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Physical Characteristics of Maize Plants for Development of Maize Cobs Picker

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ABSTRACT: In the design process of corn picker, the influence and action mechanism of corn plant characteristics on the working parts of corn harvester (including cutting device, ear picking device, conveying device) should be considered, and the physical properties of corn plant need to be analyzed. To prevent high loss rate and crushing rate of ears and grains, and low efficiency of harvesting operation due to high moisture content of ears of corn in harvest period. Therefore, it is particularly important to analyze the physical properties of maize plants. Three maize variety taken for crop characteristics *i.e.* JM-216, DKC-9188, and NK-6240. The characteristics is stem diameter, plant height, cob height from ground, maximum cob diameter, cob length. This characteristics are used to design the different component of maize cobs picker.

Keywords: Corn picker, Physical properties, harvesting operation.

INTRODUCTION

Corn (*Zea mays*) is a most important cereal crops plant belonging to the *Poaceae* family. Corn is also recognized by different synonyms such as zea, corn, silk corn, maize etc. In Hindi it is called *Makka* and *Barajovar*. Maize or corn is the third most important cereal crop after rice and wheat for India. Globally it is highly valued for its multifarious use as food, feed, fodder, and raw material for a large number of industrial products. Among the maize growing countries India rank 4th in the area and 7th in production, representing about 4% of maize area and 2% of the total production of the world. During 2018-19, in India, the maize area has reached up to 9.2 million ha (Shrivastava, 2021). During 1950-51 India used to produce 1.73 million MT maize, which has increased to 27.8 million MT by 2018-19, recording close to 16 times increase in production. The average productivity during the period has increased by 5.42 times from 547 kg/ha to 2965 kg/ha, while the area increased nearly by three times. The productivity of maize in India is at par with many lead maize-producing countries as well as almost half of the world's productivity (Jain *et al.,* 2019).

In India, maize is principally grown in two seasons, rainy (Kharif) and winter (Rabi). Kharif maize represents around 83% of maize area in India, while rabi maize corresponds to 17% of maize area. Over 70% of Kharif maize area is grown under the rainfed condition with a prevalence of many biotic and abiotic stresses. The stress-prone ecology contributes towards the lower productivity of Kharif maize (2706 kg/ha) as compared to Rabi maize (4436 kg/ha), which is predominantly grown under an assured ecosystem. In recent past spring, maize area is also growing quite fast in the northwestern parts of the country, in the states of Punjab, Haryana, and Western Uttar Pradesh. Unfortunately, the area and production data of spring maize are not well documented. However, informal estimates suggest the area be around 150 thousand ha. Among cereals, maize has the highest growth rate in terms of area and productivity. Since 2010, maize productivity in India is increasing by over 50 kg/ha/year, which is the highest among food crops. Among Indian, states Madhya Pradesh and Karnataka have the highest area under maize (15% each) followed by Maharashtra (10%), Rajasthan (9%), Uttar Pradesh (8%), and others. After Karnataka and Madhya Pradesh, Bihar is the highest maize producer state. Whereas, in terms of productivity, the rank of Andhra Pradesh is having first in India. Some districts like Krishna, West Godavari, etc. have records of highest productivity i.e. 12 t/ha. It is reported that the bulk of the maize production in India, i.e. approximately 47%, is used as poultry feed. Of the rest of the produce, 13% is used for livestock feed and food purposes, 12% for industrial purposes, 14% for starch industry, 7% as processed food, and 6% for export and other purposes. The contribution of farm mechanization help in triggering farm productivity as human resource (i.e. labor) in combination with mechanized power can execute a greater quantity of working stipulated time (Gautam *et al.,* 2017, 2018).

The physical characteristics of maize plant refer to the stem diameter, plant height, cob height from ground,

maximum cob diameter, cob length of Maize in the harvest period. The stem diameter of maize plant is generally 15-25 mm, height of maize plant is generally 2400-2650mm, cob height from ground is generally 810-1050mm, maximum cob diameter is generally 45-60mm and cob length is generally 160-220mm (Ronald *et al.,* 1973). The more significant the difference between ear diameter and stem diameter is, the more conducive it is to ear picking (Tracy & Galinat 1987, Xinping & Lianxing 2007).

