**SYNOPSIS ON**

**Pre-dissertation**

**(AGR 596)**

# " Physiological assessment of sweet sorghum (*Sorghum bicolor* L.) in different dates of sowing".

**Submitted To**

**Department of Agronomy**

**School of Agriculture**

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**Submitted By;**


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**UNDER GUIDANCE OF**


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# CERTIFICATE:

This is to certify that this synopsis entitled **"Physiological assessment of sweet sorghum (*Sorghum bicolor* L.) in different dates of sowing."** submitted in partial fulfillment of requirements for degree – Masters of Science in Agronomy by **Komal, Registration no. 11717064** to Department of Agronomy, School of Agriculture, Lovely Professional University, has been formulated and finalized by the student herself on the subject.

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# DECLARATION

I hereby declare that the project work entitled --**"Physiological Assessment of sowing of Sweet Sorghum (*Sorghum bicolor* L.) in different dates of sowing"** is an authentic record of my work carried at **Lovely Professional University** as requirements of project work for the award of degree -Masters of Science in Agronomy, under the guidance of **Dr.Anaytullah Siddique,** Assistant Professor, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India.

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## ABSTRACT:

The combined production of grain and sugar by sorghum requires efficient leaf C acquisition (source) and allocation to productive sinks, namely the stem and the panicle. Photoperiod sensitivity, which regulates plant phenology and growth, is also likely to be a key regulator of such C source-sink relationships, while it is crucial to drought adaptation. Sweet sorghum (*Sorghum bicolor* L) is characterized by High sugar content and high biomass and is of growing interest to the biofuel industry.

Sweet sorghum (*Sorghum bicolor* L.) is adapted to a broad range of environmental conditions. The crop can produce up to 40 tones per acre of biomass where 72% of the weight is a juice containing relatively high levels of fermentable sugars. The juice solids content (brix degree) of stalks harvested at early head or hard dough stage ranged from 7 to 18. It took between 120 to 160 days for sweet sorghum to reach the early heading stage depending on yearly weather condition. . At flowering, early sowing enhanced plant leaf area, stem dry weight and sugar production, and plant leaf area expressed per unit of stem dry weight was positively correlated to stem sweetness, suggesting that a high pre-flowering source-to-sink ratio favors early sugar accumulation. Late planting of Sorghum reduces biomass, early flowering, prolonging grain filling, decreased stalk yield, brix value, sucrose content and damage due to the cold autumn weather. Total sugars and predicted ethanol production were influenced by planting date, but the degree of the effects depended on the cultivar planted.

## OBJECTIVE:

During the course of my research work the following objective will be consider:

1- To study about the effect of different dates of sowing on yield attributing characters of sweet sorghum.
2- To study about the effect of different dates of sowing on juice yield of sweet sorghum.
3- To study about the effect of different dates of sowing on sugar content in juice of sweet sorghum.
4- To study about the effect of different dates of sowing on grain yield of sweet sorghum.
5- To study about the varietal response of sweet sorghum in different dates of sowing.

# INTRODUCTION

Sweet sorghum [*Sorghum bicolor* L.] belongs to the family *Poaceae* and genus Sorghum. Sweet Sorghum is an annual herbaceous species, with Chromosome no. 2n=20. Sorghum is an important food crop of the world. Sweet sorghums are typically characterized by low grain yields, but high biomass production along with the sugar content. It is useful mainly for grain and fibrous remainders, which are used as an animal fodder. The Sorghum stalks have sugar in their stalk therefore the researcher are showing their interest for the ethanol production either for industrial, beverage or fuel uses.

