

Research Paper :

# Development and field evaluation of tractor operated onion transplanter

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### ABSTRACT

The onion (*Allium cepa* L.) is one of the important commercial vegetable crops grown on a large area in India and abroad for local consumption as well as export purpose. Onion growers are facing lot of problems in transplanting of onion seedlings with the shortage of farm labourers during transplanting seasons. Therefore, efforts were made to develop tractor operated semi automatic onion transplanter. Engineering physical properties like height, weight, diameter, moisture content and compressive strength etc. were determined for VI<sup>th</sup>, VII<sup>th</sup>, and VIII<sup>th</sup> week age of onion seedlings. Two metering mechanism *i.e.* Fingure type and Plug type were studied in laboratory with three different travel speed of 0.75 km/h, 1.00 km/h and 1.25 km/h for different age group of onion seedlings. It was observed that plug type metering mechanism at speed of 0.75 km/h with VII<sup>th</sup> week age seedling were more suitable for transplanting. The field trials of semi - automatic transplanter revealed that with the plug type metering mechanism the row to row spacing of 20.4 -21.20, plant to plant spacing of 11.00 – 11.6 and depth of placement was observed 2.8 -4.00 cm. The missing percentage was 9.00 -10.9. The capacity of the machine was 0.1088 – 0.1174 ha/hr with field efficiency of 70.49 -71.60 per cent. The draft of machine was in the range of 450.00 – 469.80 kgf. The saving in cost of operation over manual transplanting was 40.17 per cent.

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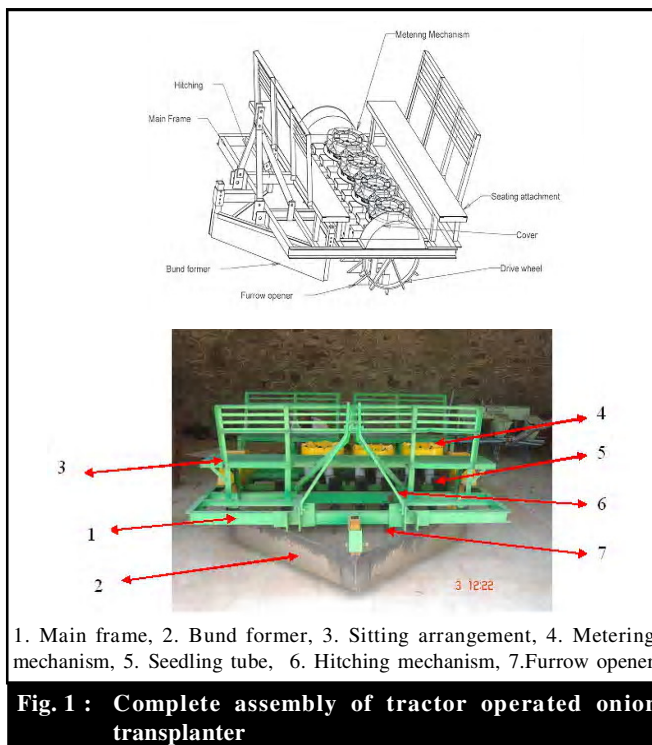
The onion belongs to the genus *Allium*, which contains about 300 species widely distributed in Northern temperate regions as biennials and perennials. The commonly used onion as dry bulbs is *Allium cepa* L. It is one of the important commercial vegetable crops grown for local consumption as well as for export purposes. Onions may be classified into two groups, green and dry green (Scallions).

### METHODOLOGY

Based on past review and considering different therotical considerations the final prototype *i.e.* semi-automatic tractor operated onion transplanter has been developed (Fig. 1).

### Development of tractor operated onion transplanter:

The newly developed tractor operated rear mounted onion transplanter (as shown in above Fig and Plate) was a semi automatic machine having overall dimensions of 1950.5 mm, 2030 mm and 1045 mm with respect to length,



1. Main frame, 2. Bund former, 3. Sitting arrangement, 4. Metering mechanism, 5. Seedling tube, 6. Hitching mechanism, 7. Furrow opener

**Fig. 1 : Complete assembly of tractor operated onion transplanter**

width and height. This machine was having minimum ground clearance of 300 mm. The weight of the entire of machine is 450.00 kg (approx).

The onion transplanter consisted of following major components.

#### **Main frame :**

Main frame was made up of type 'C' channel section and the two square box fitted diagonally up.

On the middle 'C' channel frame the two square box brackets were attached to the middle 'C' channel placed 200 mm from side 'C' channel fixing the bund former from rear side. At the rear end of main frame the M.S. angle of size 50 x 50 x 6 mm was attached for fixing the soil covering device. On the front 'C' channel of the main frame the M.S. angle brackets were attached for fixing the side links of the three point linkage.

