COOPERATIVE EXTENSION
COLORADO STATE UNIVERSITY
SEPTEMBER-OCTOBER 1999
VOLUME 19
ISSUE 8

agronomy news

Source Identification Program Is In The Works

Colorado Seed Growers program helps growers provide information and quality seed to buyers.

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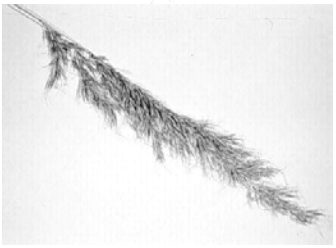

The Colorado Seed Growers Association (CSGA) is establishing a Source Identified Seed Certification program for Colorado. As a member of the Association of Official Seed Certifying Agencies (AOSCA), CSGA is using the guidelines that AOSCA has published concerning:

- "Pre-Variety Germplasm Certification Standards" for the certification of germplasms which have not reached variety status;
- "Woody Plants and Forbes Certification Standards";
- "Grass Certification Standards" for certification of seed of germplasms which have been released as a variety.

These standards apply to either wildland-collected or field-produced seed, and give a reliable way for the seed industry to offer seed of races or ecotypes to the buyer with genetic identity maintained along with accurate collection site information.

According to these certification standards, a race or ecotype of a native or naturalized species may

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Seed ID

(Continued from page 1)

be categorized into one of four classes:

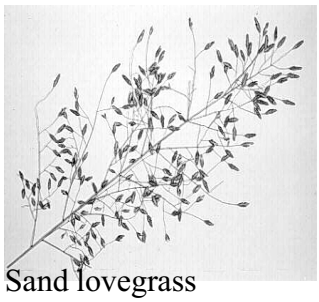
- Source Identified (yellow tag) – Comparisons with other Germplasm collections, accessions, or ecotypes of the same species not known.
- Selected (green tag) – Shows promise of superior and/or identifiable traits as contrasted with other Germplasm accessions, ecotypes or variety/cultivars of the species. Selection criteria and supporting comparative data is required.
- Tested (blue tag) – Requires progeny testing to prove that traits of interest are heritable in succeeding generations. Testing procedures (number of sites, generations required, etc.) are outlined for each species by certification agencies.
- Variety (Foundation – white tag, Registered – purple tag, and Certified – blue tag generations) – Applicable to a Tested Germplasm which, in the estimation of the developer, has sufficient marketplace potential to warrant release as a variety in compliance with Federal and State seed laws.

Canada wildrye

CSGA responsibilities

These responsibilities include developing and printing a Certified Seed Site Identification Log sheet for use by seed collectors. These log sheets will be available from seed brokers (dealers and conditioners) and from the CSGA and other agencies. This log will serve as a way to organize information such as:

- Collector's name, address and telephone number;
- Permit number; contract number, private land designation, etc.;
- Species and common name;
- Location (State, County, and elevation). It is strongly recommended additional information, such as soil type, aspect, and associated species is given, as this information would be extremely useful to the end user;
- Date(s) collected;
- Amount collected;
- Lot designation (must be indicated on bag or container also);
- Signature of collector signifying the information is correct;
- Signature of seed broker indicating that to his or her knowledge information is correct.



Sand lovegrass

CSGA will evaluate completed log sheets, seed broker's records and related documents in determining certification eligibility of seed lot. CSGA will also conduct thorough investigations on at least 5% of eligible seed lots, including verification of paperwork and prior and/or retroactive field inspection of collection sites to verify that stands are capable of producing the amount of seed indicated. Evidence of falsified logs or documents may result in loss of certification privileges.

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agronomy news
is a monthly publication of Cooperative Extension, Department of Soil & Crop Sciences, Colorado State University, Fort Collins, Colorado.
Web Site:
http//www.colostate.edu/Depts/SoilCrop/extens.html

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Seed ID

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CSGA will provide an official Source Identified, Selected, Tested, or Variety tag with appropriate site and Germplasm information. Test results, including purity, a current germination and germination date will also be printed on the tag.

Collector's responsibilities

When seed is collected for certification in the Source Identified program, the collector of the seed must complete the following actions:

Indiangrass

- Obtain, as applicable, a permit or contract/bid (for public lands) or written permission (for private lands) prior to collection.
- Keep a certified Seed Site Identification Log for seed for which certification tags are desired.
- Upon first sale, the collector will present to the seed broker copies of applicable LMA permits or private land permission documents, and signed log sheets pertinent to the seed being sold.
- Provide plant characteristics that distinguish the plant from other similar species including copies of pictures and/or drawings if available. If an identification authority has verified the species, include their written findings.

Seed broker responsibilities

Many times the collector and the broker are not the same. If the collector markets his own seed, the broker responsibilities should be included with the collector's responsibilities. The broker is required to do the following:

- Inspect information provided on permits and log sheets and sign log sheets to attest that the information is correct to the best of his or her knowledge.
- After cleaning and conditioning, have seed sampled, tested and labeled according to all CSGA, State, and Federal regulations.
- Attach tags to all bags of the seed lot that has been certified.
- Make available to CSGA office all records on certified seed lots.
- Obtain permission from the CSGA before blending lots of certified seed.
- Pay fees for certification. Fees to be determined at next CSGA Board Meeting.

