# Application of Coefficient of Variance for Population Stand Monitoring of Cane Using Canopy Reflectance-Based Vegetation Index Readings


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## INTRODUCTION

- Remote sensing is a useful technique for measuring crop production parameters faster than conventional method.
- It uses canopy reflection property of plants to calculate vegetation indices (VI) that can be used for predicting crop yield.
- The use and application of remote sensing technology in energy cane (*Saccharum sp.*) production is understudied. There have been interest in introducing remote sensing technology to improve nitrogen fertilizer management and harvesting logistics.
- Planting material may effect the population, millable stalk and ultimately yield of the cane.
- Coefficient of variance (CV) is the statistical measurement of dispersion and can be calculated as : $CV = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$
- Coefficient of variance among VI collected from whole stalk (WS) or billet (Bi) planted crops can give an estimation of variability of crop stand.

### Canopy Characterization of Different Energy Cane Varieties

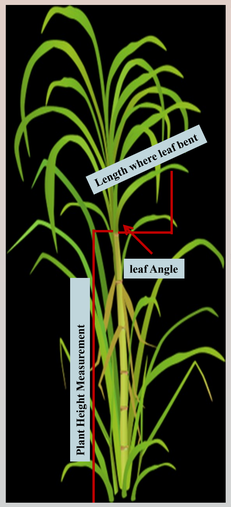







Table 1: Parameters relating to canopy characteristics of different cane variety

| Variety | Height (cm) | Leaf Angle (degree) | Total Leaf Length (cm) | Leaf Length Bent (cm) | Leaf Width (cm) | Stalk Diameter (cm) |
|---|---|---|---|---|---|---|
| Ho 02-113 | 143 | 64 | 128 | 114 | 1.20 | 1.36 |
| US 72-114 | 148 | 69 | 136 | 117 | 1.19 | 1.44 |
| L 01-299 | 134 | 67 | 129 | 121 | 1.65 | 1.83 |
| L 03-371 | 119 | 58 | 137 | 91 | 1.63 | 2.10 |
| Ho 06-9001 | 178 | 70 | 157 | 92 | 1.33 | 1.26 |
| Ho 06-9002 | 177 | 69 | 238 | 88 | 1.44 | 4.23 |

## 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





2-band GreenSeeker®
Wavebands: red = 660 nm
near infrared = 770 nm

4-band GreenSeeker®
Wavebands: red = 660 nm
near infrared = 770 nm
red-edge = 710 and 735 nm


- 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: Two planting materials (billets and whole stalks)
- Subplot: six varieties (Ho 02-113, US 72-114, Ho 06-9001, Ho 06-9002, L 01-299, L 03-371)
- Planting method: whole stalk planting was done by hand and billets were planted mechanically
- Fertilizer application: N, $P_2O_5$, $K_2O$: 112-0-78 kg $ha^{-1}$
- Planting date: Sept. 2012 (site A) and Oct. 2013 (site B)
- Data collection: Canopy reflectance reading and
- population count were done 1 (site A) and 5 months (site B) after planting (once in a month) until tillering. Whereas, tiller number was determined from May to June at one week interval up to maximum tillering stage.
- Canopy reflectance reading was collected with 2- and 4-band GreenSeekers® handheld sensors.
- Stalk count and measurement of parameters for canopy characterization were done in the month of July.
- Vegetation indices used to calculate CV were:

$$NDVI_{red}: \frac{\rho_{NIR}-\rho_{red}}{\rho_{NIR}+\rho_{red}} \qquad NDVI_{710}: \frac{\rho_{NIR}-\rho_{710}}{\rho_{NIR}+\rho_{710}}$$

