Automatic identification and precise prevention of deep green infection in tobacco leaf using a hand-held DLP-based NIR spectrometer

Yang Shuangyan[1]; Zhang Jianqiang[2]

[1] Yunnan Tobacco Biological Technology Co., Ltd
[2] Yunnan Police College

What is deep green infection in tobacco leaf ?

excessive fertilisation

total nitrogen content of infected tobacco leaves is higher

difficult to be harvested timely

can not be flue-cured in the next stage production

What is deep green infection in tobacco leaf ?

the size of the infection leaf is also bigger

the color is deep green

Traditional methods

chemical analysis in the laboratory	visually by one or more plant pathologists
• expensive • costly • can't provide the results in a short time	• experience • tiresome • may lead to errors due to fatigue

NIRS & advantages

Flexible measurements：

absorption, transmission, diffusive reflectance, …

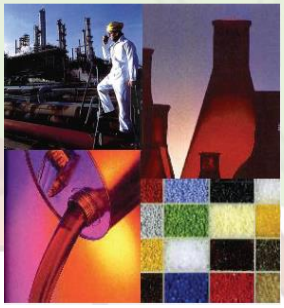
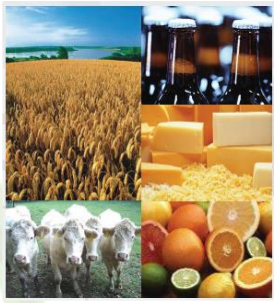
Advantages:

fast, nondestructive, on-line/site, real complex samples

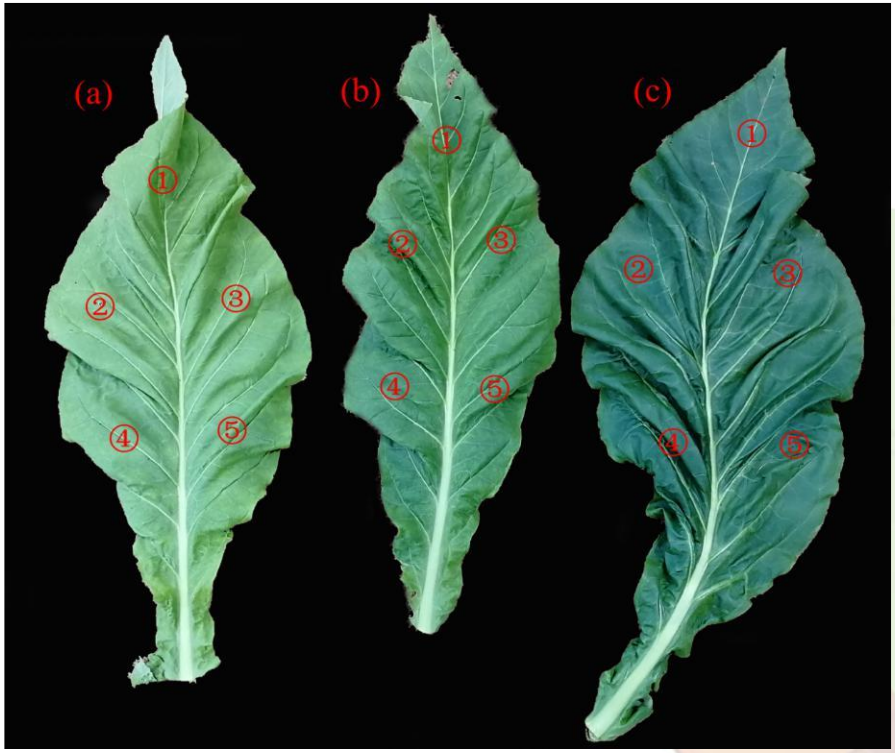
Applications:

