



## RESEARCH ARTICLE

### Determination of Physical Properties of Cotton Plant in the Development of Cotton Uprooter cum Shredder

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## ABSTRACT

The cotton in India provides direct livelihood to 6 million farmers and about 40-50 million people are employed in the cotton trade and its processing in India. Cotton is a tropical and subtropical crop. For successful germination of its seeds, a minimum temperature of 15°C is required. It is grown mainly as a dry crop in black cotton and medium black soil. The physical properties of the cotton plant are very important to optimize the design parameters of cotton uprooter cum shredder. Physical properties such as stalk stem diameter, plant height, and taproot depth were determined for the development of cotton uprooter cum shredder. The obtained results for stalk stem diameter, plant height, and taproot depth were 2.2 cm, 117.4 cm, and 32.7 cm, respectively. The moisture content of the cotton stalks is 27.3% and the soil moisture content was found to be 11.1%. The maximum deviation of the cotton plant was found to be 7.5 cm.

**Keywords:** Cotton; Deviation; Plant Height; Stem Diameter; Taproot Depth.

## INTRODUCTION

Cotton (*Gossypium*) is one of the most important cash crops in India. It is grown on an area of about 8.06 million-ha<sup>-1</sup>. After cotton picking, a large quantity of cotton stalks is left in the field. Cotton in India provides direct livelihood to 6 million farmers and about 40-50 million people are employed in the cotton trade and its processing in India. There are cotton-growing states which are divided into three zones, viz. north zone, central zone, and south zone. The North zone consists of Punjab, Haryana, and Rajasthan. The central zone includes Madhya Pradesh, Maharashtra, and Gujarat. South zones comprise Andhra Pradesh, Telangana,

Karnataka, and Tamil Nadu. Besides these ten states, cotton is cultivated in small areas of non-traditional states such as Uttar Pradesh, West Bengal, and Tripura.

Cotton is a tropical and subtropical crop. For successful germination of its seeds, a minimum temperature of 15°C is required. The optimum temperature range for vegetative growth is 21°C-27°C. It can tolerate temperatures as high as 43°C. Cotton is a growing variety of sods soil should be black medium to deep (90 cm) having good drainage availability. It is grown mainly as a dry crop in black cotton and medium black soil. Irrigated cotton is taken in the alluvial soils.

Another way of improving farm income is to utilize the byproducts of cotton cultivation beneficial. Cotton stalks are one of the important byproducts of the cotton crop. About 23 million tonnes of cotton plant stalks are generated in India annually. On average, about 2 - 3 tonnes of cotton stalks are generated in one hectare of land. Most of the cotton stalk is treated as waste, though a small part of it (15%) is used as fuel ash. The study was conducted to find out plant physiological properties as well as the deviation of the cotton plant to develop cotton uprooter cum shredder.

## **MATERIALS AND METHODS**

The experiment was carried out in the RARS Nandyal, in the ANGRAU University (A.P). 0.2 ha experimental site was chosen for the investigation. After a basic tillage operation using an M.B plough, the field was tilled once with a cultivator and blade harrow to prepare a good seedbed. Manual dibbling is used to sow the cotton crop, with a row-to-row spacing of 60 cm and a plant-to-plant spacing of 30 cm.

### **Physical Properties of Cotton Stalks**

The physical properties of cotton stalk such as stem diameter, taproot depth, moisture content of stalk, and the soil properties at the time of uprooting were measured.

#### **Stalk stem diameter**

After the final harvest of cotton from the experimental plot, ten cotton plants were chosen at random and the stalk stem diameter was measured using a vernier calliper, and the average stem diameter was determined.



**Fig.1. measurement of the diameter of the cotton plant**

#### **Height of plant**

A sample of ten cotton plants was selected randomly after the final harvesting of cotton from the experimental plot and the cotton plant height was measured by measuring tape and the average plant height was calculated.



Fig.2.measurement of the height of the cotton plant

### Taprootdepth

After the final harvesting of cotton from the experimental plot, the taproot depth of 10 cotton plants was chosen at random and measured using a measuring tape. The average taproot length was calculated.



Fig.3. measurement of taproot depth of cotton plant

### The moisture content of the stalk

Before conducting the experiment, stalk samples were obtained at random from 5 different sites to evaluate the moisture content of the stalk. The samples were weighed and dried in a hot air oven for 24 hours at  $105 \pm 5^\circ\text{C}$ . The sample was then taken out of the oven and weighed using an electronic balance. On a dry weight basis, the M.C of the stem samples was determined in equation 1. (Gary L. Barker., 1996).

$$\text{Moisture content of stalk}(\%) = \frac{W_1 - W_2}{W_2} \times 100 \quad (1)$$

Where,

$W_1$ = initial weight (gm)

$W_2$ = final weight (gm)