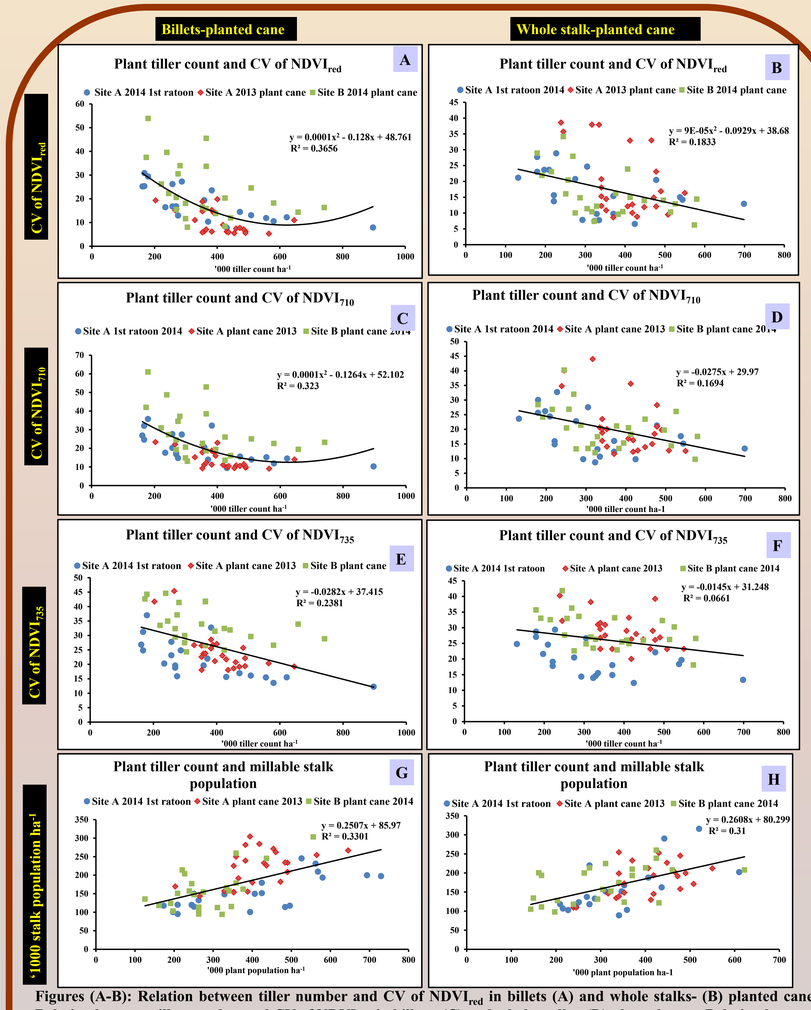
$$NDVI_{735}: \frac{\rho_{NIR}-\rho_{735}}{\rho_{NIR}+\rho_{735}}$$

## RESULTS AND DISCUSSION

Table 2: Relation between plant population, tiller number, and planting methods at different growth stages of cane.

| Parameters | Site A 2013 plant cane | | Site B 2014 plant cane | | Site A 2014 1st ratoon | |
|---|---|---|---|---|---|---|
| | Billets-planted | Whole stalk-planted | Billets-planted | Whole stalk-planted | Billets-planted | Whole stalk-planted |
| Plant population '000 $ha^{-1}$ | 91 | 60 | 48 | 51 | - | - |
| Plant population '000 $ha^{-1}$ | 411 | 398 | 286 | 308 | 366 | 331 |
| Stalk population'000 $ha^{-1}$ | 219 | 181 | 158 | 169 | 151 | 158 |

- In site A, billets-planted cane had 52% higher plant population and 21% higher millable stalks. On the other hand, both planting materials performed similar in site B




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

- Both sugar cane varieties (L 01-299, L 03-371) had wider leaf blade and stalk diameter while all energy cane varieties were taller. Lower leaf angle and length-where-leaf-bends values are expected in droopy canopy structure.
- During early population count, the plants were too small to produce any significant relation with CV among NDVI.
- Early tiller population showed highest correlation with CV among different NDVI. As the population increased, the variability between the crop stand and CV values decreased. As a result, sensitivity of the relation also decreases.
- Coefficient of variance has negative correlation with plant stand. Over all, CV of $NDVI_{red}$ provided better correlation with tiller number in both whole stalk- and billet- planted cane.
- Tiller population of both whole stalk- and billet- planted cane have positive and similar correlation with millable stalk population.