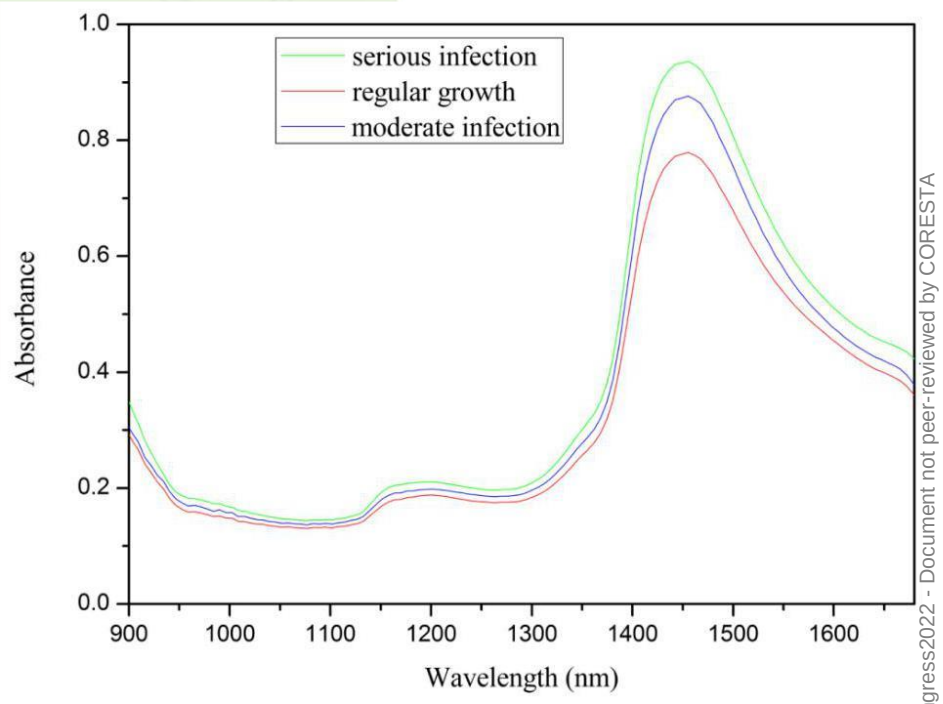
agriculture, textile, food, drug & medicine, petroleum, …




