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Comparative study of variable irrigation scheduling and moisture retention practices on sweet corn yield and growth

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Abstract
A comparative study was conducted to assess the effect of variable irrigation scheduling and moisture retention practices on the growth, yield, and agronomic performance of sweet corn (*Zea mays* L.). The experiment aimed to optimize water use efficiency and enhance crop productivity through improved moisture management strategies. Different irrigation intervals were applied alongside moisture conservation treatments such as mulching and soil amendments to evaluate their influence on key growth parameters, including plant height, leaf area, and biomass accumulation. Results indicated that optimized irrigation schedules, combined with effective moisture retention practices, significantly improved the yield and growth of sweet corn compared to conventional practices. Treatments with longer irrigation intervals paired with mulching exhibited higher water-use efficiency without compromising crop performance. These findings underscore the importance of integrating moisture retention techniques with variable irrigation schedules to achieve sustainable sweet corn production, particularly in water-limited regions.

Keywords: Moisture retention, sweet corn, yield, growth, agronomic performance

Introduction
Sweet corn (*Zea mays* L.) is a highly valued crop known for its nutritional content and economic importance in many regions. However, its production is significantly influenced by water availability and management practices. In recent years, increasing water scarcity and unpredictable rainfall patterns due to climate change have necessitated the development of efficient water management strategies to sustain crop productivity. Among these, variable irrigation scheduling and moisture retention practices have gained prominence as key techniques to optimize water use and improve agronomic performance.

Irrigation scheduling refers to the regulation of water supply at critical stages of crop growth, ensuring that plants receive the right amount of water at the right time. Previous studies have demonstrated that precise irrigation timing can enhance crop yield and water-use efficiency (Choudhary *et al*., 2022; Patel *et al*., 2021) [1, 4]. However, the efficiency of irrigation largely depends on moisture retention practices, such as mulching and soil amendments, which help reduce evaporation and maintain soil moisture for prolonged periods (Kumar & Singh, 2020) [3]. These practices are especially crucial for crops like sweet corn, which have high water requirements during the vegetative and reproductive phases (Sharma *et al*., 2023) [5]. In regions with limited water resources, integrating variable irrigation schedules with moisture conservation techniques has been shown to enhance both growth and yield of sweet corn. Recent data suggest that water-efficient irrigation practices, combined with mulching, can increase yield by up to 20% while reducing water use by 30% (Verma *et al*., 2021) [6]. Additionally, studies have reported significant improvements in plant height, biomass, and overall agronomic performance when moisture retention practices are implemented (Gupta *et al*., 2021) [2].

Given the growing challenges associated with water scarcity, this study aims to evaluate the comparative effects of variable irrigation scheduling and moisture retention practices on the yield and growth of sweet corn.

The findings will provide valuable insights into optimizing water use for sustainable sweet corn production while maintaining high agronomic performance.

