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Research Article

Growth and yield of maize (*Zea mays* L.) as influenced by date of sowing and hybrids

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Abstract

A field experiment was conducted at college of Agriculture, UAHS, Shivamogga during *kharif* 2015 to study the effect of date of sowing and hybrids on growth and yield of Maize (*Zea mays* L.). The experiment was laid out in randomized complete block design (RCBD) with factorial concept and replicated thrice. There were eight treatment combinations which includes four dates of sowing (15th June, 30th June, 15th July and 30th July) and two hybrids (PAC-740 and CP-818). Crop sown on 15th June recorded significantly higher plant height (201.03 cm), number of green leaves (3.03), leaf area (992.49 cm^2), LAI (0.74), total dry matter (305.65 g), cob length (22.16 cm), kernels cob^{-1} (670.93), kernel yield cob^{-1} (230.95 g), test weight (43.08 g), kernel yield (7632.57 kg ha^{-1}), stover yield (9512.56 kg ha^{-1}) and harvest index (44.52 %) as compared to other sowing dates. Among the hybrids CP -818 recorded significantly higher plant height (191.85 cm), number of green leaves (2.72), leaf area (954.32 cm^2), LAI (0.71), total dry matter (277.65 g), cob length (19.81 cm), kernels cob^{-1} (541.88), kernel yield cob^{-1} (207.71 g), test weight (39.16 g), kernel yield (7060.72 kg ha^{-1}), Stover yield (8839.98 kg ha^{-1}) and harvest index (44.44%) as compared to PAC-740. The interaction between dates of sowing and hybrids are non-significant.

Introduction

Maize is the third most important cereal crop in India because of its fast growing nature, ease of cultivation, high yielding potential, easy to process, readily digestible and higher profitability. Rainfed farming is the backbone of Indian agriculture, as large areas of cultivated land is rainfed. The success or failure of rainfed crops depends mostly on the pattern of monsoon rains and its distribution. Apart from rainfall thermal environment experienced by the crop also decides the maize productivity (Mehdi, 2012). Key planting factors influencing maize production are sowing date and cultivars. Different genotypes may behave differently under similar environmental conditions. Different sowing dates might create different environmental conditions from emergence to physiological maturity (Mehdi, 2012). The variation in planting dates modifies the microclimate to which the plants are exposed and it is responsible for biomass production and ultimately the yield. It is necessary to understand the knowledge of plant environment interaction for increasing yield of crop. Maize yields

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are higher when sown with the onset of monsoon. However, during recent years after the onset of monsoon, rains are delayed with dry spells leading to delayed sowing resulted in poor growth and yield. Maize is predominantly grown under rainfed condition in Southern Transition Zone of Karnataka. The occurrence of mid-season or late season drought is very common resulting in lower productivity of maize. This calls for identification of suitable hybrids of contrasting duration as well as sowing dates to realise higher yield of maize. With this background a field experiment was conducted to identify the suitable sowing date and hybrid for Southern Transition Zone of Karnataka.

Materials and Methods

A field experiment was conducted at College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka during *kharif 2015*. Which is situated at $14^{o}\ 0^{1}$ to $14^{0}\ 1^{1}$ North latitude and $75^{0}\ 40^{1}$ to $75^{0}\ 42^{1}$ East longitude with an altitude of 650 meters above mean sea level. The climate is hot, moist, sub-humid, and the annual rainfall ranges from 820 mm to 910 mm. More than 60 percent is received in the Kharif season, which is normal rainfall of 550 mm, 166 mm in the pre-monsoon and 207 mm in the northeast monsoon rainfall. The soil of the experimental site was red sandy loam with pH 6.4, medium in soil organic carbon (0.55 %), low available N (232 kg ha^{-1}), high available P_2O_5 (77.4 kg ha^{-1}) and low in soil available K_2O (193.5 kg ha^{-1}). Eight treatment combinations which includes four dates of sowing (15th June, 30thJune, 15thJuly and 30thJuly) and two hybrids (PAC - 740 and CP - 818) were tried in a randomized complete block design with factorial concept and replicated thrice. The recommended dose of manure (10 t FYM ha^{-1}) was applied 15 days before sowing and incorporated into the soil. Recommended dose of fertilizer (150:75:40 kg NPK ha^{-1}) for each treatment was appliedin terms of urea, SSP and MOP fertilizers. Furrows were opened at 45 cm interval with the help of hand hoe. Basal dose of fertilizers (50 % N and 100 % P and K) were applied at the time of sowing and remaining 50% of N was applied in two splits at 30 and 60 days after sowing.

