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Research Paper

Sugarcane Flowering in Relation to Nitrogen Fertilization and Ratoon

Mohamed[1], B. D., Mahmoud[2], E. A., El-Hennawi[2], H. H. and Mehareb[1]*, E. M.

[1]Sugar Crops Research Institute, Agriculture Research Center, Giza, Egypt.
[2]Agronomy Department, Faculty of Agriculture, Cairo University, Egypt.
*Corresponding author E-mail: elmoharb@yahoo.com

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This study consisted of 2 experiments that were carried out at El-Sabahia Research Station, Sugar Crops Research Institute (SCRI), Agricultural Research Center (ARC), (31° 12 N) during 2004/2005 (plant cane) and 2005/2006 (ratoon crop) seasons to investigate the effect of N fertilization levels; 160, 200, 240 and 280 kg/fed on behavior of natural flowering of 32 sugarcane genotypes from different origins. Results showed significant differences among the studied genotypes in their flowering % under different levels of N in plant cane and ratoon crop. The difference among N levels as well as the genotype × N levels interaction in their effects on % of flowered plants was significant in both plant and ratoon crops. The % of flowered plants within and between levels of N differed significantly in plant and ratoon crops. Moreover, increasing N levels caused a reduction in flowering behavior. The % of flowering increased in older crops.

Key words: Flowering, first ratoon, plant cane and sugar cane.

INTRODUCTION

There are many factors affecting sugarcane flowering. These essential factors that determine the flowering percentage are nitrogen fertilizer levels, sugarcane varieties as well as the application date. Inhibition increase levels of N, especially before initiation, consistently inhibit flowering (Clements and Awada, 1967; Stevenson, 1965; Gosnell, 1973; Allam *et al*., 1978; Nuss, 1977).The length of the juvenile phase of the plant cane taller than ratoon (Burr *et al.,* 1957). Berding *et al*. 2004 studied the effect of N fertilizer on the flowering of sugarcane (potted plants) in the photoperiod facilities. They noted that the importance of N in the initiation process, but the increase in N rate resulted in reduced and delayed flowering. Therefore, better definition of the lower and upper acceptable bounds for N nutrition for flowering was required. During the early stages of clonal development, N is important because it promotes vegetative growth and tillering important for the growth of the breeding genotypes. The younger the crop, the lower the quantity of N required inhibiting tasseling (LaBorde, 2007). Flowering is important by breeders to induce genetic variation for the development of improved hybrid cultivars. The objectives of this study was to evaluate the effects of N fertilization levels (160, 200, 240 and 280 kg/fed) on behavior of natural flowering of some sugarcane genotypes.

MATERIALS AND METHODS

Two experiments were conducted at El-Sabahia Research Station (31° 12 N), Alexandria, Egypt, during

Table 1. Source country of genotypes used in the experiment at Alexandria.

No.	Genotype	Source/country	No.	Genotype	Source/country
1	GT54-9	Egypt	17	BO 60	Indonesia
2	G95-21	*Egypt*	18	F 144	Taiwan
3	G98-24	Egypt	19	F 146	Taiwan
4	G 98-28	Egypt	20	Ph 6553	Philippine
5	G 99-165	Egypt	21	Ph 6722	Philippine
6	EH 94-181-1	Egypt	22	Ph 8013	Philippine
7	EH94-119-72	Egypt	23	CP 34-38	U.S.A
8	NCO310	South Africa	24	CP 44-101	U.S.A
9	BO 3	Indonesia	25	CP 57-614	U.S.A
10	BO 18	Indonesia	26	CP 67-412	U.S.A
11	BO 19	Indonesia	27	CO 310	India
12	BO 21	Indonesia	28	CO 842	India
13	BO 41	Indonesia	29	SP 711-406	Brazil
14	BO 47	Indonesia	30	B 37-61	Barbados
15	BO 49	Indonesia	31	IN 84-106	Indonesia
16	BO 55	Indonesia	32	POJ 2878	Indonesia

Table 2. Mean squares of flowering % during 2004/05 and 2005/06 seasons.

