crops requiring much energy. The direct seeding was done in puddled, un-puddled conditions and zero tillage fields, whereas, transplantation was done in zero tillage fields and on raised bed. Zero till establishment is used widely for many crops around the world but there has been less work on rice. This technology has potential to save time, energy, water and labour during rice establishment. It has been found that there was a problem of weed control in direct seeded rice particularly under un-puddled conditions.

KEY WORDS : DSR, Zero till DSR with residue, Zero till DSR without residue, Zero till MTR

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The most common method of land preparation for wetland rice (*Oryza sativa* L.) in south and Southeast Asia is puddling. This method primarily helps water saving by decreasing percolation and preventing leaching losses of plant nutrients. Puddling generally refers to breaking down soil aggregates at near saturation into ultimate soil particles. The degree of puddling also depends on tillage implement and intensity of puddling. During the puddling operation, the soil is rigorously manipulated, soil structure is thoroughly disturbed and air filled pore volume is drastically reduced. Land preparation for puddling starts in summer, whenever soil moisture conditions permit ploughing. After the onset of the monsoon when there is some standing water in the bunded rice fields, the puddling operation is performed. Farmers of Chhattisgarh do not drain the ponded water from their field as a precautionary measure to save the crop from intermittent dry spells. Due to the practice of keeping extra amount of standing water in the field, percolation losses increase several folds. Soil manipulation through puddling decreases permeability, increases water retention capacity, facilitates transplanting and eradicates weeds especially in heavy textured soil with high activity clay (Lal, 1985).

Rice is a major crop that is grown in more than 109 countries. The total area planted under rice in India is 44.5 million hectares which is largest in the world against a total area of 156.6 million hectares. The total rice production in the world was 652.18 million tonnes out of which 141.13 million tonnes were produced in India (Anonymous, 2009).

Studies conducted during last decade in Haryana and other parts of India indicated that direct seeding in basmati rice and machine transplanting under unpuddle situations can offer an alternative to transplanting that can reduce both the delays and cost of rice establishment (Malik and Yadav, 2008; Yadav *et al.*, 2009).

Current practice of rice establishment in IGP is by

conventional transplanting method under puddled soil conditions. There are several pressing reasons for changing production systems in rice including scarcity of labour, degradation of soil health due to puddling and declining water table. There is need for replacement of the traditional method of rice establishment with new techniques without any requirement for puddling. Hence, there is a need for comparison of different establishment methods under zero-till and unpuddle conditions with conventional puddle transplant rice (PTR).

RESEARCH PROCEDURE

A field experiment was conducted at MIT Bulandshahar Regional Research institute affiliated to uttar Pradesh technical university Lucknow during *Kharif*, 2012. The treatments included DSR, zero-till DSR with residue, zero-till DSR without residue, zero-till MTR, unpuddle MTR, puddle MTR and conventional PTR. *Basmati* rice cultivar CSR30 was used for sowing/ transplanting (Table A).

Soil of the experimental field :

The field selected was for the study uniform fertility analysis was done. A composite soil sample from 0-30 cm soil depth was taken randomly at three places from the field before layout of experiment. The sample were mixed thoroughly, dried and were subjected to mechanical and chemical analysis (Table B).

Performance evaluation of transplanting/sowing machine under different treatment :

The field performance of self propelled rice transplanter and zero tillage seed cum ferti drill having inclined cell type seed metering mechanism were compared with manual method of rice transplanting. Field area of 0.014 ha for each treatment with adequate irrigation facilities was selected in RRS Kaul. Following treatments were used for the study.

Rice crop (CSR-30) was transplanted/sown in each plot at desired depth and recommended seed rate with both the machine. Recommended agronomic practices were followed for raising the crop. Field emergence in each plot was recorded after 7 days, 14 days and 21 days of transplanting/sowing of the crop. Cost analysis based on labour requirement, cost of operation, breakeven point and payback period of both the machines was calculated for their economic feasibility.

Table A : Transplanting/sowing field preparation according to treatments

Treatments	Methods	Description	Plot size (m^2)
T_1	Direct seeded rice (vattar)	One ploughing (with harrow) + planking (with cultivator) + sowing by drill	45.75
T_2	Zero till-direct seeded rice without residues	Sowing by drill (no tillage)	45.75
T_3	Zero till-direct seeded rice with residues/Sesbania	Sowing by drill + residues (no tillage)	45.75
T_4	Zero till-mechanical transplanting	Self propelled rice transplanting (no tillage in standing water)	45.75
T_5	Unpuddle-mechanical transplanting	One ploughing (with harrow) + planking (with cultivator) + self propelled rice transplanting (standing water)	45.75
T_6	Puddle-mechanical transplanting	One ploughing (with harrow) + planking (with cultivator) + puddling (with rotavator) + self propelled rice transplanting	45.75
T_7	Puddle-manual transplanting	One plouging (with harrow) + planking (with cultivator) + puddling (with rotavator) + manual planting	45.75

Table B : Physico-chemical analysis of the soil of the experimental field

Soil separates	Content (%)
Sand	32
Silt	38
Clay	30
Soil pH (1:2)	8.2
Organic carbon (%)	0.32
EC (ds/m)	0.27

Variables and their measurement :

Plant height :

The height of plant was measured from five different locations in each plot. Height of plant was recorded with the help of a meter rod after 7 days, 14 days, 21 days and at harvesting time of the crop.

