SCREENING AGRONOMICALLY ACCEPTABLE CLONES FROM FAMILIES ASSESSED UNDER NON-MOISTURE LIMITING CONDITIONS IN A MANAGED MOISTURE-LIMITED ENVIRONMENT FOR ENHANCED PRODUCTIVITY AND DETERMINATION OF POSSIBLE SELECTION TRAITS

By

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Abstract

MOISTURE stress is the primary abiotic stress occurring in almost all cane growing areas of India, causing drastic reduction in cane and sugar productivity. Under this situation, development of productive, moisture-stress tolerant cultivars assumes greater importance to sustain cane and sugar production. Hence, the study was undertaken to identify families and traits of importance for genetic enhancement of sugarcane productivity under moisture-stress environment. A hybrid seedling population of 45 diverse inter-varietal crosses was studied for variability parameters and percent superior segregates for cane and sugar productivity in seedling and clonal generations under non-moisture stress and moisture-stress environments, respectively. Further, path analysis and mean performance were studied to identify important contributing traits for productivity under moisture stress involving 50 productive selections in clonal stage III with three standards. The polycrosses involving Co 8013, CoV 92101, C 81615, CoC 771, Co 8371, general crosses involving Co 88025 and CoC 671 as female parents, and a cross Co 740 × CoA 7602 exhibited a better range of variability for sugar and cane productivity and produced better percent superior/transgressive segregants. The genotypic path analysis involving six biophysical traits revealed that the light use efficiency (LUE) under moisture stress and photosynthesis rate after alleviation of stress through enhanced transpiration largely contribute to cane productivity. Similarly, the path analysis of 20 other traits under moisture stress emphasised the major role of early internode formation, root length and biomass, leaf area and leaf sheath moisture at the end of the formative stage for higher cane yield. The other traits like tiller number at the mid-formative stage and single cane weight (SCW i.e stalk weight) at harvest can also be considered as selection criteria for improvement of cane productivity. Hence, for genetic enhancement of sugarcane productivity under moisture-limited environments, the families/crosses identified could be considered as 'proven' for isolating productive moisture stress tolerant progenies. The traits identified are effective and useful for identification of productive moisture-stress tolerant clones. Clones identified could be promoted to advanced yield trials.

Introduction

Moisture stress is one of the major constraints to improving sugarcane productivity in India. The extreme decline in the cane area and production due to drought is a strong reminder of the dependence of the sugarcane production on rainfall. The majority of the sugarcane area in the country experiences drought during the formative phase (60–150 DAP) which is the most sensitive growth stage (Naidu, 1976; Gascho and Shih 1983; and Venkataramana, 2003). In this context, for sustained cane and sugar production, development of productive sugarcane cultivars which can tolerate moisture stress assumes greater importance.

In breeding for stress tolerance, cane yield and tolerance to the stress factors are to be considered, as the cane yield under stress is a function of genotype response to stress and the yield potential (Moore, 1987). Selection for stress tolerance in a suboptimal environment (moisture stress) may advance seedlings with poor yield potential. Hence, with this basic philosophy in view, initial seedling selection based on productivity features is conducted under non–moisture limiting conditions. Further, the fairly large selected population consisting of productive progenies is advanced to clonal stage-I and evaluated under moisture-limiting conditions to identify tolerant genotypes, families, and contributing traits.

The estimates of genetic variability parameters for cane and sugar yield component traits in seedling generation under non-moisture stress and in clonal stage I and its ratoon under moisture stress is reported in our earlier paper (Patil et al., 2008). The study identified the traits *viz.,* tiller number, number of millable cane (NMC), single cane weight (SCW), and hand refractometer (HR) Brix (°) as most reliable and repeatable across seedling and clonal generations under non-moisture stress and moisture-stress environments, respectively.

In the present paper, the results obtained are discussed to identify families and traits contributing towards improved productivity under a moisture-stress regime. Further, the performance of top 10 productive clones is also discussed in the context of contributing traits.