S.O.V.	Df	2004/2005 (plant crop)				2005/2006 (Ratoon crop)			
		Nitrogen levels (kg)							
		160	200	240	280	160	200	240	280
Reps.	2	69.20	55.54	36.14	20.65	10.88	23.57	33.53	39.03
Genotypes	31	2510.65*	2320.64**	1482.15**	1045.24**	4678.81**	4318.10**	3257.84**	2432.30**
Error	62	5.44	3.69	2.80	2.26	2.50	7.42	2.57	4.35

S.O.V. (Source of Variance)

2004/2005 season (plant cane crop) and 2005/2006 season (first ratoon crop) (Figure 1) .The objectives of these experiments were to study the effects of N fertilization levels on natural flowering behavior of some sugarcane genotypes.

The experimental procedures

Thirty-two sugarcane genotypes from different origins were used in this study (Table 1). In the middle of March, 2004 three–budded/ cuttings of each genotype were planted in 3 ridge plots. Each row was 5 m long and 1 m apart. Thus, the plot size was 15 m². The experimental design was randomized complete block with 3 replications. The field was irrigated right after planting. Fertilizer levels (160, 200, 240 and 280 kg N/fed) in the form of Urea (46% N) were applied in 2 equal splits; after 90 days from planting and 45 days later. After flowering season, all plots of 2004 plant-cane were cut in March, 2005 and allowed to ratoon. In ratoon crop, the same amounts of previously described N fertilization were applied in equal splits 105 days from cutting of plant-cane and 45 days later.

Percentage of total flowered plants was recorded in January for both plant and ratoon crops, after 10 months of planting in plant cane and 10 months from harvest in ratoon crop.

Statistical analysis

Data recorded were subjected to analysis of variance as described by Snedecor and Cochran, (1967). The % of total flowered stalks was transformed to the corresponding angle values in degrees ARC-Sin according to Evwin *et al.* (1966).Treatment means were compared using LSD at 5% level of probability according to Waller and Duncan, (1969).

RESULTS AND DISCUSSION

Analysis of variance (Tables 2 and 3) revealed that significant difference were found among studied genotypes in their mean squares flowering % under each level or over levels of N in plant cane and ratoon crops.

The % of flowered plants in plant crop

Data in Table 4 indicated that 10 out of the 32 evaluated genotypes flowered under all N levels; these genotypes are BO3, BO47, F 146, BO60, POJ2878, Ph 6553, BO19, BO55, BO21 and BO18. The genotype Bo49 flowered under three N levels 160, 200 and 240 kg. While it did not flower under 280 kg. The genotypes EH 94-181-1 and CO310 flowered under 160 and 200 kg/N only, while B

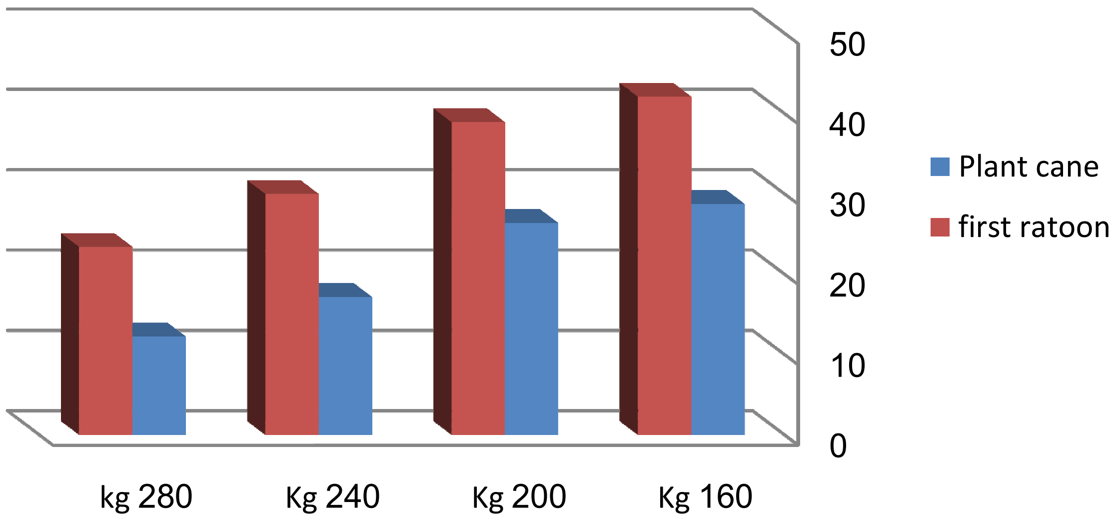

Figure 1. Compare flowering plant cane and first ratoon under levels of nitrogen.