The Source Identification program gives credibility that the seed lot being sold has a certain background. The elevation, slope, soil type and location where the seed was collected are important to the buyers of certain species. The ecosystem of the collected seed lot gives the buyer the assurance that the seed will result in plants that are adapted to the area he or she is establishing. The third party inspection and labeling of the seed lot helps assure the authenticity of the seed lot's origin to the buyer of the seed.

This information is available in the 1999 AOSCA Genetic and Crop Standards and Operational Procedures Handbooks.

Gil Waibel
Manager
Colorado Seed Growers

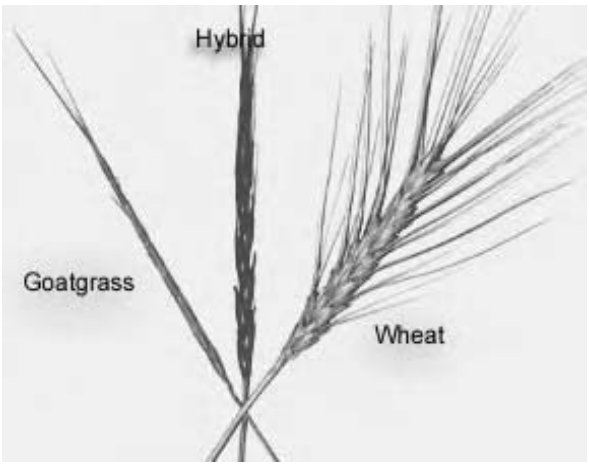
meet. . .

Sarah Ward joined CSU faculty in 1994. Her areas of expertise are crop breeding and genetics, germplasm evaluation and conservation and new and alternative crops. She has conducted various research projects on quinona, and a varietal identification project with mints. She holds the Bachelor of Science in Plant Sciences from University of London, the Master of Education in Science Education from East Carolina University, the Master and Doctorate in Crop Breeding and Genetics from Colorado State University.

Hybrid Goatgrass -- Is It A Problem?

Crossing between wheat and jointed goatgrass could create herbicide-resistant superweed.

Jointed goatgrass (*Aegilops cylindrica*) is a major weed of winter wheat in the western U.S., with over 5 million acres now infested. The weed, a native of Eastern Europe and Asia, first arrived in the US around 1900 in contaminated wheat seed brought by immigrants from Europe. In recent years, the increasing adoption of low-till cultivation practices has contributed to the spread of jointed goatgrass, and the similarity of the weed to wheat makes it very difficult to control. Jointed goatgrass shares 50% of its genes with wheat and closely mimics the life cycle of the crop, germinating with the wheat in the fall and flowering at the same time in the spring. Young goatgrass plants look very much like wheat seedlings. Cross-pollination can occur between wheat and goatgrass in the field, but until recently this was not considered a major problem as the resulting goatgrass-wheat hybrids are mostly sterile and produce very few seeds. Current research at the University of Idaho, however, has shown that although goatgrass-wheat hybrids produce little viable pollen themselves, they can easily be fertilized by pollen from nearby wheat plants, a process known as backcrossing. Goatgrass-wheat



hybrids were also found to backcross with pure goatgrass plants as well as with wheat, and in both cases the resulting plants could produce seed.

There is now much interest in the commercial possibilities of wheat engineered to contain herbicide-resistance genes. Researchers at Monsanto are working on Roundup-Ready wheat, and imidazolinone-resistant winter wheat varieties - on which herbicides such as Pursuit can be safely used - are already in the field in the northwestern U.S. Herbicide-resistant wheat could be one of the best hopes for selective control of weeds such as jointed goatgrass in wheat fields. The discovery that goatgrass-wheat hybrids will backcross to wheat, however, raises fears that wheat pollen could transfer herbicide-resistance genes to wheat-goatgrass hybrids, which in turn could spread the gene into the general jointed goatgrass population to create herbicide-resistant "superweeds". Indeed, the research team at Idaho has already found a small number of imidazolinone-resistant goatgrass-wheat hybrids growing in test plots of herbicide-resistant winter wheat, and it is very likely that these hybrid plants acquired the resistance gene from the wheat through fertilization with wheat pollen.

The best hope for avoiding the creation of herbicide-resistant jointed goatgrass populations is to engineer wheat varieties which have herbicide-resistant genes located on those chromosomes which wheat does not share with goatgrass. This would prevent gene transfer from wheat to weed. Meanwhile, researchers suggest that herbicide-resistant wheats should be used in rotation with broadleaved crops, allowing control of jointed goatgrass with alternative chemicals in the intervening years.

Dr. Sarah Ward
Assistant Professor of Plant Breeding and Genetics
Department Soil and Crop Sciences
Colorado State University

Seed Testing Rules Confusing

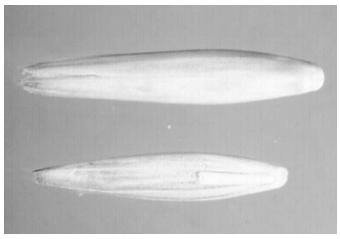
A seed analyst's explanation of how we got to this set of rules.

