TOLERANCE OF SUGARCANE PARENTS TO HERBICIDES AND ITS TRANSMISSION IN PROGENY

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Abstract

SUGARCANE varieties with one or both parents in common have been observed to show a similar tolerance level to the tank-mix of diuron and Actril-DS®. This study was initiated to evaluate parent varieties frequently used in the breeding program of the Institute, for transmission of their tolerance to herbicide in crosses. Sixty parents established in pots and later transplanted in replicated field trials were evaluated for their tolerance to the test herbicide tank-mix. Crosses were made with some selected parents with known tolerance and 15 families, comprising 40 seedlings each, were subsequently evaluated for their response to the same tank-mix. Parents differed significantly in their tolerance to herbicide and were classified as: tolerant (T) 10%; slightly susceptible (SS) 34%; moderately susceptible (MS) 25%; susceptible (S) 25%; highly susceptible (HS) 7%. The phenotypic correlation between the degree of tolerance to the herbicide tank-mix evaluated in pots and in the field was moderately high, indicating that assessment of response of genotypes in pots can provide a useful indication of expression of tolerance at field level. The families also differed significantly in their tolerance to herbicide. Generally, crosses between T/SS × MS parents produced about 40% and 46% of progenies in the T/SS and MS classes, respectively. Conversely, S × HS crosses produced a very high proportion (75%) of progenies in the S/HS. The degree of susceptibility to herbicide increases with the degree of susceptibility of the parental combination. A clear-cut segregation towards either T/SS or S/HS groups was not evident that could indicate the action of a major gene. Partitioning of variance indicated a high component of additive genetic variance, high narrow-sense heritability, and the possibility of breeding for the character through a judicious choice of parent varieties.

Introduction

Chemical weed control is a commonly used practice in sustainable sugarcane production. Herbicides are tested individually, in mixed formulation or in tank-mixes to evaluate their efficacy in weed control, the cost of application and the level of phytotoxicity to the crop. More than 100 weed species consisting of broad-leafed weeds, grasses and sedges are common in sugarcane fields in Mauritius; some sixty of the most commonly found ones have been described by Mc Intrye (1991). Tank mixing of two or more herbicides to achieve a broader spectrum of control is a common practice in sugarcane production (Seeruttun, 2007).

Diuron has been widely used as a pre-emergence treatment in sugarcane; it is also tank-mixed with Actril DS® (ioxynil + 2,4-D ester) in post-emergence of weeds. Diuron, a photosynthetic II inhibitor, is a substituted urea herbicide used to control a wide variety of annual and perennial broad-leaved weeds and grasses. Actril DS® is a selective herbicide, a member of the Nitrile and Phenoxy group with ethyl hexyl ester (2,4-D) and ioxynil as active ingredients for the control of broadleaved weeds and vines in sugarcane

Commercial sugarcane varieties have frequently been tested for their tolerance to post-emergence herbicides in Mauritius (MSIRI 1980, 1990, 1994, 1995) but information on the genetic transmission of herbicide tolerance in sugarcane has not been widely reported. Concurrently, herbicide resistance transformation technology has been widely successful in conferring herbicide tolerance in sugarcane (Autrey *et al*. 2001/2002; Leibbrandt and Snyman 2001; Enriquez *et al*., 2001; Butterfield and Ulian, 2006; Snyman *et al*., 2001,). However, herbicide-resistant (HR) transgenic crops can present several risks through escape and proliferation of the transgenic plants as weedy volunteers, hybridisation with and transgene infiltration into related or wild specie,s and changes in population dynamics of unrelated species and the development of herbicide-resistant biotypes (Warwick *et al*., 1999; Yong Woong and Do-Soon, 2001; Warwick and Francis, 2005). Breeding for herbicide tolerance constitutes a safe avenue to guard against risks associated with transgenic technology.

Several varieties, released in Mauritius, and having one or both parents in common have been observed to show similar tolerance level to the tank-mix of diuron and Actril-DS®. This study was initiated to evaluate parent varieties, frequently used in the breeding program of the Institute with a view to study the variation for herbicide tolerance and also to obtain information on the transmission of tolerance to herbicide in crosses. It aims to assess the possibility of breeding for herbicide tolerance.

