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Evaluation and performance of two row semi-automatic vegetable transplanter

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Abstract
Evaluation and performance of two row semi automatic vegetable transplanter is the main aim of this study. India ranks second in vegetable production. In India transplanting was done manually all over the world. The experiment was carried out at SHIATS Farm during *kharif* season 2016, on three vegetable crops namely, Brinjal (Swarna Shree), Tomato (Cherry) and Chilli (KA- 2) in Randomized Block Design. The treatment consisted of two level of field condition (Flat bed and Raised bed) and two level of method of sowing (Manual and Machine). The mean values of speed of operation and theoretical field capacity were 0.9 km/h and 0.135 ha/h while actual field capacity ranged in between 0.0926- 0.1016ha/h. Similarly field efficiency was in the range of 68.35 % (Tomato) to 75.26% (Brinjal).
A maximum of 80% labour saving was calculated in almost all crops while cost of saving in transplanting was obtained between 2.26 % chilli to 4.21% tomato. In treatment M**2S2**, missing hills percentage was high but minimum sapling mortality and maximum plant survival percentage were recorded under the same treatment combination in the range 6.10 (brinjal) to 7.15 (Tomto) and 84.55 (Tomto) to 88.70 (Brinjal) respectively in different crops. Time saving, labour saving, less cost of operation were achieved in machine transplanting as compare to manual transplanting

Keywords: Two row vegetable Transplanter, Performance Evaluation, Chilli and Brinjal crops.

Introduction
India is the second largest producer of vegetable crops in the world. India holds first position in the production of pens and caulilfower, second in onion, cabbage, brinjal and tomato and fourth in potato in the world (Singhal/ 2003) [4]. Potatoes, onions, tomatoes and brinjals account for bulk of the vegetables produced in India.
India contributed approximately 15% of the total vegetable production in 2007-08, with 123.9 million tonnes of vegetable grown over an area of 7.80 million hectares. (Government of India |GQ1|, 2008) [1]. Mostly vegetables are grown under two categories i.e. farmers grow for their daily consumption and in some pockets vegetables are grown commercially in large area. Brinjal, tomato and chilli are the strength crop of Uttar Pradesh State as its productivity is at par with national average or more than that. Transplanters are particularly advantageous when they can minimize a peak labor demand. These peaks occur over a relatively short period of time each year, as in the harvesting of certain fruits and vegetables. The transplanters are either semi - automatic or automatic. In semi - automatic machines, the plants are fed by hand into the plant-placing device. It also reduces the labor cost compared to automatic machines. Vegetable transplanter used in various part of India are mainly semi - automatic. This was developed so as to suitable for 33 -45 hp tractor. It is suitable to transplanting crops such as tomato, brinjal, cabbage, chilies, cauliflower and onion. It is economically viable in places where labor wages are high. Manual transplanting of vegetable crops seedlings requires high labor and causes delay in proper establishment of crop resulting in non-uniform growth. Therefore an effort was taken to meet the above requirements and conducted a study of field performance evaluation of semi-automatic vegetable transplanter.

