REVIEW ARTICLE

# POWER OPERATED PADDY SEEDER FOR DRY AND WET SEEDING

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**Abstract:** Power operated paddy seeder is an important Seeding device of pre-germinated rice seed and dry seed increasingly considers and alternate to manual transplanting because of reduce labour and drudgeries, higher profit and comparable yields. The developed the power operated paddy seeder unit could be useful in eliminating drudgery in transplanting or pulling of manual drum seeder besides other advantages of pre-germinated line seeding. It is possible to reduce the seeding rate variation by maintaining a desirable drum fill condition. The crop and yield parameter of crop sown by develop unit, were comparable to transplanted and manual drum seeded crop; whereas they were better in comparison to broadcasted crop.

**Keywords:** Power operated paddy seeder, Pre-germinated, Dry seeding, Metering device

## INTRODUCTION

Rice (*Oryza sativa* L.) is an important food crop of India. Directed seeded rice plays an important role in satisfying the rice grain requirement of the people of the world. Transplanting of rice seedlings, being a high labour-intensive and expensive operation needs to be substituted by direct seeding which could reduce labour needs by more than 20 per cent in terms of working hours. For line sowing many designs of manual drum seeders have been fabricated but pulling capacity them on puddle fields involves drudgeries problem and is classified as heavy work. Direct dry seeding is one of the best methods under rain fed field condition. In the rainy season friable field conditions soil is available for limited period. If rains continue the soil becomes saturated. Under such circumferences using the conventional seed drill becomes difficult to operate due to clogging and chocking of furrow openers. Therefore it is necessary a machine which can be operated in both dry and wet field conditions.

### Dry Direct Seeding

Rao *et al.* (1973) reported from a comparative study of different planting methods on sandy soil during Kharif and Rabi seasons on a number of paddy varieties. It was observed from the experiment that the hand dibbling resulted in maximum yield during the two seasons. Venkateswarlu (1980) reported that soaked seeds for a period of 12 to 24 hr, which will increase weight by imbibing water, would not pose any problems for sowing. Nakamura *et al.* (1983) developed a new cultivation system called Direct Seeding with coated rice in submerged paddy (DSSP System). A successful operation of the DSSP system currently requires rice drilling, coating machine and chemicals necessary for the preparation of rice seeds and pyrazolate herbicide for initial weed controls. Maru and Sirripurapu (1986) reported that field trials of drilling of paddy seeds of different densities, in separate strips indicated that the seeds with density of about 1.7 g/cc could effectively be imbedded in puddle field when they were allowed to fall freely from about 10 cm height from the seed tubes of a drill. Park *et al.* (1998) reported that a corrugated furrow seed drill was developed for direct rice seeding at the National Yeongnam Agricultural Experiment Station (NYAES) Korea Republic between 1992 and 1999. The seeder is considered as a compromise direct seeding method for both the dry and water seeding. In dry seeding, seeding is carried out simultaneously either the corrugated furrow preparation. Corrugated furrows seeding has advantages such as improved lodging tolerance and reduced weed problems on the basis of regional yield trials and farmer's field trails over 4 years period this technology recorded an average milled rice yield of 5.19 t/ha, 14 % higher than that of conventional water seeded rice and 3 % higher than that of conventional dry seeded rice system. The technology is also reported to reduce labour cost (time) by 37 % and production cost by 17 % compared to machine transplanting with seedlings. Rautaray *et al.* (1997) reported that at higher levels of puddling the water content at all the depths were higher and the rate of decrease on water content was also reported with low over 24 hours of setting time. Senapati *et al.* (1988) tested six seeding devices plastic roller with small round depression for two different seed drills, drum with holes on the periphery, circular iron belt to regulate the size of openings, for two different implements and wooden roller with small round depressions mounted on the shaft for two different seed drills have been tested under dry land condition of broadcasting. In each case the amount of energy utilization in drilling the seeds and seed distribution efficiency were determined and grain yield on the experimental fields was observed. The placement of seeds at proper depth of 2.85 cm by seed cum fertilizer drill results in a better crop stand. The

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overall efficiency of seed cum fertilizer drill developed by the Department of Agriculture, Government of Orissa, was the highest and thus it was recommended for farmers of Odisha, to use seed drill for sowing paddy seeds under dry land situation. Kachroo (2006) observed that the direct wet seeding offers the advantage of faster and easier planting, minimize labour requirement and less drudgery, 7-10 days earlier crop maturity, more efficient water use and higher to water deficit less methane mission and often higher profit in areas with assured water supply.