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Table 3. Combined analysis of variance over N levels.

Source of variation	Df	Plant crop	Ratoon
Fertilization (F)	3	3070.70**	4532.37**
Error	8	45.38	26.75
Genotypes (G)	31	6493.01**	13808.13**
F x G	93	288.54**	292.96**
Error	248	3.55	4.21

37-61 flowered only under 160 kg N. The remaining genotypes did not induce flowering at any level of N. These results indicating that the N levels required to inhibit the flowering in sugarcane differ among genotypes .The % of flowering genotypes amounted to be about 44, 41, 34 and 31 %, under 160, 200, 240 and 280 kg N/fed, respectively. These results mean that increasing N levels decreased flowering % and suggest using lower level of N to increase sugarcane flowering.

The %of flowered plants within each N level as well as between levels varied significantly among tested genotypes. With respect to genotypes that flowered under all levels of nitrogen, results indicated that 6 genotypes; BO 3, BO47, F 146, BO 60, POJ2878 and BO 18 recorded the highest % of flowered plants under 160 kg/ N (95, 61.33, 77, 80, 15 and 80%, respectively). Thereafter, the % of flowered plants decreased with the increasing N levels. On the other hand, 4 genotypes; Ph 6553, BO19, BO55 and BO21 recorded the highest % of flowered plants under 200 kg/ N (70, 82.67, 56.33 and 66 %) , respectively followed by 160 kg/ N (56, 78.33, 52.67 and 61%). This indicates that increasing N levels over 200 kg significantly reduced % of flowered plants. One genotype ; BO 49 which flowered under 160, 200 and 240 kg N gave 85, 75 and 46.33% flowering, respectively, while did not flower under 280 kg N. Therefore, the increasing of N levels not only decreased the % of flowered plants but also caused inhibition of flowering. Another 2 genotypes; EH 94-181-1 and CO 310 responded to flower under 160 and 200 kg N showed 65 and 81.67 % flowering, respectively, under 160 kg N and 45.33 and 70 % flowering under 200 kg N . While increasing N level over 200 kg N inhibited their flowering. Genotype B 37-61 flowered only under 160 kg N with 31% flowered plants, while increasing N levels over 160 kg N inhibited its flowering.

Percentage of flowered plants in ratoon crop

Data in Table 5 indicated that 13 of the 32 studied genotypes flowered under all N levels, 160, 200, 240 and 280 kg N and these genotypes are BO3, BO47, F146, BO60, POJ2878, BO19, BO55, BO21, G98-24, BO18, B37-61, BO 49 and CO 310. One genotype Ph6553 flowered under three N levels, while it failed to flower under 280 kg. One genotype; EH 94-181-1 flowered only under 160 and 200 kg N levels. Another genotype; SP711-406 flowered only under 160 kg N level. The remaining genotypes failed to flower at all N levels.

Table 4. Evaluated genotypes and their flowering % under different levels of N fertilization (plant crop).