Materials and methods

A total of 60 parent varieties produced locally and imported from diverse sources that are frequently used in the MSIRI breeding program were chosen to evaluate their degree of tolerance/sensitivity to the herbicide tank-mix diuron + Actril DS® at 2.5 + 1.3 kg a.i./a.e./ha using the precision sprayer Micron AutoDos. Five (replicates) of one-eyed cuttings of each variety were planted in plastic pots of size 15 × 15 cm on 20 September 2005 at Réduit Experimental Station (rainfall 1400 mm, elevation 300 m). The five replicates of each variety were grouped together in a single row on concrete flooring in the nurseries and allowed to grow in open sunlight. About 12 weeks after potting, the herbicide tank-mix was sprayed on each plant developed from the pots on 15 December 2005. Sensitivity to the tank-mix of herbicide was visually evaluated on the individual plants two weeks after spraying (WAS) based on a five-point scale as follows: 5-tolerant (T) - no sign of leaf damage, 4-slightly susceptible (SS) – slight chlorosis, 3-moderately susceptible (MS) – moderate chlorosis, 2- susceptible (S) – severe scorching and chlorosis and 1-highly susceptible (HS) – very severe scorching and cane growth stunted.

In April 2006, the pots were transplanted at Union Park Experimental Station (rainfall 3100 mm, elevation 375 m) in 1-m rows with two pots per row spaced at 0.50 m within rows and 1.5 m between rows with two replicates in a completely randomised block design. The plants were allowed to develop freely and they were stubble-shaved seventeen months after transplanting in September 2007. The ratoon plants were sprayed with the same herbicide tank-mix at the same dosage four weeks later in October and the degree of sensitivity to the herbicide was assessed visually four weeks later in November.

A number of crosses were attempted between May and July 2007 between parents varying in herbicide sensitivity based on the evaluation made in pots earlier in 2005 and also on knowledge acquired on the reactivity of the commercial varieties that were included in the trial. Fifteen families, from the 2007 crossing season and past years that have produced enough seedlings were chosen to study the transmission of herbicide tolerance. The trial was laid down with 40 seedlings of each family grown in plastic pots (15 cm × 15 cm) in a randomised complete block design with two replicates of 20 seedlings per family. The same herbicide tank-mix was applied on each seedling at the age of 12 weeks after potting using the precision sprayer Micron AutoDos. Visual assessment of the tolerance level of each seedling progeny was done four WAS as per the rating described above.

Statistical analyses

Means and standard errors (SE) were calculated for each parent variety evaluated in pots and in the field as well as for each family evaluated in pots. Phenotypic correlation coefficient for sensitivity levels of parent varieties recorded in pots and in field was calculated. Frequency distributions for progeny within sensitivity classes were derived for each family. Partitioning of variances was performed between and within families and the estimates of the variance components were derived as per the methodology of Kearsey and Pooni (1996) for bi-parental families.

From expectation of mean squares: $\sigma^2_W = {}^1/_2\, V_A + V_E$ and $\sigma^2_B = {}^1/_2\, V_A$, assuming negligible dominance effects; where σ^2_W = expected average variance within full-sib families and σ^2_B = expected variance of true family means, V_A = additive genetic variance and V_E = environmental variance. Narrow-sense heritability was calculated as $h^2_n = V_A/(V_A+V_E)$.

The number of progeny per family, r, was corrected for unequal number of seedlings as a result of differential mortality (Sokal and Rolf, 1981). The standard error of the estimate of narrow-sense heritability was derived from twice the square root of the variance of the intra-class correlation based on the methodology of Fisher (1954) for the estimation of standard error of repeatability.

Results and discussions

Sensitivity levels of parent varieties

The mean sensitivity levels of parent varieties and their assignment to tolerance classes observed in pots and in the field are presented in Table 1. The parent clones differed significantly in their tolerance to the herbicide tank-mix. The frequency distribution of varieties within tolerance classes measured in pots was as follows: tolerant (T) - 10%; slightly susceptible (SS) - 34%; moderately susceptible (MS) - 25%; susceptible (S) - 25%; highly susceptible (HS) - 7%. This distribution indicates a wide variation in the tolerance/sensitivity levels of the parental pool with as high as 32% of the parents with low tolerance level if S and HS classes are grouped together.

