

How to Use

1. **Checking field conditions:** Stubble shaving, off-barring/pruning, fertiliser cum seed application operations with MRD are best accomplished in well chopped trash retained fields with medium soil moisture. It does not work well in fields where moisture levels are too high. In this such situations care must be taken to prevent blockage of seed and fertilizer tube.
2. **Removal of drip system:** Removal of the drip lateral pipes before performing MRD operation from trash retained ratoon cane fields is essential.
3. **Calibration:** Calibrate the fertiliser/seed rate of MRD machine depending upon recommended basal dose of fertilisers to be applied and quantity seeds of selected intercrop in ratoon sugarcane.
4. **Spacing and depth control:** Adjust the spacing between off-bar cum root pruners and depth of shovel/ tines for seeding cum fertiliser application with help of adjustment screw before performing operation using tractor.
5. **Irrigation:** Apply the drip/furrow irrigation immediately after completion of MRD machine operations.

Precaution with the Technology

1. The MRD requires skilled tractor operator during transportation and field operations for obtaining high productivity in trash retained ratoon sugarcane fields.
2. The machine has to be operate in well trash-chopped fields only.

Cost of Technology

The maximum cost of MRD machine is upto ₹ 1 lakhs with all accessories. Net profit increased up to ₹ 50 thousand per hectare. Keeping in mind around

2.5 million ha area of sugarcane under ratoon crop, it is estimated that approximately ₹ 6.75-12.50 thousand crore per annum could be earned as an additional net profit by the farmers.

Technology spread

The technology is disseminating through field demonstration, KVKs, state departments and institute visits to more 14000 sugarcane farmers, sugarcane factories employees and entrepreneurs engaged in manufacturing of farm equipment.



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Technical Folder No. 49 (2022)

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Multi-Functional Ratoon Drill (MRD) Machine: Improving Yield, Juice Quality and Productivity of Ratoon Sugarcane



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Introduction

Ratoon sugarcane crop is grown on half (2.5 Mha) of the sugarcane area in India. Here, the management of high load (10-15 t ha⁻¹) and tough nature of loose trash generated after harvest is major challenge for implementing conservation agriculture (CA) practices. The sugarcane trash hinders most of the inter-cultural operations such as seed/fertiliser placement and thereby prevents intercropping. Moreover, surface retention of trash in fields while practicing CA in ratoon crop is continuously disliked by the farmers. Therefore, open-burning of trash is a common practice in ratoon sugarcane. This disturbs the soil biology, impairs natural geo-cycles, reduces overall fertility of the soil and contributes to environmental pollution. This also reduces ratoon cane yields by 25-30% relative to the fresh crop due to hindrance in inter-cultural operations. To address this issues three different prototypes of multifunctional ratoon drill (MRD) machine were developed and validated for their performance evaluation.

Brief Description of Technology

All three prototypes of MRD machine are tractor (35-65 hp) operated, driven by PTO and have provision to mount on three-point hitch linkages system. In addition to drilling of fertilizers (15-20 cm depth) and seeds of intercrop (5-7 cm) to soils, the machines were found suitable to perform various other operations *viz.*, trash chopping, stubble shaving, covering of trash with loose soil, off-barring and root pruning in a single go for sugarcane ratoon crop. In brief, all prototypes consisting three main components: (i) power transmission unit, (ii) central horizontal rotating disc attachment with fixed peripheral blades for stubble shaving and (iii) two vertical discs/shovels for off-barring along with root pruning cum seed-fertilizer placement mechanism. The spacing between two high carbon steel roots pruners/off bar mounted to the main frame is adjustable depending

on the row spacing used for planting sugarcane. Adjustable vertical off-bar discs/shovels cut the raised furrow (0.10-0.20 m soil depth) from outer sides and spread the lifted soil over the chopped trash. This also acts as root pruners for pruning of older roots. Fertilisers/seeds can be placed simultaneously through fertiliser box using fluted role-star wheel metering drill mechanism depending upon adjusted fertiliser rate (to specific intercrop) below the surface. Before use, all the prototype drill machines were calibrated for seed cum fertilizer application and tested for the operations of disc/shovel type off bar/root pruning/cutting mechanism at field conditions. Machine performances were evaluated in terms of growth, yield, juice quality and productivity of ratoon sugarcane in both institute and farmers' field's conditions, where comparisons were made with the usual practice of burning trash or its simple chopping and retention over the soil surface. At present more than 250 field trials/frontline demonstrations were conducted at NIASM and nearby farmers' fields. Most recently developed prototype-III of MRD was more compact and having advanced specifications over others prototypes including proto-II (SORF) upgraded and developed by ICAR-NIASM in collaboration with ICAR-IISR, Lucknow

Salient Features

The MRD machines are suitable to perform four-five major operations in a single run under chopped trash retained ratoon sugarcane.

1. **Stubble shaving:** Uneven stubbles which are left in the field after manual harvesting of sugarcane are cut very sharply at a uniform height close to soil surface with a stubble shaver.
2. **Off-baring:** Adjustable vertical off-baring discs/shovels of MRD cut the raised bed partially from outer sides and spread the cut soil over the chopped trash to accelerate its decomposition.

3. **Root pruning:** The side older roots of ratoon sugarcane are pruned to stimulate fresh root growth. The slush of newly developed roots promotes the uptake of water and nutrients for boosting initial growth of ratoon sugarcane.
4. **Placement of fertilizers:** A fertilizer attachment is utilized for band placement of fertilizer in ratoon sugarcane while retaining the trash at the surface.
5. **Sowing of intercrop:** A seed drill attachment is utilized for sowing of intercrop in ratoon sugarcane while retaining the trash at the surface.

Benefits/Utility

1. Timely completion of ratoon management and other allied operations with highest field capacity (0.60 ha h⁻¹) using 35 hp tractor at 3.2 km h⁻¹ operational speed.
2. Ratoon cane yield improved by 10-38%.
3. Healthier and more numbers of malleable canes and least tiller mortality rate.
4. Saving of 6-21% irrigation water and 20-25% fertilisers for ratoon sugarcane.
5. Band placement of fertilisers and sowing of intercrop like chickpea, sesbania and maize is possible depending on sugarcane harvesting window even in trash retained field.
6. Significant improvement in nitrogen use efficiency up to 13% and reduction in ammonia volatilization losses and N₂O emission makes the technology environment friendly.
7. Net profit increased up to Rs. 50000 ha⁻¹ and cost ratio increased up to 12.6%.
8. Improved root growth helps in mitigating the adverse effects of short-term water stress.
9. Improved the sugarcane juice purity and quality.