



Engineering Inputs for Mechanizing System of Rice Intensification (SRI)

Ajay Verma

Director Extension Services

Directorate of Extension Services, IGKV, Raipur (Chhattisgarh)

Corresponding author email: ajayaverma@rediffmail.com

Introduction

Marking the grid of 25x25 cm points to transplant 12-15 days old seedlings of rice on the puddle field and weeding are the two major challenges in SRI. Appropriate implements suitable to the varied field conditions are needed to be developed. Furthermore, these implements have to be affordable and within the reach of the small farmers. Keeping these considerations in mind, Faculty of Agricultural Engineering, IGKV, Raipur is working to support the SRI farmers of Chhattisgarh since 2005. Manual grid making for transplanting and weeding / interculture operation for SRI were mechanized through three row Rotary marker, Bamboo marker, Cono weeder and Gender friendly rice weeder. Performances of different weeders were tested under system of rice intensification under Matasi (Inceptisol) soils of Chhattisgarh during the Kharif season of the year 2005, 2006 and 2007. There were six treatments namely Conventional transplanting + two hand Weeding [T₁], SRI + Gender Friendly rice weeder (One Way) [T₂], SRI+ Gender Friendly rice weeder (Two Way) [T₃], SRI + Cono weeder (Two Way) [T₄], SRI + No weeding (Control) [T₅], SRI+ Two manual weeding [T₆]. Manual weedings were done at 25 and 45 DAT, whereas mechanized weedings were done at 15, 25 and 35 DAT. Compost @ 10 tons/ha with green manuring with *Sasbania Rostata* was used as organic source of nutrient. Fourteen days old seedling of Patel super variety were transplanted singly at 25x 25 cm grid created with the help of a three row rotary marker fabricated at Faculty of Agricultural Engineering workshop and Alternate Wet and Dry Irrigation (AWDI) was given during vegetative phase using drains provided at every 3 meter space. Physiological response, field capacity and performance efficiency of marker and weeder were recorded. Micro channels in transverse direction were formed during weeding in the rice field transplanted in grid pattern supported irrigation as well as drainage of the field. Results showed that yield increment under treatment T₂, T₃, T₄, T₆ are 29.7, 31.7, 33.1 and 20.9 percent over treatment T₁, whereas yield increment under

treatment T₂, T₃, T₄, T₆ are 59.9, 62.4, 64.1 and 49 percent over treatment T₅.

Preparation of SRI Field

For the preparation of the SRI Fields the conventional method of puddling was used. *Sasbania Rostata* was incorporated with soil as green manure to make soil organically rich. Bullock drawn disc harrow was used to incorporate green manure crop with soil. Puddling operation was carried out by the use of pair of bullock with traditional country plough two passes and planking + pair of bullock with lug wheel puddler two passes. Prior to flooding one summer, ploughing was done at friable moisture condition (18.6% db) and the tilled soil was flooded to saturation (24 h). Field was evenly leveled and there were no standing water in the field during transplantations.

Manual grid making

In SRI method, seedlings are widely spaced (25X25 cm) and only one seedling is transplanted per hill. Sixteen hills are accommodated in one square meter area. For easy weeding by mechanical weeder row-to-row and plant-to-plant distance are maintained. To maintain uniform spacing, different methods were tried.

Engineering input to increase working efficiency of human labour in SRI

Different types on "Markers" are being developed for this purpose. These markers were run over the prepared field lengthwise and widthwise. Transplanting at the marked intersection gave the required 25 X 25 cm spacing. Marker developed by the Faculty of Agricultural Engineering, IGKV, Raipur in Kharif 2005 can draw 3 rows and columns simultaneously. The marker covered width of 75 cm in a single pass. It was made by 10 mm MS round rod. Five rings were provided in a shaft with bush arrangement. To have the lines straight a rope was tied and marker was

pulled along the side of the rope. For smooth transplanting, field operations leveling and marking with marker were completed a day before the transplanting. It was noticed that for efficient marking, marker need to be pulled at an even pace. The average operating speed of the marker in the puddle field was 1 km/h. Further marker was performed properly only in the field where uniform consistency of puddle soil was maintained. The grid 25X25 cm maintained in lengthwise properly but to maintain it in widthwise was found difficult. Therefore in Kharif 2006 a simple wooden marker made of bamboo was tried in SRI field. It was made by bamboo having length of 2 m. 9 pegs made of bamboo of 20 cm height were provided in 25 cm distance apart. For easy mobility 15° backward directions inclined pegs. It was found that a man could make grid of 25X25 cm in 0.6 to 0.8 ha/day. This marker performed grid in length and width wise properly. It can perform satisfactorily even if the field is not maintained uniform of puddling in entire field.



Bamboo marker

Nursery preparation for SRI

To maintain 5-6 kg of seed rate SRI need special nursery. Therefore, nursery was grown by using friable soil. The soil was collected in dry condition before the season. It was mixed with 20% FYM. The soil manure mixture was dried and sieved by a 4 mm sieve. Certified seeds with 96-98% germination were used for nursery raising.



Nursery for SRI

Transplanting of seedling

Young, 8-12 days old seedlings are transplanted in SRI method. Care should be taken to see that the plant does not experience shock during transplanting. The farmers and farm labour need to be educated on this aspect. Care should be taken to prevent any harm to seedling while pulling them from nursery or at the time of transplanting.

