RESEARCH AND DEVELOPMENT IN SEED TESTING TECHNOLOGIES AT THE OREGON STATE UNIVERSITY SEED LABORATORY

Development of new seed testing methods based on sound research has been the way to innovate seed testing services at the OSU Seed Laboratory. Research is used to validate old methods, to introduce new techniques, to propose testing rules changes, and to assure accuracy, timeliness and efficiency of seed testing services. The innovation through research and development coupled with the continuous training and education for proficiency development of seed analysts at the OSU Seed Lab has made it possible to respond to the needs of customers in today's competitive market. While some research projects are carried out in the lab, others are done cooperatively with other laboratories, seed science centers, and through national referee studies.

The research and development at the OSU Seed Lab focuses on five areas. The laboratory takes a proactive role in generating and implementing projects in the first four areas. The fifth area is more open to respond to the needs of individual researchers, seed companies, and others who needs seed science based-testing related services.

I. Mechanization, automation, and artificial intelligence in purity testing

The purpose of this area of research is to incorporate or introduce new technologies to solve and develop methods that can respond to the current and the future industry needs. The ultimate goal of the research projects is to assure accuracy, increase testing uniformity, speed testing process, and reduce cost.

Completed Projects

a. Development of ergonomic purity examination system (Ergovision) that assure ergonomic working conditions. The new system includes automatic, mechanical seed movement through the field of vision, optimum lighting, and high optic system for accurate identification to seed components. The system has been used successfully for several years and has decreased the analysts' work related health problems; assure accuracy and timeliness in purity testing results.

b. Development of an efficient test to detect and identify *Orobanche* seeds (extremely small seeds of a parasitic species) in red clover. With some modifications this method, combined with the use of the Ergovision system could be used to detect and identify any small seeds or particles in any sample.

c. Assessment of multiple seed units (MSU) in ryegrass and tall fescue and quantification of the inert matter contained in them. The study provided valuable information to understand the MSU's and move to the second phase for practical solution.

d. Purity and germination studies on tall fescue and ryegrass with caryopsis less than 1/3 the length of the palea. Study made it possible to change the AOSA testing rules for better identification of pure seeds. The rule is in current use.

e. Development of a method to search for seeds in soil samples. The method involves filtration to separate the seeds and sand from finer soil particles; drying and screening of remaining component; and microscopic examination to detect and identify seeds. Currently, the method is used to find seeds in soil banks, feed pellets, compost, and others.

Current and Future Projects

The following studies are currently in progress or to be completed in the future:

- For the last two years, the OSU Seed Laboratory has been conducting various studies to develop a standard blowing procedures using air velocity calibration. The new method will be simpler and more efficient compared to the current method.
- Updating the purity tolerance tables in the AOSA Rules. A rule proposal is ready for submission.
- Development of artificial intelligence technology to separate seeds and seed contaminants. The concept has immediate applications for seed testing and potential to be used in labs around the world. It also can be adapted in larger commercial seed cleaning operations. The project is in preparation to be started in 2005-2006.

II. Viability, Germination, Vigor and Grow-outs

The objective of the research in this area is to validate and/or improve methods to break dormancy efficiently, speed up germination, assure germination uniformity and to verify plant types through grow-out testing.

Completed Projects

a. Studies to validate and improve a protocol for the grow-out test as an alternative test to the fluorescence test to distinguish between annual and perennial ryegrass. It was added to the AOSA Rules and included in the AOSA Cultivar Purity Testing Handbook in 2002.

b. Updating the germination tolerance tables in the AOSA Rules. A rule proposal was accepted in 2004.

c. Applications on the effectiveness of TZ test on assessment of viability of various native species (ongoing).

d. Germination study on Kentucky bluegrass. It provided supporting evidence for reducing the germination period of Kentucky bluegrass from 4 to 3 weeks.

Current and Future Projects

- A research on germination and fluorescence is being carried out at the OSU Seed Lab to study the effect of prechilling treatment and the length of test period on the final germination and fluorescence results of perennial ryegrass. The ultimate objective is to study whether seeds reach maximum germination and fluorescence before the final count (7 days prechill + 14 days warm germination). This study may result in shortening the test period.