Number of effective tillers per square meter :

Number of effective tillers in replicated plots was counted from one meter square area at three locations. The tillers recorded at the time harvesting.

Panicle length :

The panicle length was measured randomly at five locations in each plot at the time of harvesting of crop.

Number of grains per panicle :

Five panicles per plot were selected at the time of harvesting and their grains were counted. Average number of grains per panicle were measured.

1000-grain weight :

Weight of 1000-grain was recorded at 14 per cent moisture content of the grains after harvesting.

Missing index :

The missing index was worked out by dividing the number of missing hills per meter square upon total number of hills per meter square.

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under following heads :

Crop performance under different methods of rice establishment :

Plant height :

The plant height under different methods of rice establishment is given The plant height was recorded at the time interval of 7, 14, 21, 35, 42 and 49 DAS/DAP. During these time interval the maximum plant height was obtained in 4.63, 12.7, 21.86, 29.97, 35.83 and 44 cm, respectively. The minimum height of plant was obtained 4.04, 11.25, 18.73, 28.33, 34.42, and 42.60 cm with the T_1 (7), T_2 (14 and 21), T_5 (35), T_4 (42) and T_4 (49) day, respectively. The overall plant height was maximum (126.59cm) under T_6 and minimum (121.00 cm) was obtained in T_2, respectively.

Table 1 : Yield and yield attributes under different methods of rice establishment

Treatments	Days to crop maturity	Panicle length (cm)	No. of effective tillers/m^2 at harvest	No. of grains/panicle	Test weight (g.)	Grain yield (kg/ha.)
T_1	143	23.26	220	76.65	23.43	31770
T_2	143	23.25	219	73.42	23.40	31260
T_3	143	23.77	220	79.23	23.04	32319
T_4	144	22.36	219	73.30	23.11	29750
T_5	144	23.55	220	75.61	23.75	31940
T_6	144	22.97	220	78.77	24.06	32670
T_7	144	24.34	221	79.45	22.69	32020
S.E. ±	0.38	0.61	0.62	4.74	0.64	0.73
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS

NS=Non-significant

Table 2 : Economics of rice cultivation under different crop establishment techniques

Treatments	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Cost of operation	2097	629	629	1372	2840	4405	8033
Total cost of cultivation (Rs./ha)	53994	52474	52474	56673	58193	62888	62888
Market price of produce (Rs./q)	2130	2130	2130	2130	2130	2130	2130
Yield (q/ha)	31.78	31.78	31.29	32.19	29.75	31.94	32.02
Gross return (Rs./ha)	67691	67691	66647	68564	63367	68032	68202
Net return (Rs./ha)	10966	13697	14173	16090	6694	9839	5314
B:C ratio	1.19	1.25	1.27	1.30	1.11	1.17	1.08

Yield and yield attributes under different methods of rice establishment :

The effect of various treatments on yield attributes, days to crop maturity, panicle length, number of effective tillers/m^2, number of grain per panicle, 1000-grain weight (g) and grain yield were reported Table 1 at time of crop harvesting and results are reported the results recorded in Table 1 revealed that the plant height at crop maturity in mechanical transplanting varied from 121.8 to 126.5 cm whereas in DSR the plant height at crop maturity was in the range of 121 to 123.5 cm and manual transplanting, it was found 126.4 cm. The result represented in Table 1 indicated that the days to crop maturity in mechanical transplanting as well as in DSR method was found to be same (144 to145 DAS).

The number of effective tillers per square meter was found in the range of 219 to 221 (Table 1) when rice crop was transplanted with mechanical transplanter and sown with DSR method the result reported in Table 1 revealed that the numbers of grains per panicle in mechanical transplanting varied from 73.30 to 79.45 cm whereas in DSR, numbers of grains per panicle were 73.30 to 79.23 cm and in manual transplanting it was observed 79.45 cm. Test weight of grains was found in the range of 22.69 to 24.06 gram when crop was raised under different establishment methods.

The result represented in Table 1 indicated that the panicle length in mechanical transplanting varied from 22.36 to 24.34 the result recorded in Table 1 indicated that the grain yield in mechanical transplanting varied from 29.75 to 32.69 q/ha. The grain yield was observed in the range of 31.2 to 32.3 q/ha when crop was sown with DSR techniques. In manual transplanting the yield was observed 32 q/ha.

Economic analysis :

The cost analysis of different establishment methods were analyzed and given in (Table 2) The comparative economics of different establishment methods were analysed and reported in Table 2 cost of operation was maximum (Rs. 8033) under treatment T_7 followed by T_6 then T_5, T_1 then T_4 cost was in treatment T_2 and T_3. It is clear from the Table 2 because no tillage operation was performed in this treatment. The total cost of production was also maximum under treatments T_7 followed by T_6, T_5, T_4, T_1 and minimum was under treatment T_2 and T_3. the gross return (68564 Rs./ha) was maximum under treatment T_4 and minimum was under treatment T_1 and T_2 (67691) Net return (Rs. 16090/ha) was maximum under treatment T_4 and T_3 the benefit cost ratio was maximum (1.30) under treatment T_4 whereas in other treatment it varied from 1.08 to 1.27.

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