Performance and Evaluation of Six Row Self-propelled Paddy Transplanter under Different Puddling Methods

M. Murali*, M. Anantachar1, K. V. Prakash1, Sunil Shirwal1 and U. Satishkumar2

1Farm Machinery and Power Engineering Department, CAE, University of Agricultural Sciences, Raichur - 584104, Karnataka, India; murruaek919@gmail.com
2Soil and Water Engineering Department, CAE, University of Agricultural Sciences, Raichur - 584104, Karnataka, India

Abstract
Self-propelled rice transplanter was evaluated under different puddling has been conducted Agricultural Research Station, Gangavati during 2014-15. KUBOTA Model NSPU-68C (6 rows) transplanter was used in an experiment. This transplanter (Kubato Model) was in view to decrease the cost operation and it is used for transplanting purpose. The number of floating hills increased with an increasing level of puddling. The numbers of buried hills were reduced significantly with an increase in the sedimentation period as well as the both No. of passes. The field efficiency, field capacity, and fuel consumption of the transplanter were, 62.96 %, 0.54 ha/h and 4.29 l/h, respectively. The cost of operation of tractor operated disc puddler, rotovator and rotomixer was 484 Rs/h, 538 Rs/h, 551 Rs/h and cost of operation of transplanter is 965 Rs/h. Compared to manual transplanting of paddy the machine was found to be farmer friendly and feasible in terms of time, money and labour requirement.

Keywords: Floating Hills, Fuel Consumption, Missing Hills, Paddy Transplanter

1. Introduction
Paddy (Oryza sativa) is one of the most essential produce and staple food for millions of people which is grown in many countries across the world. The total area of paddy cultivation in India is 42.40 million ha, which is the largest in the world as beside the total area of 148.30 million ha. West Bengal has the highest paddy production, while Punjab has the highest productivity of paddy among the different paddy growing states of India.

The total area under paddy in Karnataka is 1.54 million ha with an annual production of 3.9 million tonnes and with a productivity of 2974 kg/ha. Transplanting is healthy and vigorous practice of produces uniform seedling stand with higher yield than traditional method.

Customarily with the help of manual transplanting paddy is mostly grown. Manual transplanting requires a large number of labours besides concerning drudgery and is also very expensive. Lack of labours availability is another major problem in most paddy growing region of
the country. Manual transplanting takes about 250-350 man h/ha which is about 25 % of the total labour requirement of the yield. Hence, there is a need of less expensive, farmer friendly and labour saving method of paddy transplanting. The mechanical transplanting of paddy have been considered the most promising alternative, as it saves labour, ensure timely transplanting and attain optimum plant density that contribute to high productivity. To overcome above mention problems, the study was conducted on self-propelled six row paddy transplanter.

2. Materials and Methods

A transplanter KUBOTA Model NSPU-68C (6 rows), was used in an experiment. It is a six-row rice transplanter suitable for mat type seedlings. The transplanter is operated in double acting mechanism. The transplanter consists of 17 hp air cool petrol engine powered with six spare seedling racks for filling of trays intermittently and it is provided with power steering. The adjustments involved in machine are number of seedlings per hill, depth of transplanting and hill-to-hill distance. During transplanting depth of transplanting was maintained from 2 to 5 cm. The row-to-row spacing is 30 cm, hill-to-hill distance 12 cm was fixed depending on desired plant population and operating speed 0-1.62 m/s was maintained. Specifications of self-propelled paddy transplanter are presented in Table 1.

The experiments were conducted during *kharif*, 2014-15 at Agricultural Research Station, Gangavati.

