ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Design, Development and Testing of Hand Held Vegetable Transplanter

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Manuscript Info

Manuscript History:

Received: 11 November 2014
Final Accepted: 15 December 2014
Published Online: January 2015

Key words:

Transplant seedlings precisely, miss planting, tilted planting, no damage to the seedlings

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Abstract

The hand held vegetable transplanter consists of different component like handle, lever, hollow pipe, jaw and jaw operating wire. The implement penetrates into soil by its self weight hold with handle, seedling is dropped into hollow pipe then the jaw opened with lever. This work is focused on design, development and testing of hand held vegetable transplanter capable to transplant seedling precisely in a straight line with uniform depth in mulch bed. The work demonstrates the application of engineering techniques to reduce the labour efforts and time required for transplanting. The result obtained from the trial tests concluded that transplanter functioned properly as there is no miss planting compared with automatic vegetable trans-planter, also the rate of tilted planting is negligible. The cost of operation is comparatively less than traditional method of transplanting. From visual observation we have seen that there is no damage to the seedling during operation. The transplanting capacity observed from trail is 0.02 ha/hr, theoretical field capacity is 0.0243 ha/hr, field efficiency is 82.30%.

INTRODUCTION

India is the second largest producer of vegetables. About 175 types of vegetables are grown in India including 82 field vegetables and 41 root (tuber and bulb) crops in India produces 14 % (146.55 million tons) of world's vegetables on 15 % (8.5 million hectares) of world area under vegetables. Productivity of vegetables in India (17.3t/ha) is less than the world average productivity (18.8t/ha) in 2012-2013. Most of the vegetables like tomato (*Solanum lycopersicum*), and peppers (*Capsicum spp*.) are first sown in nursery beds and later transplanted manually either on ridges or on a well prepared seedbed.

Nasik is leading tomato producer in Asia; pimpalgaon has been creating production record in the tomato market. This September, Pimpalgaon exported tomatoes worth Rs.90 crore to Pakistan and other neighbouring countries. Now a day's most of farmer uses mulching bed for tomato transplanting in Nasik. But they use traditional method of transplanting with hand, which is labour and time consuming.

Most of Indian farmers have small land holding and have much below living standard. It is very difficult for them to have costly agricultural machinery and equipment. But the development of Indian agriculture sector depends on the development of farm machinery. There is need of cheap and easily available farm machinery to reduce human efforts and the product damage. The available vegetable transplanter are expensive for the small scale farmer, therefore these farmers use traditional methods of vegetable transplanting. In India most of the farmers doing transplanting operation of vegetables with traditional methods, that methods include all operation such as making holes in mulching paper, dugout pits on bed and transplant seedling in each hole are done manually. This method of transplanting is time consuming and need maximum labour input, sometime there is lack of availability of labour. The unavailability of labour, cause delay in transplanting operation which directly affects crop production and economic condition of the farmer.

A human workforce contributes substantially to crop production in Indian agriculture. Approximately 220 million workers provide about eight per cent of all related agricultural activities. Although farm mechanization is increasing rapidly, it is the men whose tasks are predominantly affected. Whereas only hand tools were used in ancient times, there has been a gradual improvement in their design, efficient handling, weight, and cost and worker acceptance in recent times. People today realize that there are still many possibilities to modify these tools for better work efficiency. The development of such equipment is necessary to overcome this problem which is easy to transplant the vegetable and also labour and time saving.

II. MATERIAL AND METHOD

The prototype was design for vegetable transplanting such as tomato, capsicum, etc.

2.1 Factors influencing the design are considered in details:

1. Dimension of seedling

The dimension of seedling is important to decide the diameter of hollow pipe, height of jaw and apex angle. Canopy of seedling is considered to decide the diameter of hollow pipe, the average size of canopy is required to avoid clogging in hollow pipe, also stage of seedling decide the height of jaw. The height of seedling should not be more than 20cm

2. Dimension of coco peat

The height and diameter of seedling pot is important consideration in hand held vegetable transplanter, the dimension of seedling pot is 5cm in width and height.

3. Preparation of mulch bed

The height of the mulch bed is important to decide the height of the implement for human comfort. The dimension of mulch bed is 20cm in height and 60cm to 90cm in width is considered.

4. Hand grip

The diameter of handle is decided according to the average hand grip of human and also to maintain the distance between handle and lever which should not exceed 4cm.

