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Effects of different sowing dates on hybrid maize varieties in Allahabad region

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Abstract
A field experiment was conducted during *Rabi* season of 2014-2015 to study the effect of different sowing dates on hybrid maize varieties under Allahabad condition. The experiment was laid out in Randomize Block Design consisting of 9 treatments replicated thrice i.e. three sowing dates (12th December, 22nd December and 1st January) and were allocated randomly in each replication. The results shows that crops sown on 1st January with treatment T_9 shows maximum plant height (202.08 cm), number of cobs per plant (2.56), number of leaves per plant (16.22), number of seeds per cob (305.56), seed yield (4.63 t ha^{-1}), straw yield (7.92 t ha^{-1}), test weight (218 gm) and harvest index (37.41%) than crop sown on 12th and 22nd December. An economic analysis was also done viz. cost of cultivation of crop per hectare and cost benefit ratio showing crop sown on 1st January with treatment T_9 having maximum cost benefit ratio (1:1.73).

Keywords: Rabi maize, sowing dates, economic analysis

Introduction
Maize or corn (*Zea mays* L.) is a plant belonging to the family of grasses (*Poaceae*). Maize is an important cereal crop in world after wheat and rice. Maize is called "Queen of cereals" as importance of maize lies in its wide industrial applications besides serving as human food and animal feed. It is the most versatile crop with wider adaptability in varied agro-ecologies and has highest genetic yield potential among the food grain crops. Maize is cultivated in three distinct seasons in India: *Kharif*, *Rabi* and *Spring*. In India maize is predominantly cultivated in *Kharif* season but in past few years *Rabi* maize has gained a significant place in total maize production in India.

Different sowing dates have significant effect on the growth and development of maize plants. Of all the management aspects of growing a maize crop (cultivar selection, plant density, amount and timing of fertilizers, etc.), planting dates is probably the most subjective to variation because of the very great differences in weather at planting time between seasons and within the range of climates (Otegui *et al*., 1995) [9]. In practice, recommended dates are normally drawn up from the results of long-running series of agronomic experiments, which can give mean planting dates for highest yield together with realistic estimates of expected yield penalties for each week of delay in planting (Lauer *et al*., 1999) [7]. However, in accepting such guidelines, several reservations must be appreciated in addition to the fact that use of the recommended date is not a guarantee of highest yield for that season (Oktem., 2000) [8].

Material and Methods

The experiment was conducted in *Rabi* 2014 in the field of School of Forestry & Environment, Sam Higginbottom Institute of Agricultural, Technology and Sciences, Allahabad, Uttar Pradesh. The field experiment was carried out in a net area of 108m^2 in a randomized block design 3x3 factorial with 9 treatment combinations, each treatment replicated thrice. The factors were located randomly and three sowing dates (12th December, 22nd December and 1st January) and three hybrid maize varieties (Ganga safed-2, Ganga-11 and Ganga-5). There were a total of 27 plots and one plot size was 2x2 m^2. The seed were sown by the method of line sowing with seed rate 0f 20-25 kg/ha with plant spacing of 15 cm and row spacing of 50 cm. Recommended fertilizer doses of NPK @ 120:60:40 kg/ha at the time of sowing. Five irrigations provided to the crop at different growth stages and intercultural operations performed manually at 35 and 45 days after sowing.

Table 1: The experimental layout designs

Treatment	Treatment combination	Varities	Dates
T_1	V_1D_1	Ganga safed-2	12th December
T_2	V_2D_1	Ganga-11	
T_3	V_3D_1	Ganga-5	
T_4	V_1D_2	Ganga safed-2	22nd December
T_5	V_2D_2	Ganga-11	
T_6	V_3D_2	Ganga-5	
T_7	V_1D_3	Ganga safed-2	1st January
T_8	V_2D_3	Ganga-11	
T_9	V_3D_3	Ganga-5	

Where,
V1- Ganga safed-2 V2- Ganga-11 V3- Ganga-5
D1-12th December D2-22nd December D3-1st January

Result and discussion

The results (Table 2) revealed that growth attributes viz. plant height and number of leaves differ significantly due to different dates of sowing. Selection of good varieties of hybrid and proper planting time are important factors. The sowing date 1st January gives higher plant height (202.8 cm) and number of leaves (16.22) because of favorable weather condition in comparison to rest of the sowing dates (Bunting., 1976) [4] and (Berzenyi *et al*., 1998) [3]. The low temperature in the month of December inhibited the early emergence of leaves and plant height (Sangoi *et al*., 1998; Silva *et al*., 1998) [10, 12], (Seuguruka *et al*., 1981) [11]. Various yield attributes viz. number of cobs per plant (2.56), number of seeds per cob (305.56), seed yield (4.63 t ha^{-1}), straw yield (7.92 t ha^{-1}), test weight (218 gm) and harvest index (37.41%) were significantly influenced under different sowing dates. The results (Table 3) show that availability of solar radiation, duration, intensity and mean thermal temperature significantly affected the yield (Cirilo and Andrede., 1994) [5], (Tollenaar and Bruulsema., 1998) [13], (Jompuk *et al*., 2005) [6].

