Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 1255-1258
Received: 05-03-2020
Accepted: 07-04-2020

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Performance evaluation of manual single row vegetable planter for okra, coriander and cowpea crop

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Abstract
This study was undertaken to design, fabricates and testing of vegetable planter for selected crops. Testing of vegetable planter was done for okra, coriander and cowpea crop. Sowing is the technique of planting seeds. The purpose of sowing is to place the seed in columns at required plant to plant spacing and cover the seeds with soil. Farmers of Chhattisgarh are using indigenous method for sowing of vegetable *i.e.* broadcasting, line sowing etc. Seed drill or planter for vegetable crop is not available in Chhattisgarh. Sowing of crops is carried out by conventional method like broadcasting and by using traditional implements which results in low productivity due to its inefficient performance. Apart from that manual sowing is cumbersome process.
The developed vegetable planter is manual operated. The planter consist of power transmission system, seed box, frame, drive wheel, support wheel, furrow opener, metering mechanism for seed, delivery tubes etc. The seeds of "Kashi Kanchan" variety of cowpea, "Pant Haritama" variety of coriander and local variety of okra were selected for the tests. For okra TFC was found to be 0.125 ha/h, similarly for cowpea and coriander TFC was found 0.112 ha/h and 0.05 ha/hr respectively. The actual average travelling speed of operation of the developed vegetable planter was found 2.4 km/hr. It was found that Effective Field Capacity for okra, cowpea and coriander were 0.104, 0.093 and 0.039 ha/h respectively. Field efficiency was determined from the value of TFC and EFC for each crop. It was found that the field efficiency for okra was 83.2%, for cowpea it was 83.03% and for coriander it was found 78%. The cost of developed vegetable planter was found 5930 Rs.

Keywords: Performance evaluation, fabricates, vegetable planter, nutritional problem, carbohydrate

Introduction
In our world after cereals and milk vegetables constitute the most important food. Its importance has been well advocated in solving food and nutritional problem. More than 80% of this population will live in today's developing world. Vegetables are excellent source of carbohydrate, vitamins and minerals particularly calcium, iron and magnesium and these are necessary for building nourishment and help to generate resistance against a variety of diseases. It is additionally fascinating to take note of that one hectare of vegetable provides substantially more calories than grains.
Coriander (*Coriandrum sativum L.*) is a yearly herb, mostly grown for its organic products just as for the delicate green leaves. Cowpea is known as drought stable nature because of its wide and weary leaves keeps soil moisture conserved due to shading effect. Its botanical name is *Vigna sinensis Savi*.
Owing to these reasons, the design and development of manual operated single row vegetable planter has been taken up. Taken care to ensure that the cost of the machine, functioning cost and maintenance cost are low. Also to reduce the weight of the machinery to increase the productivity of crop. Various health problems can be minimized by considering anthropometry data in design. This machine is easy to use and less effort required as compared. It is helpful for small scaling farming.

Review of literature
Nakate Shivaprasad Madan (2011) [14] developed manually operated single row multi crop planter. The planter was tested in laboratory for the calibration and to know the seed damage. The planter was field tested in 0.075 hectare area. Field test was conducted at the forward speed of 1.80 km/h. The field trial of the developed planter indicated that it did the intended functions satisfactorily with an average field efficiency of 69.44% and the field capacity of 0.075 ha/h with Rs.357 per hectare as an average cost of operation.

Doppalapudi Srigiri (2015) [21] fabricated the multi crop precision planter. The effective field capacity of the planter was found to be 0.081 ha h-1, 0.152 hah-1 and 0.059 ha h-1 for Bengal gram, red gram and paddy respectively. The field efficiency was found to be 77.33%, 81.06% and 78.66% for Bengal gram, red gram and paddy respectively. The seed to seed spacing was found to be 0.2820 m, 0.2742 m and 0.2664 m for Bengal gram, red gram and paddy respectively. This variation was due to some early dropping of seed from hopper sometimes at edges of metered cone to furrow openers.