5. Apex angle

The apex angle 2Ɵ is inclined angle formed between the two edges, according to singh (1998). It ranges between 36° to 60° for proper penetration of implement into the soil; therefore apex angle of jaw is taken as 47.26°.

2.2 Design of various components of hand held vegetable transplanter is explained as below:

1. Hollow pipe

The hollow pipe is made up of mild steel, the diameter of pipe was 7cm decided on the basis of dimension of coco peat and canopy of seedling. The height of hollow pipe is also important to decide for ergonomic consideration, which is 74cm. Thickness of hollow pipe is 0.2cm, the hollow pipe is use to pass the seedlings to the mulch bed.

2. Handle

It is use to hold and penetrate the jaw in the soil bed. It is made up of mild steel, diameter of handle (pipe) is 2.5 cm decided according to average hand grip of human and length of handle is 14cm.The height of the handle is calculated on the basis of average standing elbow height of female operator. Average standing elbow height of female operator is 100 cm.

2.2 Working principle of the developed hand held vegetable transplanter

The main working principle of hand held vegetable transplanter is lever operated. This prototype has simple mechanism; the jaw is operated with lever which is connected by gauge wire. The prototype in held position with handle as the jaw penetrate into soil bed, pick up one seedling and drop into hollow pipe, then pull the lever upside. The action of lever open the jaw inside the soil, at that condition seedling is drop into the pit. Now pick up the implement in same position (jaw in open position), the outermost soil from jaw is come towards the root zone of seedling. The main parts of implement are hollow pipe, handle, lever, jaw operating wire and jaw.

Adjustment:

1. Position of handle
2. Distance between handle and lever
3. Length of jaw operating wire
4. Diameter of hollow pipe

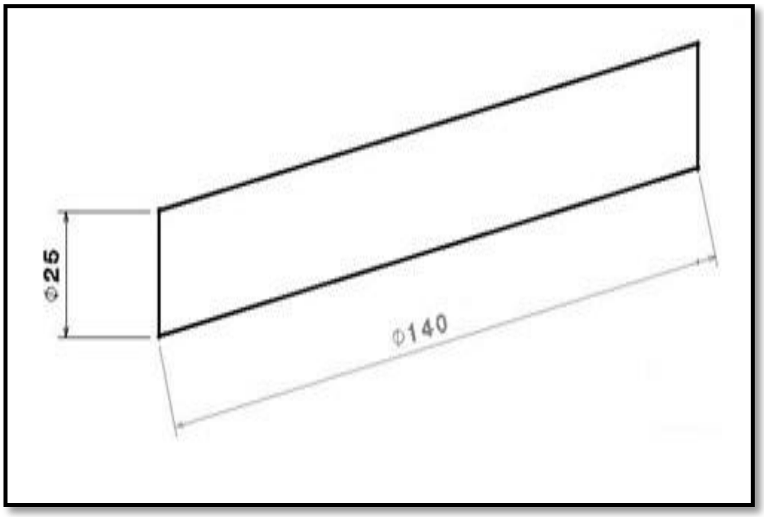

Fig.1: Front view of handle

3. Lever

The lever is use to operate the jaw, which is made up of mild steel. The length of lever is 13cm, width is 2cm and the thickness of lever is 0.3cm**.**

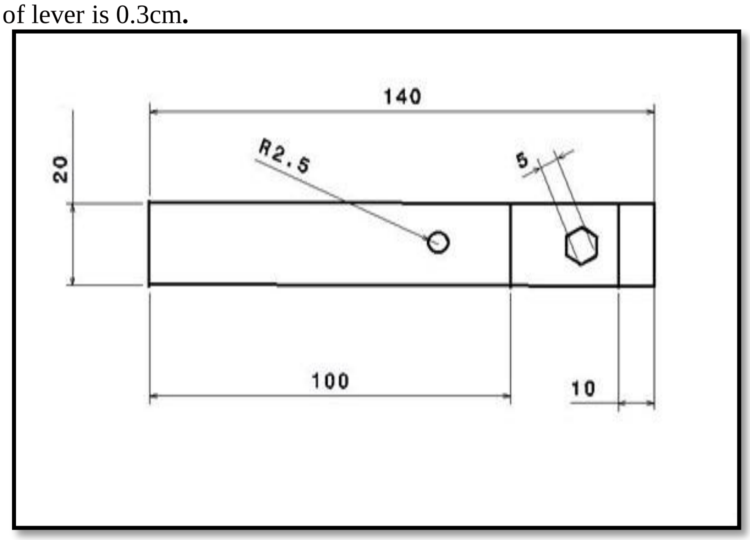

Fig.2: Front view of lever

4. Jaw

The jaw of prototype is functional part of implement, which include important operation during transplanting. The length of jaw is 19.5cm and top width is 7cm. The apex angle 2Ө is inclined angle formed between two cutting edges.

