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Field Evaluation of a Single Row Manual Vegetable Transplanter in Comparison with Traditional Method

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ABSTRACT

Present study was carried out during the year 2015-16 to evaluate the single row manual vegetable transplanter on three vegetable crops *i.e.* brinjal, chilli and tomato at two different sites and compare it with traditional method of transplanting. The manual single row vegetable transplanter consists of different component like hopper, handle, seedling delivery tube, jaw opening lever and jaw mouth. The results obtained from the trial tests concluded that transplanter functioned properly as there is no miss planting, also the rate of tilted planting is negligible. From visual observations it was observed that there was no damage to the seedling during operation. The transplanting mean effective field capacity observed from trial was 0.029 ha/h, mean field efficiency was 91.34% and mean labour requirement was 35.87 man-hr/hr with single row manual vegetable transplanter. The transplanting mean effective field capacity observed from trial with traditional method was 0.014 ha/h, mean field efficiency was 90.64% and mean labour requirement was 75.85 man-hr/hr. The mean effective field capacity was 52.36 per cent higher over traditional method of transplanting. Significantly lower labour was required with developed prototype over traditional method with an average saving of 52.83 per cent of time and labour.

1. Introduction

India is the second largest producer of vegetables after China with a total vegetable production of 146.55 million tons in the year 2010-2011. Area under cultivation of vegetable is 8.49 million hectares with an average yield of 17.26 tons/ha (Anonymous, 2014). In Jammu and Kashmir, the total area under vegetable is 30% out of total agricultural area and the area under cultivation of vegetable is 63.10 thousand hectares with a production of 1395.5 thousand tones and productivity is 22.1 tons/ha. The main vegetables grown in J&K include tomato, onion, cabbage, brinjal, chilli *etc*. where, brinjal and tomato contributes 8.1 and 11.3 per cent of the total area under vegetable cultivation respectively. Vegetable cultivation in the state has a spectacular success story and covers about 0.51 lakh hectare in J&K. There has been an increase from 13.92 lakh Mts in the FY 2009 to 14.65 lakh Mts in FY 2011 and from 60,000 hectares to 62,000 hectares in the area under vegetable cultivation during the same period.Vegetable exports from the state has more than doubled from Rs.100 crore in the FY 2009 to Rs.225 crore in the FY 2011. Around three quarters increase is expected in the FY 2012 over the export earnings of FY 2011 (Anonymous, 2014). Most of the vegetables like cucurbits, beans, okra and leafy vegetables are sown directly in the field. Vegetables like tomato, eggplant and peppers are first sown in nursery beds and later transplanted manually either on ridges or on a well prepared seedbed Ghai and Arora, 2007. An automatic vegetable transplanter was developed by Tsuga (2000) where it was found that the prototype enabled continuous transplanting work on 2 rows simultaneously.

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Yadav*et al.* (2007) evaluated manually operated six row paddy transplanter with field capacity 0.38 ha day^{-1} and 0.04 ha day^{-1}while transplanting by hand. Narang*et al.* (2011) developed a two-row vegetable transplanter with revolving magazine type metering mechanism for evaluation of brinjal crop with average field capacity of 0.122 $ha.h^{-1}$ and the cost of transplanting per ha for brinjal crop was Rs.2919.37 as compared to Rs.5080 for manual transplanting. Nandede*et al.* (2013) evaluated a multi-stage automatic transplanter for tomato cultivation with field capacity of 0.114$ha.h^{-1}$ and field efficiency of 30.6%.

2. Materials and Methods

The field evaluation of the single row manual vegetable transplanter was carried out on sandy loam and clay loam soil on two different sites with three vegetable crops namely, brinjal chilli and tomato incomparision with the traditional method with three replication of each crop using RCBD two factorial design at Sher-e-Kashmir University of Agricultural Science and Technology, Shalimar campus, Kashmir. Fertilizers and other practices for growing vegetable crops were followed as recommended by the SKUAST-Kashmir Figure 1.1. The penetration resistance was measured at both the sites before carrying out the experiment with digital cone penetrometer (DIK 5531). The following parameters were studied to study the performance testing of the single row manual vegetable transplanter.

1. Clogging percentage: The total number of seedlings clogged were recoded for a row length of 10 m during transplantation with the developed transplanter.

Clogging (%) =	No. of plants clogged per 10 m row length	×100
	Total No. of plants in 10 m	

2. No. of damaged seedlings: Rate of damaged seedlings were recorded per 10m row length during transplanting with vegetable transplanter.

