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Raised Bed Planter for *Kharif* Pulse Cultivation in Assam

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Raised beds are formed by moving soil from the furrows to the area of the bed with a raised bed planter, thus raising its surface level. The furrows serve as irrigation channels, drains and traffic lanes. Changing from flat to bed layouts alters the hydrology of the system and allows greater control of irrigation, better surface drainage and possibly better capture and use of rainfall. The irrigation water moves laterally from the furrow into the bed, and is driven upwards towards the bed surface by evaporation and capillarity, and downwards largely by gravity. The altered hydrology affects nutrient transformations and transport. For example, transport of solutes towards the surface of the beds can create problems such as salinisation of the seed zone and reduced availability of nutrients to the crop. Normally only the top of the bed is planted, in defined rows, but in some situations the furrows or sides of the beds may also be planted. Assam receives very high rainfall during kharif. The kharif pulse cultivation therefore is always risky. There is possibility of poor germination because saturated soil moisture condition and even inundation because of water logging. Raised bed planting will be good strategy for risk reduction for sustainable pulse production in Assam during kharif season by facilitating drainage. A tractor operated raised bed planter will make the planting easier, drudgery less and cheaper

Construction and specification:

The machine (Raised Bed Planter) consists of a frame, fertilizer box, multi-crop sowing attachment, furrow openers, ridger for making beds, leveler and roller type bed shaper. The machine has a trapezoidal hopper and seed metering unit. A suitable furrow opener system is equipped with the machine to place the seeds at the bed at desired depth. The machine conventionally makes two beds each of 67.5 cm base width, 35 cm top width and slanting height of 20 cm. However the width may be adjusted. Power transmissions to the metering unit are through a ground wheel by chain-sprockets

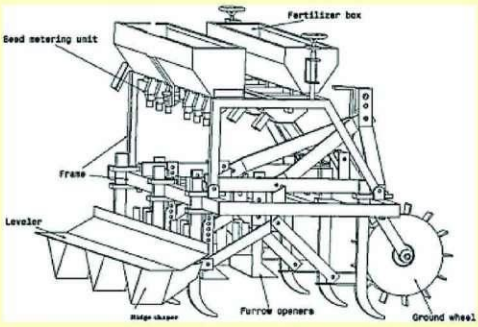


Figure 1: Isometric view of raised bed planter

system. The fertilizer box is fitted on the mainframe with cup feed metering mechanism. The power to the seed metering is transmitted from the spiked ground wheel through chain and sprocket and set of bevel gears. The power transmission wheel is fitted with a tensile spring, which helps in avoiding slippage and that subsequently reduce missing rows in unleveled fields. The machine can act as a zero tillage planter when the shaper is removed and tines are spaced on the three bars. Added spacing provided by the 3-bars, eases loose residue-raking problem of the machine. An isomeric view of the planter is shown in Figure 1 and the detail specifications of functional components of the same are given in Table 1.

Table 1: detail specifications of functional components of the machine

Particulars	**Specification**
Type	Tractor operated 6 row on 2-bed
Reported field capacity (ha/h)	0.3–34
Source of power (hp)	45 (34 kW)
Overall dimensions ($L \times W \times H$) (mm)	2080 × 1870 × 1350
Weight (kg)	270
Shape and size of frame	Rectangular (tubular: cross section 50 mm × 50 mm) Size: 2080 mm × 685 mm
Furrower for beds	
Number	03
Size (length × width) (mm)	600 × 370
Spacing (mm)	730
Furrower openers for seeding	
Type	Shoe edge type
Size (mm)	40
No. of tynes	06
Spacing (mm)	150
Drive wheel	
Location	Front-center
Size (diameter × width) (mm)	450 × 80
No. of lugs	12
Lug spacing (mm)	90
Lug height (mm)	40
Power transmission	Sprocket and chain system
Seed metering	
Type	Fluted roller type

Seed metering	
Type	Fluted roller type
No. of fluted rollers	06
Size of fluted roller (diameter × length) (mm)	50 × 45
No. of flutes	10
Size of flutes ($L \times W$) (mm)	45 × 10
Size of seed box ($L \times W \times H$) (mm)	1250 × 260 × 200
Fertilizer metering	
Type	Cup feed type
No. of cups	10
Diameter of cup roller (mm)	140
Size of fertilizer box (L × $W \times H$) (mm)	1250 × 260 × 200
Leveler's shape and size (length × diameter) (mm)	Round pipe section, 1150 × 30
Shaper's shape	Trapezoidal section for bed and triangular for furrow
Top width (mm)	340
Base width (mm)	640
Height (mm)	150
Slope (°)	45
Materials of construction	
Furrower	Mid steel (M.S.) flat and sheet
Frame	MS flat square pipe channel and
Seed metering unit	Sheet
Fluted roller	MS sheet and angle
Fertilizer metering unit	Aluminum compound
Box	MS sheet and angle
Fertilizer metering roller	Cast iron
Seeding tynes	MS flat, sheet and pipe

Experience at AAU:

Studies were undertaken to test and evaluate tractor drawn Raised Bed Planter under AICRP on Farm Implement and Machinery, AAU, Jorhat Center during 2014 & 2015 with concurrent front Line Demonstrations. Green gram (var. Pratap) and Black Gram (var: KU 301) were tested and result compared with manual raised bed planting. Observation on seed placement depth, mean seed spacing ,missing index, multiple index and quality of feed index was determined. Observation on shape of bed was also estimated. Summary results are presented in Table 2

