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Suitability of Rice Transplanters and Weeders in Different Soil Types

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To evaluate the performance of existing models of rice transplanters in different soil types, to evaluate the performance of existing models of power weeder in different soil types, and to reduce the cost of cultivation and enhance the rice production and profitability.

Study design: Strip plot design with different soil types as main-plot treatments(3), existing models of rice transplanter(5) as sub-plot treatment and existing models of power weeder(3) as sub-sub-plot treatments.

Place and duration: Experiments were conducted in six locations of delta zones of Tamil Nadu representing three soil types viz., sandy clay loam, sandy loam, and clay loam during *samba* season(2019 & 2020) with the medium duration rice variety 'TKM 13.

Methodology: Transplanter machine related parameters of actual field efficiency, theoretical capacity and field efficiency and weeder machine related parameters of field capacity and field

efficiency and weed control efficiency was observed in different soil types. Suitability of transplanter and weeder combination on rice growth and yield parameters and yield, reduction of cost of cultivation and increase in net return and net income were observed and calculated.

Results: Among growth and yield parameters, the 6 row yanmar transplanter along with conoweeding combination were recorded higher tillers and productive tillers (16.28 & 20.65/hill), number of filled grains (113 & 145/panicle) seed yield (5922 & 5733 kg/ha) respectively in sandy clay loam and sandy loam soil. Similarly, higher net return (Rs. 70195/ha & Rs. 55343/ha) and BCR (2.62 & 2.28) in sandy clay loam and sandy loam soil respectively. Furthermore, they achieved additional grain yield of 1769 kg/ha and 1873 kg/ha with the additional net profit of Rs. 37027/ha & Rs. 34813/ha in sandy clay loam and sandy loam soil respectively. Yanmar 8 row transplanter along with single row power weeder combination were recorded higher productive tillers (15.25/hill), filled grains (122/panicle) and seed yield (5506 kg/ha) with higher net return (Rs. 58175/ha) and BCR (2.32) in clay loam soil. Furthermore, they achieved with an additional grain yield of 1121 kg/ha with additional net profit of Rs. 24618/ha and net income change of Rs. 24618/ha in clay loam soil compared to farmers practice.

Conclusion: Cultivation of rice by using 6 row yanmar transplanter and weeding by cono weeder along with agronomic practices is important to achieve higher yield performance and net return and BCR in sandy clay loam soil and sandy loam soil. Cultivation of rice by using 8 row Yanmar transplanter for transplanting and single row power weeder for weeding operation along with recommended agronomic practices is important to achieve higher yield performance and net return and BCR in clay loam soil.

Keywords: Transplanters; weeders; economics; partial budgeting.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crops and the most important staple food of India. Paddy is grown by transplanting under wetland conditions or direct sowing depending upon the availability of water. Transplanting method is more popular among farmers due to higher yield and less weed growth compared to direct seeded rice. However, it requires high energy and it is labour intensive [1].

Transplanting of paddy is a highly labour intensive operation and is still done manually. One of the feasible options to solve the problem of labour intensive would be the adoption of mechanical transplanting. Less expensive and labor saving method of rice transplanting without yield loss is the urgent need of the hour. Mechanical rice transplanter is cost effective and operation friendly. The performance of the mechanical transplanter was satisfactory with a labor requirement of 3 man days per hectare to 33 man days per hectare in case of manual transplanting [2]. The field capacity of six-row manually operated paddy transplanter was 0.38 ha per day, while for hand transplanting it was 0.04 ha per day [3]. In spite of having an edge over the traditional transplanting, the adoption rate of mechanical transplanters is low due to high initial investment and lack of knowledge in growing mat type nursery. Mechanization has a

crucial role in this venture as it functions as a force multiplier to compensate the human labour shortage for those engaged in food production [4]. Similar fact of reduced labour requirement and timely completion of crop establishment operations were reported [5]. Majority of the beneficiaries (95 per cent) have reported that machine transplanting facilitates timely planting and solves the issue of labour scarcity [6]. Cent percentage of the beneficiaries reported that machine planting requires appropriate technical skills in nursery rising. In India, mechanical transplanters were developed and now popularized among farmers. Skills involved in nursery preparation and 'more care should be given after planting in the main field' as the two major demerits in mechanical transplanting [7]. For better performance of the transplanter, there is a need to optimize the nursery mat characteristics (mat thickness, seedlings per square meter, seedling age, base material) based on soil type. Transplanter capable of working under adverse field conditions viz., standing water on fields, less prepared field, plant residue on the surface, needs to be tested. Similarly, weed problem is higher in direct seeded rice compared to transplanting. Weeding accounts for about 25 % of the total labour requirement (900–1200 manhours/hectare) during a cultivation season [8]. The most common methods of weed control are mechanical, chemical, biological and cultural