Material and methods

The potted seedling population, comprising 3124 sturdy hybrid progenies derived from 45 diverse inter-varietal crosses, was transplanted to an augmented randomised block design –II, with 22 blocks and four commercial check cultivars *viz.*, CoC 671, Co 86032, CoM 88121 and Co 740 at the Agricultural Research Station, Sankeshwar ([2]University of Agricultural Sciences, Dharwad, Karnataka, India, 15°29'N, 74°59'E) under non-moisture stress conditions. The trial had an inter-row spacing of 0.9 m and an intra-row spacing of 0.6 m. Any gaps from failed seedlings were filled with corresponding hybrid seedlings after 15 days. Recommended cultural operations were carried out during the crop season with regular irrigation schedule based on 75% moisture depletion. The seedling population was evaluated for various cane yield traits *viz.,* tillers per seedling (at 90 days after transplanting), cane girth (cm), millable cane height (cm), number of internodes, internode length, number of millable canes (NMC), single cane weight (SCW), cane yield per clump and HR Brix (°) (270 days after transplanting).

A total of 828 seedlings were selected based on superior or on par cane yield and/or HR Brix (°) compared to the best commercial check. The selected clones were planted in 3-m row length in an augmented RBD-II with nine blocks (CT-I) in a moisture-stress environment. Each block comprised 92 clones and four check cultivars planted randomly. The seed rate of 12 eye buds/m was followed with recommended practices under moisture stress. The stress was created by withholding irrigation from 50 to 160 days after planting (DAP), *i.e.,* formative phase which generally coincides with summer months during which the crop generally suffers from moisture stress and the clones were scored for important cane yield traits and HR Brix (°) (330 DAP).

Fifty moisture-stress tolerant selections from clonal stage I and three commercial check cultivars were evaluated in RBD with two replications. The trial was planted in paired rows of 6 m length with spacing of 1.8 m and 0.9 m between and within pairs respectively. The seed rate (10 eye buds/m) and all standard management practices, excluding drought management practices, were followed for raising the crop. In this experiment, irrigations were skipped from 50–160 DAP and observations on various traits *viz.,* physiological, biophysical, root parameters, cane and sugar components were recorded. The physiological traits *viz.,* leaf area index (LAI) and mean tilt angle (MTA) of leaves at 150 DAP were measured by using portable LICOR canopy analyser system. The characters like 8th leaf area (as per Romero, 1987), leaf sheath and lamina moisture percent and relative water content were also measured using standard procedures followed in sugarcane and other field crops. The portable photosynthesis system (LI-6400 LICOR, Nebraska, Lincoln., USA) was used to measure biophysical traits like rate of photosynthesis (μ mol $CO_2/m^2/s$), transpiration (m mol of $H_2O/m^2/s$), conductance (μ mol $CO_2/m^2/s$), leaf temperature (°C), water use efficiency (μ mol CO_2 / m mol of H_2O) and light use efficiency (μ mol Co_2 / μ mol PAR). These observations were made on the top fully opened leaf, from 10 am to 12 noon, on both sampling stages *i.e.*, at moisture stress (mid-formative phase) and after alleviation of stress (*i.e.*, after irrigation at the end of formative phase). The root parameters like number and dry weight (g) per clump and root length were also recorded in cm.

The data collected on various traits were subjected to correlation and path analyses. The data were subjected to Anova and Anacova by the methods proposed by Cochran and Cox (1957). The genotypic correlation coefficients (r_G) among all the traits were determined from the variance and covariance components. The correlation coefficients were further partitioned into direct and indirect effects with the help of path coefficient analysis. The 10 most productive clones, relative to the commercial checks, were considered in detail to determine what traits may be important in determining productivity under moisture-limited conditions.

Results and discussion

Among 20 biparental crosses involving commercial cultivars, the cross Co 740 × CoA 7602 produced progenies with a better range for cane yield and HR Brix (°) with better percent superior progenies in normal irrigated environment (Table 1). Though one transgressive segregant was recovered from the cross in clonal stage III, the cross scored a lower percentage of superior progenies in the moisture-stress regime in clonal stage I.

Out of 17 poly crosses, five involving female parents Co 8013, Co 8371, CoC 771, CoV 92101, and C 81615 produced better percentage of superior progenies with a wide range of variability for cane yield and HR Brix (°) both in seedling and clonal generation under non-stress and stress environments. Transgressive segregates (productive) under moisture stress were recovered from all these five polycrosses. The CoV 92101 PC produced a maximum of three productive segregants.

