

Influence of Staggered Sowing on Growth, Seed Yield and Quality of Single Cross Hybrid Maize : MAH 14-5 (*Zea mays* L.)

G. S. ANIL KUMAR, T. M. RAMANAPPA AND R. SIDDARAJU

Department of Seed Science and Technology, College of Agriculture, UAS, GKVK, Bengaluru - 560 065

E-mail: ramantm@gmail.com

ABSTRACT

An experiment was carried out on staggered sowing to study synchronization of flowering between female (CAL 1443) and male (CML 451) parents of new single cross hybrid maize, MAH 14-5 during *kharif*2017. Staggered sowing on plant growth parameters *viz.*, plant height, number of leaves per plant, days to 50 and 100 per cent tasseling and silking in male and female respectively, ear height and days to maturity found to be non-significant in both female and male parents. The results revealed that sowing female and male parents on same day (S_3) recorded significant differences for yield parameters like ear length (18.33 cm), number of seeds per row (28.15), ear weight (140.35 g), seed weight per ear (115.75 g), seed yield per plant (140.10 g), seed yield per plot (2.24 kg) and seed yield per ha (34.09 q) in female parent and non-significant for male parent, while non-significant differences in both female and male parent for number of ears per plant, ear diameter, number of rows per ear and pith weight was noticed. Sowing of female and male parent on same day (S_3) also revealed significantly higher seed quality parameters pertaining to female parent like hundred seed weight (35.20 g), germination (85.75 %), seedling length (33.88 cm), seedling dry weight (1020 mg) and seedling vigour index-I (2905), seedling vigour index-II (8732). Hence, maximum synchronization of flowering could be achieved by sowing of female and male parents on the same day.

Keywords: Maize, Single cross hybrid, Staggered sowing and Synchronization

MAIZE (*Zea mays* L.; $2n = 20$) is one of the most commercially grown crops belongs to family *Poaceae* and it ranks third in the world next to wheat and rice. Being a C_4 plant, maize is physiologically more efficient, adaptable to wide range of environmental conditions and has higher yield potential. It can be grown as a potential source of food for human beings, cattle feed, poultry and as industrial raw material for production of starch, syrup, alcohol *etc.*

In India, maize ranks third with 24.17 mt. production from an area of 9.18 m ha with productivity of 2630 kg ha⁻¹. Karnataka is one of the leading maize producing states in the country grown in an area of 1.34 m ha and ranks second in production with 3.98 mt and productivity of 2990 kg ha⁻¹. The average productivity in Karnataka is much higher than the national average. Due to its high yielding and wider adaptability, area under maize cultivation is rapidly increasing in the state (Anon., 2017).

For hybrid seed production many factors play an important role in maximising the seed yield and quality of single cross hybrid maize. Synchronization of flowering between female and male parents is one of most important and crucial factor to get higher seed yield and quality from seed parent. Without proper synchronization of female and male parent the seed yield of seed parent drastically reduces during hybrid seed production. Of the many ways to achieve synchronization between female and male parents, the staggered sowing of parents is best, easy and cost effective method even from farmers point of view. The knowledge on days taken to 50 and 100 per cent tasseling and silking in male and female parents respectively is necessary for adjusting dates of sowing to get better synchronization of flowering in male and female parents, so that seed yield on seed parent is enhanced, resulting in cost effective hybrid seed production.

As and when the new hybrids are released by the research institutes, there is a need for standardisation of seed production techniques like staggered sowing, planting ratio *etc.* The staggered sowing of male and female parents is required to achieve synchronized flowering, so that there will be abundant pollen for receptive stigma enabling enhanced fertilization and seed set resulting better seed yield. The new hybrid MAH 14-5 with parentage of CAL 1443; female parent and CML 451; male parent need standardization of hybrid seed production techniques like staggered sowing for better adjustment of pollen shedding in male and silking in female parents. Considering above factor the research was undertaken to see the influence of staggered sowing on growth, yield and quality of single cross hybrid maize.

METHODOLOGY

The field experiment was laid out at National Seed Project, University of Agricultural Sciences, Bengaluru, Karnataka during *kharif* 2017.

To know the synchronization between female and male parents, staggered sowing had been undertaken in five different treatments *viz.*, S₁ (Sowing of female parent four days earlier to male), S₂ (Sowing of female parent two days earlier to male parent), S₃ (Sowing of female and male parents on same day), S₄ (Sowing female parent two days after male parent) and S₅ (Sowing of female parent four days after male parent). The experiment was laid out in RCBD (Randomized Complete Block Design) with four replications. In the study staggering had done to female parent instead of the male parent because the control of pollen is the major problem when male is staggered and don't know which staggered male parent contribute pollen to fertilize the female when no barrier is present. Thus, pollen from male parent equally distributed to all the females. The five competitive plants were tagged at random in each treatment in each replication for recording various growth and yield parameters.

The germination was tested as per the procedure outlined by (Anon., 2010), seedling length and seedling vigour index was calculated as per the Abdul Baki

and Anderson (1973) and Ching (1973). The data collected from the experiment was analysed statistically by the procedure prescribed by Sundarraj *et al.* (1972). Critical differences were calculated at 5 per cent level whenever 'F' test was significant.