How to collect the spectral data of the samples

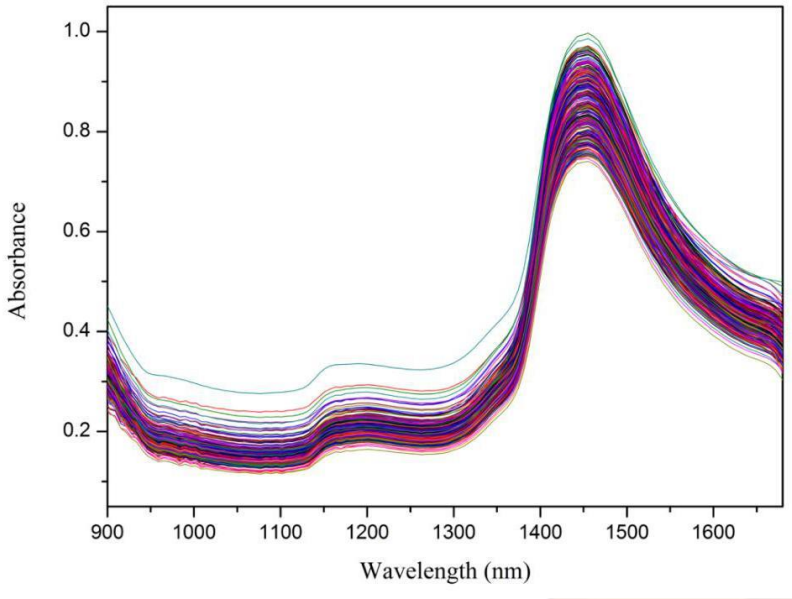


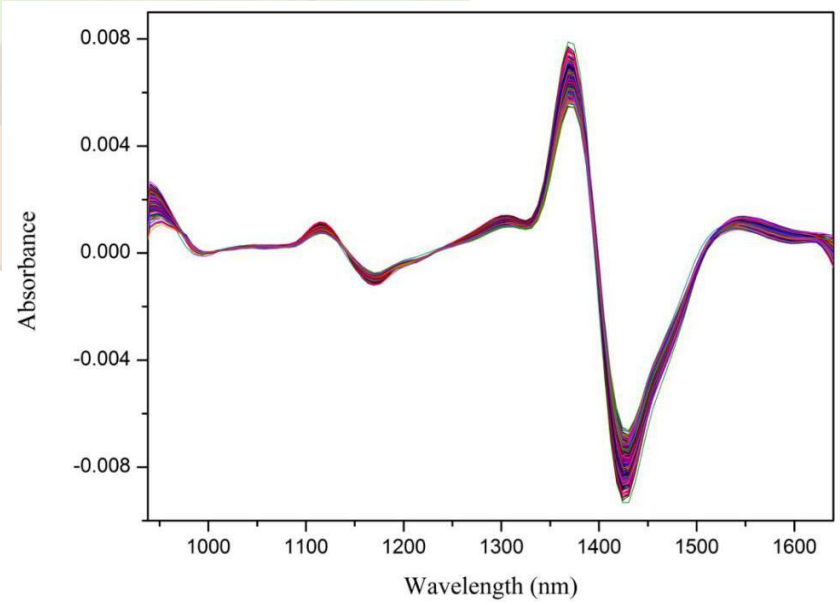


Detail of the samples

Year	Location	Spectral features	Levels	Total nitrogen(%)	Samples	Training samples	Test samples
2018	Bajie, Yunnan, China	320	serious infection	4.01-6.00	105	70	35
2018	Bajie, Yunnan, China	320	moderate infection	2.21-4.00	105	70	35
2018	Bajie, Yunnan, China	320	regular growth	1.00-2.20	105	70	35

Spectral data of the samples and pre-processing results





Classification results by different algorithms

Levels (test numbers)	Calculate times	LDA	PSO-SVM	ELM
		Classification accuracy	Classification accuracy	Classification accuracy
Serious infection (35)	10	302/350, 86.28%	313/350, 89.43%	338/350, 96.57%
Moderate infection (35)	10	299/350, 85.43%	324/350, 92.57%	335/350, 95.71%
Regular growth (35)	10	286/350, 81.71%	311/350, 88.86%	329/350, 94.00%
Average accuracy	/	887/1050, 84.48%	948/1050, 90.28%	1002/1050, 95.43%

The tobacco leaf can be initially determined if it has been infected or the severity of the deep green tobacco leaf infection by using hand-held NIR spectroscopy technology together with ELM algorithm.

Tobacco

Quantitative model built process

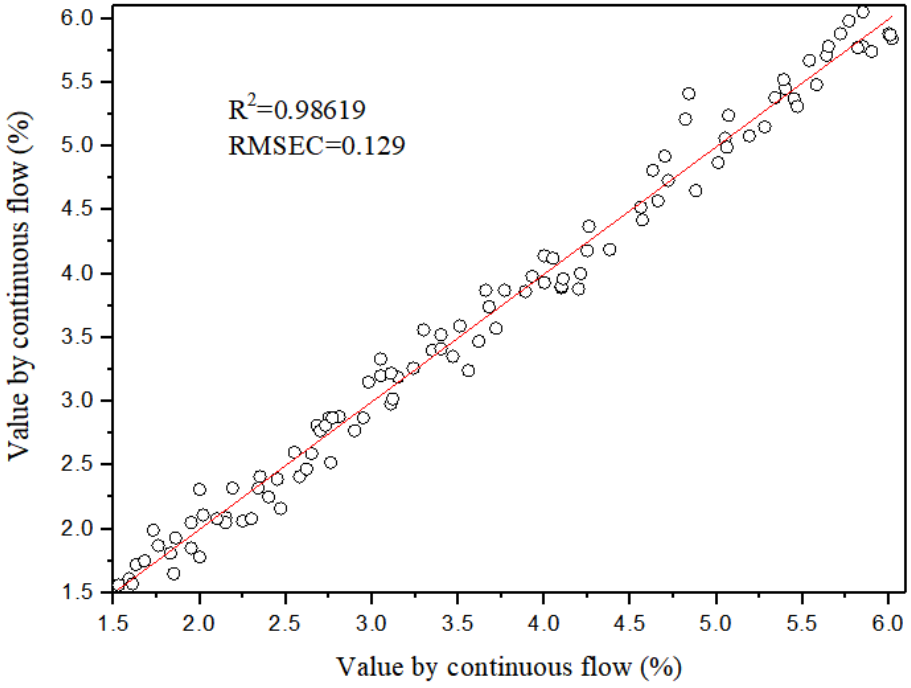
(1) The training samples were selected and the spectral measurements were performed by the use of a hand-held DLP-based NIR spectrometer.

