

## SPITTLEBUGS INJURY ON SUGARCANE INCREASED SUGAR COLOUR

By

M.J.R. MUTTON, L.L. MADALENO, G.C. RAVANELI,  
D.B. GARCIA and M.A. MUTTON

*FCAV/Unesp, Universidade Estadual Paulista, Departamento de Tecnologia, Brazil*  
[mjrmut@fcav.unesp.br](mailto:mjrmut@fcav.unesp.br)

**KEYWORDS:** *Saccharum spp.*,  
*Mahanarva fimbriolata*, Clarification.

### Abstract

SPITTLEBUGS may cause a reduction in sugarcane quality, problems with juice clarification and lower the VHP sugar quality by increasing phenol compounds and colour. A randomised complete-block design experiment with three replicates was conducted. The first factor tested was spittlebug injury to cane stalks with a control (0%) and different levels of infested stalks (15, 30 and 60%). The second factor tested was the timing of harvest; May-June and October of the 2007/2008 season. The highest spittlebug injury levels resulted in decreased sugar quality and reductions in brix, pol and pH and increased fibre, colour and total acidity. For clarification, better results were achieved in the second harvest period and demonstrated in a significant reduction in total acidity of extracted juice and low levels of phenol compounds and sugar colour. Spittlebug injury increased sugar colour. During May-June, the 30% level of spittlebug injury resulted in increases in phenol compounds (41%) and sugar colour (39%).

### Introduction

The increase in green cane harvesting contributed to a significant increase in the population of *Mahanarva fimbriolata* (Stål) (Hemiptera: Cercopidae). Infestations caused by this pest affect cane quality (Gonçalves *et al.*, 2003). The aim of this study was to evaluate the effect of spittlebugs on the quality of the raw material, the purification process, phenol concentrations and the colour of sugar.

### Material and methods

The experiment was carried out at a commercial sugarcane area in Guariba, SP region, (Lat 21°21'S, Long 48°13'W) using a mechanically harvested 4<sup>th</sup> ratoon of variety SP80-1842 during the 2007/2008 season.

The study was arranged in a randomised complete-block design in a 4 x 2 factorial arrangement with three replicates. The first factor to test was the level of damage with healthy stalks (0%) and with 15, 30 and 60% infestation levels. The second factor to test was the two harvesting periods:

- May-June (when the crop age was 11 months, low temperature and dry soil conditions); and
- October (when the crop age was 14 months, with high rainfall and temperature conditions).

The composition of damaged stalks to simulate mechanical harvesting was in accord with Gonçalves *et al.* (2003).

The stalks were manually harvested, defoliated and topped at the apex bud and allocated to one of the four sample lots based on the infestation level. The juice was extracted by using a hydraulic press to press 500 g of disintegrated cane for one minute at 250 kg/cm<sup>2</sup> pressure to simulate the extraction of juice in roller mills (Tanimoto, 1964) for analysis and sugar production.

The cane and juice characteristics were determined with:

- Juice brix at 20°C and apparent sucrose by saccharimetric determination (Schneider, 1979);
- Juice pH measured using a digital pH meter 'Digimed DMPH-2' from Tecnal, Brazil;
- Juice acidity expressed in g H<sub>2</sub>SO<sub>4</sub>/L and juice colour (Copersucar, 2001);
- Fibre is calculated from the brix and purity of the juice extracted by the hydraulic press and the wet and dry weights of the bagasse plug and juice purity (%) (Consecana, 2008);
- Moisture by drying cane bagasse at 65°C for 48 h and then weighing; and
- Total phenol compounds as described by the Folin and Ciocalteu (1927) method.

The extracted juice was reduced to 18 brix prior to purification. In the clarification process, 300 mg/L of phosphoric acid was added to the juice and the pH was corrected to 7.0 with cold lime at 6 Bé. The treated juice was then heated to boiling point and 2 mg/L of a flocculant (Mafloc 985) was added and the juice transferred to a 1 L graduated cylinder for decantation of the flocculated mud in a lamp-heated system. The mud settling rate, mud volume and added lime were recorded and the turbidity (transmittance at 620 nm), brix (Schneider, 1979), colour (Copersucar, 2001) and pH of the clarified juice were determined.

Clarified juice with an average 16 brix, was concentrated to 60 brix effecting a rotating evaporator to produce syrup. This material was stored at -20°C until the next stage of crystallisation.

The massecuite was produced with adapted reactor with 5 L of capacity and control of temperature (61±2°C). The nucleation of crystals was made with seed process. Refined sugar (<0.5 mm) was added, to growth to 0.7–1.0 mm. After seeding, the process was conducted on metastable zone of supersaturation with feeding 60 brix syrup.