Weed Management in SRI

Dry and wet field condition in SRI provides a congenial environment for weeds to proliferate. Weeding is the major challenge in SRI. Appropriate implements suitable to the varied soil and weed condition are needed to be developed. Furthermore, these implements have to be

affordable and within the reach of the small farmers. Keeping these considerations in mind, manually operated Cono weeder and gender friendly rotary rice weeder were used for effective weed management in SRI. In these weeders, weeds can be incorporated by moving the weeder between the rows. If these weeds are incorporated into the soil, they serve as green manure. First weeding operation was performed 10-12 days after transplanting. Later, depending on the need, weeding can be done once every 10 days. These weeders help in green manuring due to incorporation of weeds into soil, increase soil aeration, assist in enhancement biological activities of soil and increased nutrient availability and uptake. The performance result of Cono Weeder tested in SRI field during Kharif 2006 is given below

Cono Weeder

Specification of weeder

Make	: Faculty of Agricultural Engineering, IGKV, Raipur (CG)
Type of weeder	: Manual, floating type
Type of mounting	: Offset mounting of cone pair
Total weight of the weeder	: 9.5 kg
Overall	:
Dimensions	:
Cone length	: 11.5 cm
Larger diameter of cone	: 13 cm
Smaller diameter of cone	: 5 cm
Length of handle	: 130 cm
Length of float	: 30 cm
Width of float	: 12 cm
No. of blades per cone	: 12
No. of serrated blades	: 6
No. of plain blades	: 6

Field performance

Traveling speed (km/h)	: 1.6
Weeding Efficiency (%)	: 64.46
Plant damage (%)	: 12
Depth of cut (cm)	: 2.4
Field capacity (ha/h)	: 0.018
Field efficiency	: 56.25



Cono weeder



Cono weeder in operation

Performance evaluation studies on gender friendly rotary rice weeder and physiological response on female farm workers

Performance of weeder

To evaluate the performance of the weeder the weeding operation was performed by all the three subjects in the row seeded and transplanted field. The field operation of each operator was made for 4 h/day. The data given in Table 1 is the mean values of three replications. There was not much plant damage (1.5 to 2.5%) was reported during weeding operation by the weeder. The field capacity and speed of operation of the weeder were ranged between 0.0138 to 0.0177 ha/h and 2.28 to 2.64 km/h respectively (Table 1). This range in field capacity may be attributed partly to the subject's capabilities and partly to the moisture variation and weed intensity in the field.

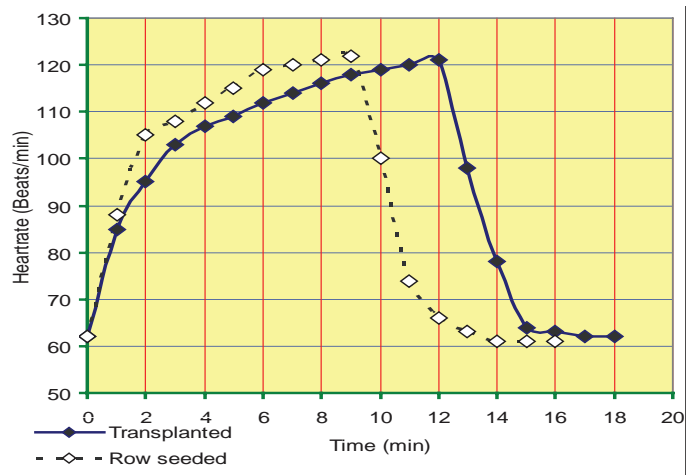


Figure 1: Stress stabilization of Gender friendly rice weeder

Table 1: Field capacity of developed rotary rice weeder in clay loam soil at saturated moisture condition

Observation	Rice cultivation practice								
	Transplanted					Row seeded			
	Subject			CD (5%)	Subject			CD (5%)	
	S1	S2	S3		S1	S2	S3		
(A) Field performance data									
Depth of operation (mm)	27	26	26	1.9	25	26	24	2.1	
Width of operation (mm)	120	120	120		120	120	120		
Height of crop (mm)	223	220	219	11.3	252	244	253	9.4	
Traveling speed (km/h)	2.64	2.56	2.37	0.24	2.35	2.38	2.28	0.24	
Weed intensity (weeds/m ²)									
(a) Before test	44	39	43	3.2	233	237	234	8.5	
(b) After test	6	5	5		44	36	39		
Weeding efficiency (%)	87	87	89		81	85	83		
Plant damaged (%)	1.7	1.5	1.9		2.0	2.3	2.4		
Field capacity (m ² /h)	177	165	152	12.4	156	149	138	14.6	
(B) Physiological cost in field operation									
Heart rate (Beats/min)									
(a) Rest	62	63	63	2.1	64	63	62	1.9	
(b) Work	116	114	117	5.8	121	119	123	4.1	
Heart rate recovery (min)	4 ± 1	4 ± 1	4 ± 1		4 ± 1	4 ± 1	4 ± 1		
Oxygen consumption (l/min)									
(a) Rest	0.18	0.17	0.18	0.02	0.18	0.18	0.17	0.02	
(b) Work	0.628	0.603	0.647	0.04	0.736	0.715	0.749	0.03	
Body part discomfort rating	21	18	23	2.3	25	27	27	1.7	

S₁₋₃ – Subject 1 to Subject 3, Plot size – 20mx5m
 The data given are mean values of 3 replications



Study of Physiological response of Gender friendly rice weeder



Gender friendly rotary rice weeder

Conclusion

It is concluded from the results of this study that the developed gender friendly rice weeder was found suitable for farmwomen. The physiological workload of farmwomen in operation was within the capability of average female farm workers. The work output of developed rotary weeder depends upon the operator capacity, ambient conditions and weed intensity. Energy expenditure for performing

weeding operation varied from 12.5 to 16.5 kJ/min. The drudgery initiation was observed shorter intervals of 9-12 minutes but the operator could continuously work on the weeder for 4 h after giving 15 minutes' rest by each task. Field capacity study showed almost constant field capacity in first two hours of work however linear decrease in work out with the advancement of working hours were observed after 2-3 hours of working.