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Suitability of a Self-Propelled Pre Germinated Paddy Drum Seeder For Women Farmers

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ABSTRACT

Rice is the most important food crop in the world and is the staple food for more than half of the world population. Transplanting of rice seedlings, being a high labour-intensive and expensive operation needs to be substituted by direct seeding which could reduce labour needs and drudgeries with comparable yields. At present manually operated pre germinated paddy seeder is being used in certain rice tracts of Kollam district. Rice Research Station, Moncombu, Kerala Agricultural University developed a self-propelled paddy drum seeder by attaching the pre germinated drum seeder to a 8 row Yanji-Sakthi paddy transplanter. Therefore, a study was undertaken to evaluate the existing self-propelled pre germinated paddy drum seeder in rice growing tracts of Kollam district. Nine female subjects were selected, those having anthropometric dimensions conforming to statistical requirements based on the anthropometric survey. There was significant difference in heart rate in the operation of selected rice farming equipment. Minimum heart rate was observed in self-propelled pre germinated paddy seeder with a value of 120 beats/ min. Studies showed that operation of self propelled paddy drum seeder resulted in higher rice yield (34.43 q/ha) followed by manually operated paddy drum seeder (33.96 q/ha) and sowing in lines manually (32.49q/ha). The maximum discomfort was experienced by the subjects in the manual line sowing of paddy with a value of 6.1 and scaled as More than moderate discomfort. Lowest overall discomfort rating was observed in self-propelled pre germinated paddy drum seeder operation with a value of 5.0. The B:C ratio was higher for self-propelled paddy drum seeder (1.43), followed by manually operated paddy drum seeder (1.32) and sowing in lines ((1.23).The rest time, for achieving functional effectiveness during operation of self-propelled paddy drum seeder was found to be 10 minutes followed by 1 hour of work.

Key Words: Discomfort, Drum seeder, Heart rate, Machinery, Paddy, Woman, Yield.

INTRODUCTION

Rice is generally sown either by direct seeding or by transplanting depending upon the availability of water. Human energy is predominantly used in most of the rice farming operations starting from land preparation to threshing. Rice transplanting is a highly labour-intensive and expensive operation which can replaced by direct seeding that can reduce labour needs by more than 20per cent in terms of working hours required. In rice cultivation operations, during transplanting the women workers adopt strongly bent posture in the muddy field for a long time in sweltering weather. The continuously bending posture, putting support on knees and repetitive movement of hands for planting of seedlings in different environmental conditions cause more discomfort and develop risk factors. The developed risk factors leads to musculockeletel disorders (Ojha and Kwatra, 2014). So, direct seeding is much helpful due to less labour, drudgery and time requirement by skipping the operation of nursery raising and transplanting to the field manually.

Broadcasting of pre-germinated paddy seeds will results in non-uniformity in plant stand and difficulty in adopting the improved intercultural tools

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for weeding. Therefore, an introduction of efficient and inexpensive implement for line sowing of pre-germinated paddy is obvious. Baruah *et al* (2001) mentioned that the manually drawn 8-row drum seeder was one of the revolutionary equipment that changed the face of sowing paddy seeds in wetland fields. Direct paddy drum seeder has eliminated the need of transplantation and hours of manual work which literally broke the back of the farmers involved in sowing the paddy seeds to the field. At one stretch with single operator effort, it covers 8 rows of 20 cm row to row spacing at a time. The seed drums are made up of plastic material, which makes it easy to carry from one place to another. However, the operators have to walk during the entire period of operation in the muddy field. To reduce the drudgery, the existing self-propelled transplanter was modified by Rice Research Station, Mancompu in Kerala Agricultural University to accommodate the drum seeder and it was evaluated by the AICRP on farm Implements and Machinery at KCAET, Tavanur (Anonymous, 2017). The transplanting assembly was removed and a new transmission system was incorporated to attach the drum seeder so that the operator can comfortably sit and operate the drum seeder.

Men and women differ in their ergonomical characteristics and therefore, it is necessary to give due consideration to their characteristics while developing farm equipment suitable to them. Also, skill up gradation of women workers is necessary to enable them to operate the machines (Mehta *et al*, 2018). The safety and efficiency aspects of self-propelled pre germinated paddy drum seeder have not been studied for women and therefore, a study was undertaken to evaluate the existing self-propelled pre germinated paddy drum seeder for women farmers in Kollam district for more safety and output.

MATERIALS AND METHODS

Selection of Rice farming implements

Two rice farming implements such as manually operated pre germinated paddy seeder and self-propelled pre germinated paddy seeder were selected for the study for comparing the performance and also to assess the suitability of self-propelled pre germinated paddy seeder for women farmers of Kollam district.