methods. Out of these four methods, mechanical weeding either by hand tools or weeders are the most effective [9]. Alternate method of weeding is important to reduce the cost of rice cultivation and timely management. Advent of mechanical rice transplanter in Indian agriculture encouraged farmers to use interrow weeding tools like rotary weeders, conoweeder, etc. These instruments are now popularized among farmers instead of tedious and low productive hand weeding [10].

With this background, existing transplanters and weeder suitability study for different soil type was proposed in different soil types of delta areas of Tamil Nadu covering sandy clay loam, sandy loam, and clay loam during *samba* season by using medium duration rice variety.

2. MATERIALS AND METHODS

2.1 Experimental Site

Experiments were conducted at six locations representing three soil types (sandy clay loam, sandy loam and clay loam) of delta zone of Tamil Nadu during 2019-20 & 2020-21 with the objective to evaluate the performance of existing models of rice transplanters in different soil types, to evaluate the performance of existing models of power weeder in different soil types and to reduce the cost of cultivation and enhance the rice production.

2.2 Experimental design

Treatments were imposed in strip plot design as follows.

Main plot treatment: Different soil types [3]

- S₁: Sandy clay loam
- S₂: Sandy loam
- S₃: Clay loam

Sub-plot treatment: Transplanter (5 models)

- T₁: Walking type (4 rows) :Mahindra and Mahindra (India)
- T₂:Walking type (4 rows) :Kubota Agrl. Machinery (Japan)
- T₃:Riding type (6 rows) :Yanmar (Japan)
- T₄:Riding type (8 rows) :Yanmar (Japan)
- T₅:Riding type (8 rows)Yanji shakthi (China)

Sub-sub plot treatment: Weeders (3 types)

- W₁: Cono-weeder
- W₂: Single row power weeder
- W₃: Double row power weeder

The experiment was conducted by preparing a mat nursery by using TKM-13 medium duration

variety treated seeds with bio fertilizers and biofungicides in the mat nursery. Eighteen days old seedlings were transferred to the plastic tray and placed in transplanters as per the size of the seedling rack (22 cm to 25cm) by cutting mat as per the size specification of transplanters. 100 seedlings per square meter were maintained in all transplanters based on adjustment on the distance between rows, distance between the hills within the row and the number of seedlings per hill without altering the distance between rows of the transplanters. Depth of transplanting was maintained @2.5 to 3cm.

2.3 Cultivation Methods

Main field was puddled and leveled; the recommended dose of fertilizer was applied as per the recommendation for medium duration variety. Field water level was maintained up to the height of 2.5 cm and transplanted as per the treatments in an area of 30 cents as sub plot treatment and 10 cents were earmarked to impose sub-sub plot treatments of different weeders. Pre emergence herbicide of Butachlor was applied @ 1.kg ai ha on the third day after transplanting. Irrigation and pests and disease were managed as per the crop production guide.

2.4 Data Collected

2.4.1 Machine efficiency

Field efficiency of transplanter, plant population (number of seedlings/m²) and establishment percentage, number of weeds at 15 DAT & 30 DAT, growth and yield parameters was observed and calculated using weed control efficiency and economics and presented in tables.

Field efficiency was calculated by calculating actual field capacity and theoretical field capacity of the machine by using the following formulas (Hunt [11]).

Actual Field Capacity (AFC) = Total area planted (sq.m) /Total time required (hr).

Theoretical Field capacity (TFC) is the rate of field capacity that would be obtained if the machine were performing its function 100 % of the time at the rated forward speed and always covered 100 % of its rated width.

TFC= Rated speed x Rated width.
Field Efficiency(%)= (AFC/TFC) x 100

Weed count and weed control efficiency (Mani et al. [12]) was calculated by using the following formulas.

