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Flowering Behavior of Sugarcane Genotypes under Artificial Photoperiod Impacted by Nitrogen, Phosphorus, and Potassium (NPK) Fertilization Rates

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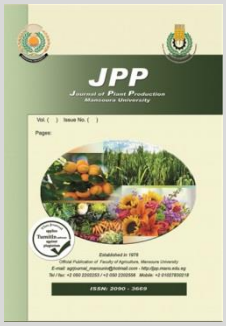

ABSTRACT

The experiment was conducted during 2021/2022 and 2022/2023 at the breeding station of the Sugar Crops Research Institute, Agriculture Research Center (ARC), Giza, Egypt (30° 0' N latitude, 31° 12' E longitude) to examine the response of ten sugarcane genotypes to NPK fertilizer application rates (600 , 900, 1000, and 1100 gram of NPK) under two photo-inductive cycles of treatments of constant 12.5- hours per day of 30-days and 60-days length followed by a declination of 30 seconds/day to 11 hour 30 min. A split spilt-plot design in a randomized complete block arrangement was used with two replications. Data on reproductive flowering characteristics (Pre-flag, flag leaf duration, tip emergence, and full emergence stages) were also gathered at the various sugarcane phases in addition to the total flowering percentage and pollen viability percentage. The genotypes under study had significantly varied flowering attributes at different times when fertilization was applied, with two continuous photo inductive cycles. Significant variations were seen in the percentages of flowering plants, pollen viability, and flowering features (per flag, flag leaf, tip, and full emergence stages) among the NPK application rates and genotype × NPK × constant inductive cycles interaction. Under inductive cycle treatments for 30 and 60 days, respectively, the percentage of flowering plants varied dramatically both inside and between NPK application rates. Additionally, compared to the optimal rate of 600 g, when NPK fertilization was applied later with increasing rates, there was a decrease in flowering behavior and an increase in the percentage of flowering.

Keywords: Sugarcane genotypes, artificial flowering, constant inductive cycles, NPK fertilization.

INTRODUCTION

Fertilization with nitrogen, phosphorus, and potassium (NPK) on sugarcane flowering influences the initiation and the induction phases. Breeders must stimulate genetic variety through flowering in order to produce better varieties. In sugarcane breeding genotypes, floral induction depends on nutrition. Fertilization starts after the sugarcane parents have germinated and begun to grow (Nuss and Brett, 1977; Aguilar and Debernardi, 2004). In order to stimulate flowering, the sugarcane-breeding program uses artificial photo inductive cycle treatment. There is not much knowledge available to sugarcane breeders about sugarcane nutrition to maximize flowering. The amount and timing of nitrogen, phosphorus, and potassium (NPK) fertilizer application are crucial decisions because NPK has a significant impact on the yield of fuzz seeds. Numerous studies have been conducted to ascertain the ideal NPK rates for different species and cultivars. Until roughly inflorescence emergence, the growing crop should keep its deeper green leaves, as it matures, these leaves will soften in color (Loch *et al.*, 1999). According to Caraballoso *et al.* (2010), sugarcane flowering is a complicated physiological process that involves several developmental stages, each of which has unique physiological and environmental requirements.

Numerous factors influence sugarcane flowering; among the most important ones are sugarcane genotypes and NPK fertilizer levels, which all affect the flowering percentage. According to Allam *et al.* (1978), inhibition raises NPK levels, particularly before initiation, and continuously prevents flowering. When tassel initiation occurs, sugarcane is typically developing quickly, the potting soil's sand has likely leached out any excess nitrogen, and the stalks have at least six mature internodes (Nuss, 1980). In several species, inflorescence size is also influenced by nitrogen and light intensity before induction; sugarcane needs to be growing aggressively for optimum tasseling. (Aguilar and Debernardi, 2004; Silva *et al.*, 2005). Nitrogen has a crucial role in the early stages of clonal formation because it encourages vegetative growth, which is necessary for the breeding genotypes to thrive. The amount of nitrogen needed to prevent tasseling decreases with crop age. Genotypes range greatly from one another; some are so sensitive that, at normal levels of fertilization, tasseling never happens. The carbon/nitrogen ratio may have an impact on sugarcane genotypes' capacity to use nitrogen without impeding tasseling, nitrogen is said to hinder tassel emergence and development (Chang and Huang, 1980).