Material and Methods

The experiment was laid out in randomized block design with four treatments replicated five times at SHIATS farms during rainy seasons, 2016. There was subplots each having a size of 1.4m x 12.5m. All the treatments were accommodated in sub-plot randomly and each sub - plot consisted of 56 plants at a distance of 45 cm x 71 m. The experimental site was upland with medium soil depth. The soil was sandy loam and the light gray centenary soil association group representing the major soli groups of Allahabad region. Transplanting was done in the respective plots in the evening. The seedlings were transplanted at a distance of 45 cm in a row. Row to row distance was 67cm for each crop. After transplanting light irrigation was given manually in traditional method, where as light irrigation was given simultaneously in vegetable transplanter. Simultaneously, all culture operation was done. The transplanter consist of tool bar and hitch system and main modular unit. The overall dimensions of unit are 1700(l) x 1500(b) x 1000(h) mm. The main frame assembly consists of two MS plates of size 65 x 10 mm, 1535 mm long, the two plates are joined by MS plate of size 100 x 65 x 10 mm size. An MS plate is also provided at the bottom of the unit for fitting of compaction spring. Each modular unit of vegetable transplanter usually consists of two covering wheels which are used to cover the seedlings from the two sides. The covering wheel design incorporated a covering wheel hub, covering wheel spoke and covering wheel rim. They were fitted on the shaft of 20 mm. diameter. The transplanting finger is attached a link chain with the help of bracket welded to link chain, and a bolt and nut. During operation, the transplanting finger travels in between two guide plates made of MS sheet of size 3 mm. the spring steel bars close the rubber flaps. A vegetable seedling is placed by the operator inside the rubber flap just before the rubber flap closes. When the finger reaches the bottom points of its revolution, it comes out of the guide plate and spring steel plate of the transplanting finger causes the flap to open and seedling is placed in the furrow. The furrow opener forces the soil sideways, opening a furrow for the plant. The width and depth of the furrow depends open the design of shoe the desired depth of operation, and type of the transplant. Seedling trays are provided on the semi-automatic transplanters to store the bare root seedlings for feeding to the planting unit. Some transplanting machines will have mechanical transfer devices that are hand-fed but which automatically place the plants in the furrow. To prevent damage to the transplants, each pocket is equipped with a rubber gripper on the inside. The soil is closed and packed around the transplants by press wheels or press-plates in the case of loose sandy soils. The next process in the transplanting operation is sometimes the addition water to the furrow at the point where the transplants are placed. On dry basis of soil was measured by oven dry method at the depth of 5 cm from the soil surface with the help of screw auger. Bulk density is the oven dry mass per unit volume of soil. It was measured by core cutter method before conducting experiment. Theoretical field capacity depends on the full operating width of the machine and average speed in the field. It can represent the maximum possible field capacity that can be obtained at the given field speed when the full operating width of the machine is used. Effective field capacity is the actual area covered by the machine based on its total time consumed and its width. Field efficiency was expressed as the percentage of a machines theoretical field capacity actually achieved under real conditions.

Result and Discussion

Cost of transplanting of two row semi- automatic vegetable transplanters and traditional method of transplanting vegetable seedlings has been portable costs was determined by standard methods. Cost of operation was calculated considering depreciation, interest, houshing, repair and maintenance, fuel cost, Iubrication cost and operator wages etc. In table- 1 it had been estimated that that cost of transplanting per hectare with the transplanter was found to be Rs. 3545.84, 3888.18 and Rs. 3711.60 wheras by Traditional method it was Rs. 3666.57, and 3797.61 for brinjal, tomato and chilli respectively. PAU (2001). The experimental evidence clearly showed that by utilizing the transplanter, the labour saving comes to 81.66, 80.64 and 80.70 percent in all the three crops i. e. brinjal, tomato and chilli respestively. It means the highest level of profit can be achieved in one essential input i. e. transplanting operation, it can also be interpreted in oter way i.e. high profit may improve the economic condition of farmer. This result is in conformity with the findings earlier reported by Satpaty and Garg (2003) [3].

Table 1: Cost of transplanting for vegetable crops

Parameters	Vegetables		
	Brinjal	Tomato	Chilli
Cost of transplanting (Traditional) (Rs/ha)	3666.57	4049.41	3797.61
Cost of transplanting (Traditional) (Rs/ha)	3545.84	3888.18	3711.60
Saving in cost(Rs.)	120.73	171.23	86.01
Savings in transplanting (%)	3.29	4.21	2.26

It is quite oblivious that missing hills percentage in machine will be more particularly by the use of transplanter, because of the fact that it is difficult to maintain the constant speed of the vegetable transplanter. Sometimes it may increase than the missing hill will be more but in manual transplanting the chances of missing hill is very less. However if it can be compared with respect to labour utilization this gap can be minimized and it will be less than that of manual operation. The data on the number of branches per plant at 50 per cent flowering has been presented in Table 2 and Fig.-1. Data showed number of branches per plant of brinjal, tomato and chilli at 50 per cent flowering after transplanting. The cause behind better plant growth in machine transplanting in raised bed due to stomata opening and cell enlargement provided better water supply to plant which helps in photosynthesis and leaf expansion that cause more number of branching per plant.