		2005				
No.	**Genotype**	**160 kg N**	**200 kg N**	**240 kg N**	**280 kg N**	**Mean**
1		95.00	87.00	70.00	52.00	76.00
2	GT 54-9	--	--	--	--	--
3	BO 47	61.33	54.33	42.67	35.33	48.42
4	Ph 8015	--	--	--	--	--
5	CP 67-412	--	--	--	--	--
6	CP 34-38	--	--	--	--	--
7	CP 57-614	--	--	--	--	--
8	EH 94-181-1	65.00	45.33	--	--	27.58
9	F 146	77.00	74.00	56.33	51.00	64.58
10	F 144	--	--	--	--	--
11	NCO 310	--	--	--	--	--
12	G 95-21	--	--	--	--	--
13	Ph 6722	--	--	--	--	--
14	BO 60	80.00	71.67	39.00	33.00	55.92
15	G 98-28	--	--	--	--	--
16	IN 84-106	--	--	--	--	--
17	EH 94-119-72	--	--	--	--	--
18	POJ 2878	15.00	13.67	9.00	4.67	10.59
19	G 99-165	--	--	--	--	--
20	Ph 6553	56.00	70.00	55.33	34.67	54.00
21	BO 19	78.33	82.67	64.67	51.33	69.25
22	BO 55	52.67	56.33	34.67	25.67	42.34
23	BO 21	61.00	66.00	58.33	37.33	55.67
24	G 98-24	--	--	--	--	--
25	BO 18	80.00	77.00	71.67	66.00	73.67
26	CP 44-101	--	--	--	--	--
27	BO 41	--	--	--	--	--
28	CO 842	--	--	--	--	--
29	B 37-61	31.00	--	--	---	7.75
30	BO 49	85.00	75.00	46.33	--	51.58
31	SP 711-406	--	--	--	--	**--**
32	CO 310	81.67	70.00	--	--	37.92
		28.72	26.34	17.13	12.22	
	LSD 0.05 for					
Genotypes (G)		3.18	2.62	2.28	2.05	1.27
Fertilization (F)						1.81
G x F						2.53

Therefore, under each level of N the % of flowering genotypes amounted to be about 50, 47, 44 and 41 %, under 160, 200, 240 and 280 kg N, respectively. The % of flowered plants within each level as well as between levels of N varied significantly. With respect to genotypes that flowered under all levels of N, results indicated that 6 genotypes; BO3, BO47, F146, G98-24, B37-61 and CO310 recorded the highest % of flowered plants under 160 kg N which were 100, 100, 100, 77, 96.67 and 96.67 %, in the same order. Thereafter, the % of flowered plants decreased with the increasing N level. Two genotypes; POJ2878 and BO19 recorded the highest % of flowered plants under 200 kg N (98.33 and 71%, respectively) followed by 160 kg N (95 and 70 %), in same order. However, increasing N levels over 200 kg significantly reduced the % of flowered plants. Results also showed that all plants of 2 genotypes; BO60 and BO55 flowered under all N levels. All plants of another genotype (BO18) flowered under 160, 200 and 240 kg N (100%), but % of flowered plants decreased dramatically under 280 kg (46%). All plants of 2 more genotypes; BO21 and BO49 flowered under 160 and 200 kg N (100%) and the % decreased after that. Genotypes Ph6553 which flowered under 160, 200 and 240 kg N did not flower under 280 kg N. One genotype EH 94-181-1 responded to flower under 160 and 200 kg N where the % of flowered plants were 73.67 and 56%, while increasing N levels over 200 kg inhibited their flowering. The genotype SP711-406 flowered only under 160 kg N with a 20% of flowered plants, while increasing N levels

Table 5. Evaluated genotypes and their flowering % under different levels of N fertilization (Ratoon crop).