Excessive nitrogen concentrations may prevent or postpone tasseling, especially at the beginning. The age, genotype, and water availability of the sugarcane all influence how much inhibition occurs. The high levels of nitrogen in the soil caused a 25-day delay in tasseling in South Africa (Nuss and Berding, 1999). When applied to tropical grass seed crops like sugarcane, nitrogen fertilizer primarily increases seed yield through an increase in inflorescence density (Berding, 2005). However, as nitrogen levels rose, so did the number of florets per spikelet and consequently per unit area, additionally, fewer

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seeds were planted per unit area. Plants can be given access to potassium, which does not easily leached from the soil (Yadava, 1993). A large percentage of sterile female flowers in plants has been linked to low potassium levels in the leaves (Wakhloo, 1975). According to Berding *et al.* (2010), nutritional fertilizer is crucial for the initiation phase; nevertheless, an increase in nitrogen rate led to less and later flowering. Consequently, it was necessary to provide a clearer characterization of the lower and higher permitted limitations for nitrogen nutrition for flowering. Fertilizer is essential in the early stages of clonal development because it encourages vegetative growth, and tillering is necessary for the breeding genotypes to flourish. The amount of nitrogen needed to prevent tasseling decreases with crop age (LaBorde, 2004). Phosphorus deficiency inhibits photosynthesis, and phosphorus-deficient leaves have considerably lower photosynthetic efficiency per unit of chlorophyll (Rossiter, 1978; Silva et *al.*, 2005). Reproductive organ formation and shoot growth rate are both slowed down by increased soil phosphorus. There is a reduction in the quantity of flowers (Bould and Parfitt, 1973), a delay in the onset of tassels, and a restriction on seed development. In particular, premature senescence of leaves is another factor limiting seed yield in phosphorus-deficient plants (Barry and Miller, 1989). The objective of this study was to evaluate the effects of four NPK fertilization rates (600, 900, 1000, and 1100 gram of NPK, respectively) and two photo-inductive cycle treatments of constant on the behavior of flowering in ten sugarcane genotypes.

MATERIALS AND METHODS

A two-year (2021/2022 and 2022/2023) fertilization with nitrogen, phosphorus, and potassium (NPK) experiment was conducted at the sugarcane breeding facilities of the Sugar Crops Research Institute, Agriculture Research Center (30° 0' N latitude, 31° 12' E longitude), Giza governorate, Egypt. The research work aimed to determine the effects of four NPK application rates as named: control (stop fertilization before inductive cycles treatment in Jun (600 g NPK), stop fertilization post inductive cycles in September (900 g NPK), October (1000 g NPK), and November (1100 g) of NPK fertilizer (20-19-19), and two photo-inductive cycles of constant length initiated with a minimum of 30 and a maximum of 60 consecutive days of 12 ½ h of constant day length on flowering of ten sugarcane genotypes (Table 1). The experimental design was a split-split plot design in two replications used in both seasons, where the main plots were allocated by two photo inductive cycles, while the sub-plots were occupied by four NPK application rates and sub sub-plots by the ten sugar cane genotypes. The 160 pots of sugarcane genotypes were divided into four similar groups, and each group (40 pots) per treatment was arranged. The pots were placed on carts and pushed in and out of the photoperiod rooms at specific times according to the planned schedule in Table 2.

One hundred sixty pots of sugarcane genotypes were filled with a mixture of clay soil, sand, and peat moss in a ratio of 3:2:1. Six single-eye cuttings per genotype were planted in 37-liter plastic pots on October 15, 2021, and October 17, 2022. The plants were maintained under greenhouse conditions until subjected to the photo inductive cycle treatments. NPK fertilizer treatments were applied on a monthly basis after two months from the sugarcane genotypes planting in 15, October 2021, and 17, October 2022, respectively, into a large pot culture (37 L). Plants were irrigated weekly, and fertilizer is applied at a rate that is equivalent to 100 grams/25 l of NPK per month for each treatment started in January. All other recommended agronomic practices were implemented.

