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Effect of different sowing date and agro meteorological condition on growth and yield of maize (*Zea maize*) crop at Prayagraj condition

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Abstract
Climate change is a natural phenomenon occurring at its own pace since the evolution of earth about 4-5 billion years ago. It gained momentum mainly due to rising greenhouse gases (GHGs) in the atmosphere by burning fossil fuels which affect the Earth's temperature, precipitation, and hydrological cycles. A field experiment was conducted during Kharif season 2018-2019 at the Forest Nursery and Research Centre, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj study the "To Study the different date of sowing and Agro meteorological Condition on growth and yield of Maize (*Zea maize*) crop at Prayagraj condition". Maize is the third most important cereal crop of world and India after wheat and Rice. Maize has been an important cereal crop sowing to its highest production potential and adaptability to wide range of environment hence called as 'Queen of Cereals. In horticulture, heat units are regularly communicated as developing degree days (GDD). Now and then developing degree days are called developing degree units (GDU) however the two terms are indistinguishable. Ascertaining GDD for a particular day utilizes a basic equation that includes subtracting a base or limit temperature from the normal temperature through the afternoon. The base temperature is the limit temperature for which plant development starts. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.7), low in organic carbon (0.35%), available N (230 kg ha^{-1}), available P (20 kg ha^{-1}) and available K (189 kg ha^{-1}). The result showed that growth attributes *viz.*, highest germination percentage (9.66%), Plant height (170 cm) at 90 DAS, No. of leaves per plant (99) at 90 DAS and Number of cobs/plant (22.82), Test weight (202.18g) and grain yield (30.24q/ha) and Straw yield (41.14 q/ha) was recorded highest under Agro meteorological Condition.

Keywords: Growth, yield, GPS, GDS, and maize, agrometeological condition

Introduction
Maize is the third most important cereal crop of world and India after wheat and Rice. Maize has been an important cereal crop sowing to its highest production potential and adaptability to wide range of environment hence called as 'Queen of Cereals' (Choudhari and Channappagouda, 2015) [6]. In world maize is cultivated in 146 million hectares with production of 685 million tonnes and an average production of 4.7t/ha. In India, maize is cultivated in 8.67 million hectares with a production of 22.26 Mt with an average productivity of 2566 kg/ha, contributing nearly 8% in the national food basket (DACNET, 2014) [7]. It provides food, feed, fodder and serves as a sources of basic raw material for the number of industrial products *viz.*, starch, protein, oil, alcoholic beverages, food sweeteners, cosmetics, more recently as bio-fuel etc. No other cereal is being used as many ways as maize. Maize grain has elevated nutritive value as it contains about 72% starch, 10% protein, 4.8% oil, 5.8% fiber and 3% sugar (Rafiq *et al.* 2010) [11]. Maize is produced over nearly 100 million hectares in developing countries, with almost 70% of the total maize production in the developing world coming from low and lower middle income countries**.** The demand of maize will double in the developing world, and maize by 2025 in the developing world is predicted to become the crop with the greatest production globally (Rosegrant *et al.* 2008) [12]. The increased concentration of CO_2 can affect plant growth directly through stimulation of photosynthesis but it can affect the plant growth indirectly by alteration of climatic factors such as temperature and precipitation (Dubrovsky *et al.* 2000) [9]. In India, maize is grown on 8.56 million hectares with 22.25 million tons of production and average grain yield of 25.60 q ha^{-1}(Anonymous 2014: b) [4].
India ranks 4th, 7th and 6th with respect to area, production and consumption of maize, respectively at the world level. In Punjab, maize is mainly grown during the Kharif season and was cultivated on 126 thousand hectares with a production of 460 thousand tones and average yield of 36.52 q ha^{-1}**.** The area under maize cultivation in Punjab is decreasing every year due