**Area and Production:** It is the 5th important rankers' cereal crop after rice, wheat, maize and barley. Sorghum is a multipurpose crop which adapted well to wide range of environmental diversity ranging from tropical to temperate conditions within 40°N and 40 °S of the equator. In India sorghum is the third important cereal after rice and wheat, grown on an average of 6.18 million ha-1 with production of 5.28 million tons and productivity 854 kg ha-1 (USDA 2013). Sorghum is grown over an area of 7.92 million hectares with a total production of 7.92 million tones with an average productivity of 1020 kg/hectare (Anonymous 2008-09; FAO, 2009). Major producers of Sorghum crops are the USA (10.55 million tonnes), Mexico (7.1 million tonnes), Nigeria (6.5 million tones), India (5.5 million tonnes), and Argentina (4.6 million tones). Sweet sorghum crop is grown in Brazil, as a source of ethanol production while in Kenya, sweet sorghum is utilize as a potential crop to avoid food insecurity by providing food and feed as well as the supply of its cane to sugarcane industries for ethanol production. The cultivation practic0es of sweet sorghum crop are very simple and readily adoptable. Sweet sorghum is a warm-season crop that matures earlier under high temperatures and short days. It is also known as "sugarcane of the desert" as it can survive in the marginal areas of the semi-arid tropics where other crops fail to thrive (Reddy *et al.,* 2012). The plants of sweet sorghum can reach up to the heights of 12 to 14 feet depending upon the environmental condition and varietal potential. The grains of sweet sorghum are often varies in different colors (white, cream, yellow, red, brown). Besides the rapid growth, high sugar accumulation and biomass production potential, sweet sorghum has wider adaptability. It can be growing with limited amount of water and minimal amount of inputs and can be harvested within a four months (Reddy and Sanjana, 2003). Sweet sorghum is a C4 plant having high efficiency of photosynthetic rate, due to which, sweet sorghum play an important role in the growth and development of agricultural production, specially livestock, energy resources, biofuel and sugar industry (Fazaeli *et al.,* 2006 Nahvi *et al.,* 1994 a, b)

**Sugar Accumulation:** The sweet sorghum juice has a good nutritional profile containing especially protein, amino acids, minerals etc. it contains enough amount of juice in their stalks (Martin, Leonard & Stamp, 1975). The stalks contain 10-25% sugars mainly sucrose, glucose, and fructose at maturity (Byrt *et al.,* 2011). Sugar accumulation in the stems of sweet sorghum regulated by many more things in which metabolism and transport processes are one of them. The main product obtained from sweet sorghums is a sugar rich juice which accumulated in the stalks in a same fashion as sugarcane. The extracted sweet juice is a mixture of many sugars in which sucrose, glucose, and fructose are found in good amount and thus can be use to produce ethanol through fermentation process. Sweet sorghum plant have a more one option for raw material of bioethanol production like sucrose content can be extract from sweet sorghum juice, while the starch content can be obtained from its grains and cellulose, hemicelluloses and lignin content from the fiber of biomass. Sugar that present in the stalk of sweet sorghum, it can be divided into two type saccharin- type and syrup-type (Anglani, 1998). In which saccharin-type sugar contains sucrose and it may be use for production of sugar in crystal form. While syrup type contains glucose and it can be use for producing syrup. (Almodares *et al*., 2008 c).

# REVIEW OF LITERATURE:

Sweet sorghum is the crop that provides grain and stem which can be used for sugar, alcohol, jaggery, syrup, fuel, fodder, ceiling, bedding, paper, swordplay and mastication. It is being used for nearly 150 years to produce concentrated syrup with a different flavor. This crop has also been used widely for the production of forage and silage for animal feed (**Schaffert, 1992**).

**Broadhead, (1972)** reported that sweet sorghum needs a long growing season and the yield declines with late sowing while yield of sweet sorghum stalk increases with early planting. It was also reported that brix value, sucrose content and juice purity were not affected by planting date (Hipp *et al.,* 1969 and Broadhead 1972).

**Almodares *et al.,* (1994)** reported that early planting of sweet sorghum results in higher stem yield, more tillers and higher length of stems than late planting.

**Inman-Bamer (1980)** reported that the early planting in sweet sorghum increase stem dry in comparison to late planting. A delay of 10 weeks resulted in a two and a half week's reduction in the time to maturity and this caused a drop in sucrose yields of about 40% (Ferraris, 1988).

**(Cowley and Smith 1972; Maheshwari *et al.*, 1974 and Inman-Bamber 1980)** states that Early planting (October) resulted in increased stem yields but reduced juice quality. A 30 cm intra-row spacing resulted in high stem yields per plant and good juice quality.

**(Balole 2001)** noted that high stem yields in early planting is associated with an increase in the growing period from emergence to panicle initation and boot stage; and increase tiller number and stem height. He also noticed that Fresh stalk weights were not significantly varied at different stages of nitrogen application.

