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Healthy mat type nursery of rice and

basmati rice for successful mechanical transplanting

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Rice occupies largest area among all the crops in India. Its cultivation is done on above 46 million hectares and it is grown mainly by manual transplanting method which is highly labour intensive. As the wages of labour are sky rocketing, the cost of cultivation of manual transplanted rice is also increasing at the same pace, in addition, manual transplanting is a time consuming method. Suboptimal planting density as compared with optimum planting density of 33 hill/m^2 and delay in transplanting of rice with this method leads to low crop productivity. These issues can be addressed by shifting transplanting method from manual to cost-effective mechanical planting technique. Different types of rice transplanters are available which have the provision to adjust the plant to plant spacing, number of seedlings per hill and depth of transplanting. However, the large scale adoption of mechanical transplanting of rice depends on successful raising of mat type nursery which seems tedious to farmers.

Keywords: Economics, Labour, Mat type nursery, Mechanical transplanting, Rice

TRANSPLANTED rice contributes nearly 90% to total rice production in India. However, production of transplanted rice is less remunerative as conventional practice of rice establishment involves huge man power for uprooting as well as transplanting of nursery. Shortage of labour during peak period of rice transplanting in north western India leads to hike in wages and late transplanting. Further, the adverse effects on yield are aggravated when less number of seedlings per unit area is transplanted by manual labour to accommodate more area in less time. Various studies showed that one month delay in transplanting can cause 25% decrease in grain yield of rice. Thus, mechanical transplanting proves to be profitable by lowering cost of cultivation and improving rice productivity as compared to manual transplanting. Different types of rice transplanters are available viz. self propelled walk behind type, self propelled single wheel riding type, self propelled four wheel riding type, etc., with the provision of adjustment of plant to plant spacing, number of seedlings per hill and depth of transplanting. On an average, 10 man hours are required for transplanting one hectare in case of mechanical transplanting with six-row self propelled rice transplanter as compared to 200 man-hours in case of manual transplanting, thus, ~75% saving of transplanting cost and ~94% saving in time. It is important to mention that for mechanical transplanting with rice transplanters, traditional nursery cannot be used but a special type of nursery called mat type nursery is required, and raising mat type nursery is considerably a cumbersome and skill based task. Experience and technical knowhow of farmers result into a great success in growing healthy mat type nursery and adoption of mechanical transplanting on a large scale.

Procedure for raising of mat type nursery

- Level the field properly after cultivation at field capacity.
- Then spread 90–100 cm wide polythene sheet of 50–60 gauge thickness having 1–2 mm diameter perforations and place one or more frames on it.
- Put the soil in the compartments of frames by taking uniformly from both sides of the frames and level it properly.
- Soil can also be prepared for filling in frame compartments by mixing sieved soil and farmyard manure.

Sowing of mat type nursery with customized drum seeder

- Then broadcast 50–60 gram pre-germinated seed per compartment uniformly so that 2–3 seeds can be ensured in one square cm.
- Manual or tractor operated roller/drum seeder can be used for even distribution of seed over frames.
- Tractor operated drum seeder makes 1 m wide beds and spreads 50–60 gauge thick polythene sheet of 1 m width over beds and uniformly broadcast seed after putting one inch layer of soil on polythene sheet.
- After seed placement, cover the seed with soil and sprinkle water slowly so that soil sets in the frames.
- After that, put off the frame carefully and place on next site for sowing of nursery as per the requirement using the same procedure.
- Polythene sheet of 15 m length is enough for raising nursery for transplanting one acre which weighs approximately 270 gram.
- Mat type nursery can be grown in trays instead of using polythene sheet and frames.
- Give light irrigation to the field carefully after sowing of nursery. Utmost care must be taken during first 2–3 irrigations so that the newly formed mats should not be damaged.
- Ensure that the mats should always have enough moisture.
- Ten days after sowing, spray 200 g urea by dissolving in 15 litre water which is sufficient for nursery required for one acre (150 mats).
- For transplanting of one acre, approximately 150 mats are required for which 10–12 kg seed is sufficient.
- Sowing of mat type nursery should be done at optimum time according to the variety of rice and basmati rice.
- Mats become ready for transplanting in 25–30 days.
- Few hours before uprooting of mats, water should be drained out.
- Mats grown on polythene sheet can easily be uprooted by giving cut on the marks of frames using sharp knife/blade.
- Size of compartments of frame should be according to the specifications of transplanter. The size should be 45 × 21 × 2 cm for engine operated transplanter and 58 × 28 × 2 cm for self-propelled machine.
- Two persons are sufficient to sow nursery for 3–4 acres in a day.