Table 2: Summary results on machine parameters of raised bed planter

Particulars	Manual raised bed planting		Raised Bed Planter	
	Green gram	Black Gram	Green gram	Black Gram
Seed placement depth, mm	28	26	46	43
Mean seed spacing, mm	92	89	86	89
Missing index	1.5	1.2	18	12
Multiple index	5	4	12	16
Quality of feed index	93.5	94.8	70	72

Mean seed spacing : Mean seed spacing (S) is the mean of total number of spacing measured.

$$s = \sum_{i=1}^{N} x_i / N$$

Where N is the total number of spacing measured ; xi is the distance between seed/plant I and the next seed/plant

The Miss Index : Missing Index is the percentage of spacings greater than 1.5 times the set spacing (X) . M = n1/N, Where, n1 = number of spacing > 1.5 X.

The multiple Index: Multiple Index (DI) is the percentage of spacings that are less than or equal to half of the set spacing (X) , DI = n_2 /N ,
Where, n_2 = number of spacing < 0.5 X.

The quality of feed index : It is the percentage of spacings that are more than half but not more than 1.5 times the set spacing. Mathematically, Quality of feed index = 100 - (miss index + multiple index)

Table -3: Summery results from experiment conducted at AAU, Jorhat 2 years (2014 & 2015)

Treatment	Yield (t/ha)		Quality of feed index		B:C ratio	
	Green gram (var : Pratap)	Black gram (var: KU 301)	Green gram (var : Pratap)	Black gram (var: KU 301)	Green gram (var : Pratap)	Black gram (var: KU 301)
Line sowing	0.41	0.46	45.2	45.0	0.89	0.26
Manual raised bed	1.04	1.15	93.9	94.3	0.59	0.29
Raised bed planter	0.92	1.06	71.4	73.2	2.80	1.61
CD at 5 %	0.072	0.097	4.7	4.02		
CV	6.52	7.79	5.19	4.31		

The experimental results revealed that raised bed planting with tractor operated raised bed planter resulted in significantly better quality of feed index irrespective of the crop (green gram and black gram).Though manual raised bed planting resulted in higher yield but it is not economically possible. Economically Mechanical raised bed planter outperformed the conventional method with better B:C ratio up to 2.80.

The Raised Bed Planter was subjected to front line demonstration across predominantly pulse growing areas of central Assam in association with KVK (Krishi Bigyan Kendra) Nagaon and Sonitpur. The summary result of FLD is shown in Table 4.

Table 4. Summary results of front line demonstrations

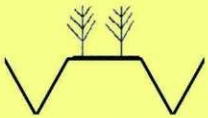
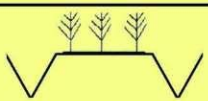
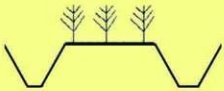
S. No.	Parameters	Raised Bed planter
1	Labour requirement,	10-12 man-h/ha
2	Type of soil	Sandy loam
3	Effective working width, mm	2000
4	Working depth, mm	adjustable
5	Size of bed (Width & Bed height)	Width 700 mm,Height 220 mm after sowing , reduced to 90 mm at harvest
6	Soil moisture,% db (before testing)	23
7	Type of seeds	Black gram (RSR 27 kg/ha), Green gram (RSR 24 kg/ha)
8	Seed rate, kg/ha	32 (Black gram) , 23.7 (green gram)
9	Seed to seed distance , cm	4-6
10	Depth of sowing, cm	3-4
11	Field capacity, ha/h	0.38
12	Fuel consumption, l/ha	1.46
13	Cost of operation, Rs/ha	1418

The technology has provided a much desired solution for growing kharif pulse which otherwise is risky crop because of higher rainfall and subsequent water logging. Based on the experiment, and FLD recommendation on raised bed planting in kharif pulse was approved for the state of Assam which read as *"Mechanical seed placement in raised bed having bed width 600-700 mm and bed height 150-220 mm by tractor drawn raised bed planter with either fluted roller type or cell type seed metering is recommended for growing green gram and black gram in Kharif season.*

Planting system:

Black gram and green gram have similar recommended crop geometry. The planting may be done in any of the ways as indicated in Table 5.

Table 5: Planting system

Planting system	Diagram	Field condition
Two row planting in raised bed		
Three row planting in raised bed		
Three row planting in raised bed in control traffic		

Operation of Raised Bed Planter:

- Transport: During transport the raised bed planter should be about 40-50 cm above the road.
- Fitting the raised bed planter : Use stand accessory and top link for hitching the planter to tractor. Use position and draft control lever, and adjust top link length of tractor to maintain the planter level.
- After fitting the planter please check
  - o Whether drive wheel is working properly or not
  - o Whether chain gear is in proper setting or not
  - o Whether seed and fertilizer pipes are clean and ready for sowing.
- Weather data is very important for operation of raised bed planter for kharif pulse. Few rainless days makes the operation of the machine easier.
- Raised bed planting in controlled traffic set up makes subsequent weeding and spraying by tractor drawn equipment possible and makes pulse growing easier and cheaper.
- Slightly higher seed rate than the recommended with closer plant spacing reduces weed problem.



Photo: Research and FLD of Raised Bed Planter conducted at Jorhat and different KVKs in Assam

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