Weed number was observed per unit area and recorded weed count on 15 and 30 DAT and different weeders was used as per the treatments and weed control efficiency was calculated by using the formula and presented in the table.

$WCE (\%) = \frac{\text{Weed count in un-weeded plots} - \text{Weed count in treated plots}}{\text{Weed count in un-weeded plots}} \times 100$.

2.4.2 Crop growth and yield parameters

The plant height at 45 days after transplanting (DAT) and at harvest, yield parameters of number of productive tillers, number of filled grains/panicle, test weight(g), seed yield (kg/ha) and straw yield (kg/ha) were observed.

2.4.3 Economics and partial budgeting

Cost of cultivation, gross return, net return, and BCR was calculated and compared with farmers practice. Using additional return, reduction in cost, additional costs incurred, and reduction return by net income changes were calculated by partial budgeting (Horton [13]) when compared to farmers practice.

2.5 Data Analysis

Experiments were conducted in strip plot design having main plot treatment, sub-plot treatment and sub-sub-plot treatment and collected data were analyzed by using AGRES software. Different soil type, different transplanter different weeder were considered as variables. Influence of transplanter and weeder were compared at different soil and significance difference was observed by using least significant difference (LSD). The purpose of this study was to reduce the labour requirement and reduction in cost of cultivation, yield improvement and changes in the income when compared to farmers' practice which was analyzed by using partial budgeting (Table 4) and indicated through additional return, reduced cost, additional cost, reduced return and net change when compared to the farmers practice.

3. RESULTS AND DISCUSSION

3.1 Performance of transplanters

To evaluate the performance of existing models of rice transplanters on machine-related

parameters of actual field efficiency, theoretical capacity and field efficiency were observed in different soil types (Table 1). Similarly, the influence of transplanters on crop establishment and population maintenance was observed in different soil types.

Among the transplanters, higher field efficiency of 74.46, 79.08 and 77.71 was recorded by 8 row riding type transplanter (Yanmar) in sandy clay loam, sandy loam and clay loam soils respectively. This might be due to wider width of the machine (2700mm) and higher transplanting speed (1.65 m/sec). Higher plant population (98 and 123) and establishment percentage (96 % & 95%) was recorded in Yanmar 8 row transplanter in sandy clay loam and clay loam soil, whereas Kubota 4row walking transplanter recorded higher number of seedlings (102/m²) and higher establishment percentage was recorded in Yanmar 6 row transplanter in sandy loam soil. Higher establishment might be due to the automatic leveling control mechanism available in transplanter. Lower establishment percentage was recorded under farmers practice in sandy clay loam and sandy loam soil. According to Murali et al. the field efficiency and field capacity were 62.96 %, 0.54 ha/h, respectively, in self-propelled rice transplanter (Kubota Model) under different puddling conditions [14].

3.2 Performance of Weeders

To evaluate the performance of existing models of weeders on machine-related parameters of field capacity and field efficiency was observed.

Among the weeders, field capacity and field efficiency were varying based on the soil types. Field efficiency was higher in single row power weeder (81.12%) compared to double row power weeder and manual conoweeder in all soil types.

Efficiency of weeders, reduction in weed count and increase in weed control efficiency was calculated in combination treatment of different transplanters and weeders in different soils (Table 1). Cono weeder recorded low weed count and higher weed control efficiency (73.01) when compared to single and double row power weeders. This might be due to the push pull mechanism available in the cono weeder and wider space of 30 cm in transplanter for easy movement of weeder. Similarly, cono weeder combined with transplanters also recorded the

same trend in sandy clay loam soil and sandy loam soil. Whereas, single row power weeder combined with transplanter was recorded lower weed count and higher weed control efficiency in clay loam soil compared to cono weeder and double row power weeder combined with transplanter. Clay soil required higher energy for operation which might be supported in single row power weeder and space availability in single row of rice crop. Karhale et al. [15], reported that the field efficiency of cono weeder was 86.5% and it can be recommended in the early stages of weed growth as the better weeding efficiency, more turning of the soil and uprooting of weeds overrules the higher cost of operation [15]. Cono weeder performed the task with comparatively higher field capacity, better performance index in the early stages of weed infestation.

3.3 Performance of Transplanter and Weeders on Crop Yield Parameters

To evaluate the suitability of transplanter and weeder combination to enhance the rice production, reduce the cost of cultivation and increase the net return and net income, different crop parameters was observed and economics were calculated and presented (Table 3) below. Plant height was observed at 45 days after transplanting (DAT) and at harvest.

