The NIR Spectroscopy Series

NIRS IN AGRI QUALITY TESTING

Images of agricultural commodities Chilli and Turmeric up for trade in Mandis in India – Chilli in Byadgi, Karnataka State and Turmeric in Nizamabad State

NIRS | Part2

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Technology Introduction
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Crop Quality Testing with Near Infra-Red Spectroscopy (NIRS)

CROP QUALITY TESTING is an essential aspect of agriculture, as it helps farmers and agribusinesses ensure that their crops meet the required standards for marketability and consumer safety. there are 2 main aspects of crop quality testing. The first set of quality tests inspect the key constituents of the crop, while the other set examines whether the crop is safe for consumption from a toxin infestation / pesticide residue / adulteration standpoint.

What are the important aspects of crop quality testing?

1. **Sampling:** Sampling is a critical aspect of crop quality testing. Samples should be representative of the entire crop and taken at different stages of production to ensure accuracy.

2. **Test Parameters:** The parameters for crop quality testing will depend on the type of crop and its intended use. Common parameters include moisture content, protein content, oil content, starch content, sugar content, and contaminant levels.

3. **Testing Methods:** There are various methods available for crop quality testing, including laboratory analysis, in-field testing, and non-destructive methods such as NIR spectroscopy. The chosen method should be accurate, reliable, and appropriate for the crop being tested.

4. **Accuracy and Repeatability:** Crop quality testing should be accurate and precise, with minimal error. Accuracy refers to how closely the test results match the true value, while repeatability refers to the consistency of results when the test is repeated.

5. **Standardization:** Standardization is crucial for crop quality testing to ensure that results are comparable and consistent across different

laboratories and testing methods. Standardization can include the use of certified reference materials and the development of standard operating procedures.

6. **Regulations and Requirements:** Crop quality testing must adhere to regulations and requirements set by government agencies, industry associations, and buyers. Compliance with these regulations and requirements is necessary for marketability and consumer safety.

Applications Of NIR Spectroscopy In Agri Commodity Testing

NIR Spectroscopy (NIRS) is a non-destructive analytical technique that measures the absorption, transmission, and reflection of light in the near-infrared range of the electromagnetic spectrum. NIR spectroscopy can be used for crop grading because it can quickly and accurately measure various parameters related to crop quality, such as moisture content, protein content, oil content, starch content, sugar content and various other key ingredients in a crop.

Moisture is an important parameter that needs to be tested in all agricultural produce. Other parameters are dependent on the commodity. For example, in spices there are key secondary metabolites like Curcuminoids, Capsaicinoids, Carotenoids which determine the quality of the spice commodity. There are also polyphenols in spices, like gingerol, menthol and similar. Whereas in food grains and cereals, the primary metabolites like starches and sugars determine the quality grade of the produce.

Regardless of the parameter to be tested, the method of testing an agri commodity using NIRS is similar. In this article, we will explain how NIRS can be used for crop testing and grading using the NIR reflection method, in a very introductory manner. The NIR method of testing commodities is termed a secondary or derived method, which uses accurate calibrations from primary chemical analyses of the various parameters in the laboratory. The steps involved are as below:

1. **Calibration:** The first step is to calibrate the NIR spectrometer with a set of representative samples. These samples should cover the range of variations in the crop of interest. For example, for wheat grading, the samples should cover different grades of wheat with varying protein and moisture content.

2. **Sample Preparation:** The crop samples are collected and prepared for NIR analysis. The samples are ground into a fine powder and placed in a sample cup.

3. **NIR Analysis:** The NIR spectrometer measures the light absorbance of the sample at specific wavelengths in the near-infrared range. The absorption pattern of the sample is then compared to the calibration curve, which was generated in the previous step.

4. **Crop Grading:** The results from the NIR analysis are used to determine the quality of the crop. For example, in wheat grading, the protein content of the wheat can be determined by measuring the absorbance of light at a specific wavelength. The result can be compared to a pre-defined standard to determine if the wheat meets the required quality standards.

5. **Crop Grade Bucketing:** Based on the same NIR spectra captured and similar calibration methods, it is also possible to classify crop sample being tested into different grade buckets – for instance wheat with 8 to 10%, 10 to 12%, 12 to 15% or 15 to 20% wheat and so on. Each grade of wheat may then be used as input raw material for specific food processing needs and may fetch a different price in the market.

6. **Moisture Control:** Grain needs to be stored at optimal moisture levels to avoid wastage due to fungal infection (excessive moisture) and wastage due to brittle grain causing whole grain to break during handling (lower than required moisture)

Once, the calibration has been completed with a broad and representative sample set, the results of the commodity test can be obtained within minutes using the NIR method. So, it is extremely time and cost efficient, enabling on-site quality testing.

In summary, NIR spectroscopy is a fast, accurate, and non-destructive method for crop grading. It can be used for a variety of crops, including wheat, corn, soybeans, rice, spices, tea, coffee and so on. It enables farmers to quickly and accurately determine the quality of their crops; at the same time, it allows traders and commodity buyers to buy crop at an appropriate price based on moisture content, which can be used to determine pricing and marketability.

In our next article in this series, we will share more details of how NIRS calibrations are achieved.

Stay tuned …