Recently, a novice seed producer called me to talk about germination and purity procedures. When I recommended the Association of Official Seed Analysts (AOSA) Rules for Testing Seeds, the seed analyst's primary reference, he said, "Oh, that's such a legalistic document. It's hard to understand." My reply was, "It has to be. Regulatory agencies need standardized methods for applying their seed labeling laws. Millions of dollars of seed sales rest on information generated from standardized seed tests."

I think the difficulty of reading the AOSA Rules for the first time is that no background is given for the seemingly arcane details. One such detail is found in Section 2.10 Inert matter, subsection b., part (2). Below this 2.10 b (2) are two entries d and e. Section (d) reads "Immature florets of quackgrass (*Elytrigia repens*) that are 2mm or less in length." and section (e) reads "free caryopses of quackgrass (*E. repens*) that are 2mm or less in length." The reader has no information about the source of this rule. Why 2mm? Why does this apply specifically to quackgrass? Nearly every section in the book generates these kinds of questions. And who is the AOSA anyway?

The AOSA is the Association of Official Seed Analysts (see www.zianet.com/aosa/index.html). Actually it is an association of official (state and federal) seed laboratories of the U.S. and Canada; each laboratory has one vote at its annual business meeting. Every year the AOSA votes on rule change proposals submitted to the AOSA Rules committee. Though this is its primary responsibility, the AOSA has many other activities besides producing and maintaining the AOSA Rules for Testing Seeds.

The fact that the AOSA rules are amended yearly, while well-known to analysts who use the Rules daily, is apparently unknown to many researchers. I read seed research articles published in journals like Ecology, Journal of Range Management and Crop Science. Almost always, any reference to the Rules is many years old. Libraries do not keep up with the updates. CSU's Morgan Library's latest copy (according to SAGE) is 1975! Why should we care about updates? Methods change and are refined. New species are added. The AOSA (member lab employees), and its sister organization, The Society of Commercial Seed Technologists (SCST) memberships combined are probably fewer than 600 people. These are people engaged in the business of seed testing without a lot of time and money for research. We need all the help we can get from researchers in related disciplines who study seeds. The more they know about our current practices, the more they can help us.



Quackgrass

Getting back to section 2.10 b (2) (d) and (e) and the questions provoked, where did this Rule come from?

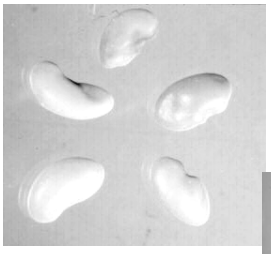
The answer is a cautionary lesson in how we retrieve and use information today. Legal professionals are used to digging deep for the historical view. We in the sciences should use this approach more often. The answers to our 2.10 b (2) (d) and (e) questions come from the 1916 Proceedings of the ninth annual meeting of the AOSA. R. C. Dahlberg of Minnesota reported on "The Germination of Seeds of *Agropyron repens*" (*Elytrigia repens* to us now). During the growing season of 1915, notes were taken about flowering dates and other characteristics. Starting with eight days after flowering, and every four days after, spikelets

(Continued on page 6)

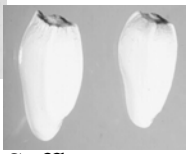
Seed Storage Life Complex Issue

Kind of seed, quality of seed, and storage conditions impact life.

Seed storage life depends on the kind of seed being stored, quality of seed stored and the storage conditions. Harvested seed should be dried to a safe storage moisture content, conditioned and placed into storage under proper storage conditions for the length of storage desired. Most seeds can be stored in ambient (uncontrolled) conditions for short-term storage (1 to 5 years). If long-term storage is desired, the seed must be dried to the proper moisture content for subzero temperature storage. Then, the seed should be sealed in a moisture proof container or stored in a dehumidified room.



Alfalfa



Safflower

The ability to store seed for long or short periods of time has been very beneficial to agriculture throughout the world. Most farmers usually store seed from one season to the next, and plant breeders store their breeding lines for a number of years. Genebanks such as the National Seed Storage Laboratory in Fort Collins, Colorado, are established to store basic genetic material for decades. In any case, when storing seed for any of the above reasons, it is important that seeds can be dried and stored at low temperatures.

Over the years, many scientists have reviewed the longevity of seed. Some of the reports of "Mummy" wheat seeds surviving 3000 years in Egyptian pyramids are clearly impossible to believe. Any seed stored under those conditions would be completely carbonized and could not germinate. However, evidence from other archeological sites, museum herbaria, and buried seed experiments indicates that seeds can survive for many years. Recent studies of seed of a Sacred Lotus (*Nelumbo nucifera*) plant have suggested that these seeds may have survived in an ancient lake bed at Pulantien, Liaoning Province, China, for 95 to 1,288 years. Even these data can be questioned, as the lake dried up over 200 years ago and one of the seeds was reported to be only 95 years old. Sacred lotus plants are aquatic. Other well-documented studies on the longevity of seed viability indicate that three of twenty-three species subjected to 100 years of burial (1880-1980), from a study by Beal, were viable. The three viable species were Malva rotundifolia, Verbascum blattaria and V. thapsus. The oldest

(Continued on page 12

Seed Testing

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were picked and seeds germinated in a chamber. These were compared with harvest dates for other crops such as brome grass, barley and oats. Spikelets of quackgrass contained germinable seeds as soon as eight days after flowering! Even by the time of Brome grass harvest, 48% of the florets of quackgrass had matured sufficiently to germinate. In 1954, Leroy Everson reported research done by Iowa State College on quackgrass germination with respect to the caryopsis length. This research is the basis for rule 2.10 b (2) (d) and (e).