Materials and Methods

The present investigation entitled "Comparative study of variable irrigation scheduling and moisture retention practices on sweet corn yield and growth" was carried out during 2022-2023 at the Agricultural Research Farm, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh. The Agricultural Research Farm of Aligarh Muslim University, Aligarh is situated at about 5 km distance from Aligarh railway station. Geographically it is situated at 27.88°N latitude, 78.08°E longitude and at an altitude of 75.5 meter in the North-Gangetic plain. Aligarh is situated in the Western part of Uttar Pradesh and enjoys subtropical climate often subjected to extreme of weather conditions i.e. heat of summer and cold of winter with an average annual rainfall of 800 mm and potential evapotranspiration (PET) account for 1500 mm annually. The mean annual maximum and minimum temperature ranges from 33 °C to 43 °C and 3 °C to 18 °C, respectively. The mean RH during morning and evening hours is 59 and 35 percent, respectively. The mean pan evaporation ranges from 5.3 to 12.1 mm and the sunshine hours ranges from 7 to 9 day^{-1}. The chemical composition according criteria laid by (Muhr *et al*., 1965) indicated that soil was low in available nitrogen (120.09 kg ha^{-1}), medium in available phosphorous (14.85 kg ha^{-1}) and very high in potassium (436.24 kg ha^{-1}). The soil was moderately alkaline in reaction (pH 7.98) with an electrical conductivity of 0.31dSm^{-1}. The field capacity and permanent wilting point was 38.97 and 19.02%, respectively with bulk density 1.38 Mg m^{-3}. The experiment was laid out in spilt plot design, during Rabi season the main plot treatments comprised of three irrigation scheduling (I_1-Two irrigations at Knee height, I_2-Tasseling stage, Three irrigations at Knee height, Tasseling, Early dough stage and I_3-Four irrigations at Knee height, Tasseling, Silking, Early dough stage). The experimental field was prepared by performing the necessary of secondary tillage operations to get the soil to the desired tilth level and levelling it equally. The land was first ploughed once using a tractor-mounted disc before the experiment began, when the soil is at its most wet harrow plough. Following the formation of ridges and furrows, an experimental arrangement was used to determine the needed volumes of farm yard manure, Vermicompost based on an equal N foundation. Manure was put to each plot in line with the treatments specified, and it was physically integrated and levelled. Sampling technique for sweet corn for recording various biometric observations, a sample consisting of ten plants was selected at random and tagged in each net plot. Observations on growth parameters were recorded at four stages namely 30, 60, 90 days and at harvest. The same plants were also used to record yield components at harvest. Three plants were selected at random from the sampling area through destructive sampling. These plants were cut close to the ground at 30, 60, 90 days and at harvest for aerial dry matter production, leaf area, chlorophyll content and its partitioning studies.

Results and Discussion

The experimental findings regarding "Comparative study of variable irrigation scheduling and moisture retention practices on sweet corn yield and growth" on yield attributes like number of cobs plant^{-1}, length of cob with husk (cm), length of cob without husk (cm), girth of cob with husk (cm), girth of cob without husk (cm), diameter of cobs with husk (cm), diameter of cobs without husk (cm), weight of cobs with husk (g plant^{-1}), weight of cobs without husk (g plant^{-1}), weight of shelled cob (g), weight of grains cob^{-1} (g), number of grains cob^{-1}, number of grain rows cob^{-1} recorded at maturity were statistically analysed. Data on the length of cob with husk at harvest as impacted by different treatments were collected throughout 2022-23, and the mean length of cob with husk at harvest was 23.96 cm over the study year. The length of cob with husk data was strongly impacted by irrigation scheduling in sweet corn crops during the Rabi season of the year. The four irrigations at knee height, tasseling, silking and early dough stage recorded the significantly longest cob (29.29 cm) over three irrigations at knee height, tasseling and early dough stage and two irrigations to sweet corn crop at knee height and tasseling stage at harvesting stage, but I_2 recorded the second longest cob (24.94) and was significantly superior to I_1 in the year. During the years of experiment, the four irrigations at knee height, tasseling, silking and early dough stage recorded significantly longer cob without husk (24.71 cm) over three irrigations at knee height, tasseling and early dough stage and two irrigations to sweet corn crop at knee height and tasseling stage, but I_2 recorded second longest cob without husk (20.45 cm) and found significantly superior over I_1 at harvest stage. The four irrigations at knee height, tasseling, silking and early dough stage produced the greatest cob girth (22.99 cm) compared to three irrigations at knee height, tasseling and early dough stage and two irrigations to sweet corn crop at knee height and tasseling stage. Furthermore, crop getting I_2 had the second highest cob girth (18.84 cm) and was shown to be considerably superior to crop receiving I_1 in the year. The diameter of a cob with husk was dramatically altered by several treatments. During the year, the average diameter of a cob with husk was 6.08 cm. The diameter of the cob with the husk was greatly impacted by irrigation scheduling in sweet corn crops throughout the rabi season of the year. The four irrigations at knee height, teaseling, silking and early dough stage recorded significantly longer cobs with husk (7.32) than three irrigations at knee height, tasseling and early dough stage and two irrigations to sweet corn crop at knee height, tasseling stage even I_2 recorded second longest cob with husk (6.00 cm) and found significantly superior over I_1 in the year. Data in respect of the weight of cob without husk as influenced significantly due to irrigation scheduling in sweet corn crops in rabi the season during the year. Data in respect of weight of grains cob^{-1} as influenced significantly due to irrigation scheduling in sweet corn crop during rabi season during the year. The four irrigations at knee height, tasseling, silking and early dough stage at harvest stage recorded significantly highest weighted grains cobs^{-1} (222.4 g) over three irrigations at knee height, tasselling and early dough stage and two irrigations to sweet corn crop at knee height and tasseling stage even I_2 recorded second longest cob with husk (171.0 g) and found significantly superior over I_1 in the year. The percentage increase in the number of grain rows cob^{-1} with four irrigations at knee height, tasseling, silking and early dough stage and with three irrigations at knee height, tasselling and early dough stage over two irrigations to sweet corn crop at knee height and tasselling stage was 42.0% during the year of the experiment. The number of grain rows cob^{-1} at harvest was significantly influenced due to different NPK levels in sweet corn crops. The application of 180:90:90 kg NPK ha^{-1} produced significantly the highest number of grain rows cob^{-1} (18.7) over the application of 120:60:60 kg NPK ha^{-1} during the year.