**(Maheshwari *et al.*, 1974)** demonstrated that juice quality that includes content of sucrose, purity of juice and value of brix were improved with delay in date of Planting.

**(Utzurrum *et al.*, 1998)** reported that late nitrogen application under water limiting conditions is effective in increasing grain yield and indicate that to have the highest stalk, sugar yield and grain. Sweet sorghum should be planted around mid May and nitrogen applied at 3- 5/8 leaf stage.

**(Pauli; Stickler and Lawless 1964; Heskerth; Chase and Nanda 1969; Caddel and Weibel 1971)** states that under moist field conditions late planting is associated with a reduction in number of days to panicle initiation and flowering, which may be the effect of temperature and photoperiod.

**(Stickler; Pauli; Laude; Wilkins and Mingis 1961)** states that early planting in grain sorghum increased grain yields through increased tillering and number of heads per unit area in Kansas.

**(Chohnan *et al.*, 2011; Rohowsky *et al.*, 2013)** states that when sweet sorghum is used as feedstock then it has following advantages for the production of bioethanol: a high biomass yield, high carbohydrate content (*e.g.,* fermentable sugars in the juice of the stem and structural sugars in the bagasse) and noncompetition with food and arable land**.**

**(Rajvanshi and Nimbkar (2005))** states that Sweet sorghum is the only crop providing grain and stem that can be used as substrates for the production of sugar, alcohol, syrup, fodder, fuel, bedding, roofing, fencing and paper

**(Parrish *et al.*, 1985**) observed that the production of readily fermentable carbohydrates, and biomass by six fuel crop candidates: grain sorghum, Jerusalem artichoke (*Helianthus tuberosus*), maize (*Zea mays*), sugar beet (*Beta vulgaris*), sweet potato (*Ipomoea batatas*) and sweet sorghum.

**(Smith *et al.*, 1987)** demonstrated that sweet sorghum is far more widely adapted than was certain for a plant of tropical origin and certainly has the potential for providing a good source of fermentable carbohydrates across a wide geographic area.

# Material and Methodology:

**Research Topic:** Physiological assessment of sweet sorghum (*Sorghum bicolor* L.) in different dates of sowing."

**Experimental Site:** Experiment is conducting at the Agricultural Farm of Lovely professional University, Phagwara Situated geographically at 31°14'48.0''N 75°41'45.0''E and 252 m above sea level. It falls under central plain zone of agro climatic zones of India.

**Soil Requirement:** Sorghum is mainly grown on low potential, shallow soils with high clay content, which usually are not suitable for the production of maize. Sorghum usually grows poorly on sandy soils, except where a heavy textured sub-soil is present. Sorghum is more tolerant of alkaline salts than other grain crops and can therefore be successfully cultivated on soils with a pH (KCl) between 5.5 and 8.5. Sorghum can better tolerate short periods of water logging compared with maize. Soils with a clay percentage of between 10 % and 30 % are optimal for sorghum production.

## Experimental detail:

Year of Crop: 2018

Recommended dose of Fertilizers (N: P: K) kg/ha: 100:60:80

**Treatments details**

1- **Variety: Three [SSV-74, SSV-84, CSV24SS]**
2- **Three dates of sowing: Three [3$^{rd}$ March, 13$^{th}$ March, 23$^{rd}$ March]**
3- **Replication: Three**
4- **Total No. of treatment: [3X3X3=27]**
5- **Total Area : 500m$^2$**
6- **Size of per plot: [21m$^2$]**

**Experimental Design**: RBD (Randomized Block Design)

## Layout of Experimental plot:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Irrigation Channel | | | | | | | | | |
| R1 | D1V1R1 | D1V2R1 | D1V3R1 | D2V1R1 | D2V2R1 | D2V3R1 | D3V1R1 | D3V2R1 | D3V3R1 |
| Irrigation Channel | | | | | | | | | |
| R2 | D3V3R2 | D3V1R2 | D3V2R2 | D1V3R2 | D1V1R2 | D1V2R2 | D2V3R2 | D2V1R2 | D2V2R2 |
| Irrigation Channel | | | | | | | | | |
| R3 | D1V1R3 | D1V2R3 | D1V3R3 | D2V1R3 | D2V2R3 | D2V3R3 | D3V2R3 | D3V3R3 | D3V1R3 |
| | | | | | | | | | |

## Agronomical practices:

- Plot is prepared in manner of Ridges and Furrows, by maintaining a distance of 5cm plant to plant and 50cm row to row in total area of 500$m^2$ which includes 27 plots, each plot is of area 21$m^2$.

