EVALUATION OF BROWN RUST RESISTANCE
(*Puccinia melanocephala*) IN SUGARCANE PROGENIES

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KEYWORDS: Sugarcane, Disease Resistance, Brown Rust.

Abstract

THE PRESENT work is aimed at evaluating rust (*Puccinia melanocephala* H. & P. Syd) resistance in sugarcane progeny as well as identifying parents able to produce progeny with a high percentage of resistant individuals that can be used as a source of resistance in a breeding program. Ten families derived from biparental crosses were evaluated for rust resistance in a randomised block design with four replicates with 50 seedlings per replication. Rust resistance was evaluated by visually rating on a scale of 1–9 based on infection on all leaves. The lowest means and variances were observed for families 9 (1.82 and 3.05) and 10 (1.06 and 0.5) in which the variety IACSP94-2094 was used as a parent. Individuals in families 8, 9 and 10 showed a 3:1 resistant:susceptible ratio, suggesting the presence of one major gene with a dominant effect. The results identify the varieties IACSP94-2094, IACSP91-2195 and SP83-2847 as sources of rust resistance.

Introduction

Sugarcane brown rust caused by the fungus *Puccinia melanocephala* H. & P. Syd is considered one of the main diseases of sugarcane with important economic losses in susceptible varieties (Matsuoka *et al.*, 1999).

Rust resistance has been considered a quantitatively inherited trait, with moderate to high heritability. In the past, sugarcane rust evaluation has been based on a subjective rating scale for disease severity (Hogarth,1987, Asnaghi *et al.*, 2001).

Although sugarcane resistance is considered quantitatively inherited, a 3:1 segregation ratio indicative of a major gene with dominance effect was observed in progeny derived from the self of the variety R570 (Daugrois *et al.*, 1996).

Since the use of sugarcane varieties resistant to rust is the best method for controlling the disease, the present work aimed to evaluate brown rust resistance segregation in 10 sugarcane families and also to identify parents that are able to generate a high proportion of individuals resistant to brown rust for use in a breeding program.

Material and methods

Brown rust resistance was evaluated in 10 families derived from bi-parental crosses between parents with different rust ratings (Table 1).

The experiment was planted in October 2007 at the Sugarcane Center from the Instituto Agronômico Campinas, Ribeirão Preto, SP, Brazil. Each family was composed of 200 individuals derived from hybridisations made in 2007. The experimental design was randomised complete

block with four replicates containing 50 individuals per family. Plots were composed of 5 rows, six metres long, with 1.5 m spacing between rows and 0.6 m between plants. Each replication was planted in a homogeneous area of the field.

Plants were rated in the field for rust, using a scale which ranged from 1 (resistant) to 9 (susceptible) (Amorim _et al._, 1987).

Scores between one and three were considered resistant, four to six intermediate, and seven to nine susceptible. The SAS[R] (1999) package was used in the analysis of variance, and means and family variance estimations.

The Tukey test was applied to verify statistically significant differences among the family means. To test the hypothesis of a 3:1 segregation ratio (resistant/susceptible), the individuals of each family were separated in two classes: resistant (score = 1.0) and susceptible (score $\geq$ 2) applying the Chi-square test with 1 degree of freedom.

Results and discussion

The lowest means and variances were observed for the families 9 (1.82 and 3.05) and 10 (1.06 and 0.5) in which the variety IACSP94-2094 was used as parent (Table 1).

The low mean and variance values of these two families indicate that most of the individuals are resistant with little phenotypic variability for rust resistance, particularly for individuals from Family 10.

These two families had means that differed significantly from those of families 1, 2, 3 and 4 (Table 1).

TABLE 1—Mean and variance of each family for rust resistance.

Family	Mean	Variance (s^2)
1 - IACSP95-3028 X IACSP95-2078	3.83 ABCDEF	8.79
2 - IACSP95-3028 X SP79-1011	4.34 ABC	8.73
3 - IACSP95-2078 X IACSP96-2019	4.35 AB	8.65
4 - IACSP95-2078 X SP83-2847	2.80 BCDEFGHI	7.56
5 - SP89-1115 X IACSP97-6682	3.96 ABCD	7.37
6 - IACSP96-2042 X SP80-185	1.97 EFGHI	4.53
7 - SP83-2847 X IACSP95-5011	1.98 EFGHI	3.98
8 - IAC91-2195 X SP80-3280	2.17 DEFGHI	3.38
9 - IACSP95-2078 X IACSP94-2094	1.82 FGHI	3.05
10 - IACSP94-2094 X SP83-2847	1.06 I	0.5
Mean	2.28	5.65

Means with the same letters did not differ significantly at the 5% level (Tukey).

Of the 10 families evaluated, families seven, eight, and nine did not deviate significantly from the 3:1 ratio (α=0.05), suggesting the presence of a major gene for resistance in one of the parents (Daugrois _et al._,1996).

Family ten did not segregate for susceptibility (1:0 ratio), i.e. all the individuals were resistant (Table 2). This suggests that there is probably a major dominant gene for rust resistance in both parents. According to Hogarth _et al._ (1993), families derived from crosses between resistant parents are likely to yield resistant progeny.