Among growth parameters, 6 row yanmar transplanter along with conoweeding was recorded higher plant height (126 cm, 120 cm and 116 cm) in sandy clay loam, sandy loam soil and clay loam soil respectively. Mechanical control not only eradicates weeds between rows, but also softens superficial soil and enhances the aeration of soil. According to Narwariya et al. weeder use alone increased the plant height and enhanced the grain yield by 10.9 % compared to manual hand weeding. Among the transplanters, Yanmar 6 row transplanter performed higher and favoured for growth and yield parameters. Among weeders, conoweeding performed and achieved higher growth and yield parameters [16].

Among yield parameters, the 6 row yanmar transplanter along with conoweeding combination was recorded higher tillers and productive tillers (16.28 & 20.65/hill), number of filled grains (113&145/panicle) seed yield (5922 & 5733kg/ha) respectively in sandy clay loam and sandy loam soil. Proper placement of seedling, higher establishment percentage of seedlings and aerated soil might be accelerated the growth

and yield parameters in rice. Yanmar 8 row transplanter along with single row power weeder combination were recorded higher productive tillers (15.25/hill), filled grains (122/panicle) and seed yield (5506 kg/ha) in clay loam soil. Singh et al. reported that mechanical transplanting significantly increased the grain yield about 23, 37, and 63%, straw yield about 17, 14 and 22% and biological yield about 20, 24 and 39% over manual transplanting, dry direct seeding and direct seeding of sprouted seeds in puddled conditions, respectively [17]. Narwariya et al. reported that the maximum cost was obtained in hand weeding (6152 Rs/ha) treatment, while the minimum cost in power weeder (1976 Rs/ha) treatment (16 a). The weeding operation cost in conoweeder, power weeder and hand weeding was decreased by 18.9, 60.2 and 67.8%, respectively, compared to hand weeding method. The results revealed that the maximum benefit-cost ratio 1.67 was obtained in power weeder treatment followed by hand weeding (1.56), conoweeder (1.5) and rotary weeder (1.43) treatment. Weeding cost in single row conical weeder, two row conical weeder, rotary weeder and power weeder was reduced by 15.7, 38.51, 22.32 and 48.70%, respectively, compared to hand weeding method Karhale et al. [15].

Farooq et al. [18] reported that yield comparison of transplantation methods, the innovator farmers reported that mechanically transplanted field yielded 200-240 kg acre⁻¹ higher as compared with the manually transplanted fields at same input level. This implies that farmers can still earn Rs. 1706 per acre more as compared to the conventional method, even after paying the transplanter's rental charge. This implies that a significant increase in paddy production can occur by widespread adoption of mechanical transplanters.

3.4 Performance of Transplanters and Weeders on Economics

Among different transplanters and weeders, the 6 row yanmar transplanter along with conoweeding achieved higher net return (Rs.70195/ha) and BCR(2.62) in sandy clay loam soil (Fig. 1). Similarly, the 6 row Yanmar transplanter along with conoweeding achieved higher net return (Rs.55343/ha) and BCR (2.28) in sandy loam soil. Whereas 8 row yanmar transplanter along with single row power weeder achieved higher net return (Rs.58175/ha) and BCR (2.32) in clay loam soil.

Table 1. Field efficiency of different transplanter under different soil types

Treatment	Actual Field capacity (ha/h)				Theoretical capacity (ha/h)				Field efficiency (%)			
	S ₁	S ₂	S ₃	mean	S ₁	S ₂	S ₃	mean	S ₁	S ₂	S ₃	mean
T ₁	0.194	0.202	0.195	0.197d	0.291	0.290	0.290	0.290d	66.70	69.91	67.17	67.92 d
T ₂	0.172	0.192	0.181	0.181e	0.250	0.250	0.250	0.250 e	68.84	76.90	72.20	72.64 c
T ₃	0.262	0.280	0.272	0.271 b	0.363	0.360	0.360	0.361 b	71.99	77.78	75.68	75.15 b
T ₄	0.284	0.299	0.296	0.293 a	0.381	0.380	0.380	0.380a	74.46	79.08	77.71	77.08 a
T ₅	0.222	0.232	0.229	0.227c	0.344	0.340	0.340	0.341 c	64.33	68.02	67.27	66.54 d
LSD (P=0.05)				0.0050				0.0015				1.893