- The experiment consists of 3 treatments and 3 replications including 3 different varities, that are SSV74, SSV84, CSV24SS.


- Before sowing I tested the soil pH and EC i.e. 7.5 and 1.9 at 200 microns.

- The sowing is done at three different dates at the regular interval of 10 days between each sowing in the following manner that is; first sowing was done on 3rd march, second sowing was done on 13th march and the third sowing was done on 23rd march. Followed by the **application of fertilizers**, that are ;

- **Nitrogen:** Nitrogen is applied in the form of urea. It was applied in two split doses: First at the time of sowing and the second dose is given after 21 Days of sowing for each sowing date in the quantity of 228gram for each plot at the time of first dose and 228gram for each plot at 21 DAS.

- **Phosphorus:** Phosphorus is applied in the form of Single Super Phosphate in the quantity of 749gram for each plot. Whole dose is applied at the time of sowing only.

- **Potassium:** Potassium is applied in the form of Muriate of Potash in the quantity of 280gram for each plot. The whole dose is applied at the time of sowing only.

**Urea:**

| Time/Date of sowing | For First Sowing | For Second Sowing | For Third Sowing |
|---|---|---|---|
| At the time sowing (First dose) | 3rd March | 13th March | 23rd March |
| At 21 DAS (Second dose) | 24th March | 3rd April | 24th April |

**Irrigation schedule:** The irrigation in the trial was given in the following manner:

**First Sowing:**

| | |
|---|---|
| 1st Irrigation | 5th March |
| 2nd Irrigation | 22nd March |
| 3rd Irrigation | 4th April |
| 4th Irrigation | 3rd May |

**Second Sowing:**

| | |
|---|---|
| 1st Irrigation | 14th March |
| 2nd Irrigation | 22nd March |
| 3rd Irrigation | 4th April |
| 4th Irrigation | 3rd May |