There was a fairly good correlation in the reaction of the clones when measured in pots and their relative rating measured in field (r=0.60**, p=0.01) although, for many of the clones, the rating was not strictly the same.

If tolerant and slightly susceptibility clones were grouped together in the tolerant class based on the reaction observed in pots, 18 out of 27 clones (67%) would have been classified in the tolerant class in the field and the rest assigned to the MS class.

From a total of 15 clones classified as MS in pots, an equal percentage of clones 67% (10) would have had the same rating in field. The highest discrepancy between the sensitivity of the clones measured in pots and in the field was observed for the S and HS classes. When these two classes are grouped together as a susceptible group measured in pots, only 33% of clones would have an equivalent rating at field level, 44% would be rated MS and 22% rated as SS such that the MS group is inflated.

It appears that the clones in the field, which were in a ratoon crop with an already well developed rooting system showed a lower sensitivity to herbicide toxicity. None of the clones rated as T/SS in pots would have acquired S/HS rating in the field and few (3) clones with S rating in pots had an SS rating in field. The measurement of herbicide tolerance levels in pots by the precision sprayer can constitute a quick and economic means for assessing the relative sensitivity of varieties to herbicides.

Sensitivity levels of progeny

Most of the crosses used in the progeny evaluation were between parents with determined herbicide tolerance, released for commercial cultivation in Mauritius. The assignment of the sensitivity level for these clones was predominantly based from current experience of their reactivity in commercial fields as well as reactivity shown in the present evaluation.

Table 1—Mean sensitivity levels (and standard error) of parent varieties to the tank-mix of herbicides observed in pots and in the field and their assignment to tolerance/sensitivity classes.

Variety	Mean (pots)	se	Tolerance class*	Mean (field)	se	Tolerance class*
M 1176/77	4.8	0.2	T	5	0	T
R 575	4.8	0.2	T	3.5	0.5	SS
M 1949/71	4.6	0.24	T	3.5	0.5	MS
M 3035/66	4.6	0.24	T	4.5	0.5	T
M 937/77	4.6	0.24	T	3	0	SS
N 8	4.6	0.24	T	4	0	SS
M 1400/86	4.4	0.24	SS	5	0	T
R 573	4.3	0.33	SS	3	0	MS
SP 703370	4.3	0.48	SS	3.5	0.5	MS
M 2256/88	4.2	0.2	SS	3	0	MS
M 1879/87	4.0	0	SS	4	0	SS
M 387/85	4.0	0	SS	4	0	SS
M 52/78	4.0	0	SS	5	0	T
M 907/61	4.0	0	SS	4	0	SS
R 541	4.0	0	SS	5	0	T
RP 35370	4.0	0	SS	5	0	T
M 1236/71	3.8	0.2	SS	3.5	0.5	MS
M 587/70	3.8	0.2	SS	3.5	0.5	SS
M 703/89	3.8	0.0	SS	4.5	0.5	SS
M 744/70	3.8	0.2	SS	4	0	SS
M 2626/88	3.7	0.33	SS	4	0	SS
NCo 310	3.7	0.33	SS	2	0	MS
CP 62258	3.6	0.24	SS	3	0	MS
M 2077/78	3.6	0.24	SS	3	1	MS
N 55805	3.6	0.24	SS	4	0	SS
NCo 376	3.6	0.24	SS	3	0	MS
M 376/64	3.4	0.24	SS	4	0	SS
UCW 5465	3.3	0.33	MS	3		MS
PT 4352	3.3	0.25	MS	3.5	0.5	MS
Co 775	3.2	0.2	MS	3	0	MS
M 2229/80	3.2	0.37	MS	4	0	SS
M 2343/77	3.2	0.2	MS	3	0	MS
F 149	3.0	0	MS	4	0	SS
M 220/80	3.0	0	MS	3.5	0.5	MS
M 695/69	3.0	0	MS	2	0	S
M 881/80	3.0	0	MS	3	0	MS
RB 739067	3.0	0	MS	3.5	0.5	MS
M 1722/71	2.8	0.2	MS	2	0	S
M 527/68	2.8	0.2	MS	3	0	MS
W 681049	2.8	0.2	MS	2	0	S
RP 8068	2.8	0.25	MS	3	0	MS
M 1394/86	2.6	0.24	MS	3	0	MS
H 328560	2.2	0.2	S	3		MS
M 1186/86	2.2	0.2	S	4	0	SS
S 17	2.2	0.2	S	3	0	MS
CP 5530	2.0	0.2	S	3.5	0.5	SS
M 1861/89	2.0	0	S	4	0	SS
M 3/82	2.0	0.32	S	3.5	0.5	MS
PR 1048	2.0	0	S	3.5	0.5	MS
Q 96	2.0	0	S	2	0	S
CP 44101	1.8	0	S	3.5	0.5	MS
M 202/46	1.8	0.37	S	4	0	SS
RB 739953	1.8	0.2	S	3.5	0.5	MS
CP 701133	1.7	0.2	S	2.5	0.5	S
M 1682/70	1.7	0.33	S	3.5	0.5	MS
NA 6390	1.6	0.33	S	2	0	S
R 570	2.0	0.24	S	2	0	HS
M 555/60	1.6	0	HS	2	0	HS
TRITON	1.4	0.24	HS	3	1	S
F 77790	1.3	0.24	HS			
M 1246/84	1.3	0.33	HS	3	0	MS

