

Mechanized sowing of mat type paddy nursery for mechanical transplanting

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Mat type nursery is a pre-requisite for mechanical paddy transplanting. Raising mat type nursery manually in open field requires many operations in series, starting from soil bed preparation to uprooting of grown up seedlings. It considerably consumes both labour and time with higher human drudgery. However, skill for raising mat type nursery in the field is the major bottleneck in the adoption of mechanical paddy transplanters in India. Hence, farmers are reluctant to raise nursery in this method. Also, the mechanization level is low (20%) in sowing/transplanting as compared to all other farm operations in paddy cultivation. Thus, Punjab Agricultural University, Ludhiana has developed a machine which is capable of accomplishing all the sowing operations required in mat type nursery in one go and can help in timely and uniform sowing of nursery for paddy. The developed machine is a forerunner to mechanical transplantation, which will avoid bending postures and rear walking.

Keywords: Farm mechanization, Mat type nursery, Nursery seeder

PADDY cultivation in India uses a lot of underground water. As a result of the looming underground water crisis in Punjab, the government passed legislation prohibiting paddy crop transplantation (before June 10). Due to the short window (20 days) for paddy transplanting, farmers face challenges in timely transplantation, either due to a lack of labour or due to the high rates sought by labour. The delayed paddy transplanting (after July 5) results in yield reduction. In addition, labour shortage is a major problem in Punjab. Primarily, paddy crop transplantation is done manually by migrant labourers from Bihar, Chhattisgarh, Orissa, and Uttar Pradesh. At present, the implementation of infrastructure schemes in various parts of the nation has created alternative employment opportunities for migrated labour. In the year 2011, farmers paid ₹6,000/ha to labours, but in 2021, they paid about ₹10,000/ha in addition to shelter amenities to ensure timely transplanting

of paddy. Moreover, the cost of production in paddy crop has increased and profitability has decreased due to rising wages in the past 4–5 years. This problem has been addressed collectively by Punjab government and Punjab Agricultural University (PAU), Ludhiana, Punjab while introducing mechanical paddy transplanters on subsidy basis to farmers and cooperative societies.

All mechanical paddy transplanters utilize mat type nursery for transplanting paddy seedlings. Mat type nursery for paddy is a pre-requisite for mechanized paddy transplanting. It can be easily rolled into a cylindrical shape for transport purpose and effortlessly served directly into the paddy transplanter. The uniform growth and dense mat can fulfill the requirement of mechanized paddy transplanting. Transplanting of paddy seedlings is done by the traditional method (human) or by mechanical method. This operation requires more man-h, higher energy

input and expects large amount of human drudgery due to bending posture. Apart from this, agriculture sector is at the door of labour scarcity throughout the country and is demanding mechanization. Labour shortage during the peak season of transplanting is being experienced in Punjab, which poses a huge constraint to transplant the seedlings in time. Alternatively, mechanical paddy transplanting saves up to 88% of labour requirement, but needs quality mat type nursery. This mat type nursery is either raised in plastic trays or on the open field. It is not cost-effective to raise nursery tray (due to the costly trays and its shorter life) to transplant paddy nursery in one season. In an open field method, 2 persons can sow mat type nursery for 2 ha in 1 day and about 50 m² nursery area is required for 1 ha paddy transplantation. Several operations are required for the manual method of raising mat type nursery. Therefore, to accomplish all the operations in one go a fast, easy,



Developed tractor-operated seeder for mat type paddy nursery

and then the frames are uplifted and the process is repeated. In case of the tray, instead of polythene sheet and frames, the trays are directly placed in line in the field and the same process is repeated for filling of soil, spreading of seed, spread of the layer of soil for protecting seed and spreading of water for settling mat of seed. The process is slow, cumbersome and involves drudgery, hence the farmers are reluctant to sow nursery in such method either in the tray or in the open field.

In order to cater the mechanization need and boost the adoption of mechanical transplanters, a tractor-operated seeder for mat type paddy nursery was developed. The machine cuts soil from both sides and transports it via inclined conveyor to the horizontally positioned soil conveying auger, which distributes the soil evenly on the sieving system. The sieving system deposits the soil in the hopper of the soil distribution unit, which is located beneath it. A soil compaction roller installed in front of the machine compacts the soil surface prior to the soil distribution unit. A polythene sheet roller was provided to lay down the polythene sheet on this compacted soil surface. Soil hopper has a soil metering roller that drops the soil at a uniform thickness on the laid polythene sheet. Simultaneously, a seed metering mechanism located at the rear of the soil distributing unit spreads the seed in a uniform manner on the prepared soil bed in one pass.

simple and cost-effective, innovative tractor-operated seeder for mat type paddy nursery was developed at PAU, Ludhiana, Punjab. This tractor-operated machine for sowing mat type nursery assists in timely sowing of nursery with reduction in cost and dependence upon labour as well as boosts the adoption of mechanical paddy transplanting.