MATERIALS AND METHODS

Crop characteristics of different variety of maize. Crop characteristics of different variety of maize taken at field condition. Three maize variety taken for crop characteristics i.e. JM-216, DKC-9188, and NK-6240. The characteristics is stem diameter, plant height, cob height from ground, maximum cob diameter, cob length. This characteristics are used to design the different component of machine.

JM-218 DKC-9188 NK-6240

Plate 1. Field view of maize varieties.

(i) Moisture content. The moisture content of the maize plant was determined by the oven drying standard method (USDA, 1970) and expressed in per cent on dry basis as given below Eqn. 1.

$$\text{Moisture content (\%)} = \frac{\text{Intial mass of seed} - \text{Final mass of seed}}{\text{Initial mass of seed}} \quad (1)$$

Maize plant of desired moisture content levels were prepared by adding water uniformly throughout the samples, by the following Eqn. 2.

$$Q = W_I X \left(\frac{m_f X m_i}{100 - m_f}\right) \quad (2)$$

Where,
Q = weight of water to be added, g;
W_I = initial weight of maize plant, g;
m_i= initial moisture content of maize plant (%db) and
m_f= final moisture content of maize plant (%db).

(ii) Stem diameter of maize plant. Measure the stem diameter of different variety maize with the help of digital vernier caliper their least count is 0.01mm. Observe the data shown in Plate 1. Stem diameter are help full the design of snapping plate, snapping roller and cutting blade of tractor operated single row corn picker

(iii) Plant height of maize. Measure the height of maize plants with the help of measuring tape. Height of maize plant help the design of length of machine and conveying chain. Taken the average value of height of plant.

(iv) Cob height from ground. Measure the cob height from ground with help of measuring tape of 50m. Cob height observation used to design of picking point of machine and snapping plate. Taken the average value of cobs height from ground.

(v) Maximum cob diameter. Measure the maximum cob diameter with the help of digital vernier caliper and their least count is 0.01mm. Maximum cob diameter used to design the snapping plate, conveying chain and collecting box

(vi) Cob length. Measure the cob length with the help of measuring scale. Cob length used to design snapping blade and conveying chain cups. Observe the average value of cob length.

Measurement of different physical parameter of maize plant are plant height, cob height from ground, maximum cob diameter, cob length and stem diameter of maize plant shown Plate 2 a, b, c, d and e respectively**.** Plant height and straw diameter directly affect whether the ear picking mechanism is blocked. Therefore, in the process of corn harvest, the corn straw fails to pull out the ear picking roller in the strong pulling section, which leads to the problem that the corn straw is centrally stuck at the end of the ear picking roller and blocks the ear picking roller. According to the plant height and straw diameter, the length, speed and clearance of ear picking roller should be designed reasonably.

