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Performance evaluation of tractor drawn 4-row turmeric seed drill

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Abstract
Turmeric is an important commercial spice crop grown in India since ancient times and named as "Indian saffron". In India turmeric was grown in an area of 2, 96,181 ha with a production of 11,78,750 tonnes during the year 2019-20. Telangana state ranks first in area and production of turmeric. In Telangana turmeric crop was grown in an area of 55,444 ha with a production of 3,86,596 tonnes during the year 2019-20 (www.indianspices.com). In Telangana state, the farmers are following conventional method of sowing for the turmeric crop which is tidy, time consuming and laborious process. The performance evaluation of tractor drawn 4-row turmeric seed drill was done to provide required technical information to the farmers. During the field evaluation, it was observed that the field capacity of the 4-row turmeric seed drill was 0.189 ha h^{-1} at an average speed of 1.259 kmph with the field efficiency of 83.72 percent. The seed rate was observed as 1543 kg ha^{-1} for 4-row turmeric seed drill. The fuel consumption was recorded as 5 l/h. The yield (dry rhizomes) was recorded as 0.82 kg m^{-2}. The performance of 4-row turmeric seed drill has shown reasonable results for sowing of turmeric.

Keywords: Turmeric seed drill, field capacity, field efficiency, seed rate

Introduction
Turmeric is an important commercial spice crop grown in India since ancient times and named as "Indian saffron". It is known as the "golden spice" as well as the "spice of life." Turmeric is now grown in countries like India, China, Pakistan, Bangladesh, Vietnam, Thailand, Philippines, Japan, Korea, Sri Lanka, Nepal, South Pacific Islands, East and West Africa, Malaysia, Caribbean Islands and Central America (Naresh babu *et al.*, 2015) [5]. India accounts for about 80% of world turmeric production and 60% of world exports (Vaijanath Bomble, 2020) [3] and (Dhanalakshmi *et al*., 2018) [1]. India produces 75 percent of world's turmeric and is the largest exporter in trade (Ajaib Singh and Sumanjit Kaur, 2015) [2].

In India turmeric was grown in an area of 2, 96,181 ha with a production of 11,78,750 tonnes during the year 2019-20 (www.indianspices.com). Major turmeric producing states in India are Telangana, Maharashtra, Andhra Pradesh, Orissa, Karnataka, Tamil Nadu, West Bengal, Assam, Mizoram and Gujarat. In India, Telangana state ranks first in area and production of turmeric. In Telangana turmeric crop was grown in an area of 55,444 ha with a production of 3,86,596 tonnes during the year 2019-20 (www.indianspices.com).

In Telangana state, the farmers are following conventional method of sowing for the turmeric crop by indigenous plough with a pair of bullocks for making furrows and keep the turmeric rhizome seeds in the furrows which is tidy, time consuming and laborious process. In this method recommended seed rate may not be achieved and affects the yield. Considering all these constraints, performance evaluation of tractor drawn 4-row turmeric seed drill was carried out to alleviate these problems and to provide required technical information to the farmers.

Material and Methods
The turmeric sowing equipment namely tractor drawn 4-row turmeric seed drill was selected to study its field performance to provide required technical information to the farmers. The tractor drawn 4-row turmeric seed drill consists of seed hopper, seed tubes, furrow openers, ridging body and seat arrangement. Four persons are required to drop the turmeric rhizome seeds in the seed tubes during operation. The experiment was conducted at College of Food Science and Technology, Regional Sugarcane and Rice Research Station and Krishi Vigyan Kendra, Rudrur during Kharif 2020 in the extent of an area about 1050 m^2 (21 m x 50 m) for

turmeric sowing. The technical specifications of selected turmeric sowing equipment is given in Table 1 and the view is shown in Fig.1

Table 1: The technical specifications of tractor drawn 4-row turmeric seed drill

S. No	Machine parameters	4-row turmeric seed drill
1	Cost of machine, Rs/-	55000/-
2	No. of furrow openers	4
3	No. of ridge formers	5
4	No. of bed formers	-
5	Row Spacing, m	0.45
6	Effective operating width, m	1.8
7	Type of metering mechanism	-
8	Power source	40 hp and above

Fig 1: View of 4-row turmeric seed drill.

Field performance of 4-row turmeric seed drill

The field was prepared by ploughing with MB plough and cultivator, followed by the soil was pulverized with rotovator to brought a fine tilth to easily formation of ridge and furrows for 4-row turmeric seed drill during sowing operation. The "Erra Duggirala" variety seed rhizomes were selected for sowing operation and cut into single node pieces before operation. During the experiment the parameters like speed of operation, effective field capacity, theoretical field capacity, field efficiency, seed rate and yield were observed by using the following procedure.

