

Improved rice sowing and transplanting machinery to address labour shortage due to COVID-19

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Coronaviruses have been causing economic disruption worldwide and also slowed Indian economy by hitting industry and service sectors badly. India has crossed 2 lakh infected cases from COVID-19 within four months and increasing at an alarming rate. In the initial phase of lockdown, the infection was restricted up to cities, but now it is widely spreading among rural areas due to migration of people to their home towns. To perform agricultural operations during upcoming kharif season, large number of farm workers will be required. Therefore, safeguarding the agricultural workers from coronavirus spread is one of the biggest challenges during this period. Though government has published guidelines on Standard Operating Procedure (SOP) for farmers' safety during planting of kharif crops, farmers should be made aware about the availability of new technologies and techniques, which can possibly keep them away from infection. The present article emphasizes mainly on sowing and transplanting equipment for rice to address the problem of labour shortage caused due to Covid-19 pandemic and safety of agricultural workers during sowing/ transplanting of rice.

Keywords: Machinery, Mechanization, Rice, Sowing, Transplanting, Wet seeding

CORONAVIRUSES (COVID-19) are the single-stranded RNA viruses that cause respiratory tract infections, which may result in mild to lethal damage. Still there are no well proven vaccines or antiviral drugs to treat coronavirus infections. Therefore, prevention attains prime importance to secure human lives from this pandemic. Coronavirus spreads primarily through respiratory droplets of COVID-19 patient through coughing, sneezing, speaking or breathing out. The researchers have found that these droplets remain suspended for three hours in air or can live for hours or even days, if fall on some surfaces/land on whatever's nearby. If someone inhale these droplets or touch these objects or surfaces and then touch their own face, he/she may get infected. Coronavirus outbreak has slowed the progress wheel of Indian economy by forcing closure of industrial and service sectors in spite of very good

performance by agriculture sector. Mr. Ramesh Chand, Niti Aayog member has stated that "The farm sector will grow by 3% this year despite adverse conditions and it would add at least 0.5% to India's GDP growth in 2020-21" (Agribusiness, 2020). It brings some rays of hope during dark clouds of pandemic as agriculture employs more than half of India's workforce. Farmers' contributions during this crucial time are more critical than ever. In every urban and rural area's grocery stores have enough healthy food on their shelves, which is coming from extraordinary efforts put by farmers for functioning of food supply chains, but it has placed lot of burden on them to secure themselves from spread of COVID-19.

Most of the labours are in their home during lockdown, fearing the virus and facing wage disruptions. Even various industries are struggling to deploy 20% of their require

workforce. The uncertainty about labour availability is one of the causes of concern along with readily availability of inputs for farmers who doubt that whether there will be sufficient labours during paddy season. Shortage of agricultural workers amid Covid-19 may leads to increase in farming expenses to double. The nationwide lockdown to combat spread of coronavirus has already crippled harvesting of winter wheat due to shortage of labours and it is now set to affect sowing of *kharif* crops especially rice, a labour-intensive activity.

Rice is one of the important *kharif* crops apart from oil seeds, spices and cash crops, which require large number of farm labourers. Rice acts as a staple food for more than 50% of world's population. Worldwide, rice is grown on 167 million hectares, with an annual production of about 782 million tons of paddy (FAO, 2018). About 90.7% of the world's

rice is produced (640 million tons) in Asia (Ricepedia, 2020). In India, total production of rice during 2019-20 is estimated at record 117.47 million tonnes from 43.86 million hectares, which was higher by 9.67 million tonnes than the five years' average production of 107.80 million tonnes (The Economic Times, 2020). Average labour requirement for cultivation of rice is reported as 360 man-days/ha (Dhital, 2017). The situation is worst in state like Punjab and Haryana a rice bowl of India, which accounts for 15% (Affan Yesvi, 2020) of nation's entire rice production, depends on migrant labours coming from eastern states like U.P., Bihar etc. Many farmers from Punjab preferred cotton over rice this paddy season due to uncertainty of availability of nearly 10 lakh migrant workers (Financial Express, 2020). Therefore, the use of improved farm equipment for sowing of rice in *kharif* is of prime importance to address labour shortage due to Covid-19 pandemic as well as to safeguard them from this pandemic.

Various rice sowing and transplanting practices and equipment have been discussed in this article to address labour shortage and make the farmers to follow the SOPs.