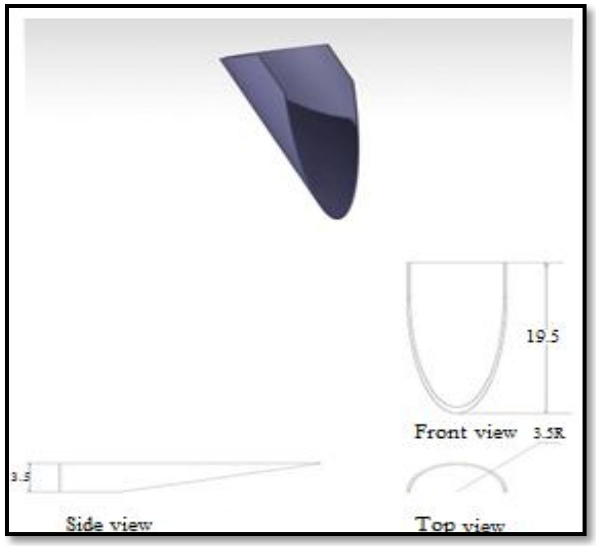

Fig.3: Isometric and different views of jaw of the prototype

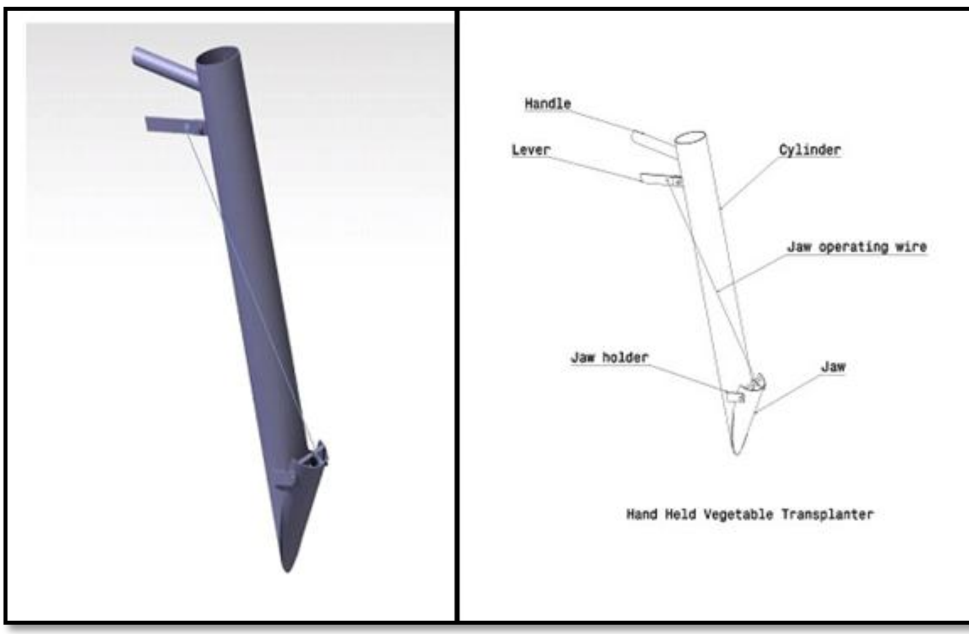

Fig.4: Isometric view and different components of prototype

Plate 1. Developed prototype of hand held vegetable transplanter

III. RESULTS AND DISCUSSION

The hand held vegetable transplanter consists of different component such as handle, lever, hollow pipe, jaw, jaw operating wire. The total weight of implement is 270 g, which is easy to hold and operate. The diameter of the hole punched is 70 mm and depth of operation achieved is 100 mm. This implement is beneficial to small land holders and to those where lack of availability of labour. It is light weight, so there is no difficulty in handling. It require skill operator for proper transplanting operation. The price of the implement is Rs.500/- which is economical to farmer. The maintenance is not essential, so it is one time investment. It is design to transplant vegetable crops only i.e. tomatoes, chilli, capsicum etc, but the canopy of seedling must be below 100 mm. The equipment is simple in design and cheap in price.

