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RAISED BED PLANTER FOR BED PLANTING OF WHEAT

- A Success Story

भाकृअनुप
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1. Introduction

Bed planting system is referred to the planting and cultivation of crops on raised beds. Generally wheat and some other crops are planted on raised beds. Researchers from several organizations (DWR, Karnal; PAU, Ludhiana; CIAE, Bhopal; PDCSR, Modipuram; CCS HAU, Hisar, RWC-IGP and CIMMYT etc.) have reported that planting wheat on raised beds has improve yield, increased fertilizer use efficiency, reduced herbicides dependence, facilitated better weed management and mobility in the crop field for other cultural operations, less lodging of crops and saved seed, fertilizer and irrigation water. The total production cost compared to flat sown although found reduced marginally at the first planting on fresh beds but it has reduced by 25-35 per cent when the beds were reused. Bed planting technique is gaining acceptance by farmers because of more benefit-cost ratio compared to the flat sown crop and it is being assessed for its suitability in different parts of the country for different cropping systems.

2. Traditional practices for sowing of wheat

The traditional method is flat sowing of wheat either broadcasting by hand or sowing behind the animal drawn country plough by dropping seeds manually through a seed tube with funnel. For tractor farmers, the conventional practice is broadcasting the seeds and fertilizer by hand on a ploughed field and then mixing the seed and fertilizer with soil by one operation of a cultivator. With these methods the farmers generally use higher seed rate to compensate for the plant mortality due to non uniform placement of seeds with inadequate soil coverage. Further, due to broadcasting of fertilizer as basal dose during sowing, the weeds take the advantage and compete the crop from the beginning itself affecting thereby the initial stand establishment of the crop.

By use of seed cum fertilizer drill the seed and basal dose of fertilizer are metered uniformly in lines on well prepared seed bed for better stand establishment of the crop and yield. However compared to flat planting the raised bed planting has been found to be advantageous and is gaining acceptance by farmers.

3. Salient features of the raised bed planter

In view of specific advantages of bed planting system, raised bed planters have been designed and developed (PAU, Ludhiana/DWR, Karnal/CIAE, Bhopal) for planting of wheat on raised beds. The making of beds on well tilled soil, planting of seeds, basal application of fertilizer and covering and dressing of planted beds are done in one operation. For planting of seeds on permanent beds the same machine is also used for single operation and it adds the advantage of conservation tillage to the bed planting thus reducing the cost of planting compared to the flat sowing of wheat. The general specifications of the machine are given in Annexure-I.

4. Evolution/Design Process

Raised bed planting of wheat in India gained momentum in the late 1990s. At Punjab Agricultural University, Ludhiana while studying the bed size configuration on wheat yield (Dhillon 1994-95). The bed planter was developed for two bed widths with two/three rows of wheat planted per bed. Simultaneously the bed planting of wheat was assessed at DWR, Karnal with development of raised bed planter in collaboration with a manufacturer. As the farmers started adopting the bed planting technology the initial design of the raised bed planter was progressively refined to the site needs based on the feed-back from different front line demonstration programmes.

The modified version of the machine consists of the following:

(i) Provision for varying the spacing of furrowers to the main frame for different sizes of beds.

(ii) Provision of leveler ahead of furrow openers for smooth surface of bed prior to planting.

(iii) Provision of shaper after the planting unit to dress the beds to shape.

(iv) Planting on bed was adjustable for 2 or 3 rows.

(v) Provision with sweep type optional tines for early interculture in furrows.

(vi) The size/section of furrower and other critical components were reduced by 25-30% to make these light weight and easy to handle.

5. Performance of raised bed planter for bed planting of wheat

The raised bed planter was evaluated for planting of wheat in friable black soils after three tillage operations (Fig. 1). The shape of bed was trapezoidal having top width, base width and height of 320, 600 and 125 mm respectively. The shape of furrow was triangular having width and depth in reference to the top of the bed for 340 and 210 mm respectively. However, the size of bed and furrow may vary depending on the soil type and condition of the soil during preparatory tillage.