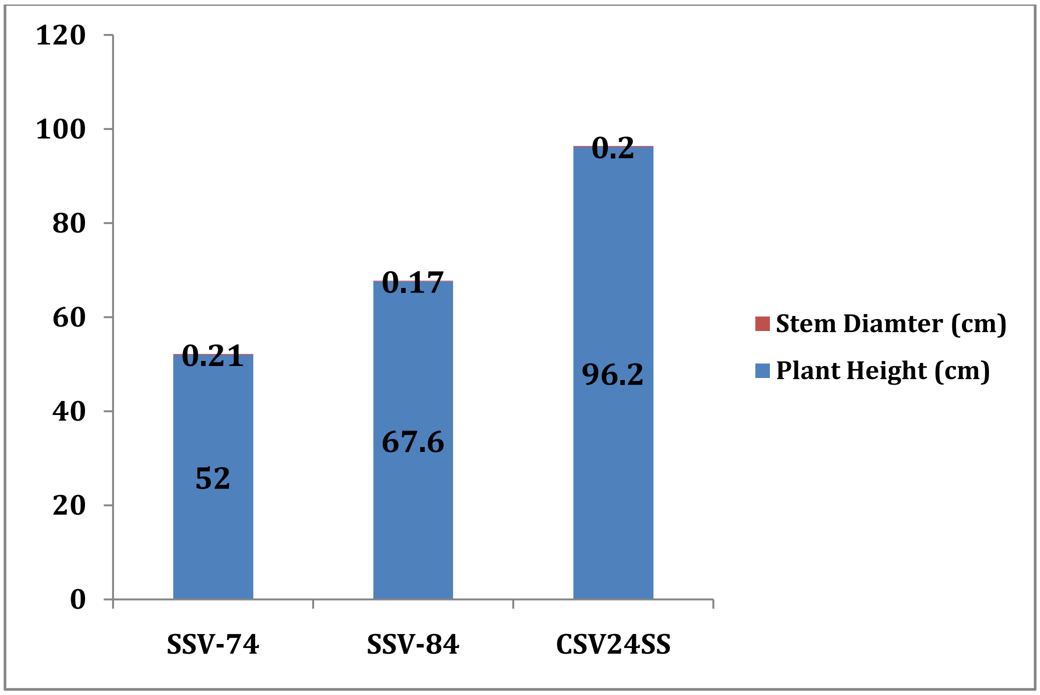
**Third Sowing:**

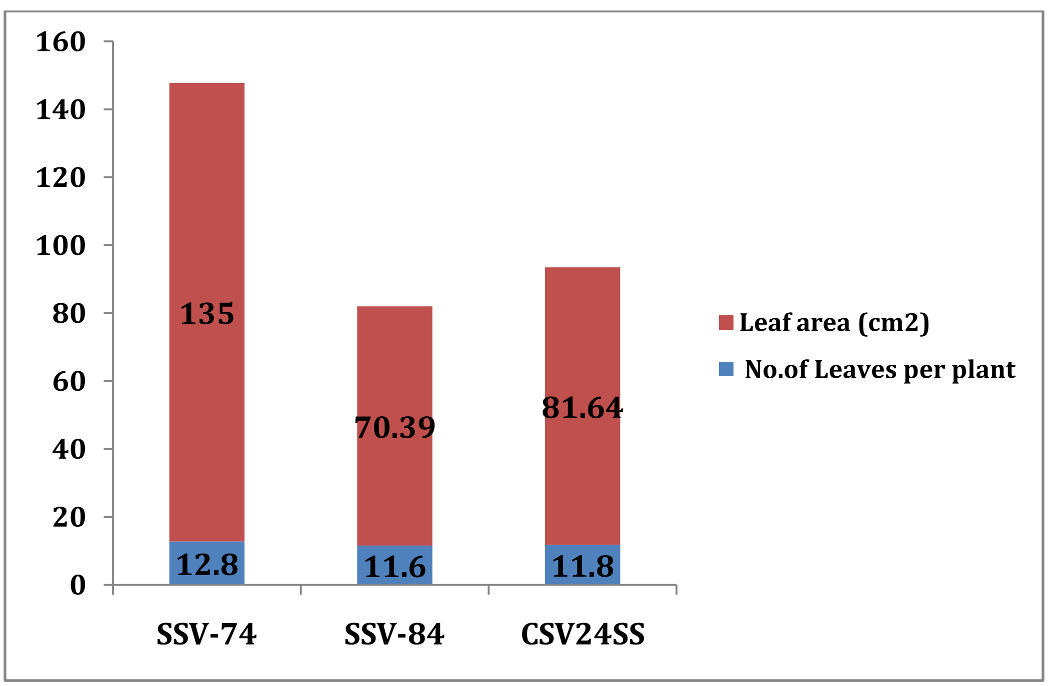
| | |
|---|---|
| 1st Irrigation | 23rd March |
| 2nd Irrigation | 4th April |
| 3rd Irrigation | 3rd May |

# Observations

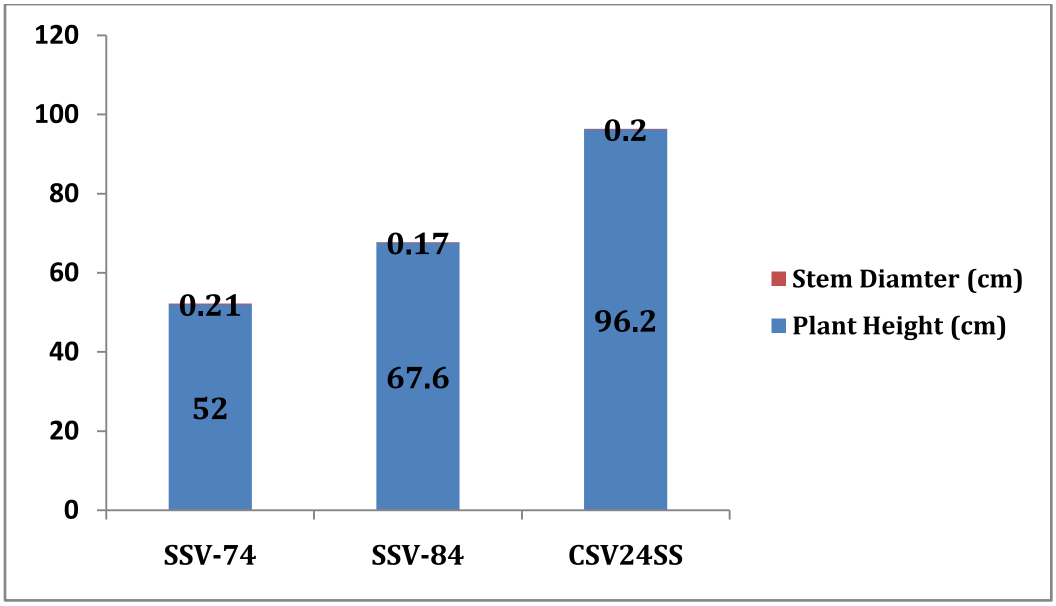
Following are the Observations recorded at 25 DAS;