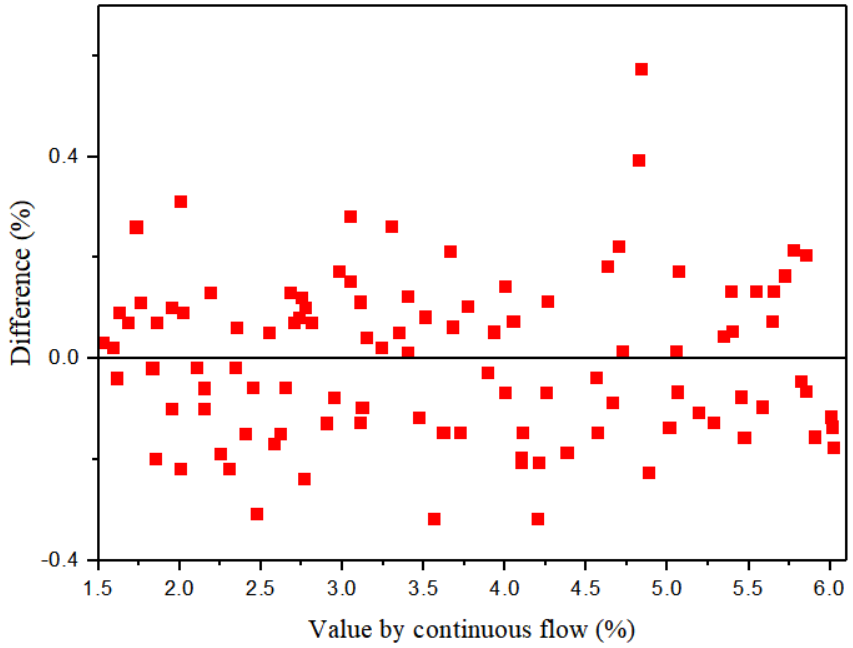
(2) The total nitrogen content of the samples was determined by the use of a conventional continuous flow analytical method.

(3) The quantitative model was constructed using the ELM algorithm with the spectral measurements and the total nitrogen content for each training sample.