*T-tolerant, SS-slightly susceptible, MS-moderately susceptible, S-susceptible, HS-highly susceptible

Progeny means for tolerance level, standard error (SE) and mid-parent values for the different categories of crosses measured in pots pooled over replicates are shown in Table 2. In general, irrespective of the tolerance level of the male parent, families with a tolerant or a slightly susceptible female parent had higher mean values for tolerance except cross 265/07 which showed high susceptibility to herbicide. Conversely, families with a MS or S female parent had slightly lower tolerance level (value) except for one cross, 1197/03, which displayed moderate tolerance level.

Table 2—Family mean, standard error and mid-parent value for tolerance level to herbicide mix measured in pots.

Family reference	Female parent	Male parent	Tolerance category*	No observed	Mid-parent**	Mean progeny	se
1577/06	M 1400/86	M 2343/77	T × MS	39	3.8	3.1	0.11
1217/03	M 1176/77	M 1246/84	T × MS	40	3.05	3.6	0.09
1287/03	M 1176/77	R 570	T × HS	40	3.4	3.2	0.13
1304/03	M 1400/86	R 570	T × HS	39	3.2	2.5	0.16
1225/03	R 575	M 1246/84	SS × MS	39	3.05	2.8	0.11
1574/06	M 744/70	M 2343/77	SS × MS	36	3.5	3.8	0.11
258/07	M 703/89	F 77790	SS × HS	34	2.55	3.6	0.13
265/07	R 575	F 77790	SS × HS	39	3.05	1.4	0.08
1197/03	S 17	M 1246/84	MS × MS	39	1.75	3.4	0.11
1293/03	S 17	R 570	MS × HS	38	2.1	2.4	0.12
275/07	S 17	F 77790	MS × HS	40	1.75	2.9	0.24
1228/03	M 695/69	M 1246/84	S × MS	40	2.15	2.2	0.12
1531/06	M 695/69	CP 62258	S × MS	39	3.3	2.7	0.11
1525/06	M 695/69	F 77790	S × HS	40	2.15	1.7	0.11
1314/03	M 695/69	R 570	S × HS	40	2.5	2.4	0.11

*T-tolerant, SS-slightly susceptible, MS-moderately susceptible, S-susceptible, HS-highly susceptible
** Value calculated from observations in pots of parent varieties from Table 1.

However, the frequency distributions of progeny within tolerance classes for the families pooled over replicates reveals better appreciation of the tolerance levels of the progenies within families (Table 3).

Table 3—Frequency distribution (%) of progenies within tolerance classes for families evaluated for a mix of herbicide in pots.