### The moisture content of the soil

Soil samples were gathered up to a depth of 10 cm to measure the moisture content of the soil. Before starting the experiment, a random sample was taken from the field. The sample was weighed and dried in a hot air oven for 24 hours at  $105 \pm 5^\circ\text{C}$ . They were then removed from the oven and weighed using an electronic balance. On a dry weight basis, the M.C of the soil samples was determined in the equation. 2. (S. Pulley and A.L. Collins., 2020).

$$\text{Moisture content of soil}(\%) = \frac{W_1 - W_2}{W_2} \times 100 \quad (2)$$

Where,

$W_1$  = Initial weight (gm)

$W_2$  = Final weight (gm)

### Determination of the deviation of the cotton plant

The rows were produced with a 4 tynebullock-drawn cultivator. Furrow widths opened by furrow openers ranged from 12 to 15 cm in most cases. Manual dibbling in the furrows have been used to place cotton seeds. The seed is placed in the centre of the furrow or on the left or right side of the furrow, as indicated in Fig.1, during manual dibbling. As a result, the seed's departure from the row's centre point ranges from 6.0 to 7.5 cm. Following germination, the first plant in a row was designated as the furrow's centre point, and a line was drawn 60 cm away from the plant as a reference line. The distance between the plant and the reference line was measured, and the readings were recorded as shown in Fig.4.

Following germination, the first plant in a row was designated as the furrow's centre point, and a line was drawn 60 cm away from the plant as a reference line. The distance between the plant and the reference line was measured, and the readings were recorded as shown in Fig.2. The method was done five times to get the average width. The goal of this study is to develop a cotton stalk uprooter cum shredder, three blades with lengths of 10, 15, and 20 cm were chosen. Fig.4. depicts the chosen blade configuration.

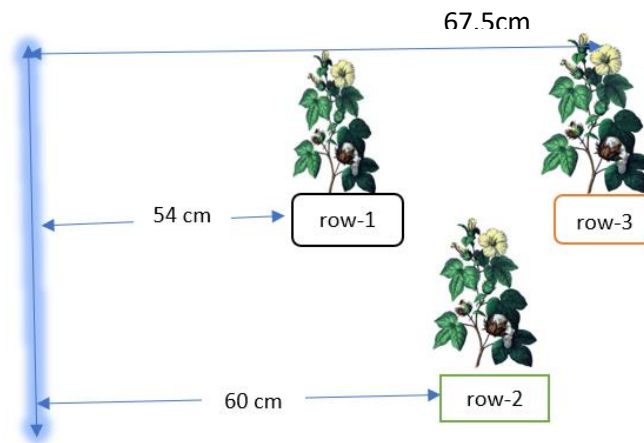


Fig.4. Deviation of the cotton plant

## RESULTS AND DISCUSSION

### Physical properties of cotton stalk

At the time of uprooting, the average moisture content of the cotton stalk and the soil was found to be 27.3% and 11.1%, respectively. Important cotton stalk parameters such as plant height, taproot depth., and stem diameter were measured at ten different locations, and Average, Standard deviation, and coefficient of variance values were computed in the following Table .1.

Table.1. Diameter of the cotton stalk (cm)

R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
2.1	2.6	2.2	2.1	2.2	1.9	1.8	2.0	2.5	2.4

Table.2. Height of the cotton plant (cm)

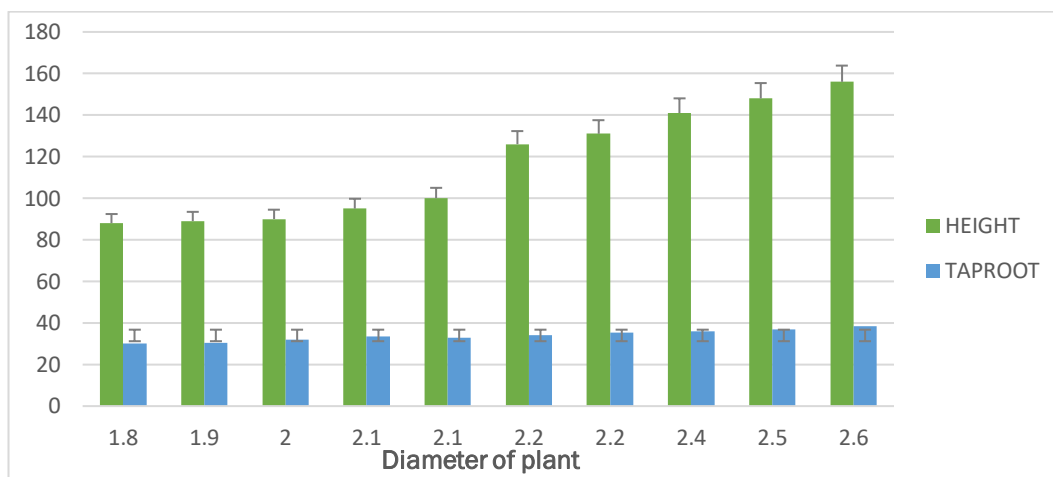
R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
156	126	131	100	118	95	141	90	88	88

Table.3. Taproot depth (cm)

