Population Stand Monitoring of Cane (*Saccharum sp.*) Using Coefficient of Variance of Canopy Reflectance-Based Vegetation Index Readings

Saoli Chanda[1], Jeffrey Hoy[2], Payton Dupree[1], Marilyn Sebial Dalen[1], Tapasya Babu[1], Brenda Tubana[1], Brandon White[1] and Suelen Cristina Mendonca Maia[3]

(1)School of Plant, Environmental, and Soil Sciences, LSU AgCenter, Baton Rouge, LA,
(2)Department of Plant Pathology and Crop Physiology, LSU AgCenter, Baton Rouge, LA,
(3)Department of Crop Science, College of Agricultural Sciences, São Paulo State University – UNESP, Botucatu, Brazil

INTRODUCTION

- Remote sensing is less labor intensive and faster than the conventional method of acquiring data from large-scale crop production field.
- The type of planting material affects plant stand, millable stalk production and the overall yield.
- Vegetation indices can be calculated using spectral reflectance obtained from vegetation canopy at two or more wavelengths.
- Coefficient of variance (CV) is a statistical measurement of dispersion. It can be calculated as: $CV = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$

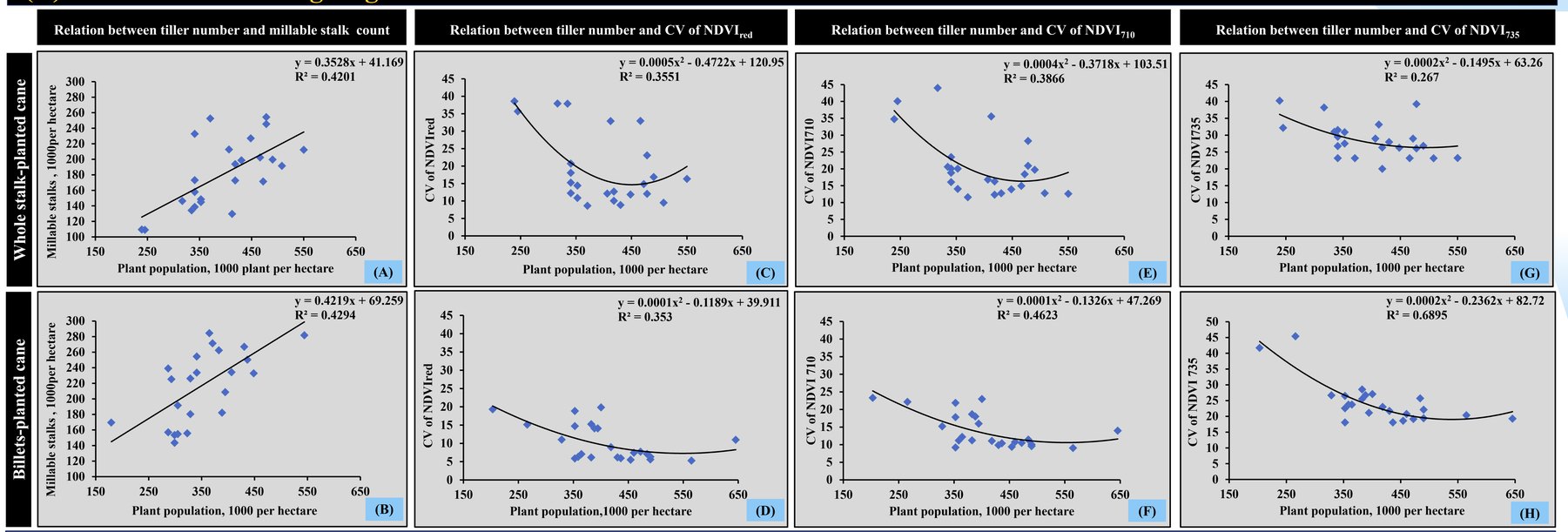
OBJECTIVES

- To establish the relationship between early plant stand population, tiller number and number of millable stalks.
- To determine if CV among plant canopy reflectance based vegetation index (VI) readings is related to plant stand and number of millable stalks.