Eight general crosses produced a better number of progenies wherein only two *viz.*, Co 88025 GC and CoC 671 GC exhibited a better range of variability for both cane yield and HR Brix (%). Both the general crosses produced transgressive segregates under moisture stress.

Table 1—Contribution of families towards production of superior progenies/transgressive segregates.

Family/cross	Seedling generation under normal irrigated			Clonal generation under moisture stress			
	Cane yield (kg/clump)	HR Brix (°)	% superior progenies based on cane yield/HR Brix	Cane yield (kg/plot)	HR Brix (°)	% superior progenies based on cane yield/HR Brix	No. of transgressive segregates recovered in stage III
	Range	Range		Range	Range		
Co 740 × CoA 7602	0.32–13.83	7.8–22.2	26.17	16–29.6	12.60–20.00	4.00	1
Co 8013 PC	0.59–10.80	12.4–21.0	36.36	21–29.0	13.07–18.73	15.00	1
Co 8371 PC	0.59– 9.92	10.4–20.0	45.07	16–27.0	8.20–18.6	6.45	1
CoC 771 PC	0.61–10.27	9.0–19.1	13.79	25–32.0	12.60–19.2	33.33	3
CoV 92101 PC	0.60–10.64	10.0–19.0	9.09	25–31.0	14.67–16.93	50.00	1
C 81615 PC	0.80–11.25	10.0–19.0	10.52	20–33.0	12.53–16.60	25.00	1
Co 88025 GC	0.90– 3.90	13.0–19.1	10.00	32–32.0	20.27–20.27	100.00	1
CoC 671 GC	0.76– 8.46	5.9–19.4	20.58	22–25.0	14.13–17.60	14.29	1

Character association analysis in selected sugarcane progenies evaluated under moisture stress environment

In sugarcane, cane yield is a complex character influenced by a number of inter-related component traits. This often influences the direct relationship with cane yield and, as a result, the information based on correlation coefficients is not dependable. Since path coefficient analysis gives a more realistic relationship of characters, an attempt has been made in the present study to identify the effective components of cane yield having either positive or negative significant association with cane yield.

Path coefficient analysis was used in working out the direct (diagonal values) and indirect (off diagonal values) effects of 20 characters on cane yield per plot under moisture stress (data not presented). The genotypic path coefficient analysis accounted for a major part of the total variation in cane yield as indicated by relatively lower residual effects.

The results of the present investigation indicated some interesting facts. The characters like average number of internodes, tillers at 80 DAP, average root length and root number had a relatively high positive correlation with cane yield, but had negative direct effects. A similar observation was made by Patel et al. (1993). However, Khan et al. (2001) reported a positive association of number of internodes, number of millable canes and millable cane height with cane yield and positive direct effect.

From a breeder's viewpoint, characters could be useful as selection criteria if they not only have a high positive correlation, but also exert high direct effects. In this context, number of internode formed shoots (at 120 DAP), single cane weight, average long root length, 8th leaf area, and leaf sheath moisture had a significant and positive association (correlation) with cane yield per plot and exerted high direct effect. Similar results were obtained by Bodhinayake et al. (1998), Kamat and Singh (2002) and Wagih et al. (2003). However, Srivastava et al. (1997) expressed a contrasting view to these findings.

Single cane weight, which is an important cane yield component, was highly significantly correlated with cane yield and with a better direct effect indicating its importance in enhancing cane yield. However, Bissessur et al. (2001) expressed that, in any environment, selection of a combination of traits is more important than any single trait.

The characters like cane height, number of internode formed shoots at 160 DAP, and root dry matter had a relatively high positive association with cane yield, but their direct effects were relatively lower indicating direct selection for these traits may not be effective under a moisture-stress environment. Bodhinayake et al. (1998) expressed similar views with respect to number of roots in the surface horizon.

The juice extraction percent, relative water content, and mean tilt angle (leaf angle) of leaves had a low non-significant negative association with cane yield but had higher direct negative effects suggesting higher cane yield genotypes can be identified with acute leaf angle.

Hence, from the genotypic path analysis study, for improvement of cane yield under moisture-limiting conditions, emphasis must be placed on the number of internode formed shoots at 120 DAP, single cane weight (at harvest), average long root length, 8th leaf area, and the leaf sheath moisture at the end of the formative stage.