Table 1. Origin of evaluated sugarcane genotypes

No.	Sugarcane Genotype	Origin Source
1	CO997	India (Coimbatore)
2	CP27-51	USA (Florida, Canal Point)
3	MEX58-1868	Brazil (Mexico)
4	G74-99	Egypt (Giza)
5	G84-47	Egypt (Giza)
6	G2003-49	Egypt (Giza)
7	CO1129	India (Coimbatore)
8	H86-37	USA (Hawaii)
9	CO744	India (Coimbatore)
10	M55-157	Mauritius

Table 2. A schedule of the experiment: nitrogen, phosphorus, and potassium (NPK) fertilization rates and inductive cycle's treatments were applied for ten sugarcanes.

Treatments Groups	NPK application rates (Rate of 100 g/25 l per treatment per month)	30 Inductive consent days	60 Inductive consent days
1 (40 pots)	Fertilizing until June (600 g NPK)	30 days of 12 h 30 min constant day light from 2 July to 1 August. with declination 30 s/d to 11 h30 hours	60 days of 12 h 30 min constant day light from 2 July to 1 September. With declination 30 s/d to 11 h30 hours.
2 (40 pots)	Fertilizing until September (900 g NPK)		
3 (40 pots)	Fertilizing until October (1000 g NPK)		
4 (40 pots)	Fertilizing until November (1100 g NPK)		

The following observations described by Abu-Ellail and Mohamed (2020) were recorded:

1. Pre-flag stage period (PFSP): was calculated as days from the start of photo inductive cycles treatment to the beginning of flag leaf formation.
2. Flag stage period (FSP): was calculated as days from the start of photo inductive cycles treatment to the flag-leaf sheath emergence.
3. Tip of arrow emergence period (TAEP): was calculated as days from the start of photo inductive cycles treatment to the tip arrow emergence.
4. Full arrow emergence period (FAEP): was calculated as days from the start of photo inductive cycles treatment until complete full extension of the inflorescence.
5. Flowering percent was calculated as:

$$\frac{\text{Number of flowers}}{\text{Number of plants}} \times 100$$

6. Pollen viability test: Every morning, a paper cone was placed under the tassel to collect a pollen sample. Special care was taken to keep the sample over 20 °C. A 1% iodine (I2) solution was used to stain pollen. Slides were viewed with a microscope, and the number of fertile (stained) and infertile (unstained) pollen grains was counted. Pollen fertility per cent was calculated (Machado, 1987).

Statistical analysis:

A combined analysis of variance of flowering data were conducted according to Snedecor and Cochran (1967). Compared using the least significant difference (LSD) at a significance level of 0.05 (Gomez and Gomez, 1984). All statistical analyses were conducted utilizing the analysis of

variance technique through the CoStat computer software package (Version 6, CoHort, USA, 2004).

RESULTS AND DISCUSSION

The number of flowering stalks was shown to have a highly significant genotype × NPK effect ($P<0.01$). Because of the significant interaction effect, each genotype was analyzed separately. NPK did not significantly increase the flower number. Since the fertilizing delay proved inferior and impractical due to a lack of flowering stalks, only fertilizing before photo inductive cycle treatments (normal NPK rate) was optimal. A better understanding of sugarcane breeding emphasizes the necessity of carefully fertilization before thought-out flowering to obtain unique crossings. Flowering genotypes are difficult to cross because they may tassel at different times and only during specified intervals (Nuss and Berding, 1999).

1. Effect of NPK fertilizer rates:

The sugarcane breeding genotypes' vegetative and flowering growth stages depended on NPK fertilization; more research was conducted to determine the ideal fertilizer treatment before the photoperiod treatments. Because the total number of tassels depended on the total number of emergent stalks, the NPK fertilizer rate (600 g) also significantly boosted the total number of tassels. Tables 3, 4, and 5's results demonstrated that increasing the amount of NPK fertilizer—from fertilizing from 600 g to 1100 g of NPK—had a significant impact on flowering percentage, pollen test, and the days of per flag stage, flag leaf stage, tip emergence stage, and full emergence stage. Tassel initiation usually happens when sugarcane is growing rapidly, the extra nitrogen in the potting soil has likely leached, and the stalks have at least six developed internodes. The lower the amount of nitrogen required to cause tasseling (Nuss, 1980). Research on nitrogen's impact on sugarcane tasseling has revealed that nitrogen affects the process's beginning and induction stages (Nuss and Berding, 1999). It seems that plants that were fertilized with NPK before being placed under an artificial photoperiod regime with a rate of 600 g NPK were healthier and more ready to go from the vegetative to the reproductive stage. Compared to the plants in the NPK fertilizer with 1100 g that received an application in November, these plants were thicker in diameter, more numerous, and had lower flowers.