to the shifting of area from maize to rice. Rice was grown on an area of 390 thousand hectare during 1970-71 and it increased to 2894 thousand hectare during the year 2014-15 (Anonymous 2016) [5]. Maize is one of the most important cereal crops next to wheat and rice in the world. Globally, it is known as queen of cereals because it has the highest genetic yield potential among the cereals. At worldwide, it was cultivated on 184.23 million hectares and recorded the production of 1016.43 million tons of grains with an average grain yield of 55.1 q ha^{-1}(Anonymous 2014: a) [3]. Climate change is a natural phenomenon occurring at its own pace since the evolution of earth about 4-5 billion years ago. It gained momentum mainly due to rising greenhouse gases (GHGs) in the atmosphere by burning fossil fuels which affect the Earth's temperature, precipitation, and hydrological cycles. The temperatures are rising, snow and rainfall patterns are shifting, and extreme climate events are becoming more common. The global average CO_2 mole fraction at Earth's surface in 2014 was 397.2 ±0.1 ppm, an increase of 1.9 ppm over the 2013 global mean (Dlugokencky *et al.* 2015) [8]. Maize (*Zea mays* L.) is the third most important cereal crop after wheat and rice. It is grown extensively in temperate, tropical and sub-tropical regions of the world. Maize grain is valuable source of protein (10.4%), fat (4.5%), starch (71.8%), vitamins and minerals like calcium, phosphorous and sulfur**.** It also provides raw materials to starch industry and is used in the preparation of many products. In Pakistan, maize was cultivated on an area of 981 ha with a total production of 3658 tones and an average yield is 3805 kg ha^{-1}, while during the same season its area of cultivation and production in Khyber Pakhtunkhwa was 512 ha with1468 tones and average yield of maize crop was 1751 kg ha^{-1} during the reported year (MINFA 2011) [10]. Maize can be grown over a range of agro-climatic zones and this quality makes it a versatile crop. Maize is suitable to be grown in diverse environmental conditions which is not possible for any other crop. It is grown from 58°N to 40°S, from below sea level to altitudes higher than 3000 m, and in areas with 250 mm to more than 5000 mm of rainfall per year (AICRP 2007, Tripathi *et al.* 2016) [1]. The total world production of maize is used for livestock feed or for commercial starch and oil production. (Anapalli SS, 2005) [2].

Materials and Methods

The experiment was carried out during Rabi season 2018, at the Nursery of College of Forestry, SHUATS, Prayagraj (U.P.) which is located at 25˚ 24' 42" N latitude, 81˚ 50' 56" E longitude and 98 m altitude above the mean sea level. The area is situated on the right sight of the river Yamuna at Prayagraj rewa road national highway at a distance of about 5 km away from Prayagraj. The climate of Prayagraj is sub-tropical. The summer season is very hot temperature reaching as high 48 ^{0}C and in winter season temperature reaching up to 2.5-4.5 ^{0}C.

Results and Discussion

Table 1: Agro meteorological Condition on growth and yield of Maize (*Zea maize*) crop on different sowing date

Plot	Germination (%)	Plant Height (cm)	Number of leaves per plant	Cobs per plant	Test weight (gm)	Grain yield (q/ha)	Straw yield (q/ha)
P1 (28-Feb)	9.66	149	90	22.44	199.20	29.11	41.14
P2 (09-Mar)	7.33	160	99	22.50	200.60	29.73	34.62
P3 (19-Mar)	6.77	170	86	22.82	202.18	30.24	37.50