Materials and methods

Development of manual operated single row vegetable planter for sowing is designed with the functional requirement of planter, agronomical requirement and economical consideration such that agriculture workers can work effectively with maximum efficiency and less drudgery. The various design parameters have consider for developing machine. The vegetable planter consist of main frame, seed hopper, seed metering mechanism, power transmission system, furrow opener with depth adjustment, seed rate adjusting lever and transport wheel.

Test procedure

Testing of the planter was done as per the guidelines of the procedure suggested by the Regional Network for Agricultural Machinery and Indian Standard test code for sowing equipment (IS 6316:1993). As per the procedure, there are following tests to be conducted on any farm machine / implement:

1. General test
2. Laboratory test
3. Field test

General test

Checking of specifications

After development of the vegetable planter, all the specifications were checked for their accuracy.

Laboratory tests: It includes seed metering test.

Field test: It consist of Bulk density test of the soil, moisture content of soil, Seed to seed spacing test, theoretical and effective field capacity test, field efficiency and plant population test.

$$\text{Theoretical field capacity (ha/hr)} = \frac{\text{width(m)} \times \text{speed(kmph)}}{10} \times 100$$

$$\text{Effective field capacity (ha/h)} = \frac{\text{Actual area(hac)}}{\text{Time required(hr)}}$$

$$\text{Field efficiency, \%} = \frac{\text{Effective field capacity (hac/hr)}}{\text{Theoretical field capacity (hac/hr)}} \times 100$$

Fig 1: CAD model of designed vegetable planter in Creo 2.0

Fig 2: Developed vegetable planter

Fig 3: Soil samples

Fig 4: Germination of okra seed

Fig 5: Germination of cowpea seed

Result and discussions

The developed manual drawn vegetable planter was tested for its performance in laboratory and in field. Based on the experiment conducted following results were obtained:

1. Calibration of manual operated vegetable planter for selected crops in laboratory:

a. For cowpea crop metering disc no.8 and scale exposure of 7 gave nearest values of seed rate 15.39 kg/ha which is in the range of 15-20 kg/ha. From calculation 16 gm seed should be discharged within 20 revolutions of wheels.

b. For okra crop metering disc no.4 and scale exposure of 4 gave 16.2 kg/ha nearest values of seed rate in the range of 15-20 kg/ha. From calculation 21 gm seed should be discharged within 20 revolutions of wheels.

c. For coriander crop metering disc no13 and scale exposure of 5 gave nearest values of seed rate 20.7 kg/ha.

2. The average moisture content of the soil was found to be 7.15% in dry basis and 6.67% in wet basis.
3. The average seed to seed distance was found 9.1 cm for coriander, 17.3 cm for cowpea and 37.5 cm for okra.
4. For okra TFC was found to be 0.125 ha/h, similarly for cowpea and coriander TFC was found 0.112 ha/h and 0.05 ha/hr respectively.
5. The actual average travelling speed of operation of the developed vegetable planter was found 2.4 km/hr.
6. It was found that Effective Field Capacity for okra, cowpea and coriander were 0.104, 0.093 and 0.039 ha/h respectively.
7. It was found that the field efficiency for okra was 83.2%, for cowpea it was 83.03% and for coriander it was found 78%.
8. The bulk density of the test plot soil was found 1.38 g/cm^3.

9. The average plant population per hectare was recorder 43000 for okra crop, similarly it was found 118000 for cowpea and 450000 for coriander.
10. The draft of planter was 15.6 kgf at 34.5^0.
11. The cost of developed vegetable planter was found 5930 Rs. It was found that cost of sowing for okra, cowpea and coriander was 423Rs/ha, 473Rs/ha and 1128Rs/ha respectively.

Conclusions

As per the objectives of the present study and results obtained, following conclusion could be drawn:

1. As per the design consideration the developed planter was rigid, reliable and light in weight.
2. The performance of the vegetable planter was satisfactorily in laboratory as well as in actual field condition for all selected crops.
3. The cost of planting operation by using the developed vegetable planter was found 423Rs/ha for okra, 473Rs/ha for cowpea and 1128Rs/ha for coriander crop.

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