Traditional practice of rice sowing/transplanting

The traditional method of rice cultivation requires ponding depth of water to facilitate land preparation and suppress weed growth thereby avoiding the use of herbicides or reducing the amount of labour requirement. Puddling followed by transplanting results in destruction of macropores, breakdown of soil aggregates and formation of hard pan at shallow depth. Transplanting of rice is labour, time and energy intensive activity as it requires 250-300 man h/ha, which is 25% of the total labour requirement for rice cultivation (Lal, 1985). During



Seed-cum-fertilizer drill

recent decades, international and national rice research institutes developed various new techniques for growing rice-aerobic, alternate wet and dry system, rice intensification and DSR (Direct Seeded Rice), which do not require ponding the field. DSR is of two types viz. dry seeding and wet seeding. Dry seeding of rice seed is done mechanically using a seed-cum-fertilizer drill in a well prepared seed bed or without any seed bed preparation. Manual dry seeding of rice is done either by broadcasting method or by dibbling method. In wet DSR, pre-germinated paddy seeds are sown in field using a drum seeder or broadcasting in wet field. DSR saves irrigation water, labour, energy, time and also reduces greenhouse gas emission, due to anaerobic decomposition of buried vegetation. Dry seeding allows early crop establishment, which reduces labour and time for crop establishment and risk from late-season water scarcity due to early harvesting. The labour requirement can be decreased to 3-5 man-days/ha with DSR compared to the 25-50 man-days/ha for transplanting of rice in puddled field (Kumar and Ladha, 2011).

Improved tools and equipment

Dry seeding: In DSR, care should be taken that sowing needs to be

done during 1-15 June in heavy textured soil to avoid yield loss due to late sowing. It requires seed rate of 25-30 kg/ha and nitrogen of 120-135 kg/ha in three equal splits at 4, 6 and 9 weeks after sowing. The spraying of 2.5-3.0 l of pendimethalin in 600 litres of water in moist soil within 48 h of sowing and 250 ml of bispyribac after 20 days of sowing leads to excellent control of weeds. Since the purpose of this article is to educate the farmers about mechanical sowing of rice, manual methods and practices of sowing have not been focused much considering SOP during COVID-19. The various

equipment used for sowing of rice in dry and well prepared field are discussed below:

Seed-cum-fertilizer drill: Seed-cum-fertilizer drill is used for sowing of various crops such as rice, wheat, sorghum, pearl millet etc. in well prepared seed bed with little modification as explained earlier. The seed-cum-fertilizer drill consists of a seed box, fertilizer box, seed and fertilizer metering mechanisms, seed tubes, furrow openers, seed and fertilizer rate adjusting lever and ground wheels. Fluted rollers fixed in the seed box, receive the seeds into longitudinal grooves and drop them in the seed tube attached to the furrow opener. Whereas gravity feed metering with agitator is used for delivering metered quantity of fertilizers. By shifting the rollers sideways, the length of the grooves exposed to the seeds gets increased or decreased, which varies the amount of seed to be sown. The machine usually comes with 9-13 furrow openers and operated by a 35 hp tractor.

Turbo happy seeder: Turbo happy seeder is prevalently used to drill wheat into loose rice residue mulch load of 8-10 t/ha (Gopal *et al.*, 2010), but can also be utilized for rice sowing under wheat residue with little modifications as discussed below. Moreover, disengage the



Turbo happy seeder



Seed-cum-fertilizer planter

power to rotor of the machine before sowing operation. It shreds the residues in the narrow strip in front of the tyne openers and places seeds and fertilizer using an inverted-T-type furrow opener. It is mounted on a three-point linkage system and is powered through the power take-off shaft of the tractor. The rotor has a horizontal transverse shaft with six to nine gamma type flanges, which helps in loose straw cutting by the action of impact force.

Seed-cum-fertilizer planter: Normal fluted roller-type seed-cum-fertilizer drills are being used for cereal crop sowing but these are less suitable for drilling of rice seeds as the seeds fall continuously without maintaining minimum distance of 2-3 cm. This makes it difficult to maintain the seed rate and plant-to-plant spacing as accurate and precise as that in inclined/cup/vertical plate type seed-metering systems (Gopal *et al.*, 2010). Seed-cum-fertilizer planter offers additional advantages of uniform sowing to achieve optimum plant population per meter square. In this equipment, the planting attachment consists of hopper, inclined plate metering mechanism fitted in the hopper, furrow openers, ground wheel, power transmission mechanism and seed tubes. Row to row spacing and plant-to-plant spacing is adjustable, which can be varied by shifting the rows and changing the

transmission ratio. It is mainly used for sowing of bold grains like maize, soybean, groundnut and cotton, etc. by changing the plates and now it is becoming popular for direct seeding of long grain rice as it reduces seed damages during planting.