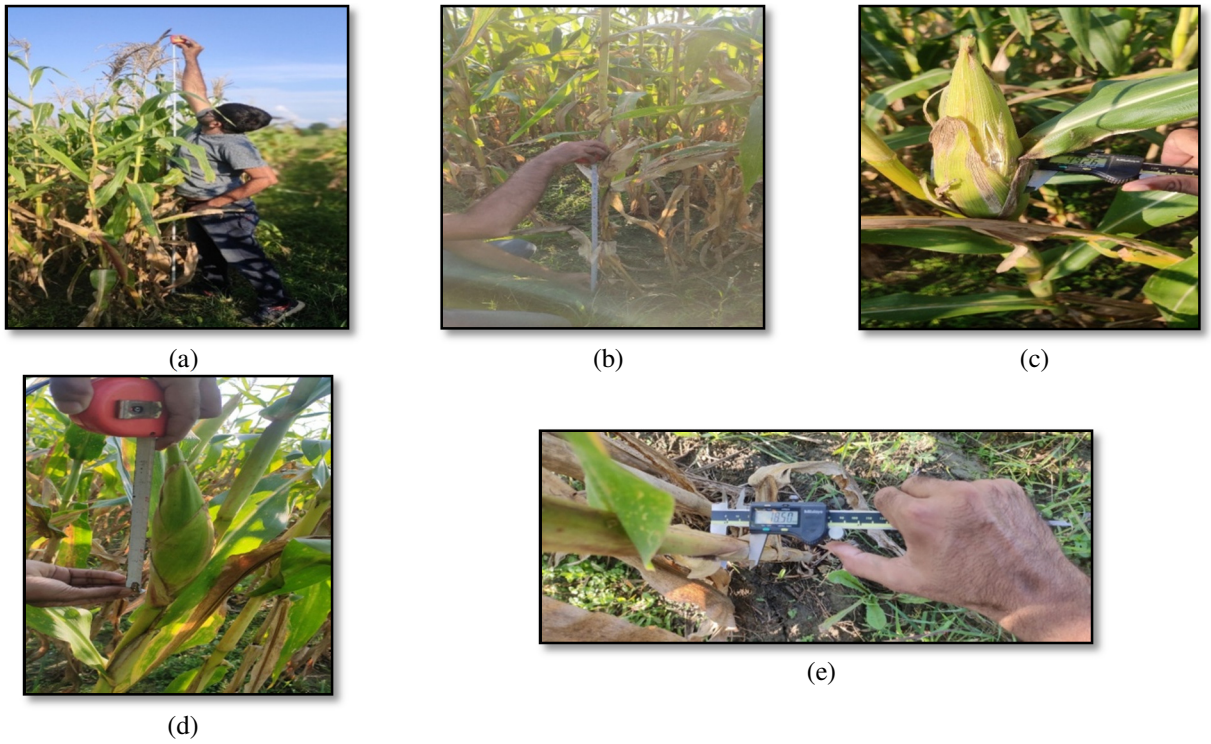

Plate 2. Measurement of different physical parameter of maize plant.

RESULT

Physical characteristics of maize plants.

(i) Stem diameter of maize plants. Measure the stem diameter of different variety maize with the help of digital vernier caliper their least count is 0.01mm. Observe the data shown in Fig. 1. Stem diameter are help full the design of snapping plate, snapping roller and cutting blade of tractor operated single row corn picker. Measure the average value of stem diameter of different variety maize shown Table 1. In Fig. 2 the relation of stem diameter and moisture content.

Table 1: Physical characteristics of maize plants.

Sr. No.	Property	Variety	Moisture Content, Per cent		
			32.1%	35.2%	38.4%
1.	Stem diameter , mm	JM-216	15.93	16.47	17.03
		DKC-9188	17.74	18.11	18.87
		NK-6240	17.02	17.43	18.1
2.	Plant height, mm	JM-216	2654.2	2654.2	2654.2
		DKC-9188	2452.9	2452.9	2452.9
		NK-6240	2522.3	2522.3	2522.3
3.	Cob height from ground, mm	JM-216	950.9	950.9	950.9
		DKC-9188	816.7	816.7	816.7
		NK-6240	996.1	996.1	996.1
4.	Max. cob diameter, mm	JM-216	53.9	54.7	55.1
		DKC-9188	47.1	47.7	48.2
		NK-6240	56.32	56.81	57.31
5.	Cob length, mm	JM-216	212.7	212.7	212.7
		DKC-9188	187.8	187.8	187.8
		NK-6240	202.2	202.2	202.2

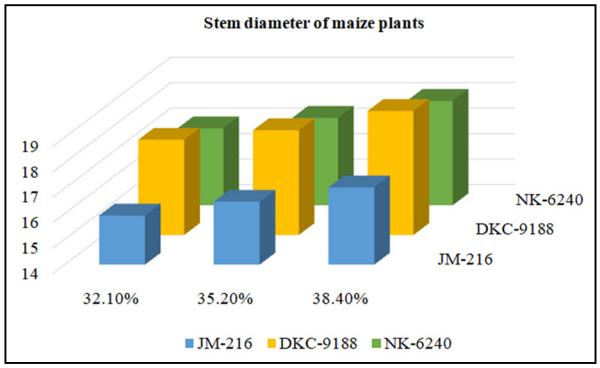

Fig. 1. Effect of moisture content on stem diameter of maize plant.

(ii) Height of maize plants. Measure the height of maize plants with the help of measuring tape. Height of maize plant help the design of length of machine and conveying chain. Taken the average value of height of plant. In Fig. 2 relation of moisture content and height of maize plants and observe that no effect of moisture content on height of maize plants.