Manually operated pre germinated paddy seeder

Pre germinated paddy seeder is a manually pulling implement developed by IRRI, Philippines, for line sowing of paddy. Tamil Nadu Agricultural University, Coimbatore has further simplified and improved by incorporating certain modifications in the design. This manually pulled implement covers 8 rows of 20 cm row to row spacing at a time. The seed drum is hyperboloid shaped with 20 cm diameter. There are eight numbers of seeding metering holes of 9 mm diameter. Baffles in the drum maintain the uniformity in seed rate. Nine numbers of seed metering holes of 10 mm diameter are provided along the circumference of the drum at the both ends for a row to row spacing of 200 mm. Baffles are provided inside the seed drum between seed holes resulting in uniformity of seed rate throughout the operation. These drums can be assembled together to sow 8 rows. A door is provided in the drum to fill the seed.

Self-Propelled pre germinated paddy drum seeder

A self-propelled pre germinated paddy seeder is a riding type machine operated by an air cooled single cylinder 2.94 kW diesel engine of the Yanji transplanter. Chinese design Yanji-Sakthi 8 row rice transplanter has eight rows with 23.8 cm row to row spacing and four standard positions (10-12cm, 12-14cm, 17-20cm and 20-23cm) for hill to hill spacing. The machine was provided with a three speed gear box for transplanting, planting and reverse speed. It had a crank type planting mechanism. The machine is provided with a pneumatic wheel in front and two smaller rigid rubber treaded steel wheels on the rear for transporting the machine. The existing improved

pre germinated paddy drum seeder developed at Tamil Nadu Agricultural University, Coimbatore was attached at the rear end of the machine. The transplanting arm and gear box unit of Yanchi transplanter was replaced by the drum seeder assembly. The drum seeder assembly contains drum seeder and a gear box with a chain drive unit. The power from the engine is transmitted to drum seeder gear box by a propeller shaft. The propeller shaft rotates at 200 rpm which was reduced to 70 rpm for drum seeder by using suitable sprocket and chain transmission.

Measurement of Heart rate

Heart rate measurements have a major advantage over oxygen consumption as an indicator of metabolic process. As the heart rate integrates the total stress on the body and responds more quickly to changes in work demand and indicates more readily the quick changes in body function due to changes in work environment, the physiological response was assessed through the measurement of heart rate while performing field operations.

Evaluation of Implements

The evaluation of the machines was carried out in the paddy field Nediyapadam Ela, Sooranad north, Kollam district, Kerala. The field was well-ploughed and puddled using power tiller rotovator and properly leveled. Water was drained out at least 24 hours before sowing to form hard slurry pan of the puddled soil. At the time of sowing only paper thin of water was maintained in the puddled field.

The manually operated pre germinated paddy seeder and self-propelled pre germinated paddy seeder were put in proper test condition before conducting the tests, i.e. in full working order with the drum filled to 2/3rd of its capacity. Nine women farmers were selected for the study. They were asked to report at the work site at 7.30 AM and have a rest for 30 minutes before starting the trial. To minimize the effects of variation, the treatments were given in a randomized order. All the subjects used similar type of clothing. The subjects were given information about the experimental requirements so as to enlist their full cooperation. The seeder was filled with Uma variety of paddy to be sown to its 2/3rd capacity. The heart rate was measured and recorded using heart rate monitor for the entire work period. Each trial started with taking five minutes data for physiological responses of the subjects while resting on a stool under shade. Each trial was carried out for 15 minutes of duration and same procedure was repeated to replicate the trials for all the selected subjects.

The physiological response of the subjects while sowing the seeds in lines was also assessed to compare the work load in farmers practice. The experiment was conducted in the adjacent plot of same field. The heart rates of the nine subjects were measured for comparison.

Overall discomfort rating (ODR)

For the assessment of overall discomfort rating a 10 - point psychophysical rating scale (0 - no discomfort, 10 - extreme discomfort) was used which is an adoption of Corlett and Bishop (1976) technique. A scale of 70 cm length was fabricated having 0 to 10 digits marked on it equidistantly (Fig.1). A moveable pointer was provided to indicate the rating. At the ends of each trial subjects were asked to indicate their overall discomfort rating on the scale. The overall discomfort ratings given by each of the nine female subjects were added and averaged to get the mean rating.