What is the cautionary lesson? In this case, it is a reminder that research from 1916 and 1954 provided the critical foundation for what we do today in 1999. The research is not outdated. It is not obsolete, and it is still essential. Also, wonderful as the internet is, you won't find the answer to these questions there.

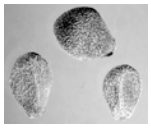
Annette Miller
USDA-ARS-National Seed Storage Laboratory

Colorado Noxious Weed Lists

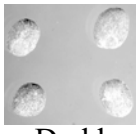
Two different acts create a dual classification system.

Weed Name		Weed Act	Seed Act	
Common	Scientific		Prohibited	Restricted # seed/lb
Anoda, spurred	*Anoda cristata*		X	
Bindweed, field	*Convolvulus arvensis*	X	X	
Blueweed	*Helianthus ciliaris*			200
Bouncingbet	*Saponaria officinalis*	X	X	
Brome, downy	*Bromus tectorum*	X		
Burdock, common	*Arctium minus*	X		200
Butterprint or Velvetleaf	*Abutilon theophrasti*	X		10
Camelthorn	*Alhagi pseudalhagri*	X	X	
Caraway, wild	*Carum carvi*	X		
Chamomile, Mayweed	*Anthemis cotula*	X		
Chamomile, scentless	*Anthemis arvensis*	X	X	
Chicory	*Cichorium intybus*	X		
Cinquefoil, sulfur	*Potentilla recta*	X	X	
Clematis, Chinese	*Clematis orientalis*	X	X	
Cress, hoary	*Cardana draba*	X	X	
Daisy, oxeye	*Chrysanthemum leucanthemum*	X	X	
Dock, curly	*Rumex crispus*			50
Dodder	*Cuscuta spp.*			20
Filaree, redstem	*Erodium cicutarium*	X		
Flixweed	*Descurainia sophia*	X		
Foxtail, giant	*Setaria faberi*			50
Foxtail, green	*Setaria viridis*	X		
Foxtail, yellow	*Setaria glauca*	X		
Goatgrass, jointed	*Aegilops cylindrica*	X	X	

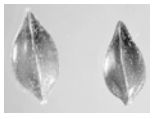
The state of Colorado has two separate noxious weed lists. There is the Colorado Noxious Weed Act with a list of targeted noxious weeds; and a list of noxious weed seeds in the Colorado Seed Act. Copies of each of these acts can be obtained from the Colorado Department of Agriculture (see website page for current internet address). This article will give a comparison of the two noxious weed lists, and explain why they are different.



Bindweed



Dodder



Dock, curly

The definition and the intent of the two noxious weed lists are different. In the Colorado Noxious Weed Act, a "Noxious weed" means an alien plant or parts of an alien plant that have

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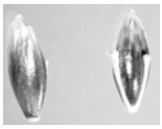
Noxious weeds

(Continued from page 7)

been designated by rule as being noxious or has been declared a noxious weed by a local advisory board, and meets one or more of the following criteria:

- Aggressively invades or is detrimental to economic crops or native plant communities;
- Is poisonous to livestock;
- Is a carrier of detrimental insects, diseases, or parasites;
- The direct or indirect effect of the presence of this plant is detrimental to the environmentally sound management of natural or agricultural ecosystems.



Johnsongrass

According to the Colorado Seed Act, a "Noxious weed seed" means the seed produced from plants which are especially troublesome and detrimental, and which may cause damage or loss to a considerable portion of land or livestock of a community. Noxious weed seeds are divided into two classes: "prohibited noxious weed

Colorado Noxious Weeds (continued)

Weed Name		Weed Act	Seed Act	
Common	Scientific		Prohibited	Restricted # seed/lb
Groundcherry, purpleflower	*Quincula lobata*			50
Groundsel, common	*Senecio vulgaris*	X		
Halogeton	*Halogeton glomeratus*	X	X	
Hemlock, poison	*Conium maculatum*	X		10
Henbane, black	*Hyoscyamus niger*	X		10
Horsenettle, Carolina	*Solanum carolinense*		X	
Horsenettle, white	*Solanum elaeagnigolium*		X	
Houndstongue	*Cynoglossum officinale*	X	X	
Johnsongrass	*Sorghum halepense*	X	X	
Knapweed, black	*Centaurea nigra*	X	X	
Knapweed,diffuse	*Centaurea diffusa*	X	X	
Knapweed,Russian	*Centaurea repens*	X	X	
Knapweed,spotted	*Centaurea maculosa*	X	X	
Knapweed,squarrose	*Centaurea virgata*	X	X	
Kochia	*Kochia scoparia*	X		
Lettuce, blue	*Lactuca tatarica subsp. pulchella*			200
Loosetrife, purple	*Lythrum salicara*	X	X	
Loosetrife, purple	*Lythrum virgatum*	X	X	
Mallow, Venice	*Hibiscus trionum*		X	
Millet, wild proso	*Panicum miliaceum subsp. ruderale*	X	X	
Mullein, common	*Verbascum thapsus*	X		
Mustard, black	*Brassica nigra*			30
Mustard, blue	*Chorispora tenella*	X		
Mustard, India	*Brassica juncea*			30
Mustard, wild	*Sinapsis arvensis*	X		30