Family reference	Female parent	Male parent	Tolerance category*	Tolerant (T)	Slightly susceptible (SS)	Moderately susceptible (MS)	Susceptible (S)	Highly susceptible (HS)
1577/06	M 1400/86	M 2343/77	T × MS	0	30.8	48.7	20.5	0
1217/03	M 1176/77	M 1246/84	T × MS	2.5	55.0	40.0	2.5	0
1287/03	M 1176/77	R 570	T × HS	0	47.5	27.5	25.0	0
1304/03	M 1400/86	R 570	T × HS	0	20.5	23.1	38.5	17.9
1225/03	R 575	M 1246/84	SS × MS	0	10.3	59.0	28.2	2.6
1574/06	M 744/70	M 2343/77	SS × MS	11.1	52.8	36.1	0	0
258/07	M 703/89	F 77790	SS × HS	8.8	44.1	41.2	5.9	0
265/07	R 575	F 77790	SS × HS	0	0	0	43.6	56.4
1197/03	S 17	M 1246/84	MS × MS	0	48.7	41.0	10.3	0
1293/03	S 17	R 570	MS × HS	0	2.6	44.7	39.5	13.2
275/07	S 17	F 77790	MS × HS	22.5	12.5	22.5	12.5	30.0
1228/03	M 695/69	M 1246/84	S × MS	0	2.5	32.5	45.0	20.0
1531/06	M 695/69	CP 62258	S × MS	2.6	5.1	56.4	35.9	0
1525/06	M 695/69	F 77790	S × HS	0	0	12.5	40.0	47.5
1314/03	M 695/69	R 570	S × HS	0	5.0	32.5	55.0	7.5

*T-tolerant, SS-slightly susceptible, MS-moderately susceptible, S-susceptible, HS-highly susceptible

Generally, crosses involving a tolerant or a slightly susceptible parent yielded a higher frequency of progenies in the T and SS classes. This was particularly prominent in the crosses 1217/03, 1287/03, 1574/06, and 258/07. Only the cross 265/07 with R 575 as the female parent produced progenies that were all susceptible or highly susceptible. Cross 1225/03, which also had R 575 as the female parent, gave progenies which were predominantly grouped in the MS and S classes. It appears that the female parent can exert a more pronounced influence on the tolerance level of its progeny suggesting the involvement of cytoplasmic inheritance. Cross 275/07 gave a wide distribution of progenies in all classes with a relatively high percentage in the tolerant class. The absolute distribution of progenies grouped in three sensitivity classes, T/SS, MS and S/HS, and the percentage of progenies that fits in each of the three classes for crosses grouped in different categories is shown in Table 4.

Table 4—Absolute number of progenies grouped within three classes, T/SS, MS and S/HS, for their reaction to herbicide mix and percentage of progenies within these classes for different categories of crosses grouped together.

Cross	Female	Male	Category*	T/SS	MS	S/HS
1577/06	M 1400/86	M 2343/77	T × MS	12	19	8
1217/03	M 1176/77	M 1246/84	T × MS	23	16	1
1225/03	R 575	M 1246/84	SS × MS	4	23	12
1574/06	M 744/70	M 2343/77	SS × MS	23	13	0
			Total (%)	40.3	46.1	13.6
1287/03	M 1176/77	R 570	T × HS	19	11	10
1304/03	M 1400/86	R 570	T × HS	8	9	22
258/07	M 703/89	F 77790	SS × HS	18	14	2
265/07	R 575	F 77790	SS × HS	0	0	39
			Total (%)	29.6	22.4	48.0
1197/03	S 17	M 1246/84	MS × MS	19	16	4
1228/03	M 695/69	M 1246/84	S × MS	1	13	26
1531/06	M 695/69	CP 62258	S × MS	3	22	14
1293/03	S 17	R 570	MS × HS	1	17	20
275/07	S 17	F 77790	MS × HS	14	9	17
			Total (%)	19.4	39.3	41.3
1525/06	M 695/69	F 77790	S × HS	0	5	35
1314/03	M 695/69	R 570	S × HS	2	13	25
			Total (%)	2.5	22.5	75.0