Comparison of raised bed planting and flat sowing of wheat with preparatory tillage

Sl. No.	Particulars	Bed planting of wheat using raised bed planter			Flat sowing of wheat using seed cum fertilizer drill		
		Preparat-ory tillage	Bed plantin g	Total	Preparator y tillage	Flat sowing	Total
1	Time required, h/ha	8.0 -3 tillage	5.0	13.0	6.6 -3 tillage	2.7	9.3
2	Cost of operation, Rs/ha	1278	1000	2278	1188	494	1682
3	Direct (operational) energy used, MJ/ha	1333	995	2328	1239	507	1746
4	Soil condition	Moisture content = 20.58%db Bulk density = 0.98 g/cc MWD of clods = 16.56 mm Depth of tillage = 142 mm			Moisture content = 20.72%db Bulk density = 1.05 g/cc MWD of clods = 22.34 mm Depth of tillage = 114 mm		

Fig 1 Field operation of raised bed planter for bed planting of wheat

The effective field capacity of the machine for fresh beds was 0.2 ha/h and its cost of operation with 45 hp tractor was Rs. 200/- per hour. The time, cost and operational energy use per hectare of bed planting with preparatory tillage were found 28.5, 26.2 and 25.0 percent higher respectively compared to the flat sowings. It was because of the fact that the required deep ploughing and straight ahead operation of the bed planter for fresh bed planting were time consuming compared to the conventional tillage and seeding operations for flat sowings.

By reuse of beds the bed planting operation was found to be energy efficient and cost effective compared to the conventional flat sowing of wheat with preparatory tillage. The reuse of beds for rice after harvest of wheat is being evaluated.

Comparison of bed planting on permanent beds, zero till drilling and flat sowing of wheat.

Sl. No.	Particulars	Planting on permanent beds	Zero-till drilling	Flat sowing with conventional tillage	Percent saving over flat sowing with conventional tillage	
					Planting on permanent beds	Zero-till drilling
1	Time required, h/ha	3.2	3.5	9.3	65.6	62.4
2	Fuel used, l/ha	11.2	14.0	30.7	63.5	54.4
3	Cost of operation, Rs/ha	645	665	1682	61.7	60.5
4	Direct (operational) energy used, MJ/ha	637	811	1746	63.5	53.5

Compared to zero-till drilling the bed planting operation by reuse of beds was also found advantageous in terms of savings in time, operational energy and cost of operation. However the performance of crops on reused beds is under evaluation to workout the cost-effectiveness of the system.

Three rows of wheat were planted shallow (depth of planting = 40 mm) at inter-row spacing of 150 mm on each bed with 80 kg/ha seed rate and fertilizer dose of N:P:K::90:30:15 kg/ha based on soil test. First irrigation (30 mm) was applied after 3 days of planting for proper germination and emergence of crops. Other cultural operations were similar to that of flat sown crop.

The performance of bed planted wheat (Figs. 3 and 4) was found superior to the flat sown in respect of growth and active tillers. Mechanical weeding was easy in furrows at early stages of the crop. Irrigation was applied for 330 mm of water compared to 500 mm in flat sown. The variety HI-8498 performed well on beds and could compensate for the gaps (furrow) between the beds in terms of required plant population at harvest with higher yield attributes.

Fig 2 Raised bed wheat (HI-8498) after 25 days of planting

Fig 3 Raised bed wheat (HI-8498) after 45 days of planting

Fig 4 Raised bed wheat (HI-8498) after 90 days of planting

Production economics and operational energy use in bed planted and flat sown wheat.

Parameters	Bed planted	Flat sown
Grain yield, t/ha	4.80 (385)	4.65 (356)
Cost of production*, Rs/ha	9770	10332
Benefit-cost ratio	3.00	2.75
Operational energy, MJ/ha	6363	6927
Specific operational energy, MJ/kg	1.32	1.49
Specific cost of production*, Rs./kg	2.03	2.22

() Figures in parenthesis show plant population with active tillers per sq.m at harvest.

* Sale price of wheat (HI-8498), Rs/kg = 6.10.

The production economics showed 8.3% higher benefit cost ratio and 8.1% lower operational energy use in bed planting system with savings in seed, fertilizer and irrigation water compared to flat sown wheat.

Advantage of bed planting of wheat over flat sowing

Particulars	Bed planting	Flat sowing	Percent savings/benefits
Seed, kg/ha	80	100	20
Fertilizer* , N:P:K, kg/ha	90:30:15	120:40:20	25:25:25
Irrigation water, mm	330	500	34

*Based on soil tests

Planting on permanent beds may however further reduce the operational energy and cost of cultivation for increased benefit cost ratio.