- Keep adding TZ testing methods for new species that are not currently available. The lab networks with other labs to exchange information and developments.
- Development of faster and effective dormancy breaking methods to speed up germination. The emphasis will be on bluegrass, ryegrass, and tall fescue.

III. Genetic and other special quality traits testing

Research projects in this area focus on traits that define the value of seeds in the market particularly in Oregon produced seeds.

Completed Projects

a. Studies on the use of flow cytometer to distinguish between diploid and tetraploid ryegrass. The study demonstrated a perfect agreement between this method and the chromosome count technique. Currently, the ploidy by cytometry method is being used for seed testing, certification, breeding programs for selection of pure diploid/tetraploid breeder seeds, and other applications.

b. Differentiation of subspecies of fine fescues and other plant species with different chromosome numbers. For example, the flow cytometer can differentiate between strong creeping fescue 56 chromosomes, chewing fescue 42 chromosomes, and sheep fescue 28 chromosome.

c. Validation of Clearfield Wheat Bioassay to detect the tolerance to the herbicide imazamox. Currently, the OSU Seed Laboratory is accredited to perform this test and is providing official testing services.

d. Studies on the use of immunoblot assay in detecting endophyte in tall fescue and ryegrass as an alternative to the microscopic method. Also, studies on the use of ELISA in detecting the toxic alkaloid (ergovaline) in tall fescue have been completed and submitted for publication. The immunoblot assay method is currently being used for endophyte testing of grass seeds.

Current and Future Projects

- Develop TZ testing procedures for new species (e.g., natives) that are entering the market.
- GMO testing as Oregon seed products become commercially available in the market.
- Applications of ploidy by cytometry method to determine the ploidy levels and differentiate between species with different chromosome numbers.

IV. Digital and electronic information systems (Data base, seed imaging, virtual information for seed industry)

The laboratory has one of the most advanced data base and programs that contain information on test results of approximately 30,000 tests every year This information is a treasure to generate knowledge on purity, germination, specific contaminants, and other tests by crops, years, companies, warehouse, etc. This information can be used to generate research to understand and solve problems, to assist specific customers, to design training activities, and to plan innovations.

Completed Projects

- Seed services database and applications programs have been developed and maintained by a team of software programmers. These resources are used daily to manage all testing information electronically, including web entry of test requests and instant web access to test results.
- Many computer searches have been performed for purity, inert, germination, and other tests by crops, years, etc. for statistical purposes for management decisions.

Current and Future Projects

- The Lab is using the database in generating information on the germination and fluorescence of ryegrass by species, crop year, variety, treatment (chilled and non-chilled) for various studies. Data will be used to understand what proportion of samples has reached maximum germination and fluorescence by the first count and what proportion needed the additional time.
- The lab will participate in a national network of AOSA-SCST laboratories to organize a virtual digital herbarium for training and educational proposes. The OSU Seed laboratory will focus on seeds (crops and weeds) that are common to Oregon and Northwest region of the US. The information will be used to organize workshops for seed analysts, growers, cleaners, dealers and extension services interested in seed identification.
- The laboratory is developing a digital system to provide instant picture information on inert, specific crop or weed seeds in a sample upon customer (grower, cleaner or dealer) request to make informed decisions for re-cleaning or other decisions.

V. Other Research Projects:

This area focuses on any seed related research in response to specific needs of research, extension, industry customers that are working on seed related projects. The following are some examples that were completed in the last few years:

Completed Projects

- The effect of maturity stages on purity and viability of some native species.
- Germination and dormancy studies of native species such as sedges *(Carex mertensii)*.
- Purity and TZ study to identify, quantify, and measure the viability of bird seeds
- The effect of heat treatment on breaking seed dormancy and increase germination of seeds.
- Ploidy germplasm screening for California brome.
- Ploidy germplasm screening for St. Augustinegrass and other species.
- Effects of various seed coating on germination of some grasses.

Future Projects

- Future projects are open to the needs of customers in seed related areas such as: moisture content, purity, germination, vigor, seed identification, ploidy, TZ, seed

search in soil or compost or feed pellets, etc. The lab will provide expertise in designing study, performing experiments, and analyzing data.

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