### Table 1. Specifications of Kubota transplanter KUBOTA Model NSPU-68C (6 rows)

| Sl. no. | Parameters                                | Descriptions                                    |
|---------|-------------------------------------------|-------------------------------------------------|
| 1       | Model                                     | NSPU-68C                                        |
| 2       | Type                                      | Ride on type 4 Wheel                            |
| 3       | Overall dimensions, mm                    | 3000 × 2210 × 2570                               |
| 4       | Minimum ground clearance, mm              | 430                                             |
| 5       | Weight, kg                                | 590                                             |
| 6       | Engine Model                              | GZ460-P-CHN                                     |
| 7       | Type                                      | 4 - cycle, water - cooled OHC Gasoline           |
| 8       | Power                                     | 17 Hp                                           |
| 9       | Applicable Fuel                           | Un leaded gasoline for automobile               |
| 10      | Fuel tank capacity, l                     | 17                                              |
| 11      | Starting method                           | Electric                                        |
| 12      | Battery                                   | 12V                                             |
| 13      | Fuel Consumption, l/h                     | 4-5                                             |
| 14      | Shifting system                           | Hydro static transmission ( HST)                |
| 15      | Steering                                  | Power steering                                  |
| 16      | Transplanting mechanism                   | Rotary, Forced Planting                         |
| 17      | Number of rows                            | 6 rows type                                     |
| 18      | Row to row spacing, cm                    | 30                                              |
| 19      | Hill space, cm                            | 12,14,16,18,21                                  |
| 20      | Planting Depth, cm                        | 2-5                                             |
| 21      | Number of hills per, m²                   | 90,80,70,60,50                                  |
| 22      | Seedlings height, cm                      | 8 to 25                                         |
| 23      | Number of leaves                          | 2-4.5                                           |
| 24      | Operation speed, m/s                      | 0-1.62                                          |
The selected variety of paddy for this study was BPT. The depth of water at the time of puddling was 10 cm. The mat density was measured from five randomly selected plants in mat density per cm²; the average mat density was observed to be 2.36 to 2.52 cm at time of planting. The maximum seedling height at the time of planting is 22.60 cm and 23.57 cm seedling height and minimum is at the base of seeding.

2.1 Field Preparation and Transplanting

The tractor drawn cultivator was used preparing the land for levelling in case of farmers practice. Second type of land preparation was puddling with rotovator followed by levelling using tractor drawn spike tooth harrow. The other one was puddling with rotomixture and levelling was done by using spike tooth harrow. Transplanting was done at different sedimentation period by the self-propelled transplanter.

2.2 Puddling Equipment

The puddling equipment are tractor drawn Cultivator disc puddler + spiketooth harrow (Balla) and Puddling with rotovator + spiketooth harrow (Balla) and puddling with rotomixture + spiketooth harrow (Balla) were used for puddling the experiment field. During the field tests the field parameters were recorded. The parameters relevant to machine performance determination and soil protection are measured. Procedure followed for calculation is discussed under the following section.

2.3 Missing Hills

It is the ratio of the total number of hills without seedlings to the total number of hills expressed in percentage and it can be calculated by the following equation².

\[ H_{pm} = \frac{H_m}{H_t} \times 100 \]

where,

- \( H_{pm} \) = Percent missing hills, per cent
- \( H_m \) = Total number of missing hills in the sampling area
- \( H_t \) = Total number of hills in the sampling area

2.4 Floating Hills

It is the ratio of the total number of hills floating after transplanting to the total number of hills expressed in percentage and it can be calculated by the following equation².

\[ \text{Floating Hills (\%)} = \frac{FH}{\text{TNH}} \times 100 \]

where,

- \( FH \) = Percent floating hills, per cent
- \( FH \) = number of floating hills, m⁻²
- \( \text{TNH} \) = Total number of hills in sampling area, m⁻²

2.5 Buried Hills

It is the ratio of the number of buried hills after transplanting to the total number of hills expressed in percentage. Buried hill were calculated by the following formulae.²

\[ \text{Buried Hills (\%)} = \frac{BH}{\text{TNH}} \times 100 \]

where,

- \( BH \) = Percent buried hills, per cent
- \( BH \) = number of buried hills, m⁻²
- \( \text{TNH} \) = Total number of hills transplanted, m⁻²