Body part discomfort score (BPDS*)*

To measure localized discomfort, Corlett and Bishop (1976) technique was used. In this technique the subject's body is divided into 27 regions as shown in Fig.2. A body mapping similar to that of Fig.2 was made to have a real and meaningful rating of the perceived exertion of the subject. The subject was asked to mention all body parts with discomfort, starting with the worst and the second worst and so on until all parts have been mentioned. The subject was asked to fix the pin on the body part in the order of one pin for maximum pain,

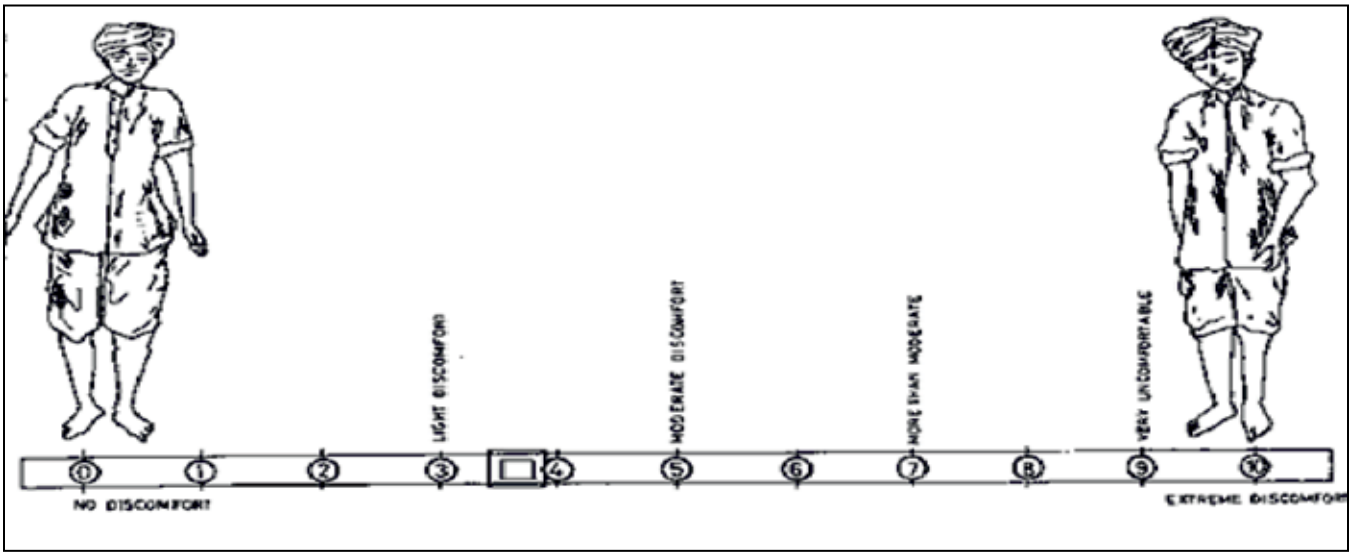

Fig.1: Visual analogue discomfort scale for assessment of overall body discomfort

two pins for next maximum pain and so on. The body part discomfort score of each subject was the rating multiplied by the number of body parts corresponding to each category. The total body part score for a subject was the sum of all individual scores of the body parts assigned by the subject. The body discomfort score of all the subjects was added and averaged to get a mean score.

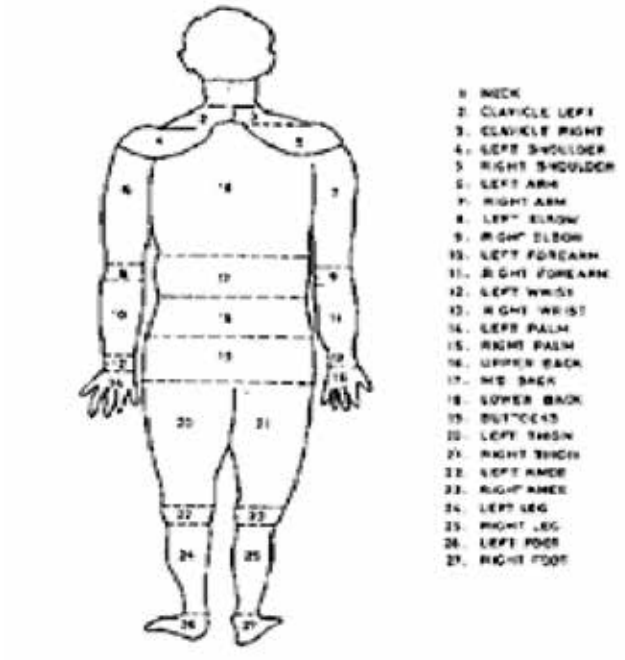

Fig.2: Regions for evaluating body part discomfort score

Work rest Cycle

During every strenuous work in field, adequate rest is required to have an optimum work output. Better performance results can be expected from the operator only when proper attention is given for the work rest schedule for different operations.

The actual rest time taken for each subject in all the selected equipment was found from the heart rate response of respective operations. The rest time was measured from the cease of the operation till the heart rate of the subject reaches resting level. The rest time taken was averaged to arrive at the mean value for each selected implement. The rest pause for each of the operation conducted in the present study was calculated theoretically using the Pheasant (1991) equation.