		2006				
No.	**Genotype**	**160 kg N**	**200 kg N**	**240 kg N**	**280 kg N**	**Mean**
1	*BO3*	100.00	94.00	75.00	56.33	81.33
2	GT 54-9	--	--	--	--	--
3	BO 47	100.00	95.00	72.00	54.33	80.33
4	Ph 8015	--	--	--	--	--
5	CP 67-412	--	--	--	--	--
6	CP 34-38	--	--	--	--	--
7	CP 57-614	--	--	--	--	--
8	EH 94-181-1	73.67	56.00	--	--	32.42
9	F 146	100.00	95.00	66.00	50.33	77.83
10	F 144	--	--	--	--	--
11	NCO 310	--	--	--	--	--
12	G 95-21	--	--	--	--	--
13	Ph 6722	--	--	--	--	--
14	BO 60	100.00	100.00	100.00	100.00	100.00
15	G 98-28	--	--	--	--	--
16	IN 84-106	--	--	--	--	--
17	EH 94-119-72	--	--	--	--	--
18	POJ 2878	95.00	98.33	79.00	51.00	80.83
19	G 99-165	--	--	--	--	--
20	Ph 6553	17.33	7.67	7.67	--	8.17
21	BO 19	70.00	71.00	57.00	37.33	58.83
22	BO 55	100.00	100.00	100.00	100.00	100.00
23	BO 21	100.00	100.00	97.33	88.67	96.50
24	G 98-24	77.00	52.33	22.67	21.33	43.33
25	BO 18	100.00	100.00	100.00	46.00	86.50
26	CP 44-101	--	--	--	--	--
27	BO 41	--	--	--	--	--
28	CO 842	--	--	--	--	--
29	B 37-61	96.67	88.33	49.33	36.67	67.75
30	BO 49	100.00	100.00	92.33	86.67	94.75
31	SP 711-406	20.00	--	--	--	5.00
32	CO 310	96.67	86.67	40.00	19.00	60.59
		42.07	38.89	29.95	23.36	
LSD 0.05 for						
Genotypes (G)						1.38
Fertilization (F)		2.16	3.72	2.19	2.85	1.39
G x F						2.76

over 160 kg N inhibited its flowering.

The studied genotypes that flowered under the tested N levels either in plant cane or ratoon crop indicated that increasing N levels reduced significantly the % of flowered plants. This result is supported by the finding of (Clements and Awada, 1967; Stevenson, 1965; Gosnell, 1973; Allam *et al.,* 1978; Nuss, 1977 and Berding *et al.*, 2004).They found that increasing N levels not only decreased the % of flowered plants but the heavy N fertilization prevents sugarcane flowering even for profusely flowering varieties and this may be related to the C/N ratio (Chang and Huang, 1980).

Conclusion

Sugarcane plants different in flowering from plant cane to first ratoon, but performance of genotypes under first ratoon was more than plant cane (Figure 1). The % of flowering increased in older crops (in first ratoon), high levels of N to inhibit flowering.

REFERENCES

Allam AI, Nour AH, Fayed A (1978). Effect of nitrogen and moisture on sugarcane flowering. Proc. ISSCT.16:875-882.

Berding N, Dunne V, swain RS, Owens WG (2004). Tropical managed initiation of sugarcane flowering:Optimization of non-photoperiodic variables. Conference-of-the-Australian-Society-of-Cane-Technologists-held-at-Brisbane,-queensland,- Australia. Pp.1-13.

Burr GO, Hartt CE, Brodie HW (1957). The sugarcane plant. Annual Review Plant Physiology, 8:275-308.

Chang YS, Huang KM (1980). Effect of endogenous C/N ratio and gibberellin-like substance on floral initiation in sugar cane. Rep. Taiwan Sugar Res. Inst. 90:1-8.

Clements HF, Awada M (1967). Experiments on the artificial induction of flowering in sugarcane. Proc .ISSCT., 12:795-812.

Evwin LL, Warren HL, Andrews GC (1966)."Field plot technique"

transformation of experimental data. Burgess pub. Comp America, p. 338-349.
Gosnell JM (1973). Some factors affecting flowering in sugarcane. Proceeding of African Sugarcane Technology Association 47:144-147.
Laborde CM (2007). Sugarcane tasseling under artificial photoperiod conditions as affected by nitrogen rate and temperature. 84f. Dissertation Submitted to the Graduate Faculty of the Louisiana State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy.
Nuss KJ (1977). Synchronization of flowering to implement a proven cross breeding system in sugarcane. Proc. ISSCT., 16:111-119.
Snedecor GV, Cochran WG (1967). Statistical methods, 6th Ed. Iowa State Univ. Pross Ames Lawa, USA.
Stevenson GC (1965). Genetics and breeding of sugarcane. , longmans.
Waller RA, Duncan DB (1969). A bays rule for the symmetric multiple comparison problem. Amer. State. Assoc. J. Dec.,1485-1503.