Operating time for each operation

To determine operating time, time was noted at starting and ending point of sowing operation by using stop watch, so that actual time required for sowing with 4-row turmeric seed drill was computed in terms of h/ha. The time required for one turn of the machine and time consumed for adjustments were also noted to compute time loss in operation.

Speed of operation

To determine the speed of operation, mark the length of 25 m and the tractor drawn 4-row turmeric seed drill was operated in the marked run length. A stop watch was used to record the time for sowing to traverse the marked run so that the speed of travel was computed in m s^{-1}.

Effective field capacity

Effective field capacity was measured by the actual area covered by the implement, based on its total time consumed and its width. Effective field capacity was determined by the following relationship.

$$\text{Effective field capacity, ha h}^{-1} = \frac{\text{Total area covered,ha}}{\text{Total time taken,h}} \text{ x } 100$$

Theoretical field capacity

Theoretical field capacity is the rate of field coverage of the machine, based on 100 percent of time at the rated speed and covering 100 percent of its rated width. The theoretical field capacity was determined using the following relationship.

$$\text{Theoretical field capacity, ha h}^{-1} = \frac{\text{width (m)x Speed (kmph)}}{10}$$

Field efficiency

Field efficiency is the ratio of effective field capacity to theoretical field capacity. It was determined by the following formula

$$\text{Field efficiency, \%} = \frac{\text{Effective field capacity,}(\frac{\text{ha}}{\text{h}})}{\text{theoretical field capacity }(\frac{\text{ha}}{\text{h}})} \text{ x } 100$$

Seed rate

The seed rate was determined by taking the weight of seed before and after sowing operation. Then subtracted the final weight of seed from initial weight of seed so that the seed rate was obtained and the results were expressed in terms of kg ha^{-1}.

Yield

Turmeric yield was determined from one m^2 area. Five random observations were taken from the field and thoroughly removed the soil from the rhizomes. After completion of cleaning, the weight of turmeric rhyzomes were recorded and the converted to kg ha^{-1}.

Results and Discussion

The field performance and cost analysis of tractor drawn 4-row turmeric seed drill was done at College of Food Science & Technology, Regional sugarcane and Rice Research station and Krishi vigyan Kendra, PJTSAU, Rudrur, Nizamabad to provide required technical information to the farmers to choose best one.

During the field evaluation, it was observed that the field capacity of the 4-row turmeric seed drill as 0.189 ha h^{-1} at an average speed of 1.259 kmph with the field efficiency of 83.72 percent. The seed rate was observed as 1543 kg ha^{-1} for 4-row turmeric seed drill. The fuel consumption was recorded as 5 l/h. The yield (dry rhizomes) was recorded as 0.82 kg m^{-2} with 4-row Turmeric seed drill sowing method. The results of field performance of tractor drawn 4-row Turmeric seed drill given in Table 2 and field operation of details are shown in Fig. 2 and Fig.3 respectively.

Fig 2: Sowing operation of turmeric with 4-row seed drill (ridge and furrow method)

Fig 3: Field view of turmeric crop sown with of 4-row seed drill

Table 2: Field performance of tractor drawn 4-row Turmeric seed drill

S. No	Machine parameters	4-row turmeric seed drill
1	Plot dimensions (L x W), m	50 x 21
2	Area, Sq. m.	1050
3	Date of sowing	6/7/2020
4	Depth of planting, cm	10-12
5	Row to row distance, cm	45
6	No. of rows	4
7	Trapezoidal Bed dimensions (Top width x Bottom width X Height), cm	-
8	Bed to Bed distance	-
9	Plant to plant distance, cm	20
10	Width of operation, m	1.8
11	Speed, kmph	1.259
12	Theoretical Field capacity, ha/h	0.227
13	Effective Field Capacity, ha/h	0.189
14	Field Efficiency, %	83.721
15	Fuel consumption, l/h	5
16	Seed rate,kg/ha	1543
17	Number of labour required	5
18	Fresh Yield, kg/m^2	3.5385
19	Fresh Yield, kg/ha	35385
20	Dry yield, kg/m^2	0.823
21	Dry yield, kg/ha	8230

Conclusions

The following conclusions were drawn from the study

- It was observed that the field capacity of the 4-row turmeric seed drill) as 0.189 ha h^{-1} at an average speed of 1.259 kmph with the field efficiency of 83.72 percent.
- The seed rate was observed as 1543 kg ha^{-1} for 4-row turmeric seed drill
- The fuel consumption was recorded as 5 l/h.

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