The pre-emergent herbicide (Atrazine) was sprayed on the day of sowing to all the plots at the rate of 1.5 kg a. i. ha^{-1}. The plots were weeded manually twice at 30 and 50 days after sowing. Growth parameters like plant height, number of leaves, leaf area, and total dry weight were recorded at 30, 60, 75, 90, 105 DAS and at harvest. Yield parameters like cob length, cob girth, kernels per cob, kernel yield per cob and test weight were recorded at harvest. The data was subjected to statistical analysis by using SPSS software V20. Further, date of sowing was converted in to into Julian day on which a particular treatment was sown and grain yield was regressed against Julian days sowing to assess the effect of sowing dates on yield of maize.

Results and Discussion

The growth parameters of maize as influenced by date of sowing and hybrids at harvest were presented in table 1. Crop sown on 15th June recorded significantly higher plant height (201.03 cm), number of green leaves (3.03), leaf area (992.49 cm^2), LAI (0.74) and total dry matter (305.65 g) as compared to other sowing dates. Among the hybrids CP -818 recorded significantly higher plant height (191.85 cm), number of leaves (2.72), leaf area (954.32 cm^2), LAI (0.71) and total dry matter accumulation (277.65 g) as compared to PAC 740. Interaction between date of sowing and hybrids did not influence the growth parameters significantly. The optimum planting time play an important role in deciding the productivity and reducing climate risk especially in rainfed areas. Availability of adequate soil moisture in different crop growth and development stages is a deciding factor for its yield and yield attributes. Crop sown on 15th June has received adequate rainfall (738.4 mm) and the mean temperature ranges from 24.5 to 26.6^{0}C during different growth stages *viz.*, emergence to knee high stage, knee high stage to tasseling, tasseling to silking and silking to maturity (Fig. 1). Whereas, rainfall of 553.6, 598.6, 520.8mm and mean temperature ranges from 24.4 to 26.6^{0}C, 24.8 to 24.3^{0}C and 26.0 to 24.9^{0}C for July 1st, July 15th and July 30th Sown crop respectively. Both rainfall and temperature play key role in production of dry matter and accumulation of

higher leaf area and leaf area index. Similar findings were reported by Keerthi, et al. (2017); Umesh et al. (2017); Chavan and Chavan (2010) and Marjan et al. (2010) in maize. Significantly higher value of growth parameters recorded with CP-818 might be due to maximum utilization of solar energy and soil moisture for longer period due to its long duration in nature. Higher LAI due to higher leaf area and leaf number per plant resulted higher dry matter accumulation.