The other traits like number of internode formed shoots at 160 DAP, cane height and girth at harvest also can be considered as additional selection criteria for improvement of cane yield, under moisture-limiting conditions.

Path coefficient analysis of bio physical traits for cane yield

Path coefficient analysis was used to determine the direct (diagonal values) and indirect (off diagonal values) effects of six biophysical traits under moisture stress and non stress (after alleviation) conditions on cane yield per plot (data not presented). The genotypic path coefficient analysis accounted for only about 50 percent of the total variation in cane yield as indicated by considerable residual effects.

All the bio-physical traits under stress condition in the mid-formative stage had no significant association with cane yield. Similarly, little variation for photosynthetic traits among sugarcane clones was observed by Singh et al. (1994). Even after alleviation from stress, all the photosynthesis related traits except photosynthesis rate had non-significant association with cane yield, whereas photosynthesis rate only had significant positive association with cane yield indicating the clones differed significantly with respect to this parameter after alleviation from moisture stress. The cultivars also differed for their ability to recover from stress after irrigation. Ali et al. (2003) reported that drought tolerant clones had a remarkable ability to recover after re-watering if the stress period was not prolonged or too severe.

Photosynthetic rate after alleviation from stress (0.716) had the highest direct positive effect on cane yield, followed by Light Use Efficiency (LUE) under moisture stress (5.322). The highest negative direct effect on cane yield was from transpiration rate after alleviation of stress (–0.644) followed by photosynthetic rate under moisture stress (–6.001) (Table 2). This suggests that the varietal adjustment/adaptive ability under moisture stress through better light use efficiency and regaining higher photosynthesis rate after relief from stress are important parameters which had positive direct effects on cane yield, and high rate of photosynthesis after stress alleviation is equally important for rejuvenation of cultivars which was achieved through high transpiration. The better LUE under stress and high photosynthesis rate after alleviation of stress are important for mitigating stress and regaining normal (or enhanced) growth. Genotypes with such important features could be ideal under moisture stress, as results clearly indicated the role of these traits towards higher productivity. This finding is in accordance Adarsha (2004), who reported cotton genotypes responded for rejuvenation ability through higher stomatal conductance. Both the maintenance of photosynthetic ability in stress and better rejuvenation capacity after stress alleviation are important for imparting moisture stress tolerance in sugarcane progenies studied. Srivastava et al. (1996) reported the role of rejuvenation capacity for drought-tolerant cultivars Co 1148, Co 5769, and Co 5823 through high stomatal conductance and transpiration. The higher positive indirect contribution of photosynthesis rate to cane yield per plot was through LUE under stress.

Hence, from the genotypic path analysis study, LUE under stress and high photosynthesis rate after stress alleviation through high transpiration largely contribute to cane yield. Hence, for improvement of cane yield under moisture stress environments, emphasis must be placed on LUE under stress and high photosynthesis rate after stress alleviation as evidenced in productive progenies in the moisture-stress environment.

Contribution of important traits towards productivity under moisture stress

The analysis of variance of the replicated clonal data revealed highly significant differences among the genotypes for all characters except leaf temperature, WUE percent under stress, and 8th leaf area. The mean values for important contributory traits in the top ten superior cane yielding progenies over best check are given in Table 2.

The important cane yield components, single cane weight, NMC, and millable cane height played a major role among various other components, contributing towards excellence of nine progenies:-, SNK 632, SNK819, SNK 822, SNK 827, SNK 024, SNK 813, SNK 707, SNK 782, and SNK 806 over the best check Co 86032.

The internodes formed shoots, root dry weight, average long root length, LAI, and 8th leaf area had a significant role among various physiological parameters studied in cane yield formation. The superior top 10 cane yielding progenies recorded a higher number of internode formed shoots even under moisture-stress condition indicating their tolerance to moisture stress or the potential to maintain growth rate under moisture-stress condition. The tolerance capacity could be due to higher root dry matter and deeper (long) root growth, features observed in top productive progenies compared to the best check Co 86032. In addition, these progenies also had higher leaf sheath moisture percent, lower leaf lamina moisture percent, and higher LAI and 8th leaf area.