In DSR, existing seed-cum-fertilizer drills or seed drills used in conservation agriculture can be adopted with little modifications. The procedure for modifying seed drill to match the required seed rate (25-30 kg/ha in hybrid seeds and 40-50 kg/ha in regular seeds) is explained as below:

- For DSR, rice seeds should be in water for 8-10 hours and then dried in shade for better germination.
- Fill the seed and fertilizer boxes by placing it on levelled ground.
- Open the slots of fluted rollers located at the bottom of seed and fertilizer boxes by adjusting respective control levers. Open the length of fluted roller enough to

avoid seed damage.

- Block the alternate slots of fluted roller with wax to lower the seed rate to 25-50 kg/ha.
- Jack-up the ground wheel and rotate it for 20 revolutions and collect seeds and fertilizer in polybag.
- Calculate the length to be covered by seed drill in 20 revolutions of ground wheel by multiplying perimeter of ground wheel with 20.
- Collect the seeds in polybags from each seed tube, separately.
- Calculate the desired quantity of seeds per unit length, which should be 16-20 seeds/m.
- Repeat the similar procedure until desired number of seed achieved.

Wet seeding

Despite knowing that DSR saves nearly 30% water and cost of operation, it has failed to attract farmers as farmers fear about uncontrolled growth of weeds and severe iron deficiency in crop. It is debatable issue that whether Covid-19 spreads through water or not and still there are no evidences of that. But, precautions have to be taken while engaging large work force for field preparation and transplanting of rice especially in puddled field. However, risk of spreading this pandemic may be reduced during sowing operation by mechanizing them with limited manpower. It is



Drum seeder

also challenging for farmers to shift on DSR from their traditional methods of rice sowing/transplanting operation. Therefore, selected machinery for transplanting and wet seeding have been also been discussed below to make farmers aware about all possible options for rice sowing.

Paddy drum seeder: Paddy drum seeder is used for line sowing of sprouted paddy seeds in puddled field at row to row spacing of 20 cm. Drum seeders are available for sowing of four and eight rows. They consist of drive wheels with lugs, drive shaft, hyperboloid shaped drums and swinging type pulling beam. The drum has 18 holes of 10 mm diameter for dropping the sprouted seeds in puddled field. About 40-50 kg/ha of seeds are required for sowing. The drum is filled with sprouted paddy seeds to half of its capacity. Then the lid of the drum is closed and locked. The seeder is operated at a walking speed of 1-1.5 km/h in the puddled field. During operation, the seeds get dropped through the holes. The weight of equipment is about 8.0 kg and its cost is about Rs. 5000/-. The paddy drum seeder saves 50% of seed compared to broadcasting of rice. It takes a day to sow one hectare of land. The introduction of paddy drum seeder reduces the cost of cultivation to Rs. 10000/ha and obtains yield in the range of 4.2 to 5.4 t/ha, which is 13 to 28% higher than that of conventional transplanting practice. Pre-germinated rice sown using drum seeder gets matured early by 10-15 days compared to transplanted rice. While understanding the use of paddy drum seeder, it is also necessary to know the supporting practices such as seed and land preparation as discussed below:

- Puddle the land and level thoroughly then drain out excess water before sowing, but do not let the soil surface become dry.
- To make seed ready for sowing using drum seeder, the seeds are dipped in salt solution (1-2 teaspoon salt/litre of water) so that damaged seeds floating on water surface are removed.
- The seeds are then washed with

normal water and soaked for 24 hours.

- The seeds are then taken out in a jute bag and kept in a dark and warm place with frequent sprinkling of water on the jute bag.
- The jute bag is opened on next morning and these sprouted seeds are used for sowing with the paddy drum seeder.
- Sow the seeds using drum seeder with uniform speed.
- Do not irrigate for 2-3 days after sowing to allow roots to anchor thereafter, increase the depth of water gradually as the seedlings grow but do not completely submerge seedlings to get wash out.