(Continued on page 9)

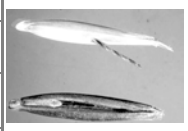
Noxious weeds

Colorado Noxious Weeds (continued)

Weed Name		Weed Act	Seed Act	
Common	Scientific		Prohibited	Restricted # seed/lb
Mustard, black	*Brassica nigra*			30
Mustard, blue	*Chorispora tenella*	X		
Mustard, India	*Brassica juncea*			30
Mustard, wild	*Sinapsis arvensis*	X		30
Nightshade, black	*Solanum nigrum*	X		
Nightshade, hairy	*Solanum sarrachoides*	X		
Nutsedge, yellow	*Cyperus esculentus*	X	X	
Oat, wild	*Avena fatua*			10/lb in oats, barley, wheat, rye and tirticale 100 per lb in other species
Pepperweed, perennial	*Lepidium latifolium*	X	X	
Plantain, buckhorn	*Plantago lanceolata*			100
Povertyweed, mouse-ear	*Iva axillaris*			200
Povertyweed, silverleaf	*Ambrosia tomentosa*		X	
Povertyweed, woollyleaf	*Ambrosia grayi*		X	
Puncturevine	*Tribulus terrestris*	X		50
Quackgrass	*Elytrigia repens*	X		50
Rocket, Dame's	*Hesperis matronalis*	X		
Rue, African	*Peganum harmala*	X	X	
Rye, Medusahead	*Taeniatherum caput-medusae*		X	
Sage, Mediterranean	*Salvia aethiopis*	X	X	
Saltceder	*Tamarix parviflora*	X	X	
Saltceder	*Tamarix ramosissima*	X	X	
Sandbur, longspine	*Cenchrus longispinus*	X		50
Skeletonweed, rush	*Chondrilla juncea*	X	X	
Sorghum, almum	*Sorghum x almum*		X	

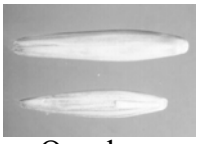
seed" and "restricted noxious weed seed" and are defined as follows:

- "Prohibited noxious weed seed" means the seed of perennial, biennial and annual weeds, which are highly detrimental and especially difficult to control. The presence of prohibited noxious weed seed in seeds precludes the sale of seed for propagation. Prohibited noxious weed seed includes the seed of any weed so designated by the commissioner.



Oat, wild

- "Restricted noxious weed seed" means the seed of weeds which are very objectionable in fields, lawns and gardens but which can be controlled by good cultural practices. Restricted noxious weed seed includes the seed of any weed so designated by the commissioner.



Quackgrass

Editorial note: In the last year, allowable limits on how many seeds per pound of a restricted noxious weed seed have been defined. These limits are listed in the enclosed table.

There are some important

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Noxious weeds

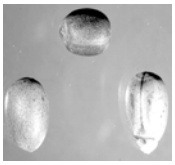
(Continued from page 10)

issues to discuss about the two different noxious weed lists. The Colorado Noxious Weed Act is an overall statewide effort to identify and target undesirable weeds throughout the state. Each county has input as to what species are on this list. There are many ecosystems in the counties throughout our diverse state. Each county wants to target different weeds. An agricultural county will focus on hard to control, or poisonous species, while a county that is more urban or recreational will target different kinds of species. Downy brome is a good example. Downy brome has been responsible for many fires in recreational parts of the state, particularly in grassland and mountainous environments. Downy brome is very invasive, but is easily controlled in an agricultural cropland environment, and if controlled, it is of little economic importance. Since downy brome is so prevalent throughout the state, it is very difficult to produce grass seed without any downy brome contamination. The cost of agricultural and horticultural seed would be very high if we made downy brome a noxious weed on the Colorado Seed Act's "Noxious Weed Seed" list. This does not mean that seed sold in Colorado will be highly contaminated by downy brome. Seedsmen make every effort to produce weed free seed. Seed analysts find a very low number of downy brome seed in most grass samples. However, downy brome is one of the most commonly

(Continued on page 11)

Colorado Noxious Weeds (continued)

Weed Name		*Weed Act*	*Seed Act*	
Common	**Scientific**		**Prohibited**	**Restricted # seed/lb**
Sowthistle, perennial	*Sonchus arvensis*		X	
Spurge, cypress	*Euphorbia cyparissias*	X	X	
Spurge, leafy	*Euphorbia esula*	X	X	
Spurge, myrtle	*Euphorbia myrsinites*	X	X	
St. Johnswort, common	*Hypericum perforatum*	X	X	
Starthistle, yellow	*Centaurea solstitialis*	X	X	
Tansy, common	*Tanacetum vulgare*	X		
Tarweed, coast	*Madia sativa*	X	X	
Teasel, common	*Dipsacus sylvestris*	X		
Thistle, bull	*Cirsium vulgare*	X		10
Thistle, Canada	*Cirsium arvense*	X	X	
Thistle, musk	*Carduus nutans*	X	X	
Thistle, plumeless	*Carduus acanthoides*	X	X	
Thistle, Russian	*Salsola collina*	X		
Thistle, Russian	*Salsola iberica*	X		
Thistle, Scotch	*Onopordum acanthium*	X	X	
Thistle, Scotch	*Onopordum tauricum*	X	X	
Toadflax, Dalmation	*Linaria dalmatica*	X	X	
Toadflax, yellow	*Linaria vulgaris*	X	X	
Velvetleaf or Butterprint	*Abutilon theophrasti*	X		10
Whitetop	*Cardaria draba*	X	X	
Whitetop, hairy	*Cardaria pubescens*		X	
Whitetop, tall	*Lepidium latifolium*	X	X	
Woad, Dyer's	*Isatis tinctoria*	X	X	



