AGRICULTURAL RESEARCH FOUNDATION
INTERIM REPORT
FUNDING CYCLE 2016 – 2018

TITLE: Development of near-infrared reflectance spectroscopy methods for rapid seed moisture testing in grass seed crops

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SUMMARY:

Seed moisture content is the most reliable indicator of seed maturity and harvest timing in grass seed crops. Swathing within the correct range of seed moisture contents will maximize harvestable seed yield and minimize losses of seed due to shattering during harvest. Taking an accurate measurement of seed moisture content is a key component of economic grass seed crop management. The problem is that the most widely adopted seed moisture testing methodologies are slow and as a result, it is difficult to make timely management decisions about harvest timing of their crops. Harvest is a busy time and often several crops are coming to maturity at or near the same time in fields spread out across the grass seed grower's farming operation. A rapid and reliable method to test seed moisture content could increase seed yield and profitability of Oregon's grass seed production enterprises. Near-infrared reflectance spectroscopy (NIR) has been widely used for the determination of moisture content in agricultural products. Seed moisture determination by NIR in cereal grains and oilseed crops has proven to be both rapid and reliable, but no information is available on the testing of grass seed for moisture content. Since seed moisture testing by NIR is a secondary method, calibration against a primary seed moisture testing method is needed before this technology can be used as a harvest timing tool in grass seed crops. Recent technological advancements have now made it possible for NIR testing of seed moisture content at the farm level, including portable field-based models.

OBJECTIVES:

1. Conduct field trials with perennial ryegrass, turf-type tall fescue, forage-type tall fescue, and orchardgrass for rapid and reliable determination of seed moisture content by NIR.
2. Determine seed moisture content of grass seed crops with NIR and air-oven methods from the start of seed development to after harvest maturity.
3. Develop calibrations for NIR seed moisture testing in grass seed crops by partial least squares regression.

4. Share results with grass seed growers and other interested clientele.

PROCEDURES:

Seed moisture testing methods for the NIR and the needed calibrations will be developed for four grass seed crops: perennial ryegrass, turf-type tall fescue, forage-type tall fescue, and orchardgrass. Previous work has shown that there are differences in seed moisture content and harvest timing for the two types of tall fescue. All work will be conducted at Hyslop Farm near Corvallis. The work will be done in two harvest seasons, 2016 and 2017.

Seed moisture content will be determined daily on each crop by use of the NIR and by laboratory air-oven methods. Testing will begin a couple of days past peak flowering of the crops and continue until seed harvest by swathing of the standing crop. Additional seed moisture content measurements will be made on seed in the swath leading up to combining and on seed that is past harvest maturity in un-harvested plots.

Representative samples will be taken daily from each crop as outlined above. This will be done by stripping seed from 30 spikes or panicles into airtight container and keeping cool until ready for NIR determination. Samples will be taken in mid- to late morning to ensure that dew is no longer present. Analysis of NIR will be done for seed moisture content per the manufacturer's recommendations with modifications as needed to accommodate grass seed moisture content determination. The NIR will also be used to evaluate in situ seed moisture content measurement capability of the device with seed not removed from the plants. This in situ approach has never been attempted before with any seed moisture measurement equipment and could serve as the basis for future development of precision agriculture solutions to the seed moisture measurement problem.

Procedures for the reference oven will include taking three 10 gram subsamples from the same sample used to determine NIR seed moisture content. Each subsample was will be placed in a metal sample container and weighed prior to oven-drying. The subsamples will then be arranged in a laboratory air-oven and dried at 130°C for 2 hours. After drying has been completed, the cover will be placed on each metal container and cooled to room temperature prior to weighing in a desiccant-containing chamber. The seed moisture content will be calculated from the weights prior to and after drying and expressed as a percentage.

The seed moisture content results from NIR (seed removed and in situ) will be calibrated against the air-oven reference method. This calibration will be made using partial least squares regression analysis. Results will be analyzed by using analysis of variance.

Research results and photos from the field trials will be posted periodically on OSU's Seed Production Blog site (http://blogs.oregonstate.edu/seedproduction/) for public viewing as they become available. Results will also be published in refereed journals and in practitioner-oriented publications. Seed growers and other industry practitioners will have an opportunity

to view and comment on the results and recommendations produced by the study at OSU Field Days, and at various OSU Extension meetings.

SIGNIFICANT ACCOMPLISHMENTS TO DATE:

A portable, hand-held NIR device manufactured by Digi-Star was purchased using ARF funds (Figure 1). The efficacy of this NIR device for testing seed moisture content in grass seed crops was examined in field trials with perennial ryegrass, turf-type tall fescue, forage tall fescue and orchardgrass in 2016 and these results compared to the air-over test currently employed by grass seed growers.

Figure 1. Digi-Star Moisture Tracker hand-held NIR device.

Seed moisture was tested on stripped seed and in-situ. Results were most consistent with stripped seed as is employed in the air-oven test. Figure 2 shows the relationship of the NIR seed moisture content reading versus air-oven test seed moisture content for perennial ryegrass in 2016. The data in the figure reveals a highly significant relationship between the NIR readings and oven derived seed moisture contents.

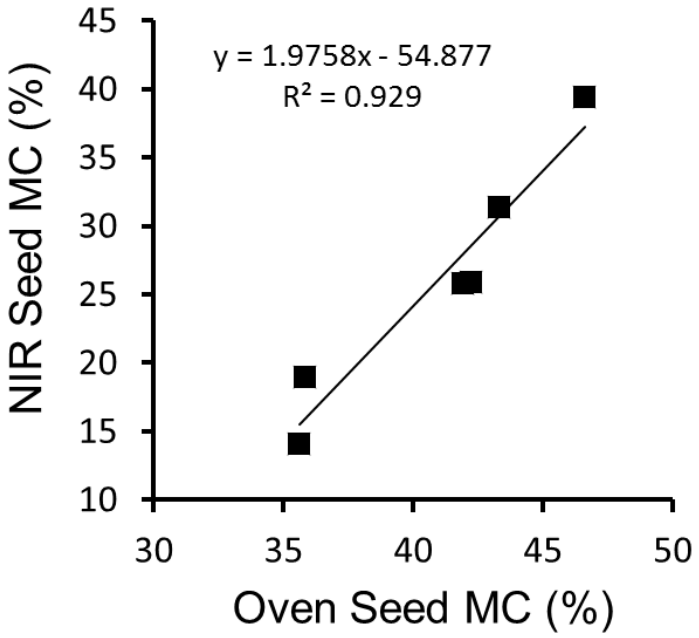

Figure 2. Relationship of NIR reading (seed moisture content) with air-oven seed moisture content in perennial ryegrass in 2016.

The work to date shows that there is very good potential for using hand-held NIR devices to measure seed moisture content in grasses. The NIR will need to be calibrated for the grass seed crops so that the NIR readings on the device display agree with the oven seed moisture content. The manufacturer of the device has indicated a strong interest in having their software engineers conduct this instrument calibration once we have a robust data set from two field seasons. Our plan for 2017 is to examine the effect of plant growth regulator application, nitrogen rate, and rust fungicide on seed moisture content in the grass seed crops as determined by NIR.

Seed producers indicate that in the peak of the harvest season that they do not have the time to conduct all of the air-oven seed moisture tests required to determine harvest readiness for their crops. The NIR device would shorten the time required for each test from hours to minutes.

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:

None at this time.

FUTURE FUNDING POSSIBILITIES:

A proposal will be submitted to the Oregon Seed Council to expand this work and to examine precision agriculture applications of this methodology.