Laying of polythene sheet and iron frames

Transplanting with mechanical rice transplanter

In our experiments, six-rowed Japanese transplanter Model: NSPU-68 C was used which has the provision of plant to plant spacing of 12 cm, 14 cm, 16 cm, 18 cm and 21 cm and spacing can be changed with a simple hand driven lever given in the machine. Spacing of 30 cm × 12 cm found to be optimum with 4.7 and 12.2% increase in grain yield over 30 cm × 14 cm and 30 cm × 16 cm spacing, respectively and better weed suppressive ability for mechanically transplanted rice. Transplanting of 3 weeks-old seedlings of rice proved better than 4 and 5 weeks-old seedlings in terms of growth. Further, it was observed that mechanical transplanting of 3 weeks-old seedlings in conventional tillage without puddling with spacing of 30 cm × 12 cm resulted in higher grain yield and net returns as compared to manual transplanting as less cost of cultivation was incurred on mechanical transplanting and it also helped to attain highest energy use efficiency due to less energy input mainly on human resources and high energy output.

Similarly, mechanical transplanting of 3 weeks-old seedlings of basmati rice at 30 cm × 12 cm spacing recorded significantly higher plant height, dry matter accumulation, leaf area index and number of effective tillers/unit area than 3, 4 and 5 weeks-old seedlings at 30 cm × 16 cm spacing. The grain yield of mechanically transplanted 3 weeks-old seedlings at 30 cm × 12 cm spacing was 4.1 and 12.1% higher over mechanically transplanted 3 weeks-old seedlings at 30 cm × 14 cm and 30 cm × 16 cm spacing, respectively. Although the grain yield under mechanical transplanting of 3 weeks-old seedlings at 30 cm × 12 cm spacing was statistically similar with manual transplanting at 20 cm x 15 cm and 30 cm x 12 cm, but the net returns and benefit:cost ratio of mechanically transplanted 3 weeks-old seedlings at 30 cm × 12 cm spacing (₹ 77.58 ×

Table 1. Effect of age of seedlings and spacing on growth and yield of mechanically transplanted rice (pooled data of *kharif* 2010 and 2011)

Treatments	Leaf area index at panicle initiation	Tillers/m^2 at harvest	Dry matter accumulation (g/m^2) at harvest	Grain yield (q/ha)
Age of seedling				
3 weeks-old	4.39	431.1	1586.5	71.6
4 weeks-old	4.30	426.9	1519.4	71.8
5 weeks-old	4.04	420.5	1442.2	70.9
Spacing				
30 cm x 12 cm	4.53	441.6	1590.4	75.3
30 cm x 14 cm	4.27	422.2	1526.3	71.9
30 cm x 16 cm	3.89	414.8	1431.6	67.1

Source: Aggarwal N and Singh A. 2015. Crop performance, nutrient uptake vis-a-vis weed suppressive ability of mechanically transplanted rice (*Oryza sativa*) as influenced by age of seedlings and planting density. *Indian Journal of Agronomy* **60** (2): 255–260.