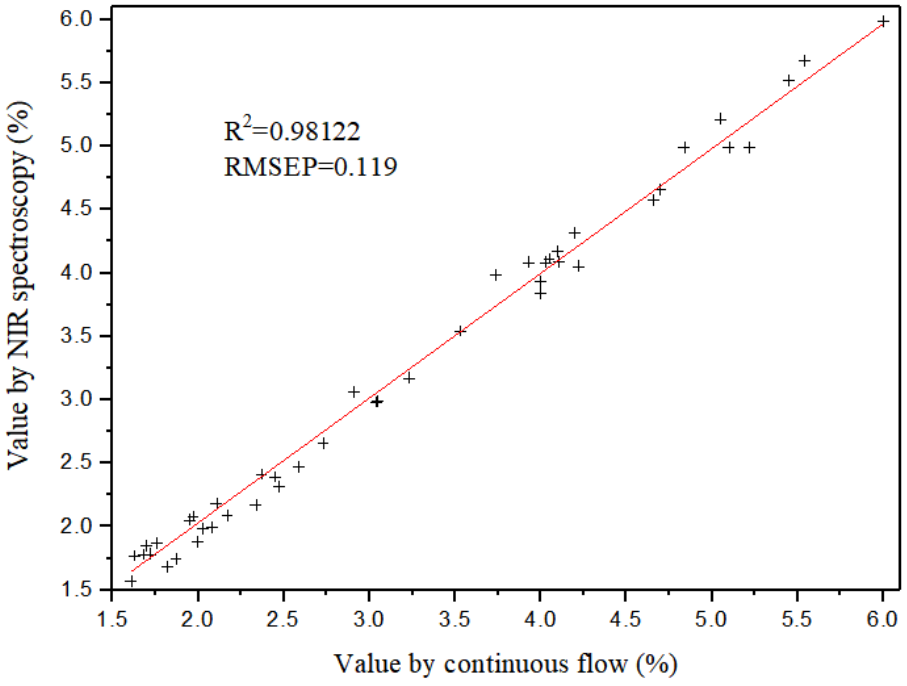
(4) The precise total nitrogen content of the test sample was automatically and rapidly determined by the use of the model constructed in step 3.