**Direct Paddy seeder (Power Operated)**

Baqui and Lantin (1982) reported about the human energy expenditure in rice transplanting using the IRRI manual rice transplanted (model TRI) and the traditional hand transplanting method. Energy expenditure was determined by indirect calorimeter. The maximum energy expenditure per plant was reported to be much lower in machine (0.019 kcal) as compared to hand transplanting (0.069 kcal). Khan *et al.* (1989) reported that rice seedling withdrawal force was a good index of seedling anchorage in puddled soil. The study was carried out to obtain basic information on rice seedling and puddled soil characteristics needed for the rational design and development of bar root rice transplanter. The seedling withdrawal force was found to increase with soil aging. The effect of planting speed (strain rate) was found inconsistent on the withdrawal force. A minimum of 3 days of puddled soil aging and rice seedlings with 2 cm root lengths were found necessary for evaluating the performance of the root washed paddy transplanted. Gupta and Herwanto (1992) reported that to overcome high human stress and drudgery in transplanting operation, a direct paddy seeder to match a two-wheel tractor was designed and developed. The seeder has a working width of 2 m row length and 8 rows. It had field capacity of about 0.5 ha/h at forward speed of 0.81 m/sec and field efficiency of 78%. The seed rate was 15 to 20 kg/ha. Damage due to metering mechanism was nil for soaked seeds and 3 % of pre-germinated seeds. Sahoo *et al.* (1994) developed a six-row power tiller operated pre-germinated paddy seeder. The effective field capacity of this seeder was 0.168 and 0.114 ha/h for 9.9 cm and 25.3 cm hardpan depth, respectively. A net saving of Rs. 327/ha and Rs. 452/ha can be obtained by using the power tiller operated paddy seeder in lieu of the manual-hill dropping and transplanting methods. Jinfu (1997) developed a new direct paddy seeder at the Department of Agricultural Engineering, Huazhong Agricultural University. The performance test showed that the feed quantity could be adjusted from 30 to 150 kg/ha, the standard deviation of feed quantity was 2.95 g , the drilling rate was nil, the damage rate due to metering mechanism was 0.045 %, the field capacity was 0.67-0.8 ha/h, and the fuel consumption was 1.2-1.54 kg/ha. As compared with mechanical transplanting, manual broadcasting and manual transplanting the seeder obtained the yield of grain by 12.72-14.48 %, reduced production cost by 1.0-15 %, saved manpower by 27.0-484.5 men days h/ha, and increased net income RMB Yen 429.60-740.55/ha. Geo *et al.* (1997) developed the new seeder, which is used in direct paddy seeding. The high field capacity and low fuel consumption was founded (0.67-0.8 ha/h) and (1.2-1.5 kg/ha). As compared with mechanical transplanting, manual broadcasting and manual transplanting, drilling with the new seeder can increased grain yield (14.48 %, 12.72 %, and 12.96% respectively), reduced production cost, save manual power and increase net income. Dalin *et al.* (2005) developed a check valve mechanism as an attachment to a power tiller operated cup feed seeder in the Department of Machinery, Tamil Nadu Agricultural University, Result showed that the field capacity of the seeder with check valve (0.06 ha $h^{-1}$) was lesser by 11.2 to 34.5 % than that of the seeder without check valve. The field efficiency of the seeder with or without the check valve was almost the same, at ground approximately 70 to 75 %. Mathankar *et al.* (2006) developed a self propelled rice ridge seeder for pre-germinated seeding at Central Institute of Agricultural Engineering Bhopal. They reported that, the effective field was 5.3 t/ha and it was comparable to manual transplanting 5.7 t/ha and manual drum seeder 5.1 t/ha and it was higher than manual broadcasting 4.4 t/ha.