Data in Table 3 showed that increasing the rates of NPK fertilization from fertilizing with 600 g until June to fertilizing with 1100 g until November of rating fertilization under artificial flowering significantly decreased mean pre flag leaf stage days by 28.3 days and 43.2 days under 30 and 60 days inductive cycles, respectively. While under fertilization with 1100 g until November of rating fertilization, the decrease in days to flag leaf stage amounted to 22.8 and 35.9 in the 30 and 60-day inductive cycles, respectively, compared with fertilizing with 600 g until June (control).

Researchers agree that nutrient is the important factor influencing sugarcane's tasseling activity. They also agree that the transition of sugarcane apices from vegetative to reproductive growth is either facilitated or hindered by the interaction between photoperiod and soil fertility during inductive day lengths (Dunckelman and Blanchard, 1974). Additionally, the main way that fertilizer nitrogen enhances flowering is by increasing the size and number of inflorescences. Increased inflorescence density is the primary result of nitrogen fertilizer used to sugarcane (Hill and Loch, 1993). A phosphorus and potassium deficit inhibits photosynthesis and flowering. In addition, phosphorus- and potassium-deficient leaves have considerably lower photosynthetic efficiency per unit of chlorophyll (Rossiter, 1978; Abu-Ellail and McCord, 2019).

Increasing the rates of fertilization to November (1100 g NPK) significantly decreased the days to tip emergence and full emergence stages under both systems during inductive cycles (Table 4). The tip emergence stage decrease amounted to 29.9 and 22.3% under the 30 and 60-day inductive cycles, respectively, compared with fertilizing with 600 g NPK until June (control). While under increasing fertilization rates (1100 g) until November, the decrease in days to full emergence stage amounted to 38.3 and 29.7 in the 30 and 60-day inductive cycles, respectively, compared with fertilizing by 600 g until June (control). Tassel emergence and development are hampered under increased fertilization (Allam *et al.*, 1978). Particularly in the beginning, tasseling may be prevented or delayed by excessive nitrogen concentrations. Tasseling was delayed by 25 days due to high nitrogen levels in the soil (Nuss and Berding, 1999). In plants lacking in phosphorus, tasseling occurs later and produces fewer flowers (Barry and Miller, 1989). A large percentage of sterile blooms has been linked to low potassium levels in the leaves (Yadava, 1993).

Table 3. Evaluated ten genotypes and their artificial flowering behavior under different application rates of nitrogen, phosphorus, and potassium (NPK) fertilization and inductive photoperiod constant cycles.

Inductive cycles (B)	Per flag stage											Flag leaf stage										
	30 days					60 days					G. Mean	30 days					60 days					G. Mean
Genotypes	NPK rats (A)					NPK rats (A)						NPK rats (A)					NPK rats (A)					
(C)	1	2	3	4	Mean	1	2	3	4	Mean		1	2	3	4	Mean	1	2	3	4	Mean	
CO997	84	74	61	57	69.0	104	98	99	61	90.5	79.8	124	108	103	100	108.8	145	125	122	112	126.0	102.9
CP27-51	74	61	58	30	55.8	124	103	100	95	105.5	80.7	108	105	102	91	101.5	153	137	125	121	134.0	107.3
MEX58-1868	63	50	44	36	48.3	104	105	94	75	94.5	71.4	122	110	100	95	106.8	149	140	130	117	134.0	102.7
G74-99	78	60	51	45	58.5	135	108	104	64	102.8	80.7	121	115	100	94	107.5	153	141	134	104	133.0	106.8
G84-47	70	59	55	51	58.8	137	107	98	88	107.5	83.2	123	114	100	95	108.0	156	124	121	115	129.0	106.1
G2003-49	87	-	-	-		-	-	-	-	-	-	121	-	-	-	-	-	-	-	-	-	-
CO1129	74	68	63	55	65.0	102	94	91	88	93.8	79.4	118	109	98	93	104.5	140	135	127	121	130.8	105.1
H86-37	91	87	78	61	79.3	115	98	95	91	99.8	89.6	121	115	119	95	112.5	144	121	118	111	123.5	106.5
CO744	89	85	76	68	79.5	124	104	94	87	102.3	90.9	118	108	105	104	108.8	135	115	115	102	116.8	103.9
M55-157	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	80.4	70.3	63.2	52.1	66.5	120.7	103.5	94.4	77.5	99.0	65.5	119.9	110.3	104.7	97.1	108.0	148.8	131.4	124.4	112.9	129.4	84.1
LSD at 5%																						
A										1.38											1.27	
B										1.39											1.81	
C										2.14											2.53	
A*B*C										4.76											3.64	