6. General useful hints for use of raised bed planter

i. Preparatory tillage may be done at friable condition of soil to avoid clod formation and a deeper tillage (150-200 mm depth) is desirable.

ii. Sowing on beds by use of bed planter may be done shallow (depth of sowing : 40-50 mm) and covering of seeds may be ensured for proper seed-soil contact.

iii. Seed rate of 80 kg/ha is sufficient for wheat and it would give average of 30 plants per meter length of row on beds.

iv. Basal dose of fertilizer (P and K full and one third of recommended N) may be applied during sowing and the balance top dressed in two splits.

v. 75 percent of the fertilizers recommended for flat sown wheat is sufficient in bed planting for yield average of 4.8 t/ha.

vi. First irrigation (30-40 mm) may be applied after 3/4 days of planting to ensure proper germination and emergence of crops.

vii. Application of irrigation water may be frequent depending on soil type and weather conditions but the total water requirement for wheat may not exceed 60-70 percent of what is required for flat sown crop.

viii. First weeding may be done by improved weeders in furrows after 20-25 days of sowing and subsequent weedings may be done by moving through the furrow spaces.

7. Facts at a glance about raised bed planter

Bed planting compared to flat sown cultivation of wheat.

- Improves yield by 05-10%.
- Saves seed and fertilizer by 25-30%.
- Saves irrigation by 30-35%.
- Prevents lodging of crop.
- Facilitates easy mechanical weeding and reduces herbicides dependence.
- Higher benefit-cost ratio.
- More energy efficient and cost effective when planting is done on reused/permanent beds.

8. Precautions for proper operation of the raised bed planter

- Check the machine components such as furrowers, seed/fertilizer units, leveler and shaper for their proper orientation and alignment with the main frame.
- The machine may be properly hitched to the three point linkage of the tractor by adjusting the top link.
- The sprocket-chain system should be properly tightened and aligned with the drive wheel for positive rotation of seed/fertilizer metering shafts.
- The seed must be clean and graded and fertilizers be free from clods for smooth metering. As far as possible use only granular fertilizers which meter easily and uniformly.

- Calibrate the machine for metering of required quantity of seed and fertilizer.
- The furrow openers for placement of seed/fertilizer should be in between the furrowers ahead. The furrow openers may be adjusted as per crop row spacings desired. The furrow openers may be a shovel type for loamy soil and shoe edge type for heavy soils. See carefully that the furrow openers do not choke with moist soil or carry trash underneath. Check the depth of sowing of seed/fertilizer by removing the soil from the sown line.
- To train the operator for straight ahead operation and to place the machine at the headland for subsequent passes the machine may be operated for some time in the field for practice before actual planting is done.
- The depth of operation of the machine should be limited to the depth of the tilled soil to avoid excessive draft load on the tractor.
- For planting on permanent beds the tractor wheels must run on the previously created furrows so that the beds are reshaped by the furrower and shaper simultaneously during planting.

9. Care and maintenance of the raised bed planter

- Ensure shape of the components/parts against bending and dislocations.
- Repair/replace the broken parts and keep tightening the nut/bolts as and when required.
- Clean throughly the seed and fertilizer boxes and the metering devices after the day's work.
- Lubricate the parts of the machine periodically.
- The machine especially the seed and fertilizer boxes may be painted after the planting season to avoid corrosion and rusting.
- The transmission parts should be regularly cleaned, oiled and protected from dust.
- The machine should be properly stored for protection against rain and dust.

1[illegible] Status of the technology

The raised bed planter was tested for bed planting of wheat after harvest of rice and soybean. The machine has been used for bed planting of wheat in nearly 100 ha (1999-2000 and 2000-2001) on farmer's fields in Punjab, Haryana, Uttar Pradesh, Madhya Pradesh and Bihar under the National Agricultural Technology Project (NATP) - Rice Wheat Mechanization.

Under the Department of Agriculture and Co-operation (DAC) - Indian Council of Agricultural Research (ICAR) central sector scheme Front Line Demonstrations (FLD) of raised bed planter have been implemented in 12 states (Punjab, Haryana, Uttar Pradesh, Uttranchal, Bihar, Madhya Pradesh, Chhattisgarh, West Bengal, Rajasthan, Himachal Pradesh, Assam and Jammu and Kashmir) through 24 locations in which 30 number of raised bed planters are under demonstrations in farmer's fields with target area of 300 hectares.

List of Selected manufacturers of raised bed planter is given in Annexure-II.