R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
39	36	37	34	35	33	38	32	32	31

Table.4. Physical property of the cotton plant

Sl. No	Parameters	Observations	Avg (cm)	S. D	C.V (%)
1	Plantheight (cm)	10	117.4	± 7.8	6.6
2	Taprootdepth (cm)	10	34.7	± 2.6	7.4
3	Diameter of the stem(cm)	10	2.2	± 0.2	10.9



**Fig.5. Relation between diameter, height, and taproot depth of cotton plant**

From the above Fig.5. The smallest diameter of the cotton plant was observed to be 1.8 cm and the height of the plant obtained was 88 cm at that plant the minimum taproot depth obtained was 30 cm. The maximum diameter was 2.6 cm then the height of the plant was found to be 156 cm for the same plant the maximum taproot depth was found to be 38.5 cm. The diameter of the plant, as well as the height, increased then the taproot depth increased.

### Deviation of the cotton plants

From Fig.3., the deviation of the plants from the centre of the furrow varies from 6.0 to 7.5 cm, when the first plant in a row is taken as 60 cm away from the reference line. The minimum deviation from the reference line was obtained as 1 cm and the maximum deviation of the plant from the reference line was found to be 7.5 cm from the reference line the five rows were measured for the investigation from 60 cm to 300 cm as shown in the below figure.6. The cotton stalk uprooter cum shredder was worked with three blades in that maximum uprooting efficiency was found with a 20 cm working width of the blade.

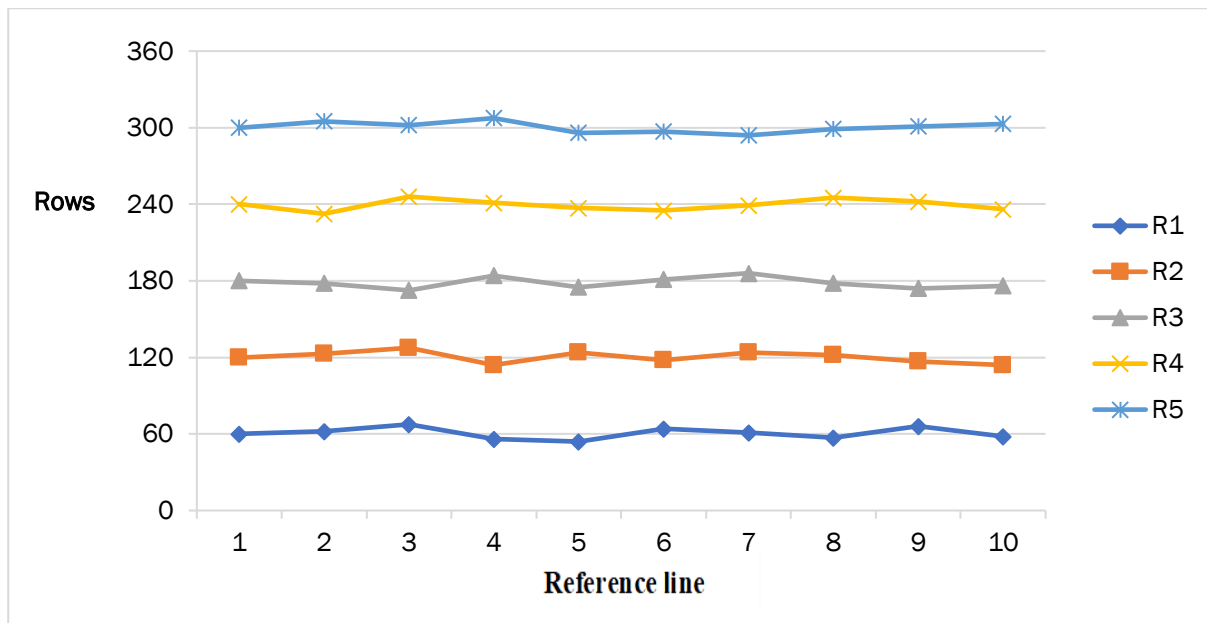


Fig.5. deviation of the cotton plant

## CONCLUSION

The average diameter of the stalk stem was found to be 2.2 cm, plant height was 117.4 cm, and taproot depth was 32.7 cm, respectively. The standard deviation for the stem diameter, plant height, and taproot depth was as followed as  $\pm 0.2$ ,  $\pm 2.6$ , and  $\pm 7.8$ . At the time of uprooting, the moisture content of the cotton stalk as well as the soil was found to be 27.1% and 11.1% respectively. The maximum deviation of the cotton plant from the centre of the row varied from 6 to 7.5 cm. Due to this deviation, the three uprooter blades were chosen in that the maximum uprooting efficiency was found to be 92.6% with the 20 cm width of the blade.

## Funding and Acknowledgment

We gratefully acknowledge the Department of farm machinery and power engineering for providing the fund.

## Consent for publication

All the authors agreed to publish the content.

## Competing interests

There was no conflict of interest in the publication of this content.

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