Table 2: Performance of growth attributes viz. plant height and number of leaves

Treatment	Plant height (cm)				No. of leaves/plant			
	30 (DAS)	60 (DAS)	90 (DAS)	120 (DAS)	30 (DAS)	60 (DAS)	90 (DAS)	120 (DAS)
T_1	64.86	143.89	155.01	155.51	5.33	9.89	11.22	12.22
T_2	69.18	145.98	157.42	157.59	5.67	10.44	11.67	12.33
T_3	70.01	148.20	159.70	159.94	5.89	10.78	12.11	13.11
T_4	66.92	149.53	161.24	161.23	6.22	11.22	12.44	13.00
T_5	68.73	151.69	163.73	163.87	6.78	11.56	12.67	13.00
T_6	81.79	161.93	174.33	174.46	7.44	12.00	13.11	14.11
T_7	92.00	174.33	190.87	190.93	8.00	12.78	14.00	14.00
T_8	90.96	180.09	192.30	192.36	8.56	13.56	14.78	15.78
T_9	95.02	189.39	201.87	202.08	8.78	14.33	15.56	16.22
F -test	S	NS	NS	NS	NS	NS	NS	NS
S. Em(±)	1.858	2.775	2.726	1.319	0.259	0.454	0.467	0.475
C.D.at5%	3.939	5.884	5.780	2.797	0.548	0.963	0.989	1.008

Table 3: Performance of Yield attributes parameters

Treatment	No. of cobs/plant	No. of seeds/cob	Seed yield(tha^{-1})	Straw yield(tha^{-1})	Test weight (gm)	Harvest index (%)
T_1	2.00	248.67	2.64	5.09	201.00	34.14
T_2	2.11	253.56	3.00	5.75	203.67	34.25
T_3	2.22	257.89	3.13	5.97	205.33	34.38
T_4	2.33	258.44	3.49	6.38	208.33	35.35
T_5	2.33	267.89	3.71	6.75	210.00	35.46
T_6	2.44	269.56	4.21	7.62	212.33	35.59
T_7	2.33	279.22	4.20	727	216.00	36.61
T_8	2.44	295.00	4.36	7.50	214.00	36.77
T_9	2.56	305.56	4.63	7.92	218.00	37.41
F-test	S	NS	NS	NS	NS	NS
S.Em(±)	0.007	4.666	0.220	0.405	2.027	0.238
C.D.at 5%	0.015	9.892	0.467	0.860	4.297	0.504

Maize data on economic viz, cost of cultivation of crop per hectare and cost benefit ratio under different sowing dates are shown in table 4 and table 5. Among treatment combination of maize under different sowing dates and varieties the highest cost benefit ratio (1.73) was obtained in treatment T_9 (Ganga safed-5; 1st January) in comparison to (1.02) in T_1 (Ganga safed-2; 12th December).

Table 4: Performance of conomic viz, cost of cultivation of crop per hectare and cost benefit ratio

S. No	Particulars	Quantity	Rate/unit(Rs)	Cost(Rs/ha)
(A)	**Land preparation**			
1	Ploughing	4	600	2400
2	Rotavator &leveling	4	800	3200
3	Latout of the field	6	280	1680
(B)	**Manure and fertilizer**			
1	Urea	240	8	1920
2	Diammonium phosphate	180	25	4500
3	Muriate of potash	100	12	1200
(C)	**Fertilizer application**			
1	Labour for urea top dressing	1	280	280
(D)	**Intercultural operation**			
1	Two hand weeding, thinning & gsp filling	4	280	1120
(E)	**Irrigation**			
1	Tubewell charge-5(2 hrs/irrigation)	10	300	3000
2	Labour for irrigation(2 labour/irrigation)	10	280	2800
(F)	**Harvesting**	5	280	1400
(G)	**Other operation**	5	280	1400
(I)	**Land rent**	4	600	2400
	Supervision rent	4	800	3200
	Fixed interest	4	12.5%	4108.2
	Working capital	4	9.5%	2366
	Total			36974

Table 5

Treatment	Grain yield (ha^{-1})	Straw yield (ha^{-1})	Sale rate		Gross return (ha^{-1})	Cost of cultivation (ha^{-1})	Net return (ha^{-1})	C:B ratio (ha^{-1})
			Grain (ha^{-1})	Straw (ha^{-1})				
T_1	2.63	5.09	33856	7635	41491	40814	677.3	1:1.02
T_2	3	5.75	38619	8625	47244	40934	6310.3	1:1.15
T_3	3.13	5.97	40292.5	8955	49247.5	41294	7954	1:1.19
T_4	3.49	6.38	44927	9570	54497	40814	13683.1	1:1.34
T_5	3.71	6.75	47759	10125	57884	40934	16950.13	1:1.14
T_6	4.21	7.62	54195.3	11430	65625.3	41294	24332	1:1.59
T_7	4.2	7.27	54067	10905	64972	40814	24158	1:1.59
T_8	4.36	7.5	56126.3	11250	67376.3	40934	26443	1:1.65
T_9	4.63	7.92	59602	11880	71482	41294	30188.3	1:1.73

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