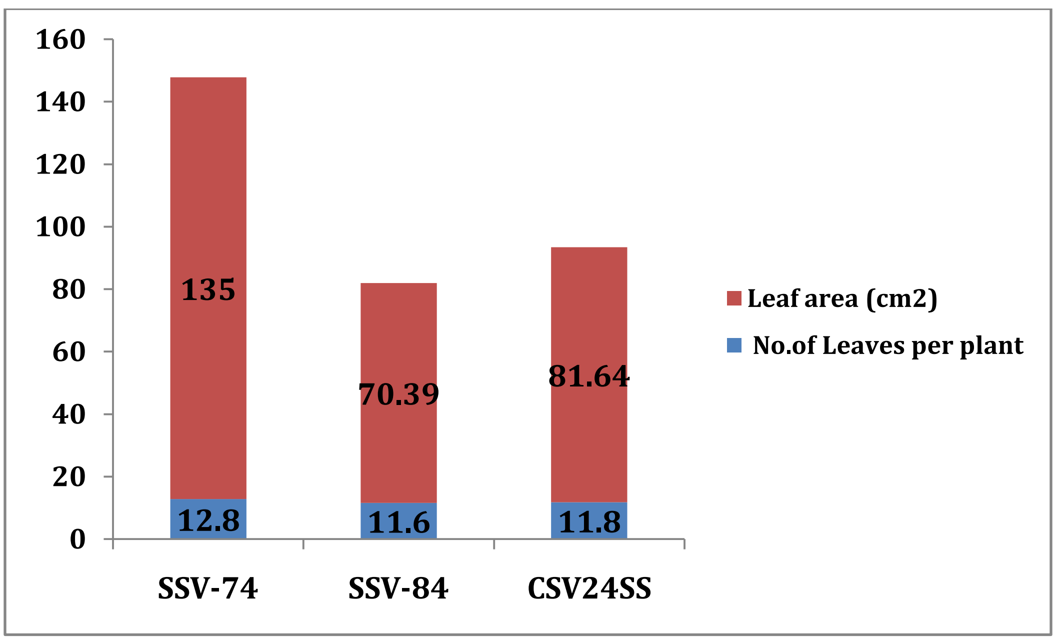
**First Sowing Date [25 DAS]**



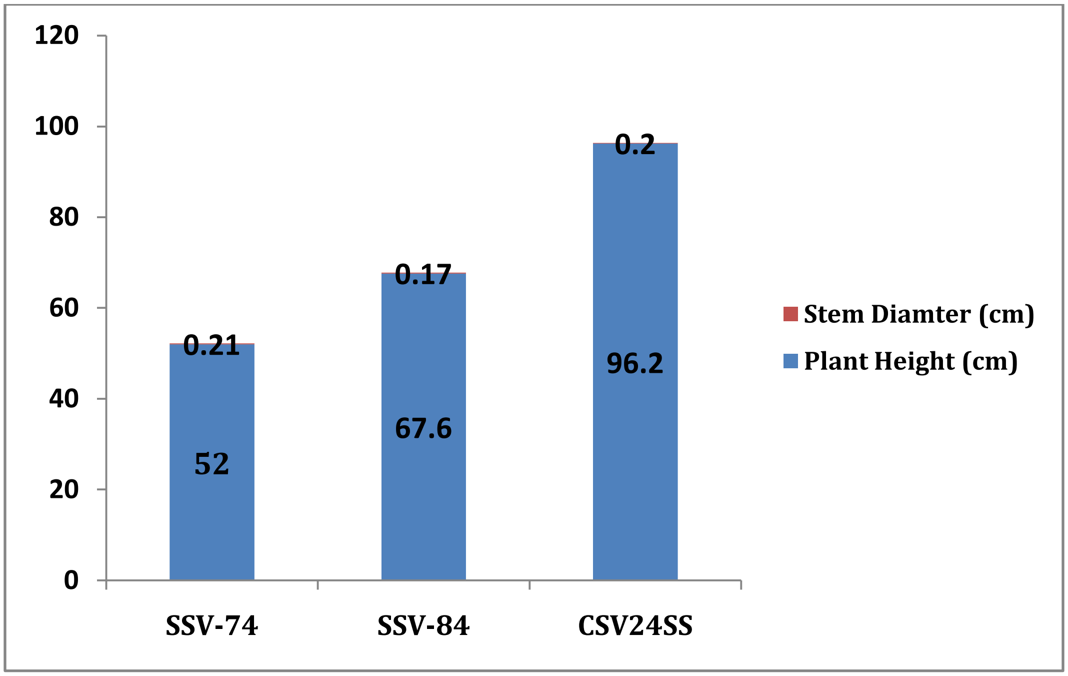



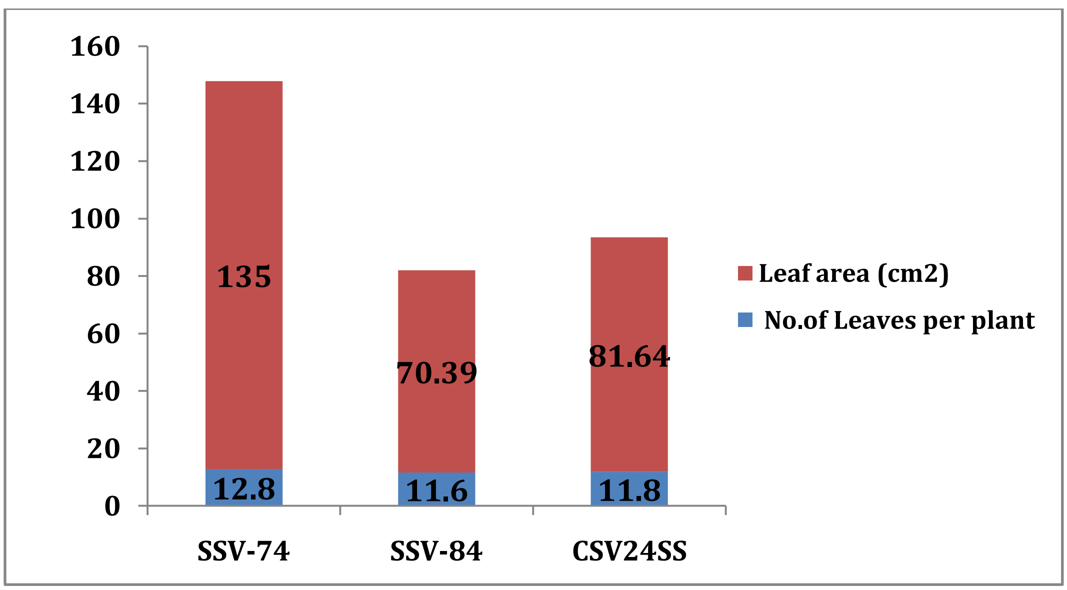