Traditional vs. Mechanized sowing

Manual method for raising mat type nursery also requires a number of operations. A well-prepared seedbed is used for sowing mat type nursery. A 1 m wide polythene sheet of 50–60 gauge thickness is spread on the prepared field and steel frames (2 cm height) made of rectangular hollow steel pipes

(having frame compartment size for manually operated transplanter 400 mm × 200 mm × 20 mm, for engine operated transplanter 450 mm × 210 mm × 20 mm and for self-propelled transplanter 580 mm × 280 mm × 20 mm) are placed on this polythene sheet in line. Soil from the sides of the frames is filled in the compartments of frames with the help of a spade and is put in the frames placed over the sheet. The soil is levelled using a wooden scraper. Pre-germinated seeds are spread manually in each individual compartment to obtain a uniform seedling density of 2–3 seedlings/cm². The seeds are then protected by a thin layer of soil over it and water is sprinkled by hand sprayer for an appropriate setting of soil



(a)



(b)

(a) A working view of the machine (b) uprooted mat type paddy nursery (30 days after sowing)

Table 1. Comparative performance results for traditional and mechanized sowing method of mat type nursery

Parameter	Unit	Sowing method of mat type nursery	
		Mechanized	Traditional
Overall seed spread	%	90–91	90–91
Overall soil spread	%	97–99	95–98
Seed germination	%	90–92	90–92
Fuel consumption	l/h	4.5–4.8	-
Effective field capacity	ha/h	0.092–0.11	0.001

Machine performance

The developed tractor-operated seeder for mat type paddy nursery has been rigorously evaluated at multi-locations (Kapurthala, Ludhiana, Mansa, Samrala, etc districts of Punjab state) at different research farms, farmer's fields and KVKs during 2018–21. Seed distribution was termed as overall seed spread when more than two seeds fell at grid size of average bite of transplanter cut, i.e. 165 mm², while overall soil spread when soil mat thickness was more than 20 mm. The machine performs smoother and better at a forward speed of

1.7 km/h with sieve oscillations of 398 strokes/min and 80 mm depth of soil cut (Table 1). At this operational setting, overall seed spread was 90–91% and overall soil spread was found to be 97–99%. The average fuel consumption of the machine was 4.65 l/ha with field capacity of the machine being 0.092–0.11 ha/h (field efficiency of 65%). Soil mat thickness ranged from 24–27 mm for the mechanized method while 20–22 mm for traditional method. In both the methods, height of seedlings was almost similar (200–220 mm) after 30 days of nursery growth.

Sowing mat type nursery with

mechanized method saved 60–65% in cost and 90–95% in labour as compared to the traditional (manual using MS frames) method (Table 2). The developed machine is a precursor to mechanical transplanting, which will avoid labour with rear walking and bending posture. The yield reduction can be avoided with timely transplanting of paddy which ultimately improves the livelihood of farmers with more net income.

Technology status

Based on the demonstrative field results, ICAR and PAU have recommended its use through the package of practices. The prestigious Giuseppe Pellizzi Prize-2020 was awarded for the development of tractor-operated mat type nursery seeder by the Club of Bologna and Feder Unacoma, Italy. This technology has been commercialized and stakeholders are satisfied with its performance.

SUMMARY

Mechanized sowing of mat type paddy nursery can be carried out with tractor-operated mat type nursery seeder. This machine performs on-the-go multitasking starting from soil digging, conveying, sieving, lightly compacting bed, laying the polythene sheet, uniform placement of soil on polythene sheet followed by uniform seed spreading on the soil mat. Saving in cost and labour for sowing mat type nursery using a mat nursery seeder was observed to the tune of 60–65% and 90–95%, respectively as compared to traditional method. This technology is a success story of mechanization in mat type nursery for boosting mechanical paddy transplantation. There is higher demand by farmers for the developed technology in the region and they are satisfied with its performance.

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Table 2. Comparative economics and labour savings for sowing of mat type nursery

Parameter	Sowing method of mat type nursery	
	Mechanized	Traditional
Cost of operation (₹/day)	9000–9500	700–750 (with 2 labour)
Area transplanted with prepared nursery (ha/day)	72–80	2.0
Cost of preparation (₹/ha)	110–125	350
Labour required (man-h/ha)	0.08	1.5
Saving in cost (%)	60–65	-
Saving in labour (%)	90–95	-



Mechanical transplanting of rice using mechanically grown nursery

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