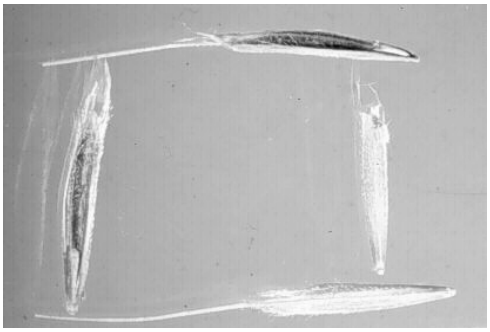
Spurge

Noxious weeds

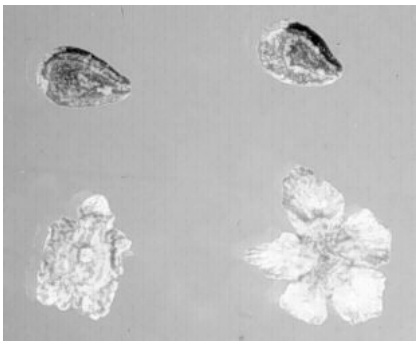
(Continued from page 10)

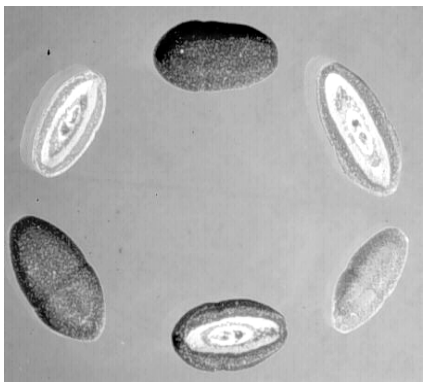
found weed seeds in grass samples. For those who are planting seed, and downy brome is unwanted in the seed lot, the buyer can specify a "downy brome free" lot of seed from the vendor of the seed. Some buyers even have the seed lot being purchased tested by a lab of their choice.

The Colorado Noxious Weed Act focuses on problem weeds that are in our state, as well as species that are expected to invade our state. Problem weeds are defined as alien (not native to Colorado), aggressively invades or invasive (a plant population that spreads rapidly and chokes out species that formerly occupied an area), poisonous, carries detrimental insects, diseases or parasites, and affects the sound management of natural or agricultural ecosystems.



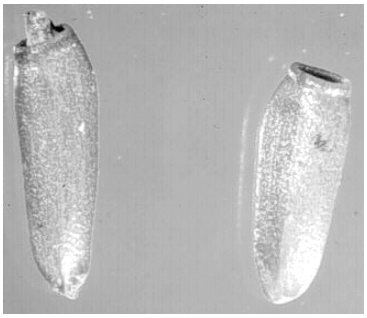
The Colorado Seed Act noxious weed seed list also considers the economic impact of noxious species within the state, as well as species that have not yet invaded our state. Not all seed planted in Colorado has been produced in Colorado. The seed act has identified some species that we do not want introduced into our state from other states, especially by means





From top to bottom: Buckhorn plaintain, Downy brome, Canada thistle, Kochia

of purposeful introduction by seed or by contaminated seed lots. The Seed Act does not concern itself with the concept of "Alien" species. Most of our major economic crops are not native. Where the Seed Act does address "alien" species, is to identify some species that are invading other states, and not Colorado. Purple loosestrife and Medusahead rye are examples of species we do not want in our state. Purple loosestrife is a beautiful, but very invasive plant, and is on both noxious lists. Loosestrife has become very invasive in a number of western states, and Colorado does not want this plant to establish itself here. Currently, Medusahead rye is only on the Seed Act list. Medusahead rye is not known to be in our state as yet, and we do not want it to be introduced through any seed lots imported into our state.



Both noxious weed lists must support each other in every way possible. We must be empathetic to a species that may not be a problem in our area, but is of major importance to another area. While the two noxious weed lists are different, they do co-exist in an effort to control noxious weeds in the state of Colorado.

Gil Waibel
Manager
Colorado Seed Growers Association

Storage

(Continued from page 6)

viable seeds from herbarium specimens of Cassia multijuga stored in the Museum of Natural History in Paris, France, were reported to be 158 years old.

Most agronomic and weed species are considered to be long lived, while most vegetable seeds are reported to be relatively short lived. However, recent studies showed extended longevity of vegetable seeds once stored (15 to 30 years) in ambient temperatures at Cheyenne, Wyoming, and are now stored at the National Seed Storage Laboratory at -18° C (0° F). For example, tomato seeds stored for 60 years germinated 82%, pea seeds stored for 51 years germinated 94%, and pepper seed stored for 51 years germinated 28%. These data suggest that the longevity of seed can be extended if proper storage conditions are utilized.