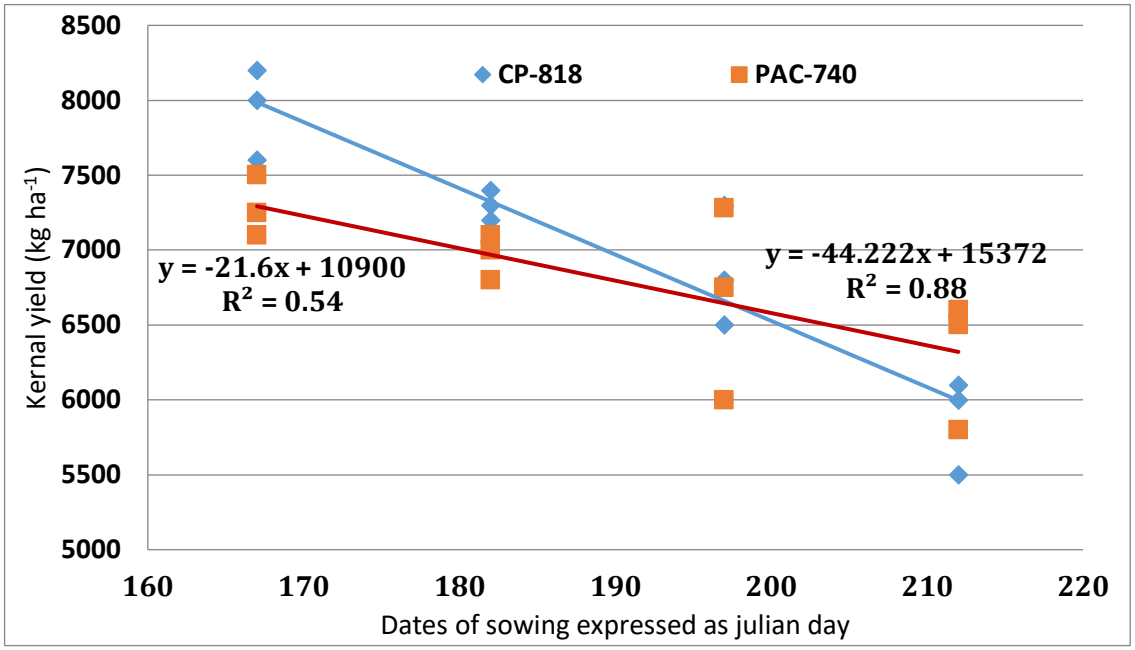

Figure 1. Relationship between kernel yield of maize hybrids and dates of sowing expressed as Julian day

It was revealed that maize cultivars had differential response to sowing date in yield attributes such as cob length (22.16 cm), kernels cob^{-1} (670.93), kernel yield cob^{-1} (230.95 g), test weight (43.08 g), kernel yield (7632.57 kg ha^{-1}), stover yield (9512.56 kg ha^{-1}) and harvest index (44.52 %) were found significantly higher in 15th June sowing. It could be due to the better growth and development of crop as Kolawole and Samson (2009), Nielson (2002) reported that due to the fact that good photosynthates accumulated in leaves and its transfer to economic part like grains and cobs. This research showed that early sowing produced greater yields compared to late sowing and also the lowest yield was obtained for the late sowing (Table 2). In addition, the late sowing date has a higher probability of experiencing water stress during the critical seed-filling phase, resulting in lower yields (Sandeep et al., 2014). It might be suggested in this study that the late planted crop had a shorter period for the production of seed and a slightly lower rate of seed production due to reduced growth, and exposure of plants to warmer and longer photoperiod (long day) after the late sowing date. Similar findings were also reported by Rowland et al. (2013) and Angel (2019). These differences were also largely related to the number of developing seed on cob. The per cent yield reduction under delayed sowing are June 30th (5.59 %), July 15th (11.65 %) and July 30th (20.16 %).

Table 1. Growth parameters of maize as influenced by date of sowing and hybrids

Treatments	Plant height (cm)	Number of Leaves	Leaf area (cm^2)	Leaf area index (LAI)	Total dry weight (g)
Dates of sowing (D)					
Jun-15	201.03	3.03	992.49	0.74	305.65
Jun-30	188.36	2.83	962.83	0.71	277.00
Jul-15	184.30	2.50	926.25	0.69	257.57
Jul-30	180.56	2.37	905.49	0.67	247.93
F - test	*	*	*	*	*
S. Em ±	0.96	0.07	7.10	0.005	2.85
C.D. at 5%	2.96	0.21	21.52	0.02	8.66
Hybrids (H)					
PAC - 740	185.78	2.65	939.29	0.70	266.43
CP – 818	191.85	2.72	954.32	0.71	277.65
F – test	*	NS	*	NS	*
S. Em ±	0.68	0.05	5.02	0.004	2.02
C.D. at 5%	2.09	-	-	-	6.12
Interaction (H X D)					
PAC - 740 + June 15	194.40	3.00	980.34	0.73	295.30
PAC - 740 + June 30	186.26	2.73	960.70	0.71	272.37
PAC -740 + July 15	183.26	2.47	917.64	0.68	255.60
PAC -740 + July 30	179.20	2.40	898.49	0.67	242.43
CP - 818 + June 15	206.66	3.07	1004.64	0.74	316.00
CP - 818 + June 30	190.46	2.93	964.98	0.71	281.63
CP - 818 + July 15	185.33	2.53	935.18	0.69	259.53
CP - 818 + July 30	181.93	2.33	912.49	0.68	253.43
F - test	NS	NS	NS	NS	NS
S. Em ±	1.37	0.10	10.03	0.007	4.04
C.D. at 5%	--	-	-	-	-