RESULTS AND DISCUSSION

The staggered sowing of female and male parents did not influenced significantly the growth parameters like plant height, number of leaves per plant, days to 50 and 100 per cent tasseling in male, days to 50 and 100 per cent silking in female, ear height and days to maturity. But significant differences were found for anthesis to silking interval among staggered sowings.

However, sowing of female parent four days earlier to male (S₁) recorded maximum values for plant height (167.39 cm), number of leaves per plant (14.15), days to 100 per cent tasseling (68.00) in male and days 50 and 100 per cent silking in female (65.50 and 68.50 respectively). While S₅ (sowing of female parent four days after male) recorded maximum values for days to 50 per cent tasseling in male (65.75) and anthesis to silking interval (0.75). Whereas S₂ (sowing of female parent two days before male) recorded maximum values for ear height (94.48 cm) and days to maturity (116.00). Nevertheless, plant height (159.13 cm), number of leaves per plant (13.60), days to 100 per cent tasseling in male (67.75) in S₅, days to 50 per cent tasseling in male (65.25), days to 50 and 100 per cent silking in female (65.25 and 68.00 respectively) and anthesis to silking interval (0.00) in S₃ and ear height (92.37 cm) and days to maturity (115.25) in S₁ registered minimum values (Table 1)

The data revealed that highly significant effect of staggered sowing on ear length, ear weight and number of seeds per row of female was observed. The maximum values for ear length (18.33), ear weight (140.35 g), number of seeds per row (28.15), seed weight per ear (115.75 g) and seed yield per plant (140.10 g) of female was observed in S₃, while ear length (14.36 cm) in S₁, ear weight (103.20 g) and number of seeds per row (19.95) in S₅ recorded minimum values of female (Table 2 and 3). However, non-significant differences with respect to staggered sowings were observed for all the yield parameters

TABLE 1
Influence of staggered sowing on growth parameters of single cross hybrid maize MAH 14-5 parents

Treatments	Plant height (cm)	Number of leaves per plant	Days to 50 per cent tasseling in male		Days to 50 per cent silking in female		Days to 100 per cent tasseling in male		Days to 100 per cent silking in female		Ear height (cm)	Days to maturity	Anthesis to silking interval
			Female	Male	Female	Male	Female	Male					
S ₁	167.39	14.15	65.50	65.50	65.50	68.00	68.00	68.00	68.50	92.37	115.25	0.50	
S ₂	163.41	13.75	65.50	65.50	65.00	68.00	68.00	68.25	94.48	116.00	0.25		
S ₃	165.02	13.90	65.25	65.25	65.25	68.00	68.00	68.00	94.11	115.25	0.00		
S ₄	164.38	13.95	65.50	65.50	65.25	68.00	68.00	68.25	94.19	115.50	0.25		
S ₅	159.13	13.60	65.75	65.75	65.50	67.75	68.50	68.50	92.92	115.50	0.75		
S.E.m±	3.40	0.190	0.15	0.15	0.52	0.11	0.45	0.78	0.21	0.021	0.067		
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
CV (%)	6.14	5.74	6.46	6.33	7.32	9.66	9.37	10.17					

TABLE 2
Influence of staggered sowing on yield parameters of single cross hybrid maize MAH 14-5 parents

Treatments	Ear length (cm)		Ear diameter (cm)		Ear weight (g)		Number of ears per plant		Number of rows per ear		Number of seeds per row	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
	S ₁	14.36	16.17	4.37	3.78	105.90	105.28	1.55	1.55	15.40	13.50	20.60
S ₂	16.04	15.37	4.59	3.78	125.55	99.38	1.55	1.60	16.00	13.60	22.25	21.45
S ₃	18.33	15.64	4.63	3.79	140.35	102.91	1.60	1.45	16.10	13.70	28.15	22.95
S ₄	15.43	15.29	4.47	3.81	114.00	100.42	1.50	1.50	15.40	14.10	21.40	22.10
S ₅	14.87	15.73	4.52	3.86	103.20	109.37	1.45	1.55	15.70	14.20	19.95	23.05
S.E.m±	0.756	0.516	0.186	0.087	2.040	5.520	0.126	0.115	0.59	0.25	1.798	1.237
CD (P = 0.05)	2.329	NS	NS	NS	6.286	NS	NS	NS	NS	NS	9.54	NS
CV (%)	9.564	8.595	8.232	7.581	8.464	10.670	14.492	13.047	7.59	8.652	13.00	10.86

TABLE 3
Influence of staggered sowing on yield parameters of seed parent single cross hybrid maize MAH 14-5

Treatments	Seed weight per ear (g)		Seed yield per plant (g)		Seed yield per plot (kg)	Seed yield per ha (q)
	Female	Male	Female	Male		
S ₁	85.25	85.18	103.2	97.3	1.65	25.12
S ₂	103.35	81.37	118.9	92.5	1.90	28.94
S ₃	115.75	83.62	140.1	91.3	2.24	34.09
S ₄	92.05	83.23	109.5	92.01	1.75	26.65
S ₅	82.30	89.43	98.2	101.2	1.57	23.90
S.Em±	2.142	5.191	1.19	0.228	0.019	0.29
CD (P=0.05)	8.60	NS	3.88	NS	0.062	0.94
CV (%)	9.47	12.27	13.91	11.35	13.91	13.91

viz., ear length, ear diameter, ear weight, number of rows per ear, number of seeds per row, seed weight per ear and seed yield per plant in male, while in female, for ear diameter and number of rows per ear recorded non-significant differences with respect to staggered sowings.