*T-tolerant, SS-slightly susceptible, MS-moderately susceptible, S-susceptible, HS-highly susceptible

Crosses between T/SS × MS parents produced about 40% and 46% of progenies in the T/SS and MS classes respectively. Those between T/SS × HS produced about 30% and 22% of progenies in the T/SS and MS classes respectively. Crosses between MS × MS, S and HS parents gave about 19% and 39% of progenies grouped in T/SS and MS classes respectively and nearly 41% in the S/HS class. S × HS crosses produced a very high proportion (75%) of progenies in the S/HS classes. It is clear that the degree of susceptibility to herbicide increases with the degree of susceptibility of the parental combination. Nearly all crosses had an appreciable percentage of progeny in the moderately susceptible class. A clear-cut segregation towards either T/SS or S/HS groups was not evident that could indicate the action of some major genes. It is possible that the two herbicides in the mix might have different genetic control that masked the action of any major gene effect. Transgenic segregation for herbicide resistance (bar) has been demonstrated in sugarcane (Butterfield *et al*., 2002) and a cultivar transformed with the *pat* gene, conferring resistance to the herbicide Buster (glufosinate ammonium) was stably expressed during three rounds of vegetative propagation (Leibbrandt and Snyman, 2003).

In addition to the genetic control underlining resistance to herbicide, morphological attributes such as epicuticular wax of leaf surface may influence tolerance level in varieties.

Bi-parental progeny analysis revealed highly significant differences between families for tolerance level to the herbicide mix. Partitioning of variances showed a high proportion of additive genetic variance and high narrow-sense heritability and low standard error estimates. (Table 5).

Table 5—Variance ratios, components of variances and heritability estimates derived from bi-parental progeny analysis of 15 families for their tolerance to herbicide mix.

Source of variation		df	MS	v.r.	F Prob
Between FS family MS		14	19.176	31.94	<0.001
Residual MS		566	0.6003		
σ^2_B	0.4787				
σ^2_W	0.6003				
V_A	0.9575				
V_E	0.1213				
V_P	1.0788				
Heritability	0.89				
se h^2_n	0.19				

However, the heritability value is somewhat inflated from the fact that a number of parents were repeated in a number of crosses. A wider range of unrelated crosses was not available on account of lower fertility levels of some crosses, insufficient pollen-shedding varieties and asynchronous flowering. Nevertheless, the study does indicate that the tolerance/sensitivity level of the progenies to the herbicide mix can be predicted reasonably well on the basis of the reaction levels of their parents and breeding for herbicide tolerance is possible.

Conclusion

This study indicated a wide variation in herbicide tolerance within the parent pool considered with about one-third of the parents rated as susceptible to the herbicide tank-mix diuron + Actril-DS® when evaluation was carried out in pots. There was a moderately high correlation between the tolerance level of varieties measured in pots and in the field, although the phytotoxicity appeared to be less severe at field level. The measurement of herbicide tolerance levels in pots by the precision sprayer can constitute a quick and economic means for assessing the relative sensitivity of varieties to herbicides. Generally, crosses between T/SS × MS parents produced about 40% and 46% of progenies in the T/SS and MS classes respectively. Conversely, progeny derived from susceptible × highly susceptible (S × HS) parents produced nearly 75% of progenies in the susceptible and the highly susceptible classes grouped together. No clear-cut evidence of a major gene to herbicide mix was evident and the transmission of tolerance level to the mixture of herbicide approached an additive model indicating that tolerance/sensitivity level of the progenies to the herbicide tank-mix can be predicted reasonably well on the basis of the reaction levels of their parents.

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TOLÉRANCE DES GÉNITEURS DE LA CANNE À SUCRE AUX HERBICIDES ET SA TRANSMISSION À LA DESCENDANCE

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MOTS CLÉS: Actril DS®, Diuron, Hérédité, Post-Émergence, Tolérance aux Herbicides.