Table 2. Effects of treatment on weeds count and weed control efficiency at 30 DAT

Treatment	Average weed count at 30 DAT (Numbers/m ²)				Weed control efficiency(%) at 30 DAT			
	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN
T ₁ W ₁	3.98	13	10.2	9.06 b	65.78	73.11	72.28	70.39
T ₁ W ₂	4.55	30	9.1	14.55 b	65.04	50.71	75.27	63.67
T ₁ W ₃	4.90	27	9.8	13.90 b	62.54	54.50	73.37	63.47
T ₂ W ₁	4.13	16	9.4	9.84 b	68.80	69.59	74.46	70.95
T ₂ W ₂	5.14	19	8.5	10.88 b	63.52	62.44	76.90	67.62
T ₂ W ₃	5.31	18	9.2	10.83 b	62.85	62.82	75.00	66.89
T ₃ W ₁	3.90	09	9.0	7.30 b	73.29	79.54	75.54	76.12
T ₃ W ₂	5.28	18	8.1	10.46 b	66.41	64.80	77.99	69.73
T ₃ W ₃	5.33	13	8.9	9.076 b	65.33	69.38	75.82	70.17
T ₄ W ₁	3.90	11	7.2	7.36 b	69.76	75.21	80.43	75.13
T ₄ W ₂	4.70	14	6.5	8.40 b	65.18	69.67	82.34	72.39
T ₄ W ₃	5.28	12	7.9	8.39 b	59.47	69.96	78.53	69.32
T ₅ W ₁	4.19	17	8.6	9.93 b	71.11	70.06	76.63	72.60
T ₅ W ₂	5.49	23	12.9	13.79 b	64.68	58.48	64.95	62.70
T ₅ W ₃	6.09	20	13.8	13.29 b	61.85	60.24	62.50	61.53
Un-weeded plot	16.02	53	36.8	35.27a				
LSD (P=0.05)				7.40				

Table 3. Effects of treatment on yield parameters of rice

Treatments	Number of productive tillers/hill				Number of filled grains/ panicle				Seed Yield (kg/ha)			
	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN
T ₁ W ₁	16.12	16.84	15.05	16.00 ab	113	127	106	115.33 abcd	5025	4843	4392	4753.33 bcde
T ₁ W ₂	15.06	14.85	15.35	15.08abc	109	116	107	110.66 bcde	4055	4367	4616	4346.00 def
T ₁ W ₃	13.98	14.48	14.25	14.23 bcdef	108	109	104	107.0000 de	4153	4071	4392	4205.33 ef
T ₂ W ₁	12.99	18.35	13.40	14.91 abcd	114	136	109	119.66 ab	5253	5016	4702	4990.33 bc
T ₂ W ₂	12.15	16.62	11.95	13.57 cdef	108	122	108	112.66 bcd	4157	4548	5064	4589.66 bcde
T ₂ W ₃	11.47	15.67	11.10	12.74 def	107	114	106	109.00 cde	3952	4212	4798	4320.66 def
T ₃ W ₁	16.28	20.65	12.50	16.47 a	113	145	113	123.66 a	5922	5733	5145	5600.00 a
T ₃ W ₂	13.85	17.95	13.00	14.93 abcd	109	132	114	118.33 abc	5166	4965	5260	5130.33 ab
T ₃ W ₃	12.79	17.03	12.50	14.10 bcdef	107	120	109	112.00 bcde	4659	4486	5064	4736.33 bcde
T ₄ W ₁	12.95	16.49	14.55	14.66 abcde	108	121	119	116.00 abcd	5106	4599	5391	5032.00 ab
T ₄ W ₂	13.04	15.67	15.25	14.65 abcde	109	116	122	115.66 abcd	4681	4275	5506	4820.66 bcd
T ₄ W ₃	13.35	15.17	14.25	14.25 bcdef	108	107	116	110.33 bcde	4664	4068	5281	4671.00 bcde
T ₅ W ₁	12.60	17.53	12.40	14.17 bcdef	109	129	112	116.66 abcd	5368	4763	5099	5076.66 ab
T ₅ W ₂	11.09	16.08	12.15	13.10 cdef	109	117	114	113.33 abcd	4616	4305	5165	4695.33 bcde
T ₅ W ₃	11.41	15.46	10.95	12.60 ef	107	112	107	108.66 cde	4246	4071	5049	4455.33 cdef
Farmers practice	12.54	13.95	10.85	12.44 f	103	103	99	101.66 e	3728	3860	4385	3991.00 f
LSD (P=0.05)				2.20				10.55				568.15