Table 2. Effect of mechanical and manual transplanting on grain yield, economics and energy use efficiency of rice (pooled data of *kharif* 2010 and 2011)

Treatments	Grain yield (q/ha)	Cost of cultivation (× 10^3 ₹/ha)	Net returns (× 10^3 ₹/ha)	Energy use efficiency
Mechanical transplanting in conventional tillage without puddling				
3 weeks-old seedlings at 30 cm x 12 cm	73.0	20.47	60.54	6.21
4 weeks-old seedlings at 30 cm x 12 cm	72.1	20.47	59.53	6.08
5 weeks-old seedlings at 30 cm x 12 cm	71.0	20.47	58.37	5.92
Manual transplanting after puddling				
4 weeks-old seedlings at 20 cm x 15 cm	70.5	24.42	53.84	5.69

Source: Aggarwal N. 2013. Performance of mechanically transplanted rice (*Oryza sativa* L.) as affected by tillage systems, age of seedlings, planting densities and nitrogen levels. PhD dissertation, Punjab Agricultural University, Ludhiana, Punjab, India.

Table 3. Effect of age of seedlings and spacing on grain yield and economics of mechanically and manually transplanted basmati rice (pooled data of *kharif* 2013, 2014, 2015 and 2016)

Treatments	Grain yield (q/ha)	Cost of cultivation (× 10^3 ₹/ha)	Net returns (× 10^3 ₹/ha)	Benefit: Cost
Mechanical Transplanting				
3 weeks-old seedlings at 30 cm x 12 cm spacing	33.3	21.47	77.58	3.61
3 weeks-old seedlings at 30 cm x 14 cm spacing	32.0	21.28	74.54	3.50
3 weeks-old seedlings at 30 cm x 16 cm spacing	29.7	21.13	67.86	3.21
4 weeks-old seedlings at 30 cm x 12 cm spacing	32.5	22.02	75.45	3.43
4 weeks-old seedlings at 30 cm x 14 cm spacing	31.7	21.83	73.04	3.35
4 weeks-old seedlings at 30 cm x 16 cm spacing	29.0	21.68	65.98	3.04
5 weeks-old seedlings at 30 cm x 12 cm spacing	32.3	22.57	73.93	3.27
5 weeks-old seedlings at 30 cm x 14 cm spacing	31.4	22.38	68.76	3.07
5 weeks-old seedlings at 30 cm x 16 cm spacing	28.3	22.23	62.73	2.82
Manual transplanting				
4 weeks-old seedlings at 20 cm x 15 cm spacing	32.4	24.94	71.50	2.87
4 weeks-old seedlings at 30 cm x 12 cm spacing	32.7	24.94	72.27	2.90

Source: Kang J S, Kaur J and Sandhu S S. 2019. Performance of mechanically transplanted *Basmati* rice (*Oryza sativa*) under different age of seedlings and planting densities. *Indian Journal of Agronomy* **64** (2): 200–03.

10^3 per ha and 3.61) was significantly higher than manual transplanting at 20 cm × 15 cm (₹ 71.50 × 10^3 per ha and 2.87) and 30 cm × 12 cm (₹ 72.27 × 10^3 per ha and 2.90) spacing.

Tips for growing healthy mat type nursery and smooth operation of transplanting with mechanical rice transplanter

- Selection of site for sowing of mat type nursery is very important. The site for sowing of mat type nursery should have fertile soil, assured irrigation facility and should be near to the fields where transplanting is to be done. There should not be any hard material like stones, twigs, etc. in the field selected for sowing of nursery and it should be at least 20 m away from the trees.
- Field for raising mat type nursery and mechanical transplanting should be leveled precisely with laser land leveler to avoid seedling mortality with excess or shortage of water.
- Before transplanting with mechanical transplanter, field should be well puddled and allow the puddle to settle down for 48 hours so that seedlings do not float in standing water and establish well.
- Height of nursery or age of seedlings should be optimum, otherwise it can interfere with operation of mechanical transplanting.

View of healthy mat type nursery

Transplanting of mat type nursery with rice transplanter

SUMMARY

The farmers can grow mat type nursery of rice and basmati rice easily by following the above said points for successful mechanical transplanting with rice transplanter. Mechanical transplanting can help in achieving sustainable production of rice as it is labour and energy saving technique if technical training is acquired regarding growing of mat type nursery and operation of mechanical transplanter in different type of soils.

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