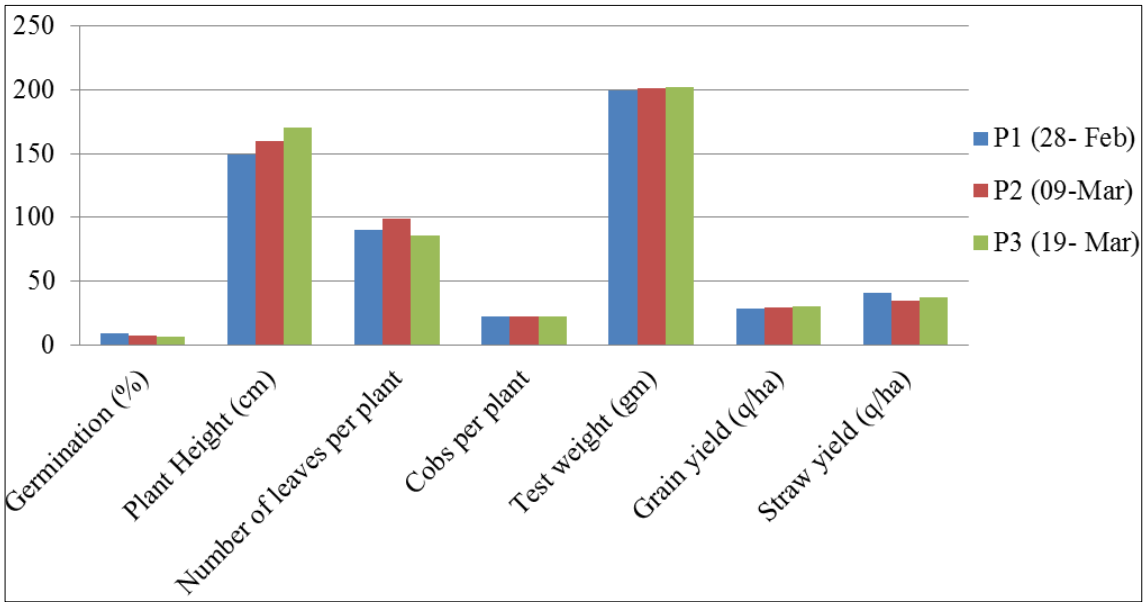

Fig 1: Data presented indicated Maize (Var.GX-888) crop

Germination (%)

Data presented in table 1 and Figure 1, indicated that Maize (Var.GX-888) crop of the highest mean germination percentage was observed in Plot P1 (9.66%) and the lowest value for the germination percentage was observed in Plot P3 (6.77%) due to the Agro meteorological Condition prevailing during the periods.

Plant Height

The average plant height was observed in the plot 1, and 3 are 149 cm, 160 cm and 170 respectively. The maximum plant height was observed in the plot 3 and minimum in plot 1 the reason of variation of plant height is due to the temperature, humidity etc. prevailing during the periods.

Number of leaves per plant
Data presented in table 1 indicated that Maize (Var.GX-888) crop sowing date with the interval of ten day of each plot (P1, P2, P3), of highest Number of leaves per plant was observed in Plot P2 (99) and the lowest value for Number of leaves per plant was observed in Plot P3 (86) under Agro meteorological Condition (temperature, humidity etc.).

Cob per plant
Data presented in table 1 indicated that Maize (Var.GX-888) crop sowing date with the interval of ten day of each plot (P1, P2, P3) of highest Cob per plant was observed in Plot P3 (22.82) and the lowest value for Cob per plant was observed in Plot P1 (22.44) under Agro meteorological Condition.

Data presented in table 1 indicated that Maize (Var.GX-888) crop sowing date with the interval of ten day of each plot (P1, P2, P3) of highest Test Weight (g) was observed in Plot P3 (202.18) and the lowest value for Test Weight (g) was observed in Plot P1 (199.20) under Agro meteorological Condition.

Grain yield
Data presented in table 1 indicated that Maize (Var.GX-888) crop sowing date with the interval of ten day of each plot (P1, P2, P3) of highest Grain yield (q/ha) was observed in Plot P3 (30.24) and the lowest value for Grain yield (q/ha) was observed in Plot P1 (29.11) under Agro meteorological Condition.

Straw yield
Data presented in table 1 indicated that Maize (Var.GX-888) crop sowing date with the interval of ten day of each plot (P1, P2, P3) of highest Straw yield (q/ha) was observed in Plot P1 (41.14) and the lowest value for Straw yield (q/ha) was observed in Plot P2 (34.62) under Agro meteorological Condition.

Table 2: Descriptive Statistics Correlations Matrix for Plant Height with Metrological factor

Plot 1						
Parameters	**Plant Height**	**T. max (^{0}c)**	**T. min (^{0}c)**	**Hum. Morning**	**Hum. Evening**	**Rainfall**
Mean	99.62	41.61	22.72	21.26	41.14	0.15
Std. deviation	45.03	7.26	6.18	4.42	7.16	0.42
Plot 2						
Mean	95.12	44.16	24.87	22.59	43.68	00
Std. deviation	52.82	3.92	5.13	3.11	3.80	00
Plot 3						
Mean	100.87	44.10	25.71	22.93	43.57	00
Std. deviation	54.83	2.74	3.66	2.29	2.86	00

Conclusion
Show that the parameters of growth and yield of hybrid Maize was maximum in plot P3 was variety of hybrid Maize i.e. GX888. The cost benefit ratio of combination plot P3 was maximum (1:1.39) whereas minimum (1:1.13) was recorded in plot P1. Therefore the combination plot P3 is recommended to the farmers of Prayagraj region for hybrid Maize cultivation.

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