Rice transplanter: Rice transplanter is mainly of two types viz. walking type and riding type. Walking type rice transplanter is manually driven and can usually transplant two to six lines in one pass whereas, riding type is power driven and usually transplant six to eight lines in one pass. It mainly consists of float to facilitate the transplanter to slide over the puddled field, seedling tray on which mat type rice nursery is set, a seedling tray shifter that shifts the seedling tray like a carriage of typewriters and plural pickup forks that pick up a seedling from tray like human fingers and put it into the puddled field. During transplanting operation, the rice seedlings mat is

fed on the seedling trays. Then the tray shifts seedlings like a carriage of typewriters as pickup forks get seedlings from the tray and put into the ground. It has a provision to adjust row to row and hill to hill spacing and planting depth (15-45 mm) as well.

Walking type rice transplanter

Walking type rice transplanters are subdivided into two types viz. manually operated and power operated rice transplanters. These transplanters can use either root wash type rice seedlings or mat type nursery seedlings.

Manual rice transplanter

Manual rice transplanter is mostly preferred by marginal and small farmers because of its lower cost and higher transplanting capacity as compared to manual transplanting. The walking type transplanter is operated using push/ pull action of an operator in puddled field having no standing water. Operator has to perform various tasks simultaneously. A worker has to walk backward for operating the rice transplanter and pulls it after every stroke. After lifting the operating handle, it may be pushed down gently to push the seedlings kept in tray for transplanting. For transplanting of 20-25 days old mat type rice seedlings manually operated rice transplanter has been used. The field



Manual Rice Transplanter

capacity of walking type rice transplanter is about 0.015-0.035 ha/h. The cost of equipment is ranged between Rs. 6000 to 12000/-. It saves 70% in cardiac cost of worker; hence 282% productivity of workers is increased compared to traditional way of transplanting. A net profit of Rs. 1417/ha is realized by using manual transplanter over the hand transplanting but ergonomically, it is not suitable for continuous work under puddled field condition.

Hand cranking type rice transplanter

Hand cranking type rice transplanter is manually operated transplanter and requires one person for transplanting of root washed type rice seedlings. The operator walks backward for rice transplanting while cranking simultaneously. In this machine, the seedlings are loaded on tray horizontally after sprinkling little water for smooth sliding. The picking mechanism picks up the seedlings and transfers it to shifter-cum-erector mechanism, which enables the seedling to stand verticle in the puddled soil. It is useful over manual transplanting methods as it avoids bending postures and performs line sowing, which helps to perform intercultural operations. The equipment's cost is Rs. 15000 and it covers an area of 300 m²/h. It reduces 70.5% cost of operation and improves work output by 7.8 times over traditional manual methods of transplanting.

Power operated walk behind type rice transplanter

The acceptability of self-propelled paddy transplanter is low in India due to its higher cost and requirement of mat type nursery seedlings. Whereas manual transplanting of rice is time, labour and cost intensive operation. Therefore, power operated walk behind type rice transplanter provide solutions for both. It consists of petrol or diesel engine to provide power to driving wheel and transplanting mechanism. The mat type seedlings are

placed across the tray while picking mechanism pick up the seedlings due to cam action and get placed in soil at a depth of 40-50 mm by pushing mechanism. Power operated rice transplanter plants 34-40 hills/m². It gives the field capacity and field efficiency in the range of 0.035-0.045 ha/h and 40-45%, respectively. It saves 50% of time of operation over hand crank operated walking type rice transplanter.

Riding type rice transplanter

Mechanical rice transplanting is one of the best options for rice sowing under puddled field. It comes with single wheel as well as four wheels. The riding type transplanter employs a double acting transplanting mechanism for enhanced transplanting speed and in turn high field capacity. Self-propelled rice transplanter has a field capacity of 0.13-0.2 ha/h and transplant up to 1.2-1.6 ha/day compared to manual transplanting of 400-500 m² area in one day. The mat-type nursery preparation is one of the crucial operations before rice transplanting as it is labour intensive operation. Its cost of operation is Rs.1200/ha, which is five times lower than that of manual transplanting (Rs. 6000/ha). Mechanical rice transplanter offers additional advantageous of transplanting of seedlings at the optimal age (14-18 days), uniform hill spacing (26-28 hills/m) with optimum plant density (2-3 seedling/hill) and reduces fatigue, drudgery and health risks for farm labourers.

Preparation of mat-type nursery

- Sowing of mat type nursery

should be done 15-20 days prior to transplanting. To transplant one hectare of land use 20-25 kg/ha good quality treated seeds.