Abbreviations: Rate 1 (600 g) , Rate 2 (900 g) , Rate 3 (1000 g) and Rate 4 (1100 g) of NPK

2. Effect of photo inductive cycles:

Artificial photo inductive constant cycles are sometimes created by building dark rooms where genotypes involved in sugarcane breeding can be rolled in and out at specified times to achieve the necessary amount of day length. Following the required number of inductive cycles of the artificial photoperiod regimes applied to the sugarcane breeding genotypes, tasseling will occur. The mechanics underlying tasseling were not well understood when photoperiod research first started. Most of the work was done to figure out the best day length to induce tassels (Abou-Salama, 1990; Abu-Ellail and McCord 2019 and Miller and Li, 1995).

In temperate sugarcane-growing regions of the world, artificial photo inductive cycles have been developed for certain locations to control the length of the day. In order to produce the required amount of day length, genotypes used in sugarcane breeding can be rolled in and out of dark rooms at predetermined intervals to generate treatments. Tasselling starts when a predetermined number of inductive cycles of synthetic photoperiod are applied to the genotypes used in sugarcane breeding. Under extending the duration of constant days length of conductive cycles from 30 days to 60 days, the data in tables 3, 4, and 5 demonstrated a significant increase in the number of days of perflag stage, flag leaf stage, tip emergence stage, and full emergence stage, as well as in flowering and pollen viability percentage. These results are in line with those of Mohamed (1996); Taiz and Zeiger (2010); Rizk *et al.* (2002), and other researchers who have suggested that sugarcane is a plant with short days and that flowering is initiated by a series of long nights. Plants classified as "short-day" will only start to grow if exposed to days that are shorter than a specific duration (Fisher, 1999). In sugarcane, tasseling begins at around 12 hours and 30 minutes, when the day length starts to shorten by 30 to 60 seconds every day (Berding 1995; Moore and Nuss 1987; Abu-Ellail and Mohamed 2020).

The number of days of the per flag leaf, flag leaf, tip emergence, and full emergence stages increased significantly by approximately 32.5, 21.4, 9.9, and 10.3% under 60 days of the constant day's length of conductive cycles when the days of constant day length of conductive cycles were extended from 30 days to 60 days. Day length is 12 ½ hours and declining at the end of artificial photoperiod regimes (Abu-Ellail 2015; LaBorde *et al.*, 2004). According to Abu-Ellail and Mohamed (2020), photo inductive cycles are the main factor known to govern the switch in sugarcane from vegetative to reproductive growth. On the other hand, the most flowering traits went well, but the flowering percentage dropped by about 6.6% when the constant day length was shortened to 30 days. Furthermore, the pollen value decreased by around 7.1% when the contract was extended to a 60-day period. In addition, compared to the 60 days of inductive constant cycles, the pre-flag stalk numbers and flowering percentage significantly increased with the 30 days of inductive constant cycles. According to reports, 60 days of therapy delayed tassel growth and emergence (Allam *et al.*, 1978; Miller and Li, 1995).

Table 4. Evaluated ten genotypes and their artificial flowering behavior under different application rates of nitrogen, phosphorus, and potassium (NPK) fertilization and inductive photoperiod constant cycles.