Table 4. Influence of transplanters and weeders on Net Income changes (Partial budgeting) under different soil types

Treat ment	Additional return (A)			Reduced costs (B)			Additional cost (C)			Reduced return (D)			Net change in income (A+B)-(C+D)		
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
T ₁ W ₁	15696	17694	126	3401	2110	3006	0	0	0	0	0	0	19097	21095	3132
T ₁ W ₂	0	9126	4158	2535	1478	2811	0	0	0	1764	0	0	771	11661	6969
T ₁ W ₃	0	3798	126	2217	1547	2924	0	0	0	7650	0	0	-5433	6015	3050
T ₂ W ₁	19800	20808	5706	3594	157	2691	0	0	0	0	0	0	23394	24402	8397
T ₂ W ₂	72	12384	12222	2563	1003	3290	0	0	0	0	0	0	2635	14947	15512
T ₂ W ₃	0	6336	7434	2216	1120	3110	0	0	0	3618	0	0	-1402	8552	10544
T ₃ W ₁	31842	33714	13680	5185	1099	4121	0	0	0	0	0	0	37027	38899	17801
T ₃ W ₂	18234	19890	15750	4689	2565	4541	0	0	0	0	0	0	22923	24579	20291
T ₃ W ₃	9108	11268	12222	3951	2849	4456	0	0	0	0	0	0	13059	15219	16678
T ₄ W ₁	17154	13302	18108	4592	3044	4492	0	0	0	0	0	0	21746	17894	22600
T ₄ W ₂	9504	7470	20178	4471	4003	4440	0	0	0	0	0	0	13975	11941	24618
T ₄ W ₃	9198	3744	16128	4322	3970	4815	0	0	0	0	0	0	13520	8066	20943
T ₅ W ₁	21870	16254	12852	5248	2748	3619	0	0	0	0	0	0	27118	21502	16471
T ₅ W ₂	8334	8010	14040	4001	3633	4083	0	0	0	0	0	0	12335	12011	18123
T ₅ W ₃	1674	3798	11952	3599	1291	4017	0	0	0	0	0	0	5273	7397	15969