For successful seed storage, the factors causing seed deterioration must be reduced or, if possible, eliminated. Seed deterioration begins to occur when the seed reaches physiological maturity and the seed is dried down to a safe storage moisture content. During the ripening period, the seed is no longer connected to the mother plant and is susceptible to the surrounding environment. Some of these detrimental environmental conditions are heat, frost and rain. In addition to these environmental conditions, the seed can be damaged during harvest by improper use of harvesting or conveying equipment. The conditions of storage can also affect the longevity of the seed while in storage.

The most critical conditions for seed in storage are seed moisture content and the temperature of the storage area. In addition to these factors, the freedom from inert material is important for long-term storage. Both diseases and insects can live on inert material present with the seed in storage. The temperature and relative humidity of the storage area determine the moisture content of the seed. Seeds are hygroscopic, which means that the seed takes-up or gives-off moisture to the surrounding atmosphere. The dryer the environment, the better seeds store at ambient temperatures. Generally, most seeds should be stored at low seed moisture content and at low temperature. However, when the temperature is lowered, the relative humidity increases because warm air holds more moisture then cold air. Consequently, for long-term storage the seed will need to be dried to a safe moisture content of 5 to 8% and sealed in a moisture proof container for storage in a low or subzero temperature. These conditions are not possible for large seed lots, and can only be used for small lots of basic seed stocks.

When seeds are stored at a moisture content which is not optimum, several problems can occur. Seed stored at 18 to 20% moisture content will be damaged due to heating. The heating is caused by seed respiration. As the temperature of the seed mass increases, the activity of microorganisms and insects increases, causing the seed to be damaged or killed. Microorganisms, mainly fungi, are active when the seed moisture is 18 to 30%. At ambient temperatures, seed moisture contents of 18 to 30% can be reached when the relative humidity is above 70%. At ambient temperatures and moisture contents of 8 to 9 %, insects can still damage seed. One method of controlling insects at this low moisture content is to fumigate the seed or reduce the oxygen content to below 14%. Insects can also be controlled by reducing the temperature of storage to 5° C or below. Temperature is another important factor for long-term seed storage. Generally, the lower the temperature the longer the life of the seed. However, as temperature decreases, the relative humidity of the storage area increases causing the moisture content of the seed to increase, unless the seed is stored in a moisture proof container. For unsealed short-term storage, it is recommended to store seed at 50° F and 50% relative humidity or less. Another way to determine if your conditions are good for short-term storage is to determine if the sum of the temperature °(F) and the percent of relative humidity does not exceed 100.

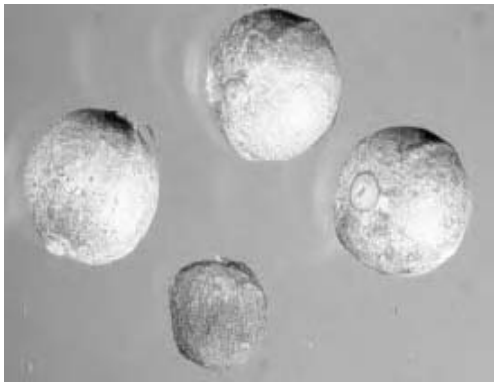
Proper seed storage takes effort. Proper moisture content and the temperature of the stored seed must be monitored throughout the year. If the seed lot is of high quality, one can expect to carry over a seed lot for several years depending on the species.

Loren E. Wiesner
National Seed Storage Laboratory

What Does the "Labeled Germination Percent" Mean?

Kind of test, size of sample, and testing treatment can all impact the germination results.

Back in 1993, I wrote an article on why potassium nitrate, KNO_3, was recommended in the Association of Official Seed Analysts (AOSA) Rules for Testing Seeds for the enhancement of germination with some particular species. Part of the reason for writing that particular article was that some Colorado farmers had bought certified crambe seed from North Dakota which was stated to germinate at 80% on the seed tag. Five hundred acres of this seed was planted in the early spring and emerged with such poor performance that the acreage was eventually replanted to sunflowers. Unfortunately for the growers, the crambe began to emerge in midsummer that season and functioned as weeds throughout the rest of that growing season.



A sample of the seed was sent to the Colorado Seed Laboratory where it was germinated in a paired test, with and without KNO_3. The results revealed that with KNO_3 the seed lot germinated at 93%. The germination results without KNO_3 showed 16% germination and 79% dormancy by TZ, giving a total viability of 95%. The original germination test in North Dakota was performed by the AOSA Rules for Testing Seeds which states that (as of 1992), crambe was to be tested with KNO_3 if it is fresh seed and dormant. Well, this seed lot was obviously dormant.

The question which all of this brings to mind is, what is the role of a seed laboratory and the seed tests to the industry and the consumer? Do the results of the seed test have any reflection of the performance of a seed lot? Are they scientifically objective enough to be used as a predictive tool for the seed industry? This KNO_3 controversy is still viable today as an indicator of the health of the seed testing industry.