To optimise the crystal growth, the massecuite was put in a 2 L beaker with intermittent agitation by spatula at 1 min intervals. After massecuite temperature dropped from 60 to 55±2°C, the centrifugation was made to separate sugar and molasses with use of 1 kgf/cm<sup>2</sup> for 2 seconds of steam to clean sugar on start of process.

The crystals were previously drawn with forced ventilation (40°C) and agitation. After, for complete draw, the process continues in an oven (30°C), without air circulation, for 12 h. The production of VHP sugar was 300 g for each experimental parcel. On-product was made: a) ICUMSA colour (CTC, 2005); b) total phenol compounds: 26 g of sugar in 100 mL of distilled water and the method of Folin and Ciocalteu (1927) with adaptation, using 0.5 mL of extract. The data were expressed in mg of total phenol compounds per kg of sugar.

The data were submitted to ANOVA and means were compared by Tukey test (P=0.05). The significant quantities (% of damaged stalks) parameters were submitted to regression analysis (Banzatto and Kronka, 2006).

## Results and discussion

The analysis of variance indicated that elevated spittlebug damage caused a reduction in brix (F=3.5110; P<0.05), pol (F=9.2224; P<0.01) and pH (F=18.9835; P<0.01) in juice and increased the level of Tanimoto fibre (F=5.7908; P<0.01). The reduction in quality of sugarcane by insects was observed by various studies including, for example, Gonçalves *et al.* (2003), Ravaneli *et al.* (2006) and Madaleno *et al.* (2008).

For regression analysis, it was observed that there was a reduction in quality mainly during the second period (Figure 1). Damaged stalks (30%) reduced brix by 3% in May–June; 6% in the first and 4% in the second period for pol; 0.5% and 2.3% between periods for pH; and increased by 5.5% for Tanimoto fibre in October.

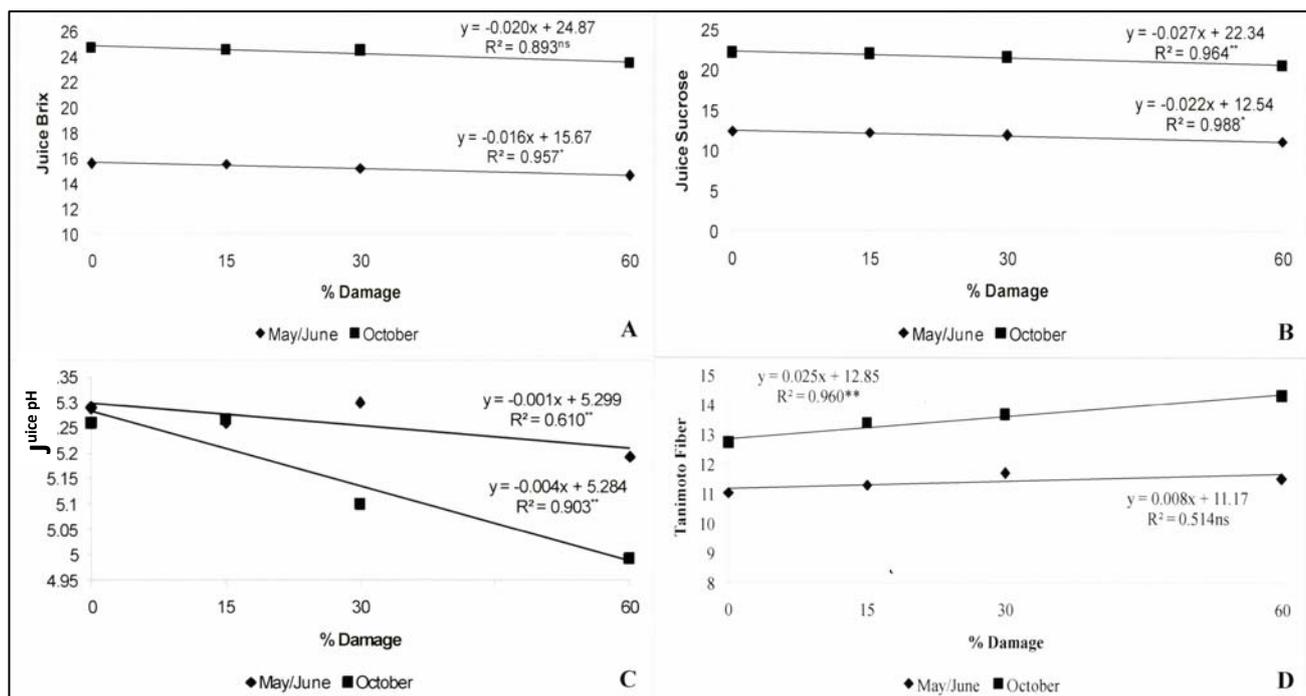


Fig. 1—Regression of damage (%) caused by spittlebugs on juice quality. **A.** Brix; **B.** apparent sucrose; **C.** pH and **D.** Tanimoto fibre.

