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ECO-RESPONSIVE FEEDING AND NUTRITION

LINKING LIVESTOCK AND LIVELIHOOD

ABSTRACT PAPERS

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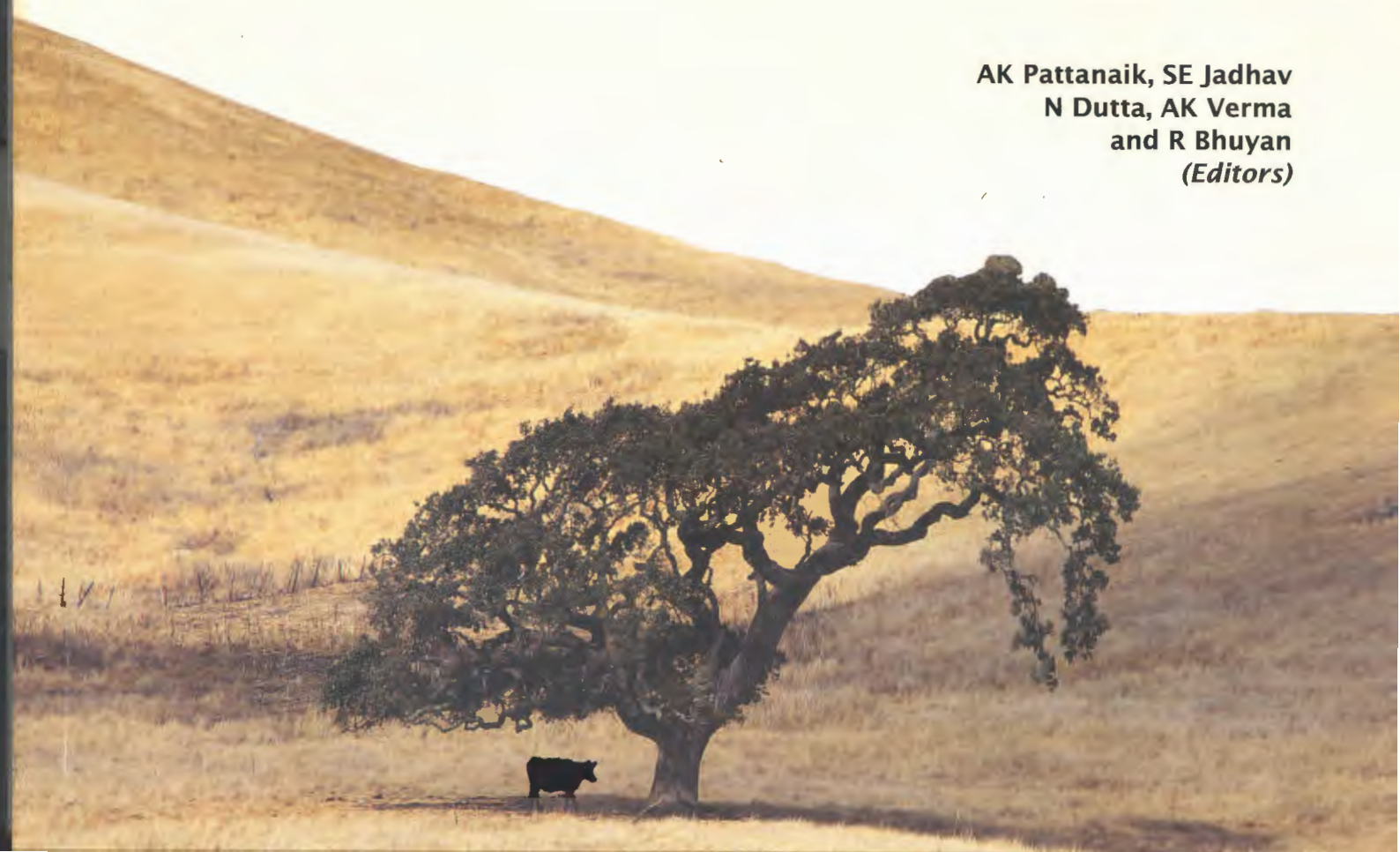

FFS 18

Quantification of Dhurrin in Different Types of Sorghum Forages by Near-Infrared Reflectance Spectroscopy

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SUMMARY: Hydrogen cyanide (HCN) is a toxic chemical that can potentially cause mild to severe reactions in animals upon feeding forage sorghum. Developing technologies to monitor the level of HCN in the growing crop could prevent livestock poisoning. In this study near-infrared spectroscopy (NIRS) calibration to estimate HCN in forage sorghum is developed. The full spectral NIRS range (1100-2498 nm) was used as well as specific spectral ranges within the full spectral range, i.e., visible (400-750 nm), shortwave (800-1100 nm) and near-infrared (NIR) (1100-2498 nm). Using the full spectrum approach and the modified partial least-squares (MPLS), the calibration produced a coefficient of determination (R^2)= 0.869 and standard error of cross-validation (SECV)= 97.53%, while the validation set had a R^2= 0.624 with a low standard error of prediction (SEP= 205.801%).