The maintenance of a productive shoot population under moisture stress is an important character for better productivity. This was studied through mortality percent of tillers at 90 and 120 DAP, *i.e*., mid-formative stage under moisture stress. The top productive progenies exhibited lower mortality percent at the initial (90 DAP) stress period, whereas higher mortality was observed at later (severe) stages of moisture stress, thereby reducing total shoots per unit area. The progenies produced a higher number of productive shoots (internode formed shoots) compared to the check variety Co 86032. In the case of the moisture-stress sensitive variety Co 86032, though total shoot population maintained was high with reduced mortality, the productive shoots (internode formed shoots) were lower, thereby reducing single cane weight and lower NMC at harvest.

The top productive progenies did not differ much from the best check Co 86032 for all the photosynthesis related traits under the moisture-stress condition, indicating minimum role of these traits for imparting moisture stress tolerance. Instead, the high productive progenies SNK 632, SNK 819 and SNK 024 had inferior water use efficiency because of higher transpiration compared to checks. The higher productivity in spite of lower water use efficiency could be due to their inherent capacity to utilise moisture available at lower soil layers through a deep root system compared to the check cultivars which were more sensitive to moisture stress. Thereby these progenies maintain growth under stress at comparatively high expense of water, i.e., low water use efficiency.

The rejuvenation capacity after alleviation from moisture stress is also an important parameter for higher cane productivity under a moisture-stress environment. In the case of top productive progenies, SNK 632 and SNK 819, photosynthesis rate was significantly higher compared to the best check (Co 86032) after relief from stress (Table 2), indicating their higher rejuvenating potential to utilise available moisture, and this could also be due to a better root system.

The pedigree of these top productive progenies indicate that the crosses Co 8013 PC, CoV 92101 PC, C 81515 PC, Co 88025 GC, Co 740 × Co A7602, CoC 771 PC, Co 8371 PC, CoC 671 GC, and CoC 771 PC were promising for obtaining superior progenies to improve productivity under a moisture-stress environment. This indicates the role of parents, Co 740, CoA 7602, and Co 8013 in attributing drought tolerance to their progenies. These findings suggest the importance of family selection and also the role of parental selection with required features to obtain heterotic progenies combining better moisture-stress tolerance and higher productivity.

Conclusion

The bi-parental cross Co 740 × CoA 7602, the poly crosses involving female parents Co 8013, Co 8371, CoC 771, CoV 92101 and C 81615 and general crosses involving female parents Co 88025 and CoC 671 found proven on the basis of variability obtained for cane yield and HR Brix (°) and recovery of transgressive segregates. For improvement of cane productivity under a moisture-stress regime, emphasis must be placed on traits like early cane internode formation, stalk weight at harvest, root length and leaf sheath moisture at end of formative phase. Among biophysical traits, the light use efficiency at stress and photosynthesis rate after alleviation of stress are important for identification of productive genotypes. The performance of the top 10 productive hybrid progenies clearly demonstrated the contribution of the above traits towards improved productivity under moisture stress. The productive progenies could be promoted to advanced yield trials and also be utilised in current breeding programs as donors for moisture-stress tolerance.

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Table 2—Mean values of important contributing traits for top 10 superior cane yielding progenies over best check under moisture stress environment.