Table 2. Yield and yield parameters of maize as influenced by date of sowing and hybrids

Treatments	Cob length (cm)	Kernels /cob	Kernel yield (g cob^{-1})	Test weight (g)	Kernel yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
Dates of sowing (D)							
Jun-15	22.16	670.93	230.95	43.08	7632.57	9512.56	44.52
Jun-30	20.30	533.86	208.30	38.81	7205.77	9132.53	44.11
Jul-15	18.36	472.66	194.21	36.27	6743.32	8485.98	44.28
Jul-30	17.43	416.76	171.23	32.96	6093.63	7760.25	44.03
F - test	*	*	*	*	*	*	NS
S. Em ±	0.21	9.45	5.90	1.01	129.78	86.95	0.34
C.D. at 5%	0.65	28.96	18.08	3.09	393.64	263.75	-
Hybrids (H)							
PAC - 740	19.31	505.23	194.64	36.40	6776.93	8605.68	44.03
CP - 818	19.81	541.88	207.71	39.16	7060.72	8839.98	44.44
F - test	*	*	*	*	*	*	NS
S. Em ±	0.15	6.68	4.17	0.71	91.77	61.49	0.32
C.D. at 5%	0.46	20.47	12.78	2.19	278.35	186.50	-
To be continued							

Interaction (H X D)							
PAC - 740 + June 15	21.73	630.00	219.50	41.30	7282.13	9041.30	44.61
PAC - 740 + June 30	20.20	515.86	199.13	37.38	6947.83	8755.00	44.25
PAC -740 + July 15	17.93	457.46	190.92	36.04	6594.00	8329.27	44.19
PAC -740 + July 30	17.40	417.60	169.00	30.88	6283.73	8297.17	43.10
CP - 818 + June 15	22.60	711.86	242.39	44.87	7983.00	9983.83	44.43
CP - 818 + June 30	20.40	551.86	217.48	40.24	7463.70	9510.07	43.97
CP - 818 + July 15	18.80	487.86	197.50	36.49	6892.63	8642.70	44.37
CP - 818 + July 30	17.46	415.93	173.46	35.04	5903.53	7223.33	44.97
F - test	NS	NS	NS	NS	NS	NS	NS
S. Em ±	0.30	13.37	8.35	1.43	183.53	122.97	0.65
C.D. at 5%	-	-	-		-	-	-

Significantly higher yield and yield parameters like cob length (19.81 cm), kernels cob^{-1} (541.88), kernel yield cob^{-1} (207.71 g), test weight (39.16 g), kernel yield (7060.72 kg ha^{-1}), stover yield (8839.98 kg ha^{-1}) and harvest index (44.44%) were recorded with CP-818 as compared to PAC-740 (Table 2). Higher growth and yield parameters were mainly due to higher values of growth attributes in CP-818 at all stages of crop growth coupled with its higher photosynthetic efficiency due to its optimum LAI and canopy spread which might have led to stimulation of longer sink in terms of longer cobs. Khan et al. (2002), Golla et al. (2019), Dahmardeh (2012) and Maga (2015) also reported differential response of maize varieties when exposed to different environmental conditions by means of sowing at different dates. It is also well-known fact that number of kernels per cob were higher in longer cobs than small ones apart from this the better cob filling resulted in higher kernel yield. The interaction effect is non-significant. However, the crop sown on15th June along with CP - 818 hybrid recorded higher yield as compared to other dates of sowing. Similarly, crop sown on 30th July along with CP-818 hybrid resulted lower yield.

Conclusion

The result shows that maize crop sown on 15th June was significantly better as compared to other sowing dates for the studied parameters of growth and yield. Similarly, CP-818 hybrid is well suited for early sowing for southern transitional zone of Karnataka.

Conflict of Interest

There is no conflict of interest

Authors Contribution

DBH (Post Graduate Student): Conducted field experiments and recorded field observations. SS (Professor of Agronomy): Conceived the idea and supervised the experiment and written the concept and discussion. PG (Technical Officer): written the draft, data analysis and references.

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