For the clarification process, it was observed that the level of damaged stalks did not influence any of the analysis parameters. However, there were increases in sedimentation speed ( $P < 0.05$ ), lime volume used ( $P < 0.01$ ), pH of clarified juice ( $P < 0.01$ ) and turbidity ( $P < 0.01$ ) from May–June to October.

The spittlebug damaged stalks significantly reduced the sugar quality. There were increases in colour ( $P < 0.01$ ) and total phenol compounds. In the two harvest periods, more colour ( $P < 0.01$ ) and phenols ( $P < 0.01$ ) were found in May–June. This result might have been affected by the better purification process in October.

During the first harvest period, when the clarification process was not adequate, the sample of 30% damaged stalks resulted in a 41% increase in total phenol compounds and a 39% increase in sugar colour as shown in Figure 2.

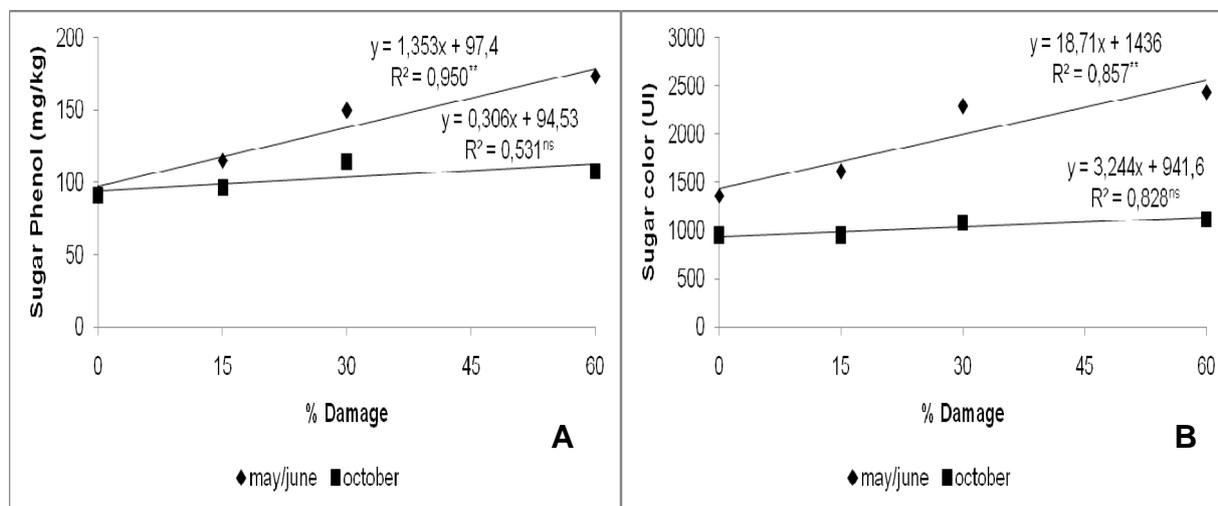


Fig. 2—Changes in the quality (phenol and colour) of the sugar as a function of the level of spittlebug damage. **A** = Total phenol compounds; **B** = Sugar colour.

Trade contracts (Amstar and Savannah Raw Sugar Contract), have been used since 1984, and include penalties for non-compliance with quality criteria that include sucrose content, moisture, ash, crystal size, dextran and colour (Chen and Chou, 1993).

### Acknowledgments

The authors are thankful to Fundação de Amparo a Pesquisa do Estado de São Paulo (process no. 06/03005-0), Syngenta Proteção de Cultivos Ltda and Louis Dreyfus Commodities, São Carlos Mills for financial support, and Cordenção de Aperfeiçoamento de Pessoal de nível Superior for the doctoral fellowships.