Clone	Cross	Tillers/plot 90 DAP	No. Int. formed shoots/ plot at 120 DAP	No. Int. formed shoots /plot at 160 DAP	Root dry. wt (g) / clump at 150 DAP	Av. root. length (cm) at 150 DAP	Area 8th leaf area at 150 DAP (cm^2)	Leaf sheath moisture % at 150 DAP	At stress LUE % (Physiol.)	Photo-synthesis rate following stress alleviation	Trans-Piration rate following stress alleviation	Average SCW (kg) at harvest	NMC (000's/ ha)	CCS%	CCS% at harvest	Cane yield (t/ha)
1. SNK 632	Co 8013 PC	138	48	68	3.18	21.53	276	46.7	3.96	58.46	4.42	2.05	53.4	12.46	11.4	109.6
2. SNK 819	CoV 92101 PC	266	33	58	2.10	17.77	380	34.0	3.38	62.00	3.64	2.01	48.7	10.56	10.8	98.1
3. SNK 822	C 81615 PC	187	34	82	2.57	23.10	302	44.9	3.69	59.42	3.51	1.62	58.1	10.94	11.6	94.4
4. SNK 827	Co 88025 GC	247	28	81	2.44	24.20	292	44.1	3.43	54.32	4.11	2.05	45.4	10.46	11.2	93.4
5. SNK 24	Co 740 × CoA 7602	184	53	71	2.34	17.85	291	29.9	3.42	54.08	3.47	1.53	61.3	10.24	11.3	90.7
6. SNK 813	CoC 771 PC	267	9	78	2.40	27.10	279	44.2	3.50	58.51	4.21	1.52	58.2	10.76	12.1	88.8
7. SNK 707	Co 8371 PC	242	5	66	1.69	22.84	290	46.2	3.63	59.81	4.31	1.25	69.9	11.52	13.3	86.9
8. SNK 782	CoC 671 GC	195	15	77	1.62	19.51	292	39.4	3.54	60.28	4.26	1.30	66.8	10.69	12.3	86.9
9. SNK 806	CoC 771 PC	255	19	50	1.90	20.10	293	43.8	3.62	58.91	4.24	1.63	52.7	10.73	12.5	86.0
10. SNK 809	CoC 771 PC	205	21	62	2.88	26.25	269	36.9	3.69	57.71	3.82	1.48	58.2	9.67	11.6	83.7
Checks																
CoC 671		170	26	52	1.20	20.15	327	40.8	4.23	59.64	3.47	1.62	39.6	8.82	13.7	64.3
Co 86032		201	17	66	1.38	19.50	242	40.8	3.32	52.83	3.50	1.57	42.6	8.79	13.1	67.0
CoM 88121		222	4	71	0.78	17.28	208	46.5	3.78	52.54	2.75	1.37	43.6	7.97	13.4	59.7
$CD_{(0.05)}$		51.6	10.8	13.9	1.00	4.85	60.8	0.7	0.68	5.13	0.40	0.37	19.3	0.08	1.1	6.8
MEAN		184.4	13.7	59.1	1.89	18.01	247.5	39.4	3.67	55.12	3.62	1.41	45.2	7.24	11.6	62.6
RANGE		88.5–266.5	0.0–53.3	26.5–90.9	0.45–4.44	10.24–27.10	173.4–379.9	25.3–48.1	3.12–4.71	41.83–62.88	2.42–5.09	0.872–2.05	17.3–74.6	6.50–12.46	6.5–13.4	21.9–109.6

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SÉLECTION DES CLONES ISSUS DES FAMILLES ÉVALUÉES SANS STRESS HYDRIQUE DANS UN ENVIRONNEMENT CONTRÔLÉ LIMITÉ EN EAU ET IDENTIFICATION DES CARACTÈRES DE SÉLECTION APPROPRIÉS

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MOTS-CLÉS: Tolérance au Stress-Hydrique, Pilotage de la Sélection sous Stress-Hydrique, Rendement, Rétablissement Post-Stress.

Résumé

LE STRESS hydrique est le principal facteur abiotique prévalent dans presque toutes les régions cannières de l'Inde, occasionnant une baisse sévère de la productivité en sucre. Sous ces conditions, le développement des cultivars productifs, tolérants au stress hydrique revêt une grande importance pour maintenir la production sucrière. Par conséquent, cette étude a été entreprise afin d'identifier les familles et les caractères appropriés pour sélectionner des génotypes améliorés capables de rehausser la productivité sous un régime de stress hydrique. Une population de plantules issues de 45 combinaisons génétiques ont été étudiées sur les générations clonales issues de plantules et de boutures pour leur paramètres de variabilité génétique à l'aptitude à produire des clones supérieurs pour le rendement en canne et en sucre en absence et en présence de stress hydrique respectivement. De plus, l'analyse des pistes et la performance moyenne ont été étudiées pour identifier les caractères importants contribuant au rendement sous les conditions de stress hydriques chez 50 génotypes sélectionnées au stade clonal III avec trois témoins. Les polycroisements impliquant Co 8013, CoV 92101, C 81615, CoC 771, Co 8371, des croisements généraux comprenant Co 88025 et CoC 671 comme parent femelle et un croisement Co 740 × CoA 7602 ont démontré une large gamme de variabilité pour le rendement en canne et en sucre et produit un pourcentage plus élevé d'individus transgressifs et supérieurs. L'analyse des pistes génotypiques comprenant six caractères biophysiques ont démontré que l'efficience de l'utilisation de la lumière (LUE) sous conditions de stress hydrique et le taux de photosynthèse après allègement du stress par le biais de la transpiration accentuée ont contribué largement au rendement canne. De même, l'analyse des pistes de 20 autres caractères sous des conditions de stress hydrique a souligné le rôle majeur de la formation précoce des entrenœuds, la longueur des racines et la biomasse, la surface foliaire et l'humidité de la gaine en fin de stade de développement pour des rendements plus élevés. Les autres caractères comme le tallage à mi-chemin du stade de formation, et le poids de la tige (SCW) à la récolte peuvent aussi être considérés comme critères de sélection pour améliorer le rendement. Par conséquent, pour le rehaussement génétique de la productivité de la canne dans les environnements de stress hydrique, les familles/croisements identifiés pourraient être considérés comme « éprouvés » pour l'identification de descendance tolérante et plus productive sous les conditions de stress hydrique. Les caractères identifiés sont efficaces et utiles pour la sélection des clones performants et tolérants au stress hydrique. Ces clones pourraient être promus au stade essais variétaux.