- Give a treatment of streptocycline @ 1g plus 10g gemisan per 10 kg seed. Dip the seeds in 10 litre of water and leave it for 8-12 hrs. After soaking, drain and cover the soaked seeds with gunny bags. Sprinkle water over seed after regular intervals and supply proper aeration. After about 20 hrs, the seed sprouts and is ready for sowing.
- A nursery bed of 50 m long and 1.2 m wide (60-80 m²) prepared on a well levelled field is sufficient for raising nursery for one hectare area. Spread an opaque 80-100 micron polythene sheet having perforations of required size on bed for oxygen and soil moisture supply.
- Prepare a mixture of weed free sieved soil and farm yard manure or vermi-compost or decomposed press mud in 4:1 ratio and spread on the plastic sheet with a layer of 1.5 to 2.0 cm. A soil mixture volume of 4 m³ is needed for each 80 m² of nursery. Place a wooden/iron frame of 50×100×2 cm divided into 4 equal segments on the plastic sheet. Fill the frame almost to the top with the soil mixture and level it. Spread 12 kg of open pollinated varieties or 9 kg hybrid seeds per 24 m² area uniformly at a depth of 2 cm and cover the seed with a thin layer (0.5 cm) of already prepared soil mixture.
- Supply sprinkled water up to 7-8 times a day up to 3-4 days in order to establish the mat type nursery, thereafter supply furrow irrigation from furrows made at the boundaries of bed. Stop irrigation 12 hours prior to transplanting.
- Application of 1.5 kg powdered DAP or 2.0 kg 15-15-15 powdered NPK fertilizer for every 80 m² of nursery area will help in faster growth that facilitate in



Hand-crank-rice transplanter



Riding type rice transplanter

transplanting of 15 days old seedling.

- In case yellowing of plants due to nutrient deficiency is observed foliar application of mixed solution of 0.5% zinc sulphate (21%) + 2.5% urea in 1.2 litres water is advisable, whereas in case of iron deficiency, foliar application of 0.5% solution of iron sulphate should be done. Once the seedlings get ready make the cakes of 60 × 20 cm size based on standard size of nursery platform of the transplanter.

Guidelines for agricultural workers during material handling, machine operation and sowing of operation

Though, a number of agricultural equipment are available for sowing of rice, it is not easy to make them available at farmers' field. It will also take time to convince them to adopt improved equipment. It is highly likely that some of them will continue the traditional sowing of rice using manual practices. The following SOP will be helpful to safeguard themselves from infection during sowing related activities.

- All farm equipment such as tractor, seed-cum-fertilizer drill, happy seeder etc. to should be sanitized before each use by keeping them under sun for 48 hours.
- For rice sowing, farmers should use tractor operated equipment to minimise labour requirement. If sowing is to be done by hand or manually operated equipment

then disinfection should be done either by keeping large equipment in sunlight or sanitizing small tools with soap water before and after use.

- Farm workers should wash their hands, legs and face with soap when coming out of the field for meal or rest.
- Safe distance of 1.5 - 2.0 m should be maintained during filling the seed, transplanting of rice seedlings either by machine or manually, loading and unloading of inputs, during rest, taking meals, etc.
- Workers should be assigned duties in shift with regard to farm activities.
- Those working in the farm should wear face masks or cover their face with three layers of "chunnis, gamchha" or towel.
- Workers should have separate utensils and clean them with soap after every use.
- Wash recycled seed and fertilizer bags with soap water and bury empty packets of agro-chemicals.
- Farmers should keep unused seeds in open, preferably under sun for 48 hours before storing.

CONCLUSION

Majority of farm operations especially in Kharif crops are labour intensive. At present, to perform agricultural operations on time without compromising the health of farmers is a big challenge due to faster rate of Covid-19 pandemic spread. Hassle-free and sustainable

agricultural operations and production will play vital role in achieving food security in near future. Mechanization of all agricultural operations will be the only solution to combat spread of Covid-19 through agriculture. Since rice is widely grown crop in India and world, adoption of machines will play a vital role in safeguarding farmers and agricultural labourers from transmitting Coronavirus during sowing of rice, which is a labour intensive operation. The adoption of tractor operated direct seeded rice drills, self-propelled transplanters and manually operated improved tools offer the advantages of achieving timeliness, precision and better input use efficiency in sowing of rice. The knowledge of preparation of seed material for paddy drum seeder and mat type nursery for mechanical rice transplanter are also equally important for better and hassle free sowing operation. Mechanization operation not only for sowing but also for all agricultural operations can make the people able to adopt and follow standard operating procedure published by government and to keep distance from this life threatening pandemic. While ensuring availability of agricultural workers for sowing operations, their safety from Covid-19 along needs to be prioritized.

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