MATERIALS AND METHODS

- Type of soil: Commerce silt loam (fine-silty, mixed, nonacid, thermic Aeric Fluvaquent).
- Experimental design: Split plot in randomized complete block design with four replications
  Main plot: Different planting materials (billets and whole stalks)
  Sub plot: six varieties (Ho 02-113, US 72-114, Ho 06-9001, Ho 06-9002, L 01-299, L 03-371)
- Establishment: whole stalk planting of cane was done by hand, while billet planting were done by machine
- Rate of N, P_2O_5, K_2O: 112-0-78.4 kg ha^{-1}
- Planting date: September 17, 2012
- Data collection: Canopy reflectance reading and population count were done one and two months after planting. Apart from this data, tiller number was also determined in spring 2013 (1st, 2nd, and 3rd week of May). Canopy reflectance reading was collected with GreenSeeker®.
- Stalk count was done in the month of July.
- Vegetation indices, used to calculate CV were:
  $NDVI_{red}: \frac{\rho_{NIR}-\rho_{red}}{\rho_{NIR}+\rho_{red}}$
  $NDVI_{710}: \frac{\rho_{NIR}-\rho_{710}}{\rho_{NIR}+\rho_{710}}$
  $NDVI_{735}: \frac{\rho_{NIR}-\rho_{735}}{\rho_{NIR}+\rho_{735}}$
- Data analysis: SAS 9.3

Pictures (A-D): (A) Mechanical planting of energy cane billets; (B) Knifing-in of liquid N fertilizer (as urea ammonium nitrate); (C) Collection of canopy reflectance reading using GreenSeeker® handheld sensor two months after emergence and (D) at maximum tillering stage



Figures (A-B): Relation between tiller number and stalk count in whole stalk - (A) and billets- (B) planted cane; Relation between tiller number and CV of $NDVI_{red}$ in whole stalk- (C) and billets- (D) planted cane; Relation between tiller number and CV of $NDVI_{710}$ in whole stalk- (E) and billets- (F) planted cane; Relation between tiller number and CV of $NDVI_{735}$ in whole stalk- (G) and billets- (H) planted cane.

Table 1: Relation between plant population, tiller number, and planting methods (billets and whole stalks) at different growth stage of cane

Plant population parameters	Billets-planted cane	Whole stalk-planted canes	Comments
Plant population, 1000 per hectare at two months after sowing	91	60	52% higher population in billet-planted cane
Tiller count, 1000 per hectare at maximum tillering stage	411	398	4% higher tiller number in billet-planted canes
Millable stalk count	219	181	21% higher millable stalk production in billet-planted plots

RESULTS AND CONCLUSIONS

- A positive correlation between early tiller number and millable stalk count was obtained for both billets- and whole stalk-planted cane (Figures A and B). The linear models suggest that only about 42% and 35% of the tiller production in spring translated to millable stalks for billets- and whole stalk-planted cane, respectively.
- In general and across planting methods, the CV values from the vegetation indices ($NDVI_{red}$, $NDVI_{710}$, and $NDVI_{735}$) decreased with increasing tiller number. There was an indication that cane planted from billets had a more uniform stand than cane planted from whole stalks. With a tiller number of 450 (x1000) ha^{-1}, the CV values from billets-planted cane's NDVI readings ranged from 5-20% compared with 15-30% of whole stalk-planted cane (Figures D, E, and H). Cane planted from billets had 52% higher population count than cane planted from whole stalk (Table 1) which could partially contribute to the generally narrower range of CV values from NDVI readings collected from billets-planted cane than whole stalk-planted cane.
- The higher early population stand of the billets-planted cane observed in spring translated into 21% higher count of millable stalk than whole stalk planted cane (Table 1).
- Both uniformity and count of tiller number at maximum tillering stage have influenced the number of the millable stalks produced in late July. Coefficient of variance among vegetation indices can potentially be used to refine cane yield estimation using optical sensor technology.