Table 1: Length of Cobs (In cm), Width of cobs (In cm), Number of Seeds/Cob, Number of rows/Cob, Weight of the cobs with husk (In gm), Seed Weight (In gm)

Treatments	Length of Cobs (In cm)	Width of cobs (In cm)	Number of Seeds/Cob	Number of rows/Cob	Weight of the cobs with husk (In gm)	Seed Weight (In gm)
C_1I_1	18.22	15.56	420.11	15.11	228.66	221.29
C_1I_2	17.00	14.56	412.00	15.00	229.91	218.97
C_1I_3	15.89	14.89	413.67	14.89	217.61	215.39
C_1I_4	14.78	14.78	410.11	14.78	224.50	216.46
C_2I_1	15.67	14.56	412.78	14.89	211.34	213.00
C_2I_2	15.44	14.67	410.00	14.22	421.73	281.99
C_2I_3	15.67	14.78	408.11	14.11	216.99	213.07
C_2I_4	15.67	14.33	408.00	14.33	216.71	213.01
C_3I_1	17.67	17.00	413.33	14.89	221.98	216.73
C_3I_2	16.44	15.22	417.00	14.89	232.44	221.44
C_3I_3	15.22	15.33	403.67	15.00	217.46	212.04
C_3I_4	15.22	15.00	397.33	15.11	223.48	211.97
C_4I_1	14.11	15.00	415.78	15.11	219.21	216.70
C_4I_2	15.00	16.56	406.89	14.56	220.79	214.08
C_4I_3	15.22	15.00	412.22	15.67	228.02	218.64
C_4I_4	16.56	14.44	415.78	14.44	223.83	218.02
CD	2.054	N/S	1.23	N/S	1.98	0.988
SEm±	0.661	0.192	6.079	0.34	2.892	0.626

Conclusion

The timing of watering in sweet corn throughout the rabi season of the year has a considerable impact on the weight of the cob with or without husk plant-1. The highest weighted cobs with or without husk were recorded during the four irrigations at knee height, tasseling, silking and early dough stage (I_3) at harvest stage as compared to the three irrigations at knee height, tasselling and early dough stage (I_2) and the two irrigations to sweet corn at knee height and tasseling stage (I_1) during the year 2022–2023. A reduction in irrigation level resulted in a drop in the cob's average weight. This may be because of the water stress, which limits food movement, photosynthesis, and metabolic activity of the plant system and causes poor cob growth. In comparison to the other irrigation schedule treatments, the four irrigations were shown to be considerably better in terms of the weight of grain cob-1, number of grains cob-1 and number of grain rows cob-1. Two irrigations produced the lowest weight of cob-1 grains. There may be a larger weight of grains cob-1 as a result of the non-stress soil moisture situation (four irrigations) supplying all the nutrients to the plants at various growth phases. With higher irrigation levels, the photosynthetic area was larger, which contributed to an increase in the synthesis and transport of photosynthesis in the plant. As a result, the number of grains and grain rows cob-1 increased.

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