Assessing the Variability of Red Stripe Disease in Louisiana Sugarcane Using Precision Agriculture Methods

R.M. Johnson and M.P. Grisham

USDA/ARS, Sugarcane Research Unit

Houma, LA 70360

A paper from the Proceedings of the
13th International Conference on Precision Agriculture
July 31 – August 4, 2016
St. Louis, Missouri, USA

Abstract. *Symptoms of red stripe disease caused by Acidovorax avenae subsp. avenae in Louisiana between 1985 and 2010 were limited to the leaf stripe form which caused no apparent yield loss. During 2010, the more severe top rot form was observed, and a study was initiated to investigate the distribution of red stripe in the field and determine its effects on cane and sugar yields. Two fields of cultivar HoCP 00-950, one plant-cane (PC) crop and one first-ratoon (FR) crop, affected by top rot were subdivided into 113 and 84 plots, respectively. Each field was grid-soil sampled (at several intensities) and red stripe ratings were collected at each point at two separate times. Soil properties exhibited significant variability (CV=6 - 64%) and were spatially correlated in 12 of 28 cases with a range of spatial correlation varying from 43 to 95-m. Red stripe ratings were also highly variability with a CV ranging from 65 to 92% and were spatially correlated in 3 out of 4 cases with a spatial range of 19 to 84-m. Sugarcane yields exhibited a CV ranging from 6 to 26% and were spatially correlated in 4 out of 6 cases with a range varying from 6 to 49-m. Red stripe ratings were correlated with several soil properties, when locations were combined, including phosphorus, potassium, calcium, copper, zinc and CEC. Red stripe ratings were also significantly correlated with sugarcane yields, most notably TRS ($r = -0.34^{***}$ to -0.61^{***}) and sugar per hectare ($r = -0.21^{**}$ to -0.36^{***}). Contour plots of soil properties and red stripe ratings levels also clearly suggested a link between several of these parameters. These combined data suggest that red stripe disease can exhibit a variable rate of infection in commercial sugarcane fields and can also significantly decrease cane and sugar yields. The rate of infection is influenced by soil properties and cultural practices, suggesting that proper management of these factors may help control the extent and spread of the disease.*

Keywords. ***sugarcane, Saccharum sp., spatial variability, red stripe disease.***

Introduction

Red stripe has been reported in most sugarcane producing countries of the world; however, economic loss has been reported only when associated with the top rot form of the disease (Martin and Wismer, 1989; Rott and Davis, 2000). Bacterial exudates of *A. avenae* subsp. *avenae* form on the leaf stripes during warm periods with high rainfall and humidity (Rott and Davis, 2000). Transmission of the bacteria is primarily by wind-blown rain from plant to plant (Martin and Wismer, 1989; Rott and Davis, 2000). Top rot symptoms observed in 1927 were also noted in another report from Louisiana in 1955 (Edgerton, 1955) as a symptom of red stripe; however, symptoms of red stripe observed in the state by the authors between 1985 and 2010 were limited to the leaf stripe form and caused no apparent yield loss. During 2010, the more severe top rot form was observed in several commercial sugarcane fields, primarily in the cultivar HoCP 00-950. Both forms of symptoms were found either separately or together, as reported previously (Martin and Wismer, 1961; Martin and Wismer, 1989). This study was undertaken to determine: 1) the yield loss potential of red stripe on yield in cultivar 'HoCP 00-950' (Tew et al., 2009), 2) if differences in soil properties are associated with the incidence of the top rot symptoms, and 3) if in-field variation of the disease is spatially correlated and related to the spatial correlation of soil properties.

Materials and Methods

Red stripe mapping experiments were conducted in production sugarcane fields of cv HoCP 00-950 (Tew et al., 2009) at two locations, the Magnolia Plantation, Schriever, LA, and the St. Louis Plantation, Plaquemine, LA in 2010. At both sites, a handheld computer (Compaq IPAQ, Hewlett Packard, Palo Alto, CA) equipped with a global positioning system (Navman, Raleigh, NC) and mapping software (Site Mate, Farmworks Software, Hamilton, IN) was utilized to determine site boundaries, total plot area and soil-sampling points. Each field was grid-soil sampled (at several intensities) and red stripe ratings were collected at each point at two separate times. Red stripe incidence was determined for each plot based on the percentage of the total number of stalks with visual symptoms (leaf stripe or top rot).

Each experimental plot was harvested with a single-row, chopper harvester (John Deere, Thibodaux, LA, USA) and the total plot weight determined using a modified single-axle high-dump billet wagon (John Deere, Thibodaux, LA) equipped with load sensors mounted on the spindles at the end of the axle and on the wagon's tongue where it connects to the tractor (Johnson and Richard, 2005). Data were subjected to univariate, correlation and geostatistical analyses.