RESULTS AND DISCUSSION

Heart rate of operation

The mean heart rates of selected operations are furnished in Table 1. There was significant difference in heart rate in the operation of selected equipment. Minimum heart rate was observed in self-propelled pre germinated paddy seeder with a value of 120 beats/min. The heart rate recorded while operating manually operated pre germinated paddy drum seeder was 126 beats/min. Maximum

Table 1. Mean heart rate of selected operations.

Sr. No.	Selected operation	Average heart rate (beats/min)
1	Sowing in lines	128
2	Manually operated pre germinated paddy drum seeder	126
3	Self-propelled pre germinated paddy drum seeder	120

heart rate was recorded in traditional method of sowing.

In traditional method of sowing in lines, female subjects took a tedious bending posture. In the distorted posture, the muscles have to contact unnecessarily for holding the body erect. Such postures may also affect the pulmonary ventilation rate and increase the respiration frequencies to expel out the extra carbon dioxide produced in the tissues by increased metabolic rate. The major portion of energy expended is consumed in bending and walking in the puddle field. In the case of manually operated pre germinated paddy drum seeder, the subjects have to walk in the muddy field during the entire period of operation. The workers had to spend more energy for taking out their legs out of the puddle field at each and every step. However in self-propelled pre germinated paddy drum seeder, an operator's seat is provided to comfortably sit and ride the drum seeder.

Field Capacity and Yield

Among all technology options, operation of self propelled pre germinated paddy drum seeder gave the highest rice yield (34.43 q/ha) followed by manually operated pre germinated paddy drum seeder (33.96 q/ha) and for manual sowing in lines by 32.49q/ha. Area covered per day during operation of self-propelled pre germinated paddy drum seeder was 1.51 ha/day while using manually operated pre germinated paddy drum seeder it was only 0.81 ha/day and for manual sowing 0.4 ha/day.

Economics and Benefit Cost ratio

The highest gross return received from self-propelled pre germinated paddy drum seeder (Rs 101075/ha) followed by manually operated pre germinated paddy drum seeder (Rs 99900/ha), lower gross return was obtained with manual sowing (Rs 96225/ha). Similarly, the net return was also higher in self-propelled pre germinated paddy drum seeder (Rs 30272/ha), followed by manually operated pre germinated paddy drum seeder (Rs 24274/ha) and for manual sowing (Rs 11899/ha). The Benefit Cost ratio was higher for self-propelled pre germinated paddy drum seeder (1.43), manually operated pre germinated paddy drum seeder (1.32) and sowing in lines ((1.23).

Postural discomfort

The maximum discomfort is experienced by the subjects in the manual line sowing of paddy with a value of 6.1 and it is scaled as More than moderate discomfort. Lowest ODR value (5.0) was observed in self-propelled pre germinated paddy drum seeder operation. Body part discomfort score was minimum with a value of 26.6 for the operation of self-propelled pre germinated paddy drum seeder, while it was maximum with a value of 36.1 for the manual sowing. Body part discomfort score while using manually operated pre germinated paddy drum seeder was 35.8. This is further confirmative of earlier result arrived that Self Propelled paddy drum seeder was more comfortable to operate than manually operated paddy drum seeder.

Work rest cycle

The rest time of the subjects for the selected operations were calculated and compared with the actual rest time taken by the subjects in the field to reach the heart rate to resting level. It was observed that the average actual rest time taken by the subjects for the selected pre germinated paddy drum seeders and traditional method were in close agreement

with the computed value of rest time. The work rest cycle for achieving functional effectiveness of the selected operations and for maintaining or enhancing the human comfort were arrived.

The rest time, for achieving functional effectiveness during operation of self- propelled pre germinated paddy drum seeder was found to be 10 minutes followed by 1 hour of work. The rest pause for manually operated pre germinated paddy drum seeder was 14 minutes followed by 1 hour of work. The rest pause for traditional method was 16 minutes followed by 1 hour of work.

CONCLUSION

A self-propelled pre germinated paddy drum seeder was assessed for its performance and suitability to women farmers. Minimum heart rate was observed in self-propelled pre germinated paddy seeder with a value of 120 beats/min followed by manually operated drum seeder (126 beats/min) and manual sowing in lines (128 beats min^{-1}). The area covered per day during operation of self-propelled pre germinated paddy drum seeder is 1.51 ha/day while using manually operated paddy drum seeder it is 0.81 ha/day and for manual sowing 0.4 ha/day. The body part discomfort score value was maximum in the operation of manual sowing in lines, where as it was minimum in the operation of self-propelled pre germinated paddy drum seeder.

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