HISTORICAL OVERVIEW OF THE SAGEBRUSH SEED INDUSTRY

Richard Stevens – UDWR Retired

Allan R. Stevens – Snow College
*Artemisia tridentata tridentata* – Basin Big Sagebrush

*Artemisia tridentata wyominensis* – Wyoming Big Sagebrush

*Artemisia tridentata vaseayna* – Mountain Big Sagebrush
Restoring Big Game Range in Utah
Major Factors that have Influenced the Acceptance of Sagebrush and the Development of the Sagebrush Seed Industry

A. Overcoming Negative, Anti-sagebrush Attitudes
B. Species Identification
C. Seed Collection, Cleaning and Storage
D. Seed Quality
E. Identifying Source of Seed Collection and Collection Permits
F. Seeding Sagebrush
G. Seed Companies
H. Seed Purchase
A. Overcoming Negative, Anti-sagebrush Attitudes
B. Species Identification
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Wyoming Big (Artemisia tridentata ssp. wyomingensis)</th>
<th>Mountain Big (Artemisia tridentata ssp. wyaneyana)</th>
<th>Sagebrush (Artemisia tridentata ssp. tridentata)</th>
<th>Plant Shape</th>
<th>Flowering Stalks</th>
<th>Leaves</th>
<th>Color of foliage</th>
<th>Soil</th>
<th>Location</th>
<th>Flowering Date</th>
<th>Crushed leaf odor</th>
<th>Layering</th>
<th>August</th>
<th>Soil moisture available most of the growing season</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Shape</td>
<td>Flat top, multiple main stems 1 1/2 to 3 1/2 ft. (5 ft.) tall.</td>
<td>Flat top, multiple main stems 1 1/2 to 3 1/2 ft. (5 ft.) tall.</td>
<td>Uneven top, usually single main stem. 2 1/2 to 6 ft. (15 ft.) tall.</td>
<td>Flat top. Multiple main stems 1 1/2 to 3 1/2 ft. (5 ft.) tall.</td>
<td>Arise throughout crown, most extend above crown.</td>
<td>3 lobed. Higher elevation type fan shaped. Lower elevation type fan shaped to straight margins. In both types terminal leaves are whorled and arise in clusters along stem.</td>
<td>Gray-green</td>
<td>Deep, well drained.</td>
<td>Valleys, foothills</td>
<td>Mid Sept. to Mid Oct.</td>
<td>Bitter pungent typical sage smell (methacoloin)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
IDENTIFICATION CHARACTERISTICS OF MAJOR SAGEBRUSH TAXA AND SPECIES ADAPTED TO AREAS INHABITED BY EACH

On western range and wildlands sagebrush species occur on millions of acres. These areas are used extensively by big game, small game, non-game, wildlife species, and by livestock