**Paddy Seeder (Manually Operated)**

Tewari and Datta (1983) have developed a manually operated 4-row sprouted paddy seeder in Agricultural Engineering Department of I.I.T. Kharagpur. It was reported to be capable of sowing 6 seeds per hill at a hill to hill spacing of 16.0 cm the average output of the machine was 43.2 kg/ha for paddy at a field capacity of 0.08 ha/h. The performance of the machine appeared to be satisfactory. Krishnaiah (1999) reported that the Directorate of Rice Research, Hyderabad India, developed a 8-row modified seeder in 1997-98. The cost of seeder was about Rs. 2000 and weight was only 12 kg. A single drum with 8-rows of holes was mounted on two wheels at the ends. The seed rate was adjustable to 50-75 kg/ha. Two workers were used for operating the machine in the field. The seeds were soaked for 24 hours and incubated for 24 hours before they were sown in the field. Patel *et al.* (1999) concluded that a manually operated 4-row seed drill developed for direct seeding of pre-germinated paddy. The drill was tested both in the laboratory and field for various conditions, and performed with average field capacity 0.114 ha/h, and 76.83 % average field efficiency at 1.8 km/h. The seed metering device resulted in 3.7 % seed damage according to the rice variety (3 varieties tested). The power required to pull the drill varied from 0.054 to 0.070 kW. Devnani (2002) reported in one of his reviewing the technology of pre-germinated paddy seeding that, the use of seeders for direct seeding as aerobic or anaerobic sowing of rice crop reduces the labour requirement in range of 5 to 14 man-hours per hectare. This value is very low as compared to 300 man-hours required for transplanting of rice seedlings under wet conditions. The experiments in India have shown that 4 to 5 t ha$^{-1}$ yields obtained under for dry seeded rice and 6 to 7 t ha$^{-1}$ for wet seeded crop. Lacayanga and Valdez (2008) revealed that manually operated four row rice hill seeder achieved an effective field capacity of 0.631 ha day$^{-1}$, field efficiency of 65.22 %, work capacity of 8.2 h ha$^{-1}$, seeding rate of 16-20 kg ha$^{-1}$ and missed hills of 13.79 %, seeding efficiency of 83.11 % and acceptable -6.12 % slippage. Devnani (2008) developed and evaluated a low cost two row pre germinated drum seeder of manually pull type that was able to sow the seeds in small ruts along the rows at a proper depth with seed rates of 127 to 215 kg ha$^{-1}$. At this seed rate, the plant stands in the test plots were in the range of 240 to 505 per sq meter. The four varieties of paddy that were sown through drum seeder resulted in crop yields of 3 to 4 tons ha$^{-1}$ which is close to the transplanted rice. Islam and Ahmad (2010) studied to determine the field and economic performance of machines and techniques for crop establishment in lowland paddy in Bangladesh. Result showed that the effect of rice seeding techniques, using pre-germinated rice seed of variety BR-1 on the effective field capacity, was highly significant. BRRI modified drum type row seeder, with a seeding rate of 60 kg per ha was shown to be better for an optimum crop yield. Sengar *et. al.* (2011) conducted the performance evaluation of rice cum green manure crops seeder and comparing the other seed drill. The study showed that the average tillering and plant population (No/m$^2$) at maturity were 5-6 and 268, respectively of RCGM. The field test result showed draft of 37 kgf with effective field capacity of 0.06 ha/h at field efficiency of 80 %. The mechanical damage of seed was found to be negligible. Ratnayake and Balasooriya (2013) conducted an evaluation study on the performance of new design conical drum seeder in the paddy fields in relation to manual broadcasting. The theoretical and effective field capacity, field efficiency and missing hill percentage were observed to be 0.22 ha h$^{-1}$, 0.18 ha h$^{-1}$, 81% and 3.7 %, respectively. The saving of pre-germinated paddy seed was about 75 % and increase in yield was about 37 % in conical drum seeder as compared to manual broadcasting. Karim (2014) designed and developed a drum seeder cum granular urea applicator. The field capacity of the applicator for applying seeds was 0.33 ha/hr and field efficiency was 86.75 %. The machine was very easy to pull because pulling force was only 11 kg. This is the main advantage over push type applicator. Overall performance of the applicator was reported satisfactory. Prakash *et. al*. (2015) carried out a study for fabrication and evaluation of 4-row drum seeder with seeder with 25 and 30 cm spacing in the same implement during kharif 2013. From the results 30 cm row spacing has got more yield and less operating cost which is more economical and suitable for farmers

**Calibration test**

Singh *et al.* (2016) study was conducted of performance Evaluation of manually operated paddy drum seeder in puddle field and the laboratory calibration was carried out and studied that laboratory calibration test the combination of half drum fill level and 1 km/h speed were selected for field evaluation of drum seeder. The theoretical field capacity 0.16 ha/h While effective field capacity of the drum seeder was observed to be 0.13 ha/h. The field efficiency of the seeder was found to be 82.08 percent. Chavan and palkar (2010) concluded from the laboratory calibration test, the combination of 75 % drum fill and 1 km h$^{-1}$ speed were selected for the field evaluation of drum seeder. The drum seeder was tested on puddled field. The theoretical field capacity was calculated as 0.2 ha h$^{-1}$ while effective field capacity of the drum seeder was observed to be 0.11 ha h$^{-1}$. Agidi and Moyosore (2014) developed a 12-row manually operated rice drum planter. A laboratory calibration was carried out with different combinations of drum fill *viz.*,1/2, 2/3, 3/4 and travel speed *viz.*, 1km/h, 1.2 km/h and 1.5 km/h. From the laboratory calibration test the combination of 2/3 drum fill and 1 km/h speed were selected for field evaluation of the drum seeder. The theoretical, effective field capacity and field efficiency of the machine were observed to be 0.38 ha/h, 0.33 ha/h and 86.8 % respectively. This performance indicates that the planter was suitable for adoption by small scale farmers.