Results and Discussion

Soil properties exhibited significant variability (CV=6 - 64%) and were spatially correlated in 12 of 28 cases with a range of spatial correlation varying from 43 to 95-m. Red stripe ratings were also highly variability with a CV ranging from 65 to 92% and were spatially correlated in 3 out of 4 cases with a spatial range of 19 to 84-m. Sugarcane yields exhibited a CV ranging from 6 to 26% and were spatially correlated in 4 out of 6 cases with a range varying from 6 to 49-m. Red stripe ratings were correlated with several soil properties, when locations were combined, including phosphorus, potassium, calcium, copper, zinc and CEC. Red stripe ratings were also significantly correlated with sugarcane yields, most notably TRS (r = -0.34*** to -0.61***) and sugar per hectare (r = -0.21** to -0.36***). Contour plots of soil properties and red stripe ratings levels also clearly suggested a link between several of these parameters (Figure 1). These combined data suggest that red stripe disease can exhibit a variable rate of infection in commercial sugarcane fields and can also significantly decrease cane and sugar yields. The rate of infection is influenced by soil properties and cultural practices, suggesting that proper management of these factors may help control the extent and spread of the disease.

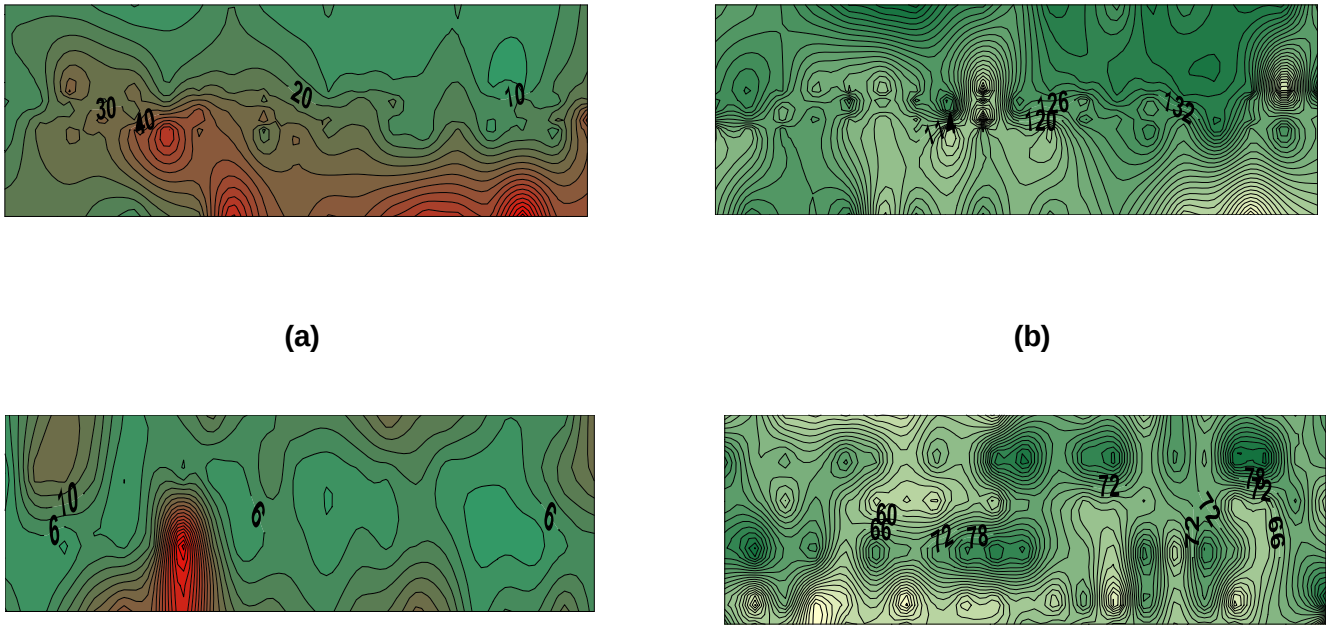

Figure 1. Contour plots for a) second red stripe assessment on 10 August 2010 at St. Louis Plantation, b) TRS at St. Louis Plantation, c) first red stripe assessment on 19 July 2010 at Magnolia Plantation, d) Cane yield (tons) at Magnolia Plantation.

References

Edgerton, C.W. (1955). Louisiana State University Press, Baton Rouge. Pp. 131-134.

Johnson, R.M., and Richard, E.P., Jr. (2005). Variability in sugar yield, sugar quality and soil properties in Louisiana sugarcane production systems. Agron. J. 97:760-771.

Martin, J.P., and Wismer, C.A. (1961). Red stripe. Pages 109-126 in: Sugar-Cane Diseases of the World, Volume 1. J.P. Martin, E.V. Abbott, and C.S. Hughes, eds. Elsevier Science Publishing Company, Amsterdam, The Netherlands

Martin, J.P., and Wismer, C.A. (revised by C.C. Ryan). (1989). Red stripe. Pages 81-95 in: Diseases of Sugarcane. Major Diseases. C. Ricaud, B.T. Egan, A.G. Gillaspie, Jr., and C.S. Hughes, eds.Elsevier Science Publishers, B.V., Amsterdam, The Netherlands.

Rott, P., and Davis, M.J. (2000). Red stripe (top rot). Pages 58-62 in: A Guide to Sugarcane Diseases. P. Rott, R.A. Bailey, J.C. Comstock, B.J. Croft, and A.S. Saumtally, eds. CIRAD ISSCT, Montpellier, France.

Tew, T.L., Dufrene, E.O., Garrison, D.D., White, W.H., Grisham, M.P., Pan, Y.-B, Richard, Jr. E.P., Legendre, B.L. and Miller, J.D. (2009). Registration of 'HoCP 00-950' Sugarcane. Journal of Plant Registrations 3:45-50.