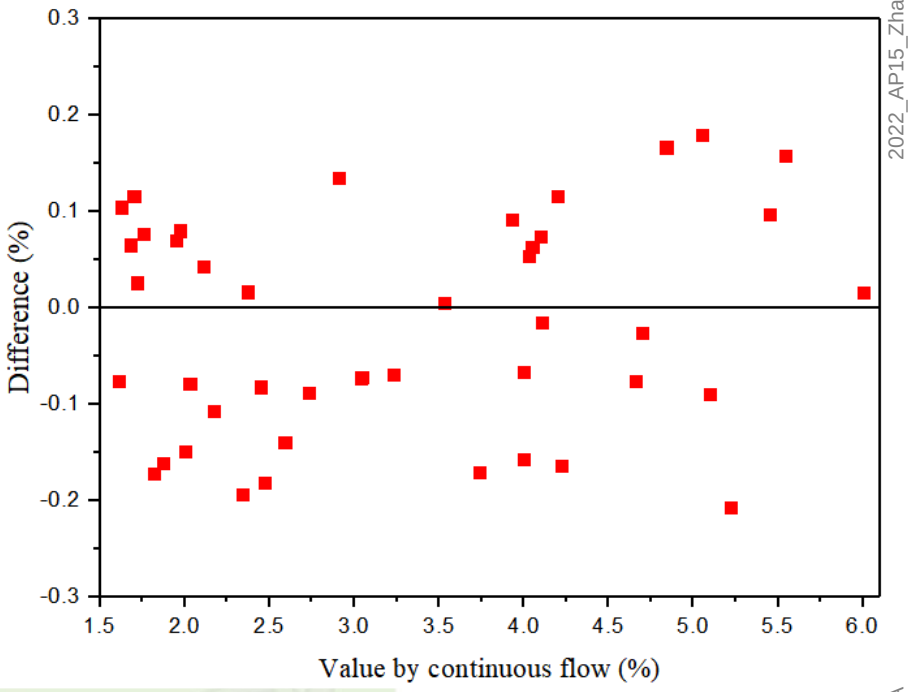
Quantitative model built results





Prediction results by use the builtqualitative model

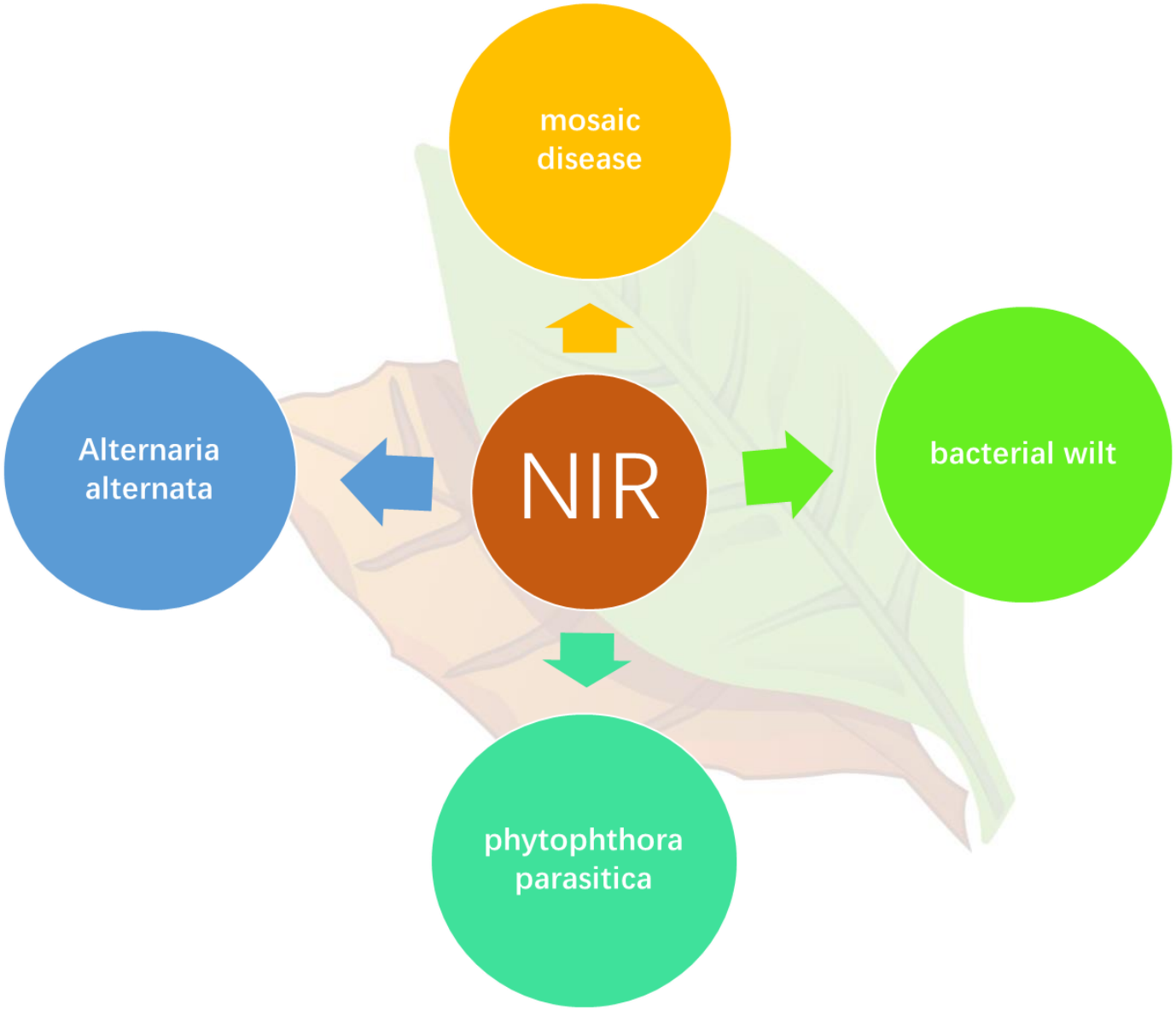




The total nitrogen content of tobacco leaf can be acquired without defoliation in the field by means of using proposed method.

It is very helpful for the farmers to make appropriate decisions in controlling the deep green disease.

What can we do in the future by using NIR?



Thanks for your attention