I think we would all agree that the germination test is a subjective test. Most of us see this as subjective from the human side. It is the analyst who brings the subjectivity to the germination test, but this isn't wholly so. It must be remembered that seed lots are not uniform. A seed lot is a population of seeds and, as with all biological populations, displays certain deviations from the norm. These may be caused by genetic factors, mutations, improper handling, and with our germination tests, strong deviations may be caused by improper or poor sampling. Genetics tells us that the F1 hybrid is supposed to be an equal mixture of the parents, and thus uniform, so we believe this. But those involved with genetics know that this is true only if certain variables are brought under control. The inbreeding must be complete and 100% for uniformity to be brought to the hybrid. Just look at any human family and see the diversity of crossing two parents without having inbred control over the parents. Statistically, inbreds in our breeding programs are not pure. Certification requirements reflect this and allow a certain percentage of permissible "off-types" to be seen within the seed lot population.

The AOSA has developed the germination rules for truth in labeling purposes under the regula-

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Germination

(Continued from page 13)

tions of the Federal Seed Act. The requirements for germination of a particular species reflect optimum laboratory germination. They make no claims for field performance or for germination under natural conditions. The purpose of the germination test is to give the potential of the seed lot if grown under the most favorable of conditions. The germination test results are meant to be used for making informed decisions in selling and buying of seed. They are to rate the potential quality of various seed lots, so the consumer is truthfully aware of what they are receiving.

Unfortunately, most people place more value on the germination test than can be taken credit for. This is seen in our KNO_3 example. Through research, it was found that crambe is one of those species which under the most favorable conditions responds to the nitrate in KNO_3 to break dormancy and give the best germination results. Looking at how nitrate levels in tilled soils vary under natural conditions, it is seen that nitrate is generally low in the spring when the weather is cool and high when the weather is warmer in late spring/early summer. So, it can be assumed that the crambe was responding in the above example as it should, germinating in early summer when the natural conditions reached the favorable conditions reflected in the laboratory germination test. Naively, most consumers would assume that the maximum germination potential should be reached quickly upon planting as the germination percentage on the tag seems to reflect this. The AOSA tag does not claim uniform and speedy germination, but that maximum germination under the most optimum conditions will produce this germination. This is the realm of vigor tests.

So, we are back to the original question. What is the role of the seed laboratory to the seed industry and to the consumer? Where in the KNO_3 example should we look for truths and wrongs? The true fact is that an understanding of the germination test and an understanding of the crop itself and its ecology could have avoided much misfortune. The test is a laboratory test. It may be that the AOSA should be required to perform a paired tests when applying dormancy breaking methods and to report the results of both. This would inform the seed company of a potential for unfavorable germination in the field if the same dormancy breaking conditions don't exist. This could also come about by the seed company requesting one or more vigor tests which would have supplemented the general information gathered from the standard germination results.

From the consumer's point of view, a knowledge of what the standard germination test is and what can be anticipated from its results may have averted the problem. I believe that a better understanding of the crop they were planting would have benefited them also. Crambe is a species which can begin germination at 20° C. This suggests that a late spring planting would be the most optimum. This is the period when the average soil temperature reaches 20° C. If you look in the AOSA Rules for Testing Seeds, you will find that 25° C is the other optimal germination temperature. This shows us that this species really likes temperatures higher than 20° C. Lower temperatures which occur with early spring planting would be less than optimal and may even increase the dormancy. Research has shown that crambe seed loses it's dormancy in time when stored. This also gives us the clue that if held until later, a more favorable period for germination will occur.

Other chemicals are used in the AOSA Rules for Testing Seeds to break dormancy or to bypass some of the dormancy mechanisms. A solid understanding of these methods by the seller and the buyer can prevent costly mistakes. The germination test IS subjective, but the analyst is not the only problem here. One of the main objectives of seed testing organizations is to educate the public as to what the results mean. The results of the germination test should not be taken as written in stone. They mean many things to different people. Communication as to what they are and how they are to be used should be top priority of all parties concerned with the sale or buying of seed.

Jim Bruce
USDA- ARS Seed Viability and Storage
National Seed Storage Laboratory

web sites

Rules pertaining to the Colorado Noxious Weed Act.
www.ag.state.co.us/DPI/rules/noxious.html

Actual text of the Colorado Seed Act.
www.ag state.co.us/DPI/rules/seed.pdf

Information on the organization with links to other sources of information.
http://www.colostate.edu/Depts/SoilCrop/extension/CSGA/default.html

Explanation of the USDA APHIS program and provides numerous links.
www.aphis.usda.gov/ppq/weeds/weedhome.html

Information on the international seed industry.
www.aiznet.com

Directories, discussions, and workshops for the Society of Commercial Seed Technologists.
www.seedtechnology.net

News, directories, a link to the Grain Handlers' Database at this American Seed Trade Association site.
www.amseed.com

Publications, events, and directory for Association of Official Seed Certifying Agencies.
AOSCA.org

Events, directory for Front Range Seed Analysts.
www.frsa.org

Events, publications, and directories for International Seed Testing Association
www.seedtest.org

Upcoming events and directories of Canadian seed industry.
www.seedanalysts.com

Links to functions, news and information on other pages.
www.aphis.usda.gov

On-line version of the magazine that serves seed industry.
www.seedworld.com

Links to news, information, various suppliers, and a global directory of the seed industry.
www.seedquest.com

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