Inductive cycles (B)	Tip emergence stage											Full emergence stage									
	30 days					60 days						30 days					60 days				
Genotypes	NPK rats (A)				Mean	NPK rats (A)				Mean	G. Mean	NPK rats (A)					NPK rats (A)				Mean	G. Mean
(C)	1	2	3	4		1	2	3	4			1	2	3	4	Mean	1	2	3	4		
CO997	142	139	133	129	135.8	170	150	142	142	151.0	143.4	153	150	136	125	141.0	151	150	141	133	143.8	142.4
CP27-51	142	140	127	126	133.8	170	167	154	142	158.3	146.1	158	150	136	118	140.5	162	158	151	133	151.0	145.8
MEX58-1868	150	136	133	123	135.5	174	158	142	133	151.8	143.7	150	136	133	120	134.8	188	166	142	135	157.8	146.3
G74-99	140	139	133	124	134.0	170	167	158	139	158.5	146.3	156	150	133	116	138.8	185	171	151	133	160.0	149.4
G84-47	142	133	129	121	131.3	170	174	142	133	154.8	143.1	150	136	133	122	135.3	188	162	153	142	161.3	148.3
G2003-49	150	-	-	-		-	-	-	-			139	-	-	-		-	-	-	-		
CO1129	150	142	129	124	136.3	168	161	150	142	155.3	145.8	150	138	133	119	135.0	188	173	164	141	166.5	150.8
H86-37	152	146	142	122	140.5	170	163	147	138	154.5	147.5	157	135	133	110	133.8	182	163	151	130	156.5	145.2
CO744	154	147	140	123	141.0	167	143	137	123	142.5	141.8	152	133	120	115	130.0	178	151	143	120	148.0	139.0
M55-157	-	-	-	-		-	-	-	-			-	-	-	-		-	-	-	-		
Mean	116.8	97.5	92.6	86.9	98.5	119.2	114.0	103.5	96.9	108.4	115.7	121.3	99.5	93.7	83.0	99.4	124.4	114.3	105.3	94.7	109.7	116.7
LSD at 5%																						
A								3.98													3.98	
B								1.62													2.67	
C								2.68													2.14	
A*B*C								3.14													4.16	

Abbreviations: Rate 1 (600 g) , Rate 2 (900 g) , Rate 3 (1000 g) and Rate 4 (1100 g) of NPK

3.Effects of sugarcane genotypes

Fertilizer application rate (600 g NPK) caused genotype differences in sugarcane under artificial flowering. Significant differences in sugarcane genotypes were seen when the constant day length of the conduction cycle was extended and when increasing the NPK fertilization (1100 g) and was postponed to November, according to the data shown in Tables (3, 4, and 5). Appropriate optimum NPK application rates greatly enhanced the number of genotypes flowering, which is essential for sufficient sugarcane tasseling. Depending on genetic features, variations in inflorescence length may be visible (Heide, 1987; Nayamuth *et al.*, 2003). There was a substantial interaction between the flowering features and NPK treatments based on genotype (Berding, 1995). For both per flag leaf and flag leaf stages, the genotypes MEX58-1868 and CP27-51 recorded the shortest duration (48.3 and 101.5 days), whereas the genotypes CO744 and H86-37 recorded the longest durations (79.5 and 112.5 days). The remaining genotypes ranged from less than 30 days. Table 3 displayed the information. Nevertheless, the genotypes that flowered in less than 60 days displayed a range of durations: G84-47 and CO744 showed 107.5 and 116.8 days, and CO997 and MEX58-1868 showed 90.5 and 134.0 days. The genotypes of sugarcane had transitioned from vegetative to reproductive growth; tasseling was impacted by low NPK rates. Neither substantial effects nor inductive constant cycles through genotype interactions were seen. The outcomes demonstrated that, compared to other genotypes, CO997 blossoms more frequently. Similar trends were noted by Berding *et al.* (2010), Partap and Singh (2003), and Abu-Ellail and Mohamed (2020), who

discovered that there were notable differences in the timing and intensity of flowering behavior amongst sugarcane genotypes