Table 2: Branches per plant at 50 percent flowering as influenced by field condition and method of transplanting.

Treatment	Branches/plant		
	Brinjal	Tomato	Chilli
Field condition			
S1- Flat bed	6.98	5.95	12.50
S2 Raised bed	9.53	6.69	14.01
SFmt	0.40	0.21	0.44
CD	1.23	0.64	1.34
Method of transplanting			
M1- Manual	7.36	7.01	12.17
M2- Machine	9.90	6.75	14.34
SFmt	0.40	0.21	0.44
CD	1.23	0.64	1.34
interaction (S×M)	N.S.	N.S.	N.S.

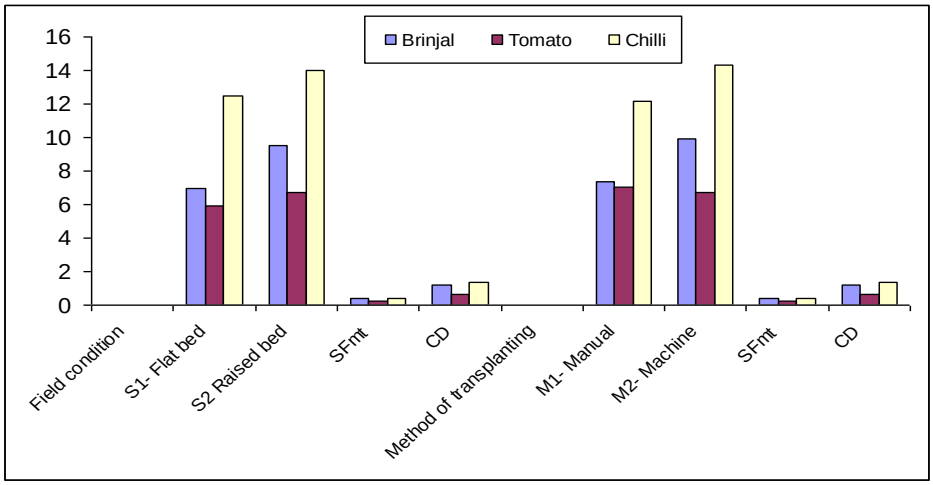

Fig 1: Branches per plant at 50 percent flowering as influenced by field condition and method of transplanting.

Summary and Conclusion

Developing countries contributes 72 per cent of total vegetable production in the world. India contributed approximately 15 % of the total vegetable production. A survey was conducted to asses mechanization gap in the field of seeding, planting and transplanting of vegetable crops (Choudhary *et al*. 1999). The transplanter selected for experimentation was bare root transplanter which had finger type metering mechanism. In two row semiautomatic vegetable transplanter, there is a provision to the row spacing adjustment for 46 cm onwards. The operating speed and per cent error were evaluated using tomato, brinjal and chili crops. Error consisted of missing. During testing, the operator was given 10-12 cm long seedling of various crops for transplanting. The mean values of speed of operation and theoretical field capacity were 0.9 km/h and 0.135 ha/h for all the three vegetable crops brinjal, tomato and chilli respectively. Actual field capacity obtained during field studies varied in between 0.0926-0.1016 ha/h for all the three vegetable crops. The field efficiency of vegetable transplanter recorded during experimentation was found minimum 68.35 percent in tomato and maximum 75.26 percent in brinjal. A maximum of 80 per cent labour saving was obtained over traditional method for all three crops. Cost of saving in transplanting was obtained between 2.26 per cent in chilli to 4.21 per cent in tomato in mechanical transplanting.

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