3. Results and Discussion

It was observed from the results (Table 2) that puddling method has influenced on floating hills. Floating hills are different for different methods. The Floating hills increased significantly when level of puddling increased from one to two passes in all treatment and the Floating hills is decreased with increased sedimentation periods. It was also noticed that Floating hills was more in case of disc puddler as compared to that other treatments. It was reported that the floating hills increased with an increasing level of puddling in the experiment. Similar readings are reported by². It was noticed that sedimentation period is increase the floating hill decreased for all treatments².¹

3.1 Missing hills

The missing hills is depends on machine performance. The missing hills increased significantly when level of puddling increased from one to two passes in all treatment and the missing hills is decreased with increased sedimentation periods. It was also noticed that missing hills was more in case of disc puddler as compared to that other treatments. It was observed from the Table 3.
3.2 Buried Hills

Effect of puddling methods (T), sedimentation period, (S) and No. of passes N1 and N2 on buried hills is presented in Table 4. The buried hills increased significantly when level of puddling increased from one to two passes in all treatment and the buried hills is decreased with increased sedimentation periods. It was also noticed that buried hills was more in case of disc puddler as compared to that other treatment. It was reported that the buried hills increased with an increasing level of puddling in the experiment9, it was noticed that sedimentation period is increase the buried hills decreased for all treatments7.

It was observed from the result is that the fuel consumption 1.43 l/h. and field capacity 0.42 ha/h, field efficiency 61.68 per cent. Cost of operation of self-propelled transplanter is calculated based on fixed cost and variable cost. It was observed that, cost of operation of tractor operated rotomixure was Rs.551 /h. Breakeven point and payback period were 113.8 h/annum and 2.06 years, cost of operation of tractor operated rotovator was Rs.538/h. Breakeven point and payback period were

### Table 2. Effect of puddling method, sedimentation period, and number of passes on, floating hills

| Sl. no. | Puddling Methods, T | Sedimentation Period, h | Floating hills, percentage |
|---------|---------------------|-------------------------|----------------------------|
|         |                     | N1          | N2          |                            |
| 1       | Disc puddler        | S1          | 4.48        | 5.28                      |
|         |                     | S2          | 3.06        | 3.36                      |
|         |                     | S3          | 1.92        | 1.96                      |
| 2       | Rotovator           | S1          | 4.15        | 4.66                      |
|         |                     | S2          | 2.58        | 3.21                      |
|         |                     | S3          | 1.50        | 1.65                      |
| 3       | Rotomixure          | S1          | 3.89        | 5.10                      |
|         |                     | S2          | 2.15        | 3.06                      |
|         |                     | S3          | 1.53        | 1.92                      |

### Table 3. Effect of puddling method, sedimentation period, and number of passes on, missing hills

| Sl. No. | Puddling Methods, T | Sedimentation Period, h | Missing Hills, Percentage |
|---------|---------------------|-------------------------|----------------------------|
|         |                     | N1          | N2          |                            |
| 1       | Disc puddler        | S1          | 5.27        | 6.50                      |
|         |                     | S2          | 4.36        | 5.82                      |
|         |                     | S3          | 2.60        | 3.57                      |
| 2       | Rotovator           | S1          | 4.32        | 5.71                      |
|         |                     | S2          | 3.17        | 4.60                      |
|         |                     | S3          | 2.28        | 3.58                      |
| 3       | Rotomixure          | S1          | 4.31        | 6.14                      |
|         |                     | S2          | 3.70        | 5.64                      |
|         |                     | S3          | 2.06        | 2.91                      |
96.44 h/annum and 1.87 years, cost of operation of tractor operated disc puddler was Rs.484/h. Breakeven point and payback period were 54.26h/annum and 0.97years. The transplanter was Rs.965/h. Breakeven point and payback period were 418 h/annum and 7.4 years.

4. Conclusion

Following conclusions are drawn from the study
- The number of floating hills increased with an increasing level of puddling.
- The number of buried hills increased with an increasing level of puddling from one to two passes.
- The numbers of buried hills were reduced significantly with an increase in the sedimentation period as well as the both No. of passes.
- The cost of operation of tractor operated disc puddler, rotovator and rotomixer was 484 Rs/h, 538 Rs/h, 551 Rs/h and cost of operation of transplanter is 965 Rs/h.

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