Table (3) gave data indicating that the genotype CP27-51 had the lowest duration days of per flag and flag leaf stags under increasing NPK fertilization rate (1100 g) until November, followed by genotypes MEX58-1868, CO997, and G74-99. The genotype G84-47 recorded the shortest duration days for the tip and emerging stages, followed by CO744 and H86-37. Under the highest fertilization rate (1100 g) applied in November, the highest flowering and pollen viability percentage was recorded by the genotype G84-47 followed by genotypes CO997, CO1129. Reproductive factors significantly influenced by NPK rates through photoperiod treatments were inflorescence emergence and flowering percentage (NPK x Genotype significant). The pollen variability was shown to be greatly reduced by the inductive cycles. An increase in inflorescence appearance may arise from the use of optimum rates of NPK. There is a chance that more blooms per inflorescence will produce pollen that is more viable. These findings concur with those of Berding *et al.* (2007) and Abu-Ellail and McCord (2019), who discovered that variables like constant inductive cycle days and nutrition therapy had an impact on flowering features.

Table 5. Evaluated ten genotypes and their artificial flowering behavior under different application rates of nitrogen, phosphorus, and potassium (NPK) fertilization and inductive photoperiod constant cycles.

Inductive cycles (B)	Flowering percentage											Pollen viability%										
	30 days					60 days				Mean	G.	30 days					60 days				Mean	G.
Genotypes	NPK rats (A)				Mean	NPK rats (A)				Mean	Mean	NPK rats (A)				Mean	NPK rats (A)				Mean	Mean
(C)	1	2	3	4		1	2	3	4			1	2	3	4		1	2	3	4		
CO997	66.7	60.3	54.6	42.5	56.0	68.7	64.2	61.4	58.5	63.2	59.6	41.3	37.6	35.1	33.4	36.8	37.5	33.4	30.6	29.4	32.7	34.8
CP27-51	50.0	47.1	45.2	40.7	45.8	53.0	50.4	48.5	45.9	49.5	47.7	43.5	41.3	39.4	36.3	40.1	38.7	34.7	32.6	28.4	33.6	36.9
MEX58-1868	52.0	40.6	38.9	36.4	42.0	57.0	53.6	51.4	49.7	52.9	47.5	46.8	43.2	41.5	37.3	42.2	39.6	37.4	34.7	30.1	35.5	38.9
G74-99	50.0	43.2	41.2	39.6	43.5	51.0	48.5	46.2	44.3	47.5	45.5	56.1	52.4	48.6	43.5	50.2	43.6	40.6	37.8	31.2	38.3	44.3
G84-47	83.3	79.4	71.2	69.1	75.8	84.0	81.3	76.5	72.3	78.5	77.2	56.7	53.2	46.5	40.1	49.1	47.1	41.2	38.6	34.3	40.3	44.7
G2003-49	50.0	-	-	-	50.0	-	-	-	-	-	-	30.2	-	-	-	-	-	-	-	-	-	-
CO1129	60.0	57.8	53.2	50.1	55.3	66.7	61.5	59.8	54.1	60.5	57.9	56.9	50.5	48.6	46.5	50.6	50.7	47.8	43.2	38.6	45.1	47.9
H86-37	42.0	41.3	39.4	35.6	39.6	50.0	47.5	45.4	41.2	46.0	42.8	51.5	47.6	43.4	36.4	44.7	46.4	42.1	37.4	36.4	40.6	42.7
CO744	66.7	64.5	61.3	59.7	63.1	67.7	62.3	59.6	54.7	61.1	62.1	57.0	50.9	47.6	40.2	48.9	47.3	42.1	40.7	34.5	41.2	45.1
M55-157	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	57.1	53.2	49.4	45.1	51.2	63.1	59.0	56.4	52.7	57.8	44.0	52.5	47.4	44.3	39.7	45.9	44.4	40.1	37.5	33.3	38.8	33.5
LSD at 5%																						
A								5.25													4.61	
B								3.85													3.38	
C								2.31													2.54	
A*B*C								4.55													4.83	

Abbreviations: Rate 1 (600 g) , Rate 2 (900 g) , Rate 3 (1000 g) and Rate 4 (1100 g) of NPK