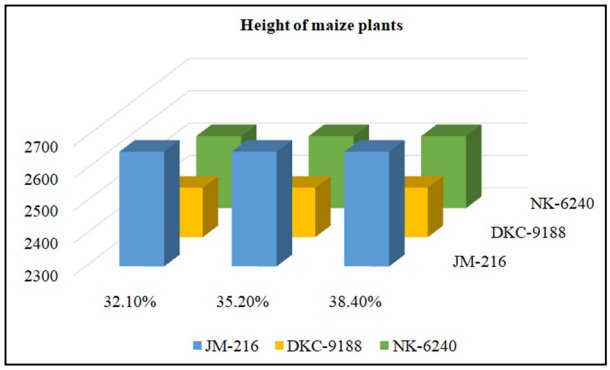

Fig. 2. Effect of moisture content on height of maize plants.

(iii) Cob height from ground. Measure the cob height from ground with help of measuring tape of 50m. Cob height observation used to design of picking point of machine and snapping plate. Taken the average value of cobs height from ground. In Fig. 3 no effect of moisture content on cobs height from ground.

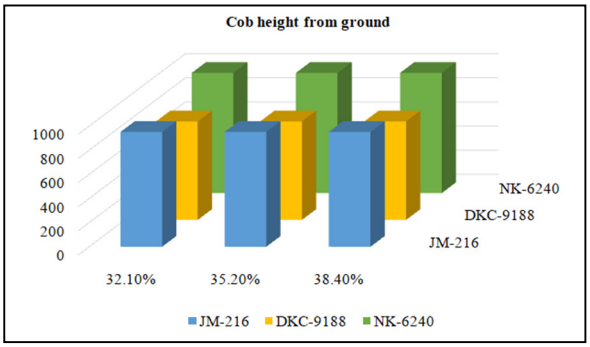

Fig. 3. Effect of moisture content on cobs height from ground.

(iv) Maximum cob diameter. Measure the maximum cob diameter with the help of digital vernier caliper and their least count is 0.01mm. Maximum cob diameter used to design the snapping plate, conveying chain and collecting box. Observe the average value of this parameter. In Fig. 4 relation between moisture content and maximum cob diameter

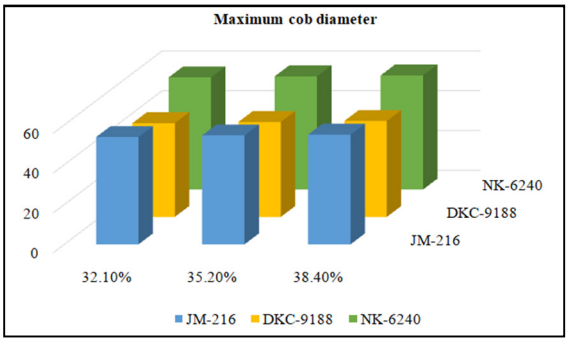

Fig. 4. Effect of moisture content on maximum cob diameter.

(v) Cob length. Measure the cob length with the help of measuring scale. Cob length used to design snapping blade and conveying chain cups. Observe the average value of cob length. In Fig. 5 effect of moisture content on cob length.

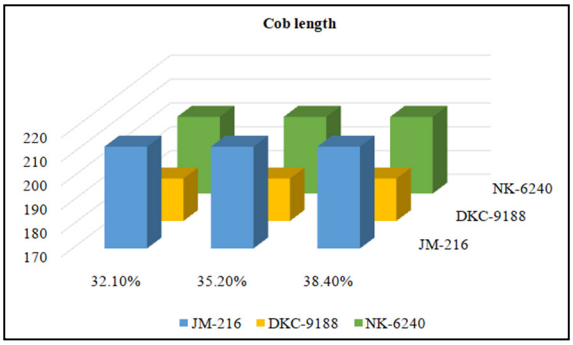

Fig. 5. Effect of moisture content on cob length.

CONCLUSIONS

Crop characteristics of different variety of maize taken at field condition. Three maize variety taken for crop characteristics i.e. JM-216, DKC-9188, and NK-6240. The characteristics is stem diameter, plant height, cob height from ground, maximum cob diameter, cob length. This characteristics are used to design the different component of maize cobs picker.

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Conflict of Interest. None.

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