PRUEBAS DE CLONES AGRONÓMICAMENTE ACEPTABLES DE FAMILIAS EVALUADAS BAJO CONDICONES LIMITADAS DE POCA HUMEDAD USANDO UN AMBIENTE CONTROLADO CON LIMITACIONES DE HUMEDAD PARA INCREMENTAR LA PRODUCTIVIDAD Y DETERMINACIÓN DE POSIBLES CARACTERES DE SELECCIÓN

Por

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PALABRAS CLAVE: Tolerancias a Estrés por Humedad, Evaluaciones de Estrés Bajo Condiciones Controladas, Producción de Caña, Rejuvenecimiento Pos-Estrés.

Resumen

EL ESTRÉS por humedad es el principal estrés que ocurre en casi todas las aéreas cañeras de la India, causando reducciones drásticas en la producción de caña y azúcar. Bajo estas circunstancias, el desarrollo de cultivares productivos y tolerantes al estrés por humedad es de gran importancia, para sostener la producción de caña y azúcar. Por ello, el estudio se llevó a cabo para identificar familias y caracteres de importancia para mejorar genéticamente la productividad bajo condiciones ambientales de estrés. Una población híbrida de 45 cruzas intervarietales fue estudiada para identificar la variabilidad de parámetros y el porcentaje de segregantes superiores para producción de caña y azúcar en plántulas de semilla sexual y trozos de generaciones clonales bajo condiciones ambientales de no-estrés y estrés, respectivamente. También, se realizó el análisis de sendero y el comportamiento promedio para identificar los caracteres importantes que contribuyen a la productividad bajo condiciones ambientales de estrés de 50 materiales seleccionados de Estado III con tres testigos. Los policruzamientos que incluyen Co 8013, CoV 92101, C 81615, CoC 771, Co 8371, y las cruzas generales con Co 88025 and CoC 671 como padres femeninos, y una cruza de Co 740 × CoA 7602 mostraron un mejor rango de variabilidad en producción de azúcar y caña, así como un mejor porcentaje de segregantes trangresivos superiores. El análisis de sendero del genotipo que incluyó seis caracteres biofísicos mostró que la eficiencia del uso de la luz (LUE) bajo estrés de humedad y la tasa de fotosíntesis luego de disminuir el estrés a través de la transpiración, contribuyó enormemente para la producción de caña. En forma similar el análisis de sendero para otros 20 caracteres bajo estrés de humedad mostró un rol principal en la formación temprana de los entrenudos, largo de raíz y biomasa, área de hoja y humedad de de la superficie de la hoja al final del estado formativo para alta producción de caña. Los otros caracteres como número de tallos en la mitad del estado formativo y el peso de tallos individuales (SCW) a la cosecha pudieron usarse como criterios de selección para mejorar la producción de caña. Para el mejoramiento de la producción de caña bajo condiciones limitadas de humedad, las familias/cruzas identificadas pudrían ser consideradas como ‘pruebas’ para separar progenies tolerantes y productivas bajo condiciones de estrés por humedad. Los caracteres identificados son útiles y efectivos para la identificación de clones tolerantes y promover su uso para otros ensayos de rendimiento.