CONCLUSION

The outcomes emphasized the significance of having enough NPK nutrients before using an artificial photoperiod regime. For this investigation, stop fertilization time in June was considered to have sufficient NPK rate (600 g). When comparing the group of plants that received the lowest NPK fertilizer rate (600 g) before the artificial photoperiod regime to the group that received the highest NPK rate (1100 g) after starting the artificial photoperiod regime, the tassels number of the former was higher. The most crucial agronomic factor seems to be flowering stalk number, since treatments that produce low numbers of flowering stalks are undesirable and impractical for the sugarcane breeding program. Delaying and increasing the NPK application rate (1100 g) until November during the post-photoperiod treatment resulted in a substantial decrease in the quantity of inflorescences ($P \leq 0.01$) and the emergence of peduncles ($P \leq 0.01$). For every sugarcane-breeding program that uses pot culture to obtain its breeding genotypes, every aspect of NPK fertilization availability needs to be assessed.

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سلوك الإزهار لبعض التراكيب الوراثية من قصب السكر المتأثرة بمعدلات التسميد بالنيتروجين والفوسفور والبوتاسيوم (NPK) تحت فترة الضوء الاصطناعي

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الملخص

يؤثر التسميد بالنيتروجين والفوسفور والبوتاسيوم (NPK) على إزهار قصب السكر على كل من مرحلتي البدء والتحفيز للتزهير . أجريت التجربة خلال عامي 2022/2021 و2023/2022 في محطة التربية التابعة لمعهد بحوث المحاصيل السكرية ، مركز بحوث الزراعة ، الجيزة ، مصر (خط عرض 30 درجة 0' شمالاً، خط طول 31 درجة 12' شرقًا)، لفحص استجابة عشرة تراكيب وراثية من قصب السكر لمعدلات تطبيق سماد NPK (600 جرام ، 900 جرام ، 1000 جرام و1100 جرام) تحت دورتين ضوئيتين تحريضيتين من المعالجات بمدة ثابتة 12.5 ساعة في اليوم لمدة 30 يومًا و60 يومًا تليها انحدار 30 ثانية / يوم إلى 11 ساعة و30 دقيقة. تم استخدام تصميم القطع المنشقة مرتين في ترتيب قطع كاملة العشوائية في مكررتين . كما تم جمع البيانات حول الصفات التزهيرية (مرحلة قبل العلم، ومرحلة ورقة العلم، ومرحلة ظهور النورات ، ومرحلة الظهور الكامل للنورة) في مراحل قصب السكر المختلفة بالإضافة إلى النسبة المئوية للإزهار الكلي ونسبة قابلية حبوب اللقاح للبقاء. أظهرت التراكيب الوراثية قيد الدراسة سمات إزهار متباينة بشكل كبير في أوقات مختلفة عندما تم تطبيق معدلات التسميد بالنيتروجين والفوسفور والبوتاسيوم، مع دورتين مستمرتين لحث التزهير. لوحظت اختلافات كبيرة في نسب النباتات المزهرة وقابلية حبوب اللقاح للبقاء، وخصائص الإزهار (لكل مرحلة قبل العلم، ومرحلة ورقة العلم، ومرحلة خروج النورة ، ومرحلة الظهور الكامل للنورة) بين معدلات تطبيق النيتروجين والفوسفور والبوتاسيوم وتفاعل النمط الجيني × النيتروجين والبوتاسيوم × الدورات الحثية الثابتة. تحت معالجات الدورة الحثية لمدة 30 و60 يومًا على التوالي، تباينت النسبة المئوية للنباتات المزهرة بشكل كبير سواء داخل أو بين معدلات تطبيق النيتروجين والفوسفور والبوتاسيوم. بالإضافة إلى ذلك، بالمقارنة مع المعدل الأمثل 600 جم (إيقاف التسميد في يونيو)، عندما تم تطبيق التسميد NPK في وقت لاحق بمعدلات متزايدة، كان هناك انخفاض في سلوك التزهير وزيادة في نسبة التزهير.

الكلمات المفتاحية: تراكيب وراثية من قصب السكر، التزهير الإصطناعي، البدء الضوئي، التسميد بالعناصر الغذائية الأساسية.(NPK)