Keywords: Dhurrin, Forage sorghum, HCN, NIRS, UPLC

BACKGROUND

Sorghum [*Sorghum bicolor* (L.) Moench] has tendency to accumulate cyanogenic glycoside. The amount of cyanide potentially be released from dhurrin is known as the cyanide potential (HCNp). The threshold at which a feed is no longer safe is approximately between 1000 to 1800 ppm of HCN (dry matter basis) and at values between 500 and 1000 ppm the forage is considered to be potentially toxic to the animals. Methods described for estimation of HCNp are time consuming and not practical for screening a large number of samples without use of hazardous and expensive cyanide standard. Developing NIRS equation to predict the level of HCN in sorghum at different stages would benefit cultivators and they can feed animals with acceptable levels of HCN in forage. The aim of this study was to determine the suitability of NIRS to estimate HCNp in different types of sorghum.

METHODOLOGY

Thirty-six improved lines of sorghum (9 grain, 12 sweet sorghum, 6 forage and 1 *bmr*) were evaluated at ICRISAT in rainy season, 2014 in randomized complete block design (RCBD) with two replications. The youngest leaf from the plants after 8 weeks of germination was harvested and subjected to freeze drying for 21 hours, later ground and sieved (size 1 mm). Dhurrin was extracted with 10% methanol (Nicola *et al.*, 2011). Supernatant was collected by centrifugation @ 10,000 rpm and 4°C, diluted in 10% acetonitrile and fed to UPLC. Dhurrin was detected at 232 nm (Nicola *et al.*, 2011). The similar set of ground samples (n= 36) were scanned in NIR spectral range from 1100 to 2498 nm in reflectance mode by using a spectrophotometer model Foss 5000 and the chemometrics software was used WinISI Version 4.6. In order to highlight chemical entities, noise from spectral distortions was reduced by use of standard normal variance (SNV) and de-trending (DT) transformation (Barnes *et al.*, 1989) spectra collected were always used. Second derivatives were computed by 4 data point gaps used for smoothing by running averages. No samples were eliminated from dataset because of spectra recordings that deviated far from mean sample spectrum by Shenk and Westerhaus, (1991). That is some samples were identified with a large H distance (Mahalanobis., 1936) which also included for NIRS calibration and validation procedures.

RESULTS

Two calibration methods were used in developing a calibration model for HCN. First was a typical approach using the full spectrum [1100-2498 nm (344 data points)] with a modified PLS regression model. The best PLS model was using the NIR spectra (1100-2500 nm), giving a coefficient of determination (R^2)= 0.86 and standard error of cross-validation (SECV)= 74.75%, using a standard normal variance (SNV) de-trend pretreatment with the second derivative, 4 nm gap, and 4 nm smoothing. The use of full spectrum NIR produced reasonable calibrations (Fig. 1). The R^2 for the validation set using the full spectrum was 0.62, with standard error of prediction (SEP)= 205.80%. The RPD was 2.76, indicating that predictive model could be used for screening in a breeding program.

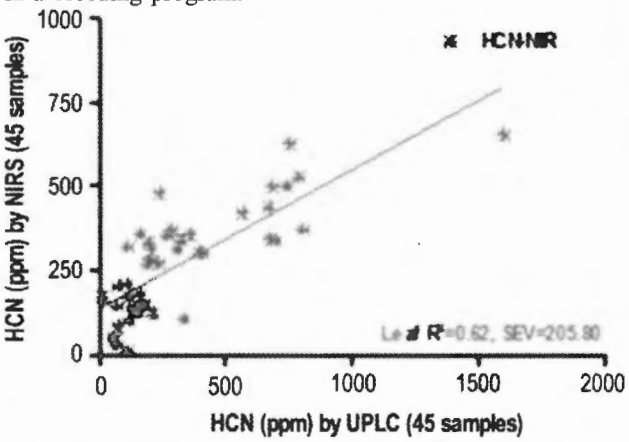

Fig. 1. The scatter plot for the actual versus predicted values

CONCLUSION

NIRS blind prediction of HCN in forage sorghum breeding could help in screening genotypes and monitoring of crops to gauge dhurrin levels prior to feeding cattle.

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