The deviation in relation to the 2:1 ratio was not significant at (p<0.05) for families 5 and 6. The rest of the families deviated from the expected 3:1 ratio when a single major gene is involved. Families number 1 and 2 showed one resistant individual to each two susceptible ones (1:2) which matches the expected rato for the presence of minor genes without dominance. Family number 3 had a high severity of rust, with a ratio of one resistant for every three susceptible (Table 2).

TABLE 2—Chi-square test for rust resistance for segregation hypotheses 3:1 (X^2, 3:1) and other segregation ratios (X^2, suggested by data).

Nº. Family	Cross	Parent score	Observed (R:S)	X^2 (3:1)	Suggested H0 (R:S)	X^2 Suggested
1	IACSP95-3028 × IACSP95-2078	2 4	60:115	154.71	1:2	0.07
2	IACSP95-3028 × SP79-1011	2 8	72:109	119.75	1:2	3.37
3	IACSP95-2078 × IACSP96-2019	4 4	57:136	212.78	1:3	2.11
4	IACSP95-2078 SP83-2847 ×	4 1	89:106	89.64	1:1	1.4
5	SP89-1115 × IACSP97-6682	4 7	128:58	3.79	2:1	0.38
6	IACSP96-2042 × SP80-185	6 1	99:67	20.89	2:1	3.69
7	SP83-2847 × IACSP95-5011	1 3	139:39	0.67	3:1	0.67
8	IAC91-2195 × SP80-3280	1 2	153:39	2.25	3:1	2.25
9	IACSP95-2078 × IACSP94-2094	4 1	142:45	0.09	3:1	0.09
10	IACSP94-2094 × SP83-2847	1 1	184:4	49.38	1:0	0.00

p-value < 0.05, $X^2 >= 3.84$.

Ramdoyal *et al.* (2000) conducted a study using parents with differential resistance to rust and reported that families derived from crosses between two resistant parents generated mostly resistant progeny while crosses between susceptible and highly susceptible parents produced families with a majority of susceptible individuals.

These results agree with the field observations from this study in which the variety IACSP95-2078 generated progeny with severe disease symptoms with the exception of the cross using this parent with IACSP94-2094.

The results from the current study suggest varieties IAC91-2195, SP83-2847 and, especially IACSP94-2094, are good sources of rust resistance.

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EVALUATION DES PROGÉNITURES DE LA CANNE À SUCRE À LA ROUILLE BRUNE (*PUCCINIA MELANOCEPHALA*)

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**MOTS CLÉS: Canne à Sucre,
Résistance aux Maladies, Rouille Brune.**

Résumé

LA PRÉSENTE étude vise à évaluer la résistance à la rouille brune (*Puccinia melanocephala* H. & P. Syd) dans les progénitures de la canne à sucre, aussi bien que d'identifier les parents capables d'engendrer des progénitures avec un pourcentage élevé des individus résistants. Ceux-ci peuvent ensuite être utilisés dans un programme d'amélioration variétale. Dix familles, dérivées d'un croisement bi-parentale étaient évaluées pour leur résistance à la rouille en bloc randomisé comprenant quatre répétitions avec 50 plantules par répétition. La résistance a été évaluée visuellement sur une échelle de 1-9 basé sur l'infection de toutes les feuilles. Les moyennes et les variances les plus bas ont été observées pour les familles 9 (1.82 et 3.05) et 10 (1.06 et 0.5) au sein de lesquels figurait la variété IACSP94-2094 utilisée comme parent. Les individus dans les familles 8, 9 et 10 étaient repartis dans un ratio 3:1 de résistants par rapport aux sensibles, suggérant la présence d'un gène majeur avec effet dominant. Les résultats ont permis l'identification des variétés IACSP94-2094, IACSP91-2195 et SP83-2847 comme source de résistance à la rouille.

EVALUACIÓN DE LA RESISTENCIA ALA ROYA ANARANJADA
(*Puccinia melanocephala*) EN PROGENIES DE CAÑA DE AZÚCAR

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Resumen

EL PRESENTE trabajo tiene como objetivo principal evaluar la resistencia a roya común (*Puccinia melanocephala* H. & P. Syd), en progenies de caña de azúcar, así como identificar parentales que muestren una producción de progenies con alto porcentaje de individuos resistentes para que puedan ser usados como fuente de resistencia para los programas de mejoramiento genético. Diez familias derivadas de un cruce biparental fueron evaluados para la resistencia a roya anaranjada en un ensayo de bloques al azar con 4 repeticiones de 50 plantas por replicación. La resistencia se evaluó usando una escala de 1 – 9, basado en la infección de las hojas. Las medias más bajas y las varianzas fueron observadas par las familias 9 (1.82 y 3.05) y 10 (1.06 y 0.5) en las cuales la variedad IACSP94-2094 fue usada como parental. Varios individuos en las familias 8, 9 y 10 presentaron una relación 3:1 de resistencia: susceptibilidad, sugiriendo la presencia de un gen mayor con efectos dominantes. Los resultados presentados, sugieren que las variedades IACSP94-2094, IACSP91-2195 and SP83-2847 pueden ser una fuente de resistencia a esta enfermedad.