Résumé

LES VARIÉTÉS de canne à sucre ayant un parent en commun ont souvent montré un niveau plus ou moins similaire de tolérance au mélange Diuron et Actril-DS®. Une étude a été entreprise dans le but d'évaluer la tolérance des géniteurs de la canne à sucre, utilisés fréquemment dans le programme d'hybridation du MSIRI, aux herbicides. Un total de soixante géniteurs établis en pots et ensuite transplantés au champ ont été évalués pour leur tolérance à un mélange d'herbicides. Des croisements ont été réalisés avec des parents éprouvés pour leur réaction aux herbicides et 15 familles, comprenant chacune 40 plantules, ont été par la suite évaluées pour leur réaction au mélange d'herbicides. Les parents ont démontré des différences significatives pour leur niveau de tolérance et ils ont été classifiés selon les niveaux suivants: tolérant (T) 10%; légèrement sensible (SS) 34%; modérément sensible (MS) 25%; sensible (S) 25%; hautement sensible (HS) 7%. La corrélation modérément élevée obtenue entre le niveau de tolérance des parents mesurés en pots et au champ démontre qu'une évaluation de la réponse aux herbicides des génotypes en pots peut fournir des indications assez fiables sur leur niveau de tolérance au champ. Les familles ont également démontré des différences significatives pour leur niveau de tolérance. Généralement, les croisements entre les parents T/SS x MS ont produit environ 40% et 46% de leurs descendants dans les classes T/SS et MS respectivement. A l'opposé, les croisements entre parents S x HS ont produit un pourcentage très élevé (75%) de leurs descendants dans les classes S/HS. Le niveau de sensibilité augmente avec le niveau de sensibilité des combinaisons parentales. Une distinction claire des descendants soit en classe T/SS ou S/HS n'était pas évidente ce qui pouvait présager la contribution d'un gène majeur. La décomposition de la variance génétique démontre une contribution importante de la variance additive et une héritabilité au sens strict relativement élevée et indique que la production de nouvelles générations de génotypes tolérantes aux herbicides est possible.

TOLERANCIA DE PARENTALES A HERBICIDAS Y SU TRANSMISIÓN A LAS PROGENIES EN CAÑA DE AZÚCAR

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PALABRAS CLAVE: Aplicaciones de Herbicidas, Herencia de Tolerancia a Herbicidas, Pos-Emergencia de Caña de Azúcar.

Resumen

LAS VARIEDADES de caña de azúcar con uno o ambos parentales en común han mostrado un nivel de tolerancia similar a mezclas en un tanque de Diurón y Actril-DS®. Este estudio se inició para evaluar a las Variedades frecuentemente usadas en el programa de mejoramiento del Instituto, sobre la transmisión de su tolerancia al herbicida en los diferentes cruzamientos. Sesenta parentales fueron plantados en macetas y luego trasplantados a ensayos replicados en el campo para evaluar su tolerancia a la mezcla de herbicida. Se realizaron cruzamientos con algunos parentales que presentan alguna Resistencia y 15 familias, con un total de 40 plántulas en cada cruza, las que fueron evaluadas también a la misma mezcla del tanque de herbicida. Los parentales fueron significativamente diferentes a la mezcla del herbicida, clasificándose como: tolerante (T) 10%; poco susceptible (SS) 34%; moderadamente susceptible (MS) 25%; susceptible (S) 25%; altamente susceptible (HS) 7%. La correlación fenotípica del grado de tolerancias a la mezcla herbicida evaluada en macetas y en el campo fue moderadamente alta, indicando que las pruebas en macetas podrían proveer información útil sobre la expresión a la tolerancia en el campo. Las familias también difirieron significativamente en el campo. Generalmente cruzas entre parentales T/SS x MS produjeron alrededor de 40% y 46% de progenies T/SS y MS respectivamente. Contrariamente, los cruzamientos S x HS produjeron una alta proporción (75%) de progenies en el S/HS. El grado de susceptibilidad al herbicida se incrementa con el grado de susceptibilidad de la combinación parental. No se evidenció una clara segregación hacia grupos T/SS o S/HS que indicaría la acción de un gen mayor. Al dividir las variancias se observó un claro efecto aditivo y una alta heredabiliad en sentido estrecho y la posibilidad de realizar mejoramiento para este carácter a través de escoger las variedades para parentales.