No. of damaged plant =	Total No. of plants to be transplanted in 10m row length - No. of plants actually transplanted in 10m row length

3. Field capacity: Theoretical field capacity was calculated based on the speed of operation and theoretical time taken where as Actual field capacity was calculated based on area covered and actual time taken for covering the area including the time lost in turning and rest

Damaged (%) =	No. of damaged plants per 10m	×100
	Total No. of plants in 10 m	

4. Field efficiency: Field efficiency was obtained by dividing actual field capacity by the theoretical field capacity.

Field efficiency =	Actual field capacity
	Theoretical field capacity

2.1 Crop observations:

1. Plant spacing: The distance between plant to plant recorded with the help of measuring tape.

2. No. of plants per meter length: The total number of plants were recorded per meter length with the help of measuring tape.

3. Plant survival: The survival was recorded in 10m row length. The observation were taken after 15 days of transplanting.

Survival of plant = Actual No. of plants transplanted − No. of plants damaged

Percentage survival =	No. of plants survived per 10 m row length	×100
	Total No. of plants in 10 m	

4. Yield data: The total yield of three vegetable crops *viz,*brinjal, tomato and chilli were calculated from both the experimental sites during the study as per the standard procedure.

Figure 1.1 View of evaluation of developed transplanter at different sites

3. Results and Discussion

The developed prototype was evaluated at two different sites on three different types of vegetable crops *i.e.*brinjal, chilli and tomato at SKUAST-Kashmir. The missing plants were those which got clogged in jaw of the vegetable transplanter while transplanting. The average clogging for brinjal seedling was found to be 7.5% where as in case of chilli and tomato it was 7.5 and 8.25% respectively by developed transplanter. The average field efficiency for transplanting brinjal, chilli and tomato with developed vegetable transplanter was 92.10, 92.68 and 89.33%, respectively and the average field efficiency for transplanting brinjal, chilli and tomato with conventional method was 84.42, 92.64 and 94.86% respectively. On an average, 0.80% higher field efficiency was observed with developed vegetable transplanter over traditional method of transplanting. The time and labour requirement has been considerably reduced by use of developed vegetable transplanter and it was seen that the average time required to transplant a hectare area by developed vegetable transplanter found tobe 29.46 man-h/ha for brinjal, 48.5 man-h/ha for chilli and 29.2 man-h/ha for tomato. The time and labour requirement to transplant a hectare by conventional method comes out to be 64.72 man-h/ha for brinjal, 105.5 man-h/ha for chilli and 57.02 man-h/ha for tomato. Highest labour requirement was found in chilli crop due to higher plant population per unit area (74074 plants/hectare) as compared to tomato (37037 plants/hectare) and Brinjal (37037 plants/hectare). Significantly lower labour was required with the developed prototype over conventional method with an average saving of 52.83 per cent of time and labour.The cost of operation for transplanting brinjal, chilli and tomato by developed vegetable transplanter were found to be 1044.75, 1697.5 and 1036 Rs./ha respectively and the cost of operation for transplanting brinjal, chilli and tomato by conventional method were found to be 2256.27, 3788.35 and 2136.4 Rs./ha respectively. On an average, 53.82 per cent saving in cost of operation was obtained with the use of developed prototype as compared to traditional method. The survival of plants was observed both in case of transplanting with vegetable transplanter and manual vegetable transplanting after 15 days of transplantation. The average plant survival in case of brinjal, chilli and tomato was 91.67, 94.43 and 92.43% with developed transplanter, respectively. The average plant survival in case of brinjal, chilli and tomato was 92.42, 92.67, and 92.38% respectively with conventional method. Statistically there was no significant difference in survival rate between two methods of transplanting and within the crops too at 5 per cent level of critical difference (Table 4.2). The yield data was recorded and the average yield data for brinjal, chilli and tomato with developed vegetable transplanter was 321, 225.25 and 119.85 quintal per hectare, respectively. The yield data for brinjal, chilli and tomato with conventional method was 332.23, 212.95 and 117.38 quintal, respectively. Statistically there was no significant difference of average yield between two methods of transplanting at 5% level of significance (Table 4.2).

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Table 4.2. Effect of methods of transplanting on time, survival and yield

Site one				Site two		
Transplanting method (M)	**Time* (min)**	**Survival** (%)**	**Yield*** (kg)**	**Time* (min)**	**Survival** (%)**	**Yield*** (kg)**
M1	3.36	96.79	0.54	3.561	88.971	0.460
M2	7.17	95.62	0.55	7.250	89.554	0.546
C.D (P≥0.05%)	0.34	N/S	N/S	0.39	N/S	N/S
Vegetable crops						
S1	5.03	95.45	0.99	5.138	88.763	0.772
S2	6.19	96.96	0.31	6.317	90.395	0.287
S3	4.58	96.21	0.33	4.762	88.630	0.315
C.D (P≥0.05%)	0.42	N/S	0.016	0.48	N/S	0.015

*Average time per ten meter row, **Average survival percentage per ten meter row, *** Average yield per plan

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