**Seed Metering Device**

Sivakumar *et al.* (2006) reported that the hyperboloid drum shape was optimized with 200 mm drum diameter, 9 numbers of seed metering holes having 10 mm diameter of seed metering hole and 1.0 km h$^{-1}$ forward speed of operation. The seeder developed using the hyperboloid drum performed better when compared to the existing seeder. Kumar *et al*. (2009) conducted an experiment was conducted to design the complex flow rate of paddy rice through the orifices on the circumference of the horizontal rotating cylindrical drum of a hand tractor drawn or self-propelled drum seeder using regression analysis and Artificial Netural Network (ANN). Result show that the optimum drum configuration was found to be the one with 36 orifices of 6 mm diameter on its total volume. Optimum speed of rotation of drum was 61 rpm which resulted in the forward speed of operation of 4.6-6.9 km/h. Pradhan and Ghosal (2012) studied five different size of cups feed metering in seed drill *i.e.* 14.83 mm, 11.71 mm, 9.48 mm, 7.84 mm and 6.58 mm depths with diameters of 8 mm, 9 mm, 10 mm, 11 mm and 12 mm, respectively were prepared keeping the volume constant. It was found that the dimensions of cup of 10 mm x 9.48 mm were found best with a permissible peripheral velocity up to 23.56 m/min. and an overall efficiency of 80.94 per cent. The above dimensions of the cup may be taken to develop a suitable seed drill for use in the field condition for sowing of paddy seeds. Dabbaghi *et al.* (2010) studied effect of fluted roller seed metering device with upside feed mechanism on different rice varieties length (3, 4, 5, 6 and 7cm) and rotational speed (5, 10, 15, 20 and 25 rpm) of metering unit was investigated on seed flow rate, variation of seed flow rate and percent of damaged seed. Seed flow rate of pre-germinated paddy seed had a highly significant effect due to rice varieties, rotational speed, length of fluted roller metering unit and their interaction. For each type of paddy variety, the seed flow rate increased with increase in length and rotational speed of metering device from 3 to 7 cm and 5 to 25 rpm respectively. Average seed flow rate of Hashemi (2.91 g $s^{-1}$) was higher than Binam (2.65 g $s^{-1}$) and Hasan (2.44 g $s^{-1}$). Tajuddin *et al.* (1994) reported that an evaluated a low land direct paddy seeder and reported that, the paddy seeder could give 104 kg/ha seed rate for 28 holed opening and 138 kg/ha for 40m holed opening. Seed germination tests conducted with the seeder showed that germination of paddy seeds was not affected by continuous rotation of seed drum. Field tests showed that, the effective field capacity of the seeder was 0.12 ha/h with 63 per cent efficiency. Cost of seeding by the seeder was Rs. 585/ha as compared to Rs. 2060/ha for manual transplanting.

**Sprout length of pre-germinated seed**

Islam and Ahmed (1999) observed that the sprout length of seeds to be used in the drum type seeder was 1 to 2 mm achieved by incubating 24 to 36 hours after soaking during the monsoon seasons in Bangladesh. Srivastava and Panwar (1988) suggested that, pre-germinated paddy seeding in puddle soil is often recommended as an alternative to manual transplanting. The study was conducted to determine the effect of sprout length of pre-germinated paddy seed on the plant population, crop growth and yield. Plant emergence, crop growth and yield were found higher in treatment for sprouted seed as compared to dry and water soaked seed. Sprout length of 2-5 mm was reported to be optimum for maximum plant population and grain yield.

## SUMMARY

The literature is related the parameter of power operated paddy seeder such as metering device, sprout length, furrow opener, forwarded speed, and pulling capacity, seeding rate and yield parameters. The developed the power operated paddy seeder unit could be useful in eliminating drudgery in transplanting or pulling of manual drum seeder besides other advantages of pre-germinated line seeding. The concluded that it is possible to reduce the seeding rate variation by maintaining a desirable drum fill condition. The crop and yield parameter of crop sown by develop unit, were comparable to transplanted and manual drum seeded crop; whereas they were better in comparison to broadcasted crop.

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