Table 1. Field test of developed hand held vegetable transplanter

Sr. no.	Length, m	Width, m	Area, m^2	Time required, min	Speed, km/hr	TFC, ha/hr	EFC, ha/hr
1	10m	5m	50 m^2	15	0.261	0.02349	0.02
2	10m	5m	50 m^2	15.5	0.255	0.02297	0.01935
3	10m	5m	50 m^2	16	0.25	0.0225	0.01875
4	10m	5m	50 m^2	17	0.247	0.02223	0.01765
5	10m	5m	50 m^2	17.5	0.245	0.022	0.0172
			Mean	**16.5**	**0.2516**	**0.02263**	**0.01859**

The area selected was 50 m^2, having a dimension 10m × 5m of rectangular field. The number of seedlings transplanted 60, time required to transplant 60 seedlings was 15 min, speed of operation found during the testing was 0.25 km/hr, therefore theoretical field capacity for 50 m^2 area transplanted in 15 min was 0.023 ha/hr and actual field capacity was 0.02 ha/hr, also field efficiency was 85.14%.

Table 2. Comparison between transplanting with traditional method and that with developed hand held vegetable transplanter

Particulars	**Traditional method**	**Hand held transplanter**
Area covered	1 acre	1acre
No. of seedling transplanted	4000	4000
Time of operation	30 hrs	20hrs
Time required for making hole on mulch paper	16hrs	-
Cost of operation	□ 4900	□ 4450

After the field test, the performance result is given by the comparison between traditional method of transplanting and hand held transplanter. One acre area for tomato transplanting which is in rectangular shape having a dimension 100 m×40 m was selected. The 25 number of mulch bed were formed in that area, also 4000 seedling were required to transplant one acre area. The required labour and time to transplant one acre area are given in Table 2.

Plate 2. Field test of hand held vegetable transplanter

IV CONCLUSIONS

During the project of design, development and testing of hand held vegetable transplanter we get following results:

1. The field capacity of hand held vegetable transplanter is more than traditional method of transplanting.
2. The time required for operation is 20 hr for 2 labours by hand held vegetable transplanter and 46 hr for 2 labours by traditional method
3. Cost of operation is much less than traditional method.

Thus the hand held vegetable transplanter was found effective for transplanting tomato on well prepared mulch bed. The performance evaluation of hand held vegetable transplanter was satisfactory for working on the well prepared mulch bed. The actual field capacity and the field efficiency were found satisfactory.

V. REFERENCES

Molin J. P., Bashford L. L., Von Bargen K., Leviticus L. I.(1996). Design and evaluation of a punch planter for no-till systems. Journal of American society of agricultural engineers, vol.41 (2), pp 307-314.

Shaw L. N. (1996).Transplanter mulch hole burner with cycloidal motion. Florida agricultural experiment station journal, vol.109, pp 168-170.

Rahimi Z, Aboutalebi A and Hasanzadeh H(2010).Effect of various culture media on tomato transplant production.International Research Journal of Applied and Basic Sciences,vol.4(2) pp 326-328.

Aikins S.H.M, Plange A.B. and Opoku-Baffour S(2010).Performance evaluation of jab planters for maize planting and inorganic fertilizer application. ARPN Journal of Agricultural and Biological Science, Department of Agricultural Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana vol.5, pp 1.

Kees gary (2010). Evaluation of single seed planter, USDA forest service, Missoula technology and development centre, pp 1024-2304.

. Prasanna G.V. Kumar and Raheman H (2011).Development of a walk-behind type hand tractor powered vegetable transplanter for paper pot seedlings. Journal of bio system engineering, Agricultural and Food Engineering Department, Indian Institute of Technology, Kharagpur 721302, West Bengal, India, pp 189-197.

Ibrahim B. and Ismail W (2013).Department of Biological and Agricultural Engineering, University Putra Malaysia, Selangor, Malaysia Asian Journal of Agricultural Sciences 6(2): 48-53.

Shanmugasundaram R., Jeyalakshmi V, Sweatha S. Mohan, Saravanan M., Goparaju V and Balakrishna P(2013).Coco peat - An alternative artificial soil ingredient for the earthworm toxicity testing .Journal of toxicology and environmental health science, vol.6(1),pp.5-12.

RNAM (1983).Specified methods for a test of hand held vegetable transplanter.