#### **Furrow openers:**

The furrow openers for onion transplanting were made of chisel type for the opening of furrow and for getting low draft of required. The soil working tool attached to the standard was made up of M.S. flat having triangular shape. The standard was made up of M.S. flat. At the upper front edge of standard the clamping attachment was welded. The furrow opener was clamped on the square box fitted diagonally up with this clamping attachment with the nut and bolt. At the lower rear end of the standard the boot was provided in which 50 mm PVC pipe was fitted for dropping the onion seedling. The side of these boot will also act as a soil covering device for this seedling dropped from the adjacent furrow openers.

#### **Metering mechanism :**

The metering system developed was of plug type. In all four metering mechanism were fitted on the machine. The trapezoidal plugs were developed such that the lower part of plug was having circular hole of 40 mm dia and upper portion was having two long sides of arc shape placed co eccentric. Each metering mechanism will drop the seedling in two furrow openers, so four metering mechanism will cover 8 rows with adjustable row spacing due to clamping mechanism provided to the furrow openers.

#### **Power transmission:**

The power was given to the metering mechanism by providing ground wheel on both sides of the machine. It consisted of following components.

- Ground wheel

- Main shaft
- Plug assembly shaft

#### **Seating arrangement:**

The sitting attachment for operators who fill the plugs with seedlings was developed at the front and at the rear end of the machine. The four operators will sit at the rear seat and four operators will sit at the front seat facing towards each others.

#### **Bund former :**

A bund former was developed such that it will work in tandem with onion transplanter. It was attached in front of the furrow openers below the main frame and hitch links. The width between the rear end of two wings was fixed. The depth of operation was adjustable with the help of square box attachment. The square boxes were inserted in the square box fitted to the main frame having larger size and were attached by nut bolts for required height.

#### **Hitching mechanism:**

A standard hitching arrangement was developed, so that the three point hitch system of tractor can be easily attached to the machine.

This machine was operated with 50 hp, DI 5310 John Deer tractor requiring one tractor driver, 8 operators for seedlings dropping and 2 helpers during field test.

### **RESULTS AND DISCUSSION**

The trials of the newly developed prototype were conducted at two different locations during 2010. The details of the trials and results are presented in Table 1 and Fig. 2.

The average row to row spacing obtained was 20.80 cm. The average plant to plant spacing obtained was 11.30 cm. The average planting depth obtained was 3.40 cm. The average height of onion seedlings observed was 11.00 cm. The average missing hill percentage was 9.95. The average number of seedlings per hill was 1.20. The average travel speed obtained during the field test was 0.732 km/h. The average theoretical field capacity observed was 0.1174 ha/h. The average effective field capacity obtained was 0.0833 ha/h. The average field efficiency obtained was 70.99 %. The average wheel slippage percentage observed was 2.77 %. The average draft observed was 459.90 kgf. The average fuel consumption observed during field test was 4.47 lit/h, for 55hp tractor. The eight unskilled and one skilled farm labour were required for tractor operated onion transplanting.

**Table 1 : Summary test results of onion transplanter**

Sr. No	Particulars	Trial – I	Trial - II	Avg.
		Results (Avg.)	Results Avg.)	Results (Avg.)
1.	Row to row spacing, cm	21.20	20.4	20.80
2.	Width of operation, cm	160	160	160
3.	Plant to plant spacing, cm	11.00	11.6	11.3
4.	Height of seedlings, cm	10.75	11.25	11.00
5.	Planting depth, cm	04.00	2.8	3.4
6.	Missing hill percentage, %	10.90	9.0	9.95
7.	No of seedlings, per hill	01.40	1.0	1.20
8.	Moisture content, wb, %	19.46	21.0	20.23
9.	Travel speed, km/h	0.784	0.68	0.732
10.	Theo. Field capacity, ha/h	0.126	0.1088	0.1174
11.	Eff. Field capacity, ha/h	0.09	0.0767	0.0833
12.	Field efficiency, %	71.60	70.49	70.99
13.	Wheel slippage, %	02.84	2.70	2.77
14.	Draft, kgf	469.80	450	459.9
15.	Fuel consumption, lit/h	4.72	4.22	4.47
16.	Labours, unskilled	111	130	120
	man-h/ha skilled	11	13	12
17.	Labour required by traditional method, man-h/ha	400	480	480
18.	Cost of operation, Rs/h	491.87	482.17	487.02
19.	Cost of operation, Rs/ha	4220.77	4952.67	4586.72
20.	Cost of operation by traditional method, Rs/ha	7500.00	7500.00	7500.00

**Fig. 2 : Crop stand of onion seedlings after transplanting**

In case of traditional method 40-60 man hrs are required for one hectare onion transplanting. The cost of operation required for one hectare was Rs.7500/- by traditional method. The cost of operation required for one hour by onion transplanter was Rs. 487.02. The cost of operation required for one hectare area by onion transplanter was Rs. 4586.72. As such there was saving of Rs. 3013/- per hectare by using tractor operated onion transplanter, over conventional method. The saving in cost of operation over manual transplanting was 40.17 per cent. Ram Reddy (1982) and Foxdrive (2007) have also

developed onion transplanter in the past but the present one is with some modifications.

The newly develop onion transplanter is economical, efficient and suitable for onion growers as compared to traditional method of onion transplanting.

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