**Second Sowing Date [25 DAS]**



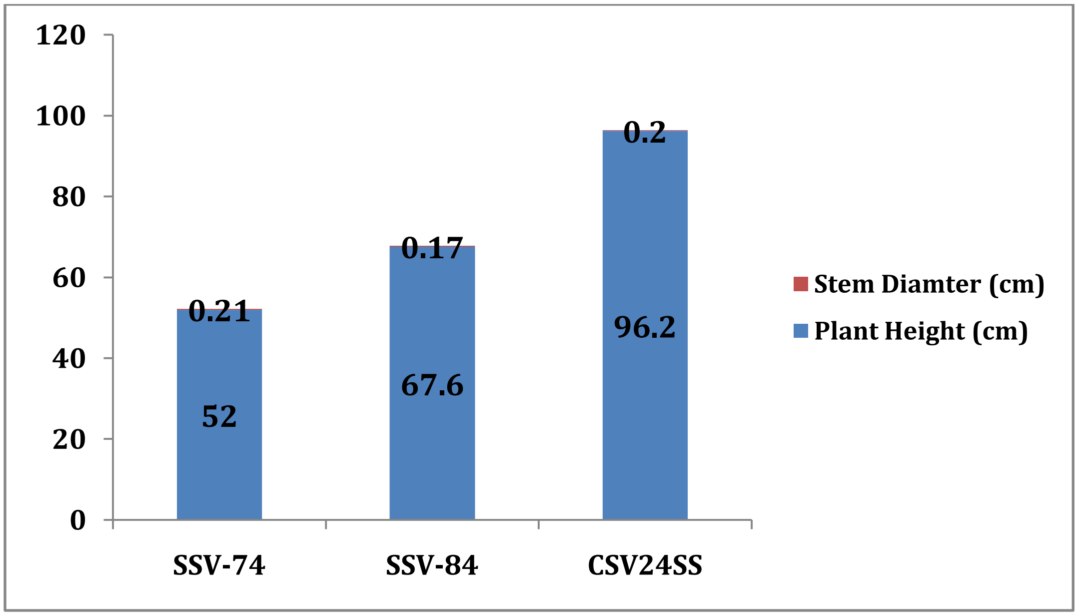
**Third Sowing Date [25 DAS]:**

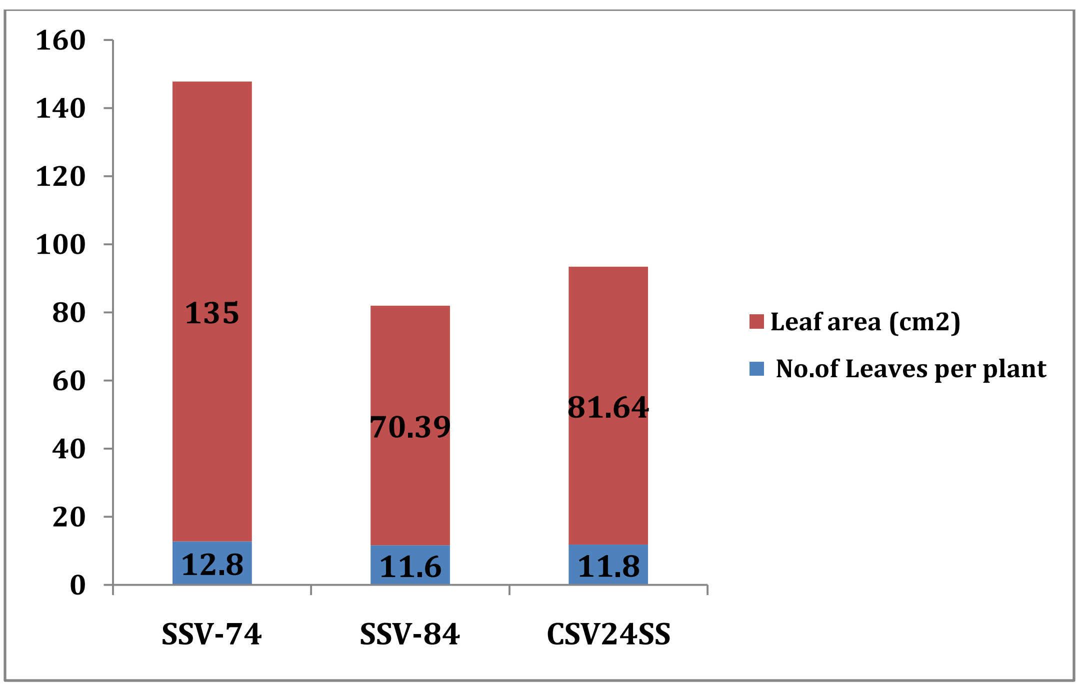


**Observations Recorded at 50 DAS:**

**First Sowing Date [50 DAS]:**



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