The staggered sowing S₃ had significant effect on quality parameters *viz.*, hundred seed weight (35.20 g), germination (85.75 %), seedling length (33.88 cm), seedling dry weight (1020 mg), seedling vigour index-I (2905) and seedling vigour index-II (8732) differed significantly from other staggered sowing (Table 4).

The growth characters are least affected by the differential dates of sowing and the genetic characters of crop not altered significantly by changing the dates of sowing. The minor changes observed could be attributed to variation in climate, nutrients in the soil and other environmental factors. Thus there is no significant difference in growth parameters by staggered sowing. Similar findings were also observed by Vinutha *et al.*, (2012) and Shashibhaskar (2015) in maize. The better synchrony in flowering of male and female parents was observed when sowing of female parent and male parent on the same day resulted in availability of requisite quantity of pollen to female

TABLE 4
Influence of staggered sowing on quality parameters of single cross hybrid maize MAH 14-5

Treatments	Hundred seed weight (g)	Germination (%)	Seedling length (cm)	Seedling dry weight (mg)	Seedling vigour index [SVI]	Seedling vigour index [SVI-II]
S ₁	27.33	80.50	25.77	630	2073	5071
S ₂	28.53	80.00	29.41	820	2352	6544
S ₃	35.20	85.75	33.88	1020	2905	8732
S ₄	28.50	78.00	29.65	930	2312	7266
S ₅	27.60	76.25	28.76	740	2192	5606
S.Em±	0.33	0.56	0.44	0.01	33.82	92.13
CD (P=0.05)	1.01	1.72	1.36	0.03	104.23	283.90
CV (%)	5.24	5.40	4.99	4.38	5.85	5.77

S₁ : Sowing of female four days before male; S₂ : Sowing of female two days before male; S₃ : Sowing of female and male on the same day; S₄ : Sowing of female two days after male; S₅ : Sowing of female four days after male

parent which may be the main reason for increased seed yield and quality of seed parent as reported by Priyanka *et al.* (2017) in pearl millet, Kannababu *et al.* (2002) in Sorghum. The availability of pollen to the receptive stigma is high when the female parent and male parent was sown on the same day (S_3), which might be the reason for increased values of above mentioned parameters.

The sowing of female and male parent on the same day gives better results in yield and yield attributes and quality of seed because of better synchronization between female and male parent compared to the staggered sowing.

REFERENCES

- ABDUL-BAKI, A. A. AND ANDERSON, J. D., 1973, Vigour determination in soybean seeds by multiple criteria. *Crop Sci.*, **13** : 630 - 633.
- ANONYMOUS, 2010, National Seed Project (Crops), *Annu. Report.*, (2009-10), Univ. Agric. Sci., Bengaluru, Karnataka, India.
- ANONYMOUS, 2017, www.indiastat.com.
- CHING, T. M., 1973, Adenosine triphosphate content and seed vigour. *Plant Physiol.*, **51** : 400 - 402
- KANNABABU, N., TONAPI, V. A., RANA, B. S. AND RAO, S. S., 2002, Influence of different synchronization treatments on floral behaviour of parental lines and hybrid seed set in sorghum. *Indian J. Plant Physiol.*, **7** (4) : 362 - 366.
- PRIYANKA, M., GURUMURTHY, R. AND DESHPANDE, V. K., 2017, Influence of synchronization techniques and dates of sowing on nicking in parental lines of pearl millet hybrid BPMH-3 seed production. *J. Pharmacognosy and Phytochemistry*, **6** (6) : 2306 - 2310
- SHASHIBHASKAR, M. S., 2015, Investigation on seed production technology for single cross maize hybrids (*Zea mays* L.) (NAH-2049 AND NAH-1137), *Ph.D., Thesis*, Univ. Agric. Sci., Bengaluru, Karnataka, India.
- SUNDARRAJ, N., NAGARAJU, S., VENKATARAMANA, S. AND JAGANATHA, M. H., 1972, Design and Analysis of Field Experiments. Univ. Agri. Sci., Hebbal, Bengaluru.
- VINUTHA, K. S., RAJENDRA PRASAD, S., RAMEGOWDA, RAVISHAKAR, P., PARSHIVAMURTHY AND JEEVAN KUMAR, S. P., 2012, Influence of staggered sowing, planting ratio and subtending cob leaf clipping on seed quality parameters of maize. *Seed Res.*, **42** (1) : 91 - 97.

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