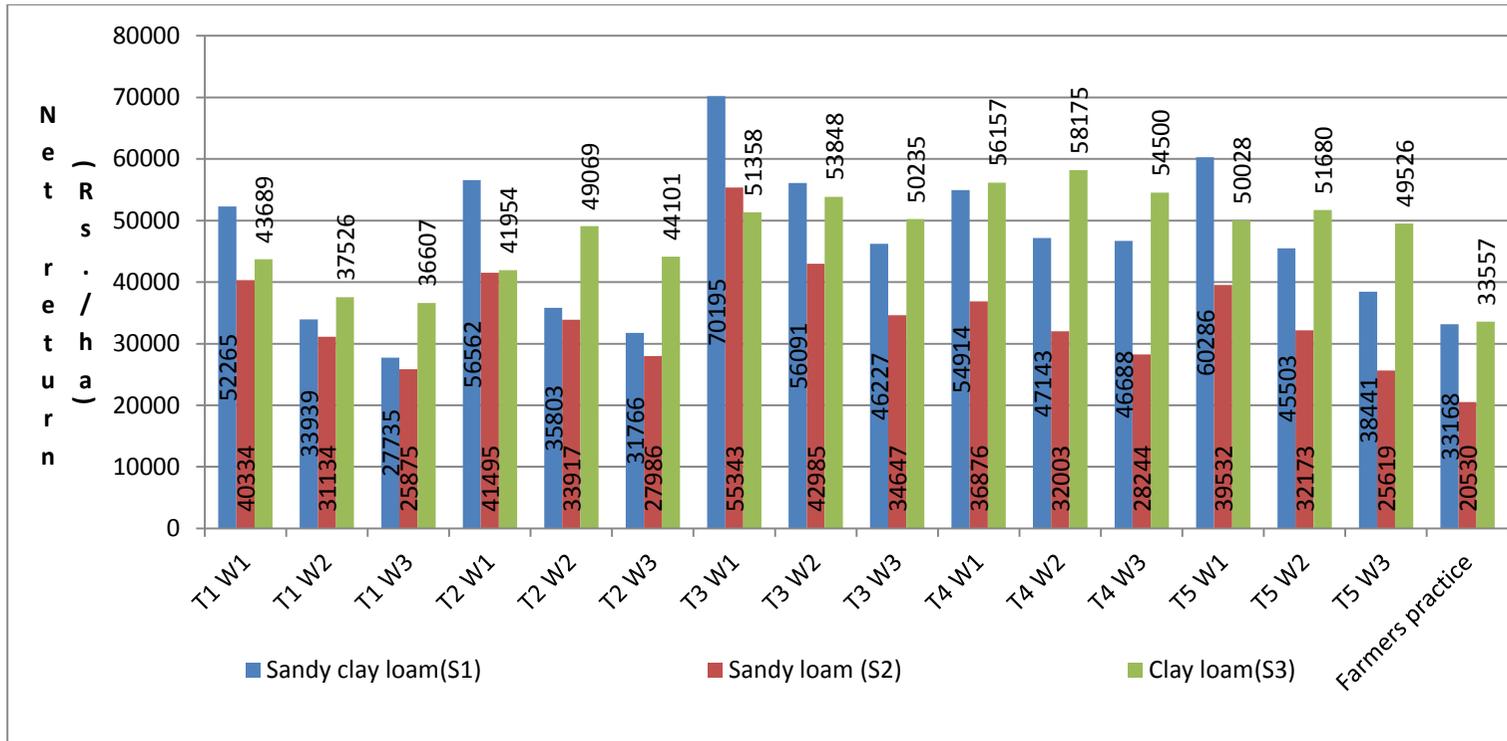


Fig. 1. Effect of treatments on Net return (Rs./ha)

Yanmar 6 row transplanter along with cono weeding were achieved additional grain yield of 1769 kg/ha and 1873 kg/ha in sandy clay loam and sandy loam soil with the additional net profit of Rs.37027/ha & Rs.34813/ha respectively. Similarly, Yanmar 8 row transplanter along with single power weeder weeding were achieved with an additional grain yield of 1121 kg/ha with an additional net profit of Rs.24618/ha in clay loam soil compared to farmers practice. Transplanter combined with weeder reduced the labour requirement, cost reduction and additional yield might be resulted in higher net return.

According to Ravikumar et al. [7], the comparative economics of conventional and machine planting revealed that the yield increased by nearly 40.00%, the cost of cultivation decreased by 21.00%, the cost of production reduced by 43.00% and ultimately net returns increased by more than four times (448.00%), over the manually planted fields.

CONCLUSION

Yanmar 6 row transplanter along with conoweeding achieved higher net return (Rs.70195/ha) and BCR (2.62) in sandy clay loam soil. Similarly, the 6 row Yanmar transplanter along with conoweeding achieved higher net return (Rs.55343/ha) and BCR(2.28) in sandy loam soil. Whereas Yanmar 8 row transplanter along with single row power weeder achieved higher net return (Rs.58175/ha) and BCR (2.32) in clay loam soil.

Yanmar 6 row transplanter along with cono weeding influenced on additional return and reduced cost and achieved a net income change of Rs.37027/ha and Rs.38899/ha in sandy clay loam and sandy loam soil. Similarly, Yanmar 8 row transplanter along with single row power weeder achieved a net income change of Rs.24618/ha when compared to the farmers practice.

Among all treatment combinations, 6 row Yanmar transplanter along with conoweeding is best suited for sandy clay loam and sandy loam soil. Riding type 8 row yanmar transplanter along with single row power weeder is best suited for clay loam soil, when compared to other transplanter and weeder combinations as well as farmer practice.

Cultivation of rice by using the 6 row yanmar transplanter and weeding by cono weeder along

with other agronomic practices is important to achieve higher yield performance and net return and BCR in sandy clay loam soil and sandy loam soil.

Cultivation of rice by using 8 row Yanmar transplanter for transplanting and single row power weeder for weeding operation along with other recommended agronomic practices is important to achieve higher yield performance and net return and BCR in clay loam soil.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Verma A. Modelling for mechanization strategies of rice cultivation in Chhattisgarh, India. *Agril. Mech. in Asia, Africa and Latin America*. 2010;41(1):20-26.
2. Manjunatha, MV, BG Masthana Reddy, SD Shashidhar and VR Joshi. 2009. Studies on the performance of self-propelled rice transplanter and its effect on crop yield. *Karnataka Journal of Agricultural Sciences*. 2009;22(2):385-387.
3. Yadav R, Patel M, Shukla SP and Pund S. Ergonomic evaluation of manually operated six-row paddy transplanter. *Int. Agril. Engg. J.* 2007;16(3-4):147-157.
4. Harisudan, C. Partial mechanization of rice cultivation for enhancing productivity and energetics. In *Proc. of International symposium on "100 years of Rice science and looking beyond"* to be held during 9th -12th January, 2012 at TNAU, Coimbatore.
5. Mohammad Shahid, Nayak AK, Tripathi R, Sangita Mohanty, Panda BB, Saha S, Vijayakumar S, Mohapatra SD, Priyadarsini S, Guru PK, Munda S, Sarangi DR, Udaya Sekhar Nagothu, Pathak H. *Machanical Transplanting of rice*.

- Resilience. Technology Brief no. 3, ICAR, Cuttack; 2019.
6. Nirmala Devi, MC, Harisudan, Arunachalam R. Impact Study of Machine Transplantation in Rice and its Socio Economic Comparison with Conventional Method in Cauvery Delta Region of Tamil Nadu, India. *Int. J. Curr. Microbiol. App. Sci.* 9(06):977-983. DOI:<https://doi.org/10.20546/ijcmas.2020.906.122>.
 7. Ravi Kumar Theodore, Venkatesa Palanichamy N. Use of mechanical transplanter for rice cultivation in Cauvery delta districts of Tamil Nadu : Impact and feedback assesment. *Crop Research* (0970-4884) . Sep-Nov2018; 53(5/6):257-264.8.
 8. Yadav R, Pund S. Development and ergonomic evaluation of manual weeder. *Agricultural Engineering International: the CIGR Ejournal*. Manuscript. PM 07 022. October; 2007;IX.
 9. Manjunatha K, Shirwal S, Sushilendra, Vijayakumar P. Development and Evaluation of manually operated sprocket weeder. *International Journal of Agricultural Engineering*. 2014;7(1):156-159.
 10. Remesan R, Roopesh MS, Remya N, Preman PS. Wet land weeding-A comprehensive comparative study from south India. *The CIGR E-journal*. Manuscript. 2007;PM 07011(9):1-21.
 11. Hunt D. Farm Power and Machinery Management cost determination,95h edition, IOWA State University, Press, USA; 1995.
 12. Mani VS, Malla ML, Gautam KC, Bhagwandas. Weed killing chemicals in Potatocultivation. *Indian Farm*. 1973;22:17-18.
 13. Horton D. Partial Budget Analysis for On-Farm Potato Research. *Technical Information Bulletin* 16. International Potato center. Lima, Peru. 1982;1-17.
 14. Murali M, Anantachar M, Prakash KV, Sunil Shirwaland, Satishkumar U. Performance and Evaluation of Six Row Self-propelled Paddy Transplanter under Different Puddling Methods. 2016. *Indian Journal of Science and Technology*. 9(47).
 15. Karhale SS, Lambe SP, Neharkar PS. Mechanical weed control by conoweeder in SRI method of paddy cultivation. *International Journal of Advance Research in Science and Engineering*. 2015;4.
 16. Bhagwan Singh Narwariya1, Tiwari KB, Prateek Shrivastava. Performance evaluation of different manual operated weeding equipment for Paddy crop in vertisols. *Eco. Env. & Cons.* 22 (June Suppl.) : 2016;(S357-S363).
 17. Singh KK, Lohan SK, Jat AS, Rani T New technologies for planting rice for higher production. *Research on crops*. 2006;7(2):369-371.
 18. Umar Farooq, Sheikh AD, Muhammad Iqbal, Arshed Bashir, Zubair Anwar. Diffusion possibilities of mechanical rice Transplanters. *International Journal of Agriculture & Biology*; 2001. DOI: 1560–8530/2001/03–1–17–20.

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