### REFERENCES

- Banzatto, D.A. and Kronka, S.N.** (2006). Experimentação Agrícola. 4. ed. Jaboticabal: FUNEP, 237 p.
- Chen, J.C.P. and Chou, C.C.** (1993). A Manual for Cane Sugar Manufactures and their Chemists. 12 ed. New York: John Wiley & Sons, Inc., 1089 p.
- Consecana** (2008). Normas de avaliação da qualidade da cana-de-açúcar. Disponível em: <<http://www.unica.com.br>>. Acesso em: 21 Set.
- Copersucar** (2001). Manual de controle químico da fabricação de açúcar. Piracicaba. (CD-Rom).
- CTC** (2005). Manual de métodos de análises para açúcar. Piracicaba, Centro de Tecnologia Canavieira, Laboratório de análises, disponível em. CD-ROM.
- Folin, O. and Ciocalteu, V** (1927). On tyrosine and tryptophane determinations in proteins. The journal of biological chemistry, Bethesda, 73(2): 627–50.
- Gonçalves, T.D., Mutton, M.A., Perecin, D., Campanhão, J.M. and Mutton, M.J.R.** (2003). Qualidade da matéria prima em função de diferentes níveis de danos promovidos pela cigarrinha-das-raízes. STAB Açúcar, Álcool e Subprodutos, Piracicaba, 22(2): 29–33.
- Madaleno, L.L., Ravaneli, G.C., Presotti, L.E., Mutton, M.A., Fenandes, O.A. and Mutton, M.J.R.** (2008). Influence of *Mahanarva fimbriolata* (Stål) (Hemiptera: Cercopidae) injury on the quality of cane juice. Neotropical Entomology, Londrina, 37(1): 68–73.
- Ravaneli, G.C., Madaleno, L.L., Presotti, L.E., Mutton, M.A. and Mutton, M.J.R.** (2006). Spittlebug infestation in sugarcane affects ethanolic fermentation. Scientia Agricola, Piracicaba, 63(6): 543–546.
- Schneider, F.** (1979). Sugar Analysis ICUMSA methods. Peterborough:ICUMSA. 265 p.
- Tanimoto, T.** (1964). The press method of cane analysis. Hawaiian Planters' Record, 57: 133–150.

## LES CANNES ATTAQUEES PAR LES «SPITTLEBUGS» DONNENT DES SUCRES DE COULEURS ELEVEES

Par

M.J.R. MUTTON, L.L. MADALENO, G.C. RAVANELI,  
D.B. GARCIA and M.A. MUTTON

*FCAV/Unesp, Universidade Estadual Paulista, Departamento de Tecnologia, Brazil*

[mjrmut@fcav.unesp.br](mailto:mjrmut@fcav.unesp.br)

**MOTS-CLEFS:** *Saccharum spp.*,  
*Mahanarva fimbriolata*, Clarification.

### Résumé

LE «Spittlebug» peut causer une réduction de la qualité des cannes, des problèmes de clarification, et peut réduire la qualité de sucre VHP en augmentant les phénols composés et les couleurs. Une expérience basée sur des principes statistiques, avec trois répliques a été effectuée. Le premier facteur testé a été le degré de l'attaque des «spittlebugs» sur la tige; on a choisit un contrôle (0%) et différents niveaux de tiges infestées (15, 30 et 60%). Le deuxième facteur testé était la date de la récolte; mai-juin et octobre de la saison 2007–2008. Les plus hauts niveaux de blessures par «spittlebugs» ont entraînés une diminution de la qualité du sucre, des réductions des brix, pol et pH et une augmentation de la fibre, de la couleur et de l'acidité totale. De meilleurs résultats ont été réalisés en clarification pendant la deuxième période de récolte; on a trouve une diminution significative en acidité totale des jus et de faibles niveaux de phénols composés et une couleur de sucre plus basse. La présence du «Spittlebug» augmente la couleur du sucre. En mai et juin, le niveau de 30% de blessure a cause une augmentation des composés de phénol (41%) et de la couleur de sucre (39%).

## INCREMENTO EN EL COLOR DEL AZÚCAR POR CAÑA DAÑADA POR SALIVAZO

Por

M.J.R. MUTTON, L.L. MADALENO, G.C. RAVANELI,  
D.B. GARCIA y M.A. MUTTON

*FCAV/Unesp, Universidade Estadual Paulista, Departamento de Tecnologia, Brazil*

[mjrmut@fcav.unesp.br](mailto:mjrmut@fcav.unesp.br)

**PALABRAS CLAVE:** *Saccharum spp.*,  
*Mahanarva fimbriolata*, clarificación.

### Resumen

EL SALIVAZO puede causar una reducción en la calidad de la caña, problemas en la clarificación de jugo y disminución de la calidad del azúcar de alta pureza por el incremento de compuestos fenólicos y el color. Se efectuó un diseño experimental de bloques completos al azar con tres repeticiones y el primer factor probado fue el daño a los tallos, con un control (0%) y diferentes niveles de infestación (15, 30 y 60%). El segundo factor fue el tiempo de cosecha, Mayo-Junio y Octubre de la zafra 2007–2008. Los mas altos niveles de daño resultaron en menor calidad del azúcar y reducciones en brix, pol, pH y en un incremento de fibra, color y acidez total. En clarificación, los mejores resultados se obtuvieron en el segundo periodo de cosecha, evidenciados en una reducción significativa en la acidez total del jugo extraído y menores niveles de compuestos fenólicos y color de azúcar. El daño por salivazo incrementó el color del azúcar. Durante Mayo-Junio, el nivel de daño del 30% resultó en incremento de compuestos fenólicos (41%) y de color del azúcar (39%).