

Assessment of manual paddy transplanters for drudgery reduction of farm women in Mayurbhanj district of Odisha

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■ **ABSTRACT :** Transplanting of paddy is very tedious job mostly done by female workers. Manual hand transplanting consumes a lot of energy, time and fatigue, but the poor socio-economic condition of the farmers does not allow them to adopt power operated transplanter. Different manual transplanters have been developed by different research centres as 2 row, 3 row and 4 row paddy transplanter. Keeping this in view KVK, Mayurbhanj-1 has undertaken OFT on different transplanters in drudgery aspect and compared with manual transplanting. Seven female subjects were selected in the age group 17-45years in the farmer's field. The mean value of age, weight, height, VO_2 max and body surface area was found to be 29.1 years, 50.7 kg, 152.5 cm, 1.68 l/min and 1.49 m². The mean value of working heart rate was observed to be maximum of 130.6 beats/min in 3 row paddy transplanter followed by 126.7 beats/min in 2 row transplanter and 112.4 beats/min in local transplanting, respectively. The Oxygen consumption rate and relative cost of workload were observed to be maximum 1.01 l/min and 59.6 per cent in 3 row transplanter followed by 0.8 l/min and 57.8 per cent in 2 row transplanter and lowest in local practices, *i.e.* 0.5 l/min and 33.4 per cent. The field capacity was observed to be maximum 0.066 ha/day in 3 row transplanter followed by 0.03 and 0.054 ha/day in 2 row and local method of transplanting. The 3 row paddy transplanter was observed to be the best among all manual operated paddy transplanters.

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Rice is one of the staple food crop of our state Odisha (Patra and Nayak, 2001). Transplanting is generally preferred over direct sowing of seeds due to severe problem of weeds (Obulamma and Reddy, 2002). Generally it is found that the production increases 10-12 per cent in transplanting in comparison to direct sowing. Transplanting of seedling in puddle soil is the widely accepted practice in rice cultivation (Goel and

Verma, 2000). In our country mostly this tedious, laborious and time consuming process is done by women. Transplanting is very drudgerious operation in overall paddy cultivation processes and 22.3 % of total time is spent in this operation. Now a days shortage of labour and high labour costing is one of the major issues of concern as it leads to failure of scheduled transplanting of rice. In India several attempts have been taken to

mechanize this transplanting operation by introducing various transplanters and this research is under progress to improve the cost of production with less fatigue. In CRRRI four row and in OUAT two and three row transplanters have been developed for female workers to reduce their drudgery and to improve the efficiency during transplanting time.

This study is conducted to compare the ergo-economical suitability among two row and three row transplanter with traditional manual transplanting procedure. The human physiology study is done to compare the comfortness of mechanical transplanters with manual transplanting. Generally a female worker has 2/3rd of energy of male worker (Satpathy and Mohanty, 2005). The manual transplanting requires frequent bending down and straighten up for transplanting process where as mechanical transplanters require energy for pulling the transplanter in puddled field. Pradhan and Mohanty (2014) conducted an experiment by selecting fifteen female subjects of different age. They used 4 row, 3 row and 2 row paddy transplanter on the basis of their study of various parameters and they concluded that the 3 row rice transplanter was the best among all transplanting methods. Mohanty and Ghosal (2014) concluded in their experiment that the physiological responses reduced in two row paddy transplanter from that of four row paddy transplanter. The overall body parts discomfort reduced by 11.19 % in case of two row transplanter. Similarly Yadav *et al.* (2007) had conducted an ergonomic evaluation of six row manually operated rice transplanter where the capacity of transplanter was more as compared to traditional method and average force required for pulling the transplanter was considered to be 130.32 N for male and 145.12 N for female subjects.

Optimum plant density and timely operation in the

rice cultivation has been considered essential for maximising the yield of paddy (Khan and Gunkel, 1988; Syedul *et al.*, 2000 and Manjunath *et al.*, 2009). Hence mechanical transplanting has been considered as the most suitable option as it saves time and labour and minimizes drudgery and stress and ensures timely transplanting and attains optimum planting density contributing higher productivity (Tripathi *et al.*, 2004). Now a days different types of power operated transplanter is also available in the market but the socio-economic condition of the farmers of this district does not allow them to go for this transplanter. Ergonomically suitable and low cost small manual implements need to be designed for the farm women, so the male counterpart may engaged in other profitable business for raising the income of their family.

In Mayurbhanj district rice is also taken as the first cereal crop by most of the people in their diet. In this district, it is grown in an area of more than 2.98 lakh ha with a production of about 9, 74, 460 tones of paddy per year. Farmers are preferred transplanting than direct sowing of paddy and mainly the farm women are involved in this operation. An attempt in this paper has been made by Krishi Vigyan Kendra, Mayurbhanj-1 to study the suitability of operating three row transplanter for the farm women of Mayurbhanj district and to compare it with manual and a two row transplanter with a view to get them involved in the mechanical rice transplanting by using the most comfortable one.

■ RESEARCH METHODS

This study was done at village Kansapal of Bangiriposi block of Mayurbhanj district in *Kharif*, 2016 and *Rabi*, 2016-17. For Physiological data at first the HR_{rest}, VO_{2 rest}, BSA, BMI, weight, age of the workers were measured and the mean value was considered for ergonomic evaluation. The seven selected subjects are

Table A : Physical and physiological parameters of samples			
Physical and physiological parameters	Range	Mean	Std. Deviation
Age, years	17-45	29	11.05
Weight, kg	44-57	50.7	4.49
Height, cm	142-162	152.5	8.2
HR _{rest} , beats/min	64-73	68.7	3.36
HR _{max} , beats/min	175-200	185	9.78
VO _{2 rest} , l/min	0.16-0.24	0.19	0.03
VO _{2 max} , l/min	1.56-1.81	1.68	0.01
BSA, m ²	1.37-1.69	1.49	0.12
BMI, kg/m ²	21.25-23.5	21.39	0.83
Blood lactate accumulation (mM/l of blood)	0.85-1.3	1.08	0.19

Table B : Comparisons between specifications of transplanters			
Sr. No.	Details	Specifications	
1.	Name	OUAT 2-row transplanter	OUAT 3 row transplanter
2.	Type	Manual using mat type seedling	Manual using mat type seedling
3.	Dimensions(L×W×H)	630×600×400	600×600×940
4.	Weight ,kg	16	18
5.	No. of rows	2	3
6.	Row spacing, cm	24	24
7.	Planting depth	3-4	3-4
8.	No. of hills per square meter	30-35	30-35
9.	No. of seedlings per hill	2-5	2-5
10.	Area coverage, ha/day	0.03	0.066
11.	Man days/ha	33.34	15.15
12.	Force requirement	108 N(11 kgf)	145 N(14.8 kgf)
13.	Field efficiency	65 %	58 %
14.	Cost of transplanter, Rs.	7500/-	8500/-

in the age 17-45 and their body weight varies from 44-57 kg. The transplanting operation was done from 10.30 A.M. to 2.00 P.M. and 3 P.M to 5 P.M. Before going to field their HR_{rest}, Body Mass Index, Body Surface Area, and Volume of oxygen uptake were measured. The operation was done in continuous transplanting for 30

minutes and taking 10 minutes break.

Selection of subject and field :

The selected seven subjects were in the age group of 17-45 years as at this age maximum strength can be utilised. The soil of the testing plot is sandy loam, size of



Fig. A : Operation of two row and three row rice transplanter

the plot is 10 x 20 m² and the test was conducted at about 31-34^o C temperature and 73-78 % humidity. The details of physical parameters are placed in Table A.

The detail specifications and performance of 2 row and 3 row transplanter are placed in Table B and operation in Fig. A.

■ RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Physical and physiological characteristics of female subjects:

The mean heart rate of subjects at rest is found in the range 64 to 73 whereas the mean value was 68.7 and the corresponding oxygen consumption was 0.19 l/min. The maximum oxygen consumption of subjects were found to be 1.68 l/min and lies in the range 1.56-1.81. The mean body mass index was found to be 21.39 kg/m² and body surface area was 1.49 m² which shows that the workers were of normal health.

Ergonomically evaluation of different transplanters with manual transplanting:

The ergonomically parameters of the female subjects changed according to the type of transplanting procedure from rest value after 30 minutes of work. These values were given in the Table 1.

Physiological response parameters changed due to work represents the level of fatigue or comfortness in a comparative way and according to these how much the workers can work efficiently. The table shows that the heart rate during work increases successively from the resting value 68.7 beats/min for local practices to 112.4 beats/min, 2 row transplanter (126.7 beats/min), 3 row

transplanter (130.6 beats/min). Likewise the volume of oxygen consumption during work increased to 0.5 l/min for local practice, 0.8 l/min for 2 row transplanter and 1.01 l/min for 3 row transplanter from the resting value. The work pulse in local practice is minimum *i.e.* 42 beats/min and maximum in 2 row paddy transplanter (63.6 beats/min) followed by 3 row transplanter (57.2 beats/min). Energy expenditure rate for 3 row transplanter is the highest (21.3 kJ/min) followed by 2 row (20.9 kJ/min) and manual practice (11.7 kJ/min). So the working heart rate is optimum in case of 3 row transplanter than the others. This higher energy expenditure results in fatigue after a small period of time where as lesser working heart rate results more effective time of work. The relative cost of work load (RCWL) which is the percentage of VO_{2max} of each subject was recorded to be 33.4, 57.8 and 59.6 for random transplanting, two row and three-row paddy transplanter, respectively.

Performance evaluation of different transplanting methods:

The force requirements in pulling the transplanter in forward direction by female subjects were 145 N and 108 N for 3 row and 2 row paddy transplanters, respectively. The field capacity of 2 row and 3 row transplanters and labour requirements is (0.03 ha/day, 33.34 man-days/ha) and (0.066 ha/day, 15.15 man-days/ha), respectively.

Conclusion:

The assessment between two transplanters revealed that the physiological response is reduced in 2 row paddy transplanter from that of 3 row paddy transplanter but the field capacity of three row transplanter is two times more than that of two row transplanter. The average field capacity was recorded minimum 0.03 ha/day in 2

Table 1 : Ergonomically parameters of transplanters			
Details	Local practices	2 row transplanter	3 row transplanter
HR _{rest} (beats/min)	68.7	68.6	68.9
HR _{work} (beats/min)	112.4	126.7	130.6
Work pulse (beats/min)	42.0	63.6	57.2
VO _{2rest} (l/min)	0.19	0.20	0.20
VO _{2work} (l/min)	0.5	0.8	1.01
EER (kJ/min)	11.7	20.9	21.3
RCWL (% of VO _{2max})	33.4	57.8	59.6
Continuous operating time (min)	56	32	28

row transplanter and maximum of 0.066 ha/day in 3 row transplanter. The continuous working time was recorded minimum of 28 minutes in 3 row and 32 minutes in 2 row transplanter and maximum of about 56 minutes in manual transplanting of paddy. Keeping all the physical, physiological and economical parameters into consideration the 3 row paddy transplanter was found to be the best among all transplanting methods. Hence three row paddy transplanter may be recommended for effective transplanting of paddy for farm women of this tribal district.

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■ REFERENCES

- Goel, A.C. and Verma, K.S. (2000).** Comparative study of directly seeding and transplanted rice. *Indian J. Agril. Res.*, **34**(3): 194-196.
- Khan, A.S. and Gunkel, W.W. (1988).** Design and development of a 6 row Korean transplanter. *Agril. Mechanization in Asia, Africa & Latin America (AMA)*, **19**(1): 27-34.
- Manjunatha, M.V., Masthana Reddy, B.G., Shashidhar, S.D. and Joshi, V.R. (2009).** Studies on the performance of self-propelled rice transplanter and its effect on crop yield. *Karnataka J. Agric. Sci.*, **22**(2): 385-387.
- Mohanty, S.K. and Ghosal, M.K. (2014).** Ergonomical Evaluation of manually operated paddy transplanter for female agricultural workers in the state of Odisha. *IJTA Serials Publications*, **35**:731-735.
- Obulamma, U. and Reddy, R. (2002).** Effect of spacing and seedling number on growth and yield of hybrid rice. *J. Res., Angraui*, **30**(1): 76-78.
- Patra, A.K. and Nayak, B.C. (2001).** Grain yield of rice under different spacings. *Indian J. Agron.*, **46**(3): 449-452.
- Pradhan, S. and Mohanty, S.K. (2014).** Ergo-Economical Analysis of Different Paddy Transplanting Operations in Eastern India. *IOSR J. Agril. & Vet. Sci.*, **6** : 23-27.
- Satapathy, G.C. and Mohanty, S. K. (2005).** Collection and compilation of anthropometric and strength data of male and female agricultural workers of Odisha. Annual Report of AICRP on Ergonomics and Safety in Agriculture, 1-10. Orissa Univ. of Agriculture and Technology, Bhubaneswar, India.
- Syedul, Md., Baque, M.A. and Ahmed, D.B. (2000).** Modification test and evaluation of manually operated transplanter for low land paddy. *Agril. Mechanization Asia, Africa & Latin America (AMA)*, **31**(2): 33-37.
- Tripathi, S.K., Jena, H.K. and Panda, P.K. (2004).** Self propelled rice transplanter for economizing labour. *Indian Farming*, **54**: 23-25.
- Yadav, R., Patel, M., Shukla, S.P. and Pund, S. (2007).** Ergonomic evaluation of manually operated six-row paddy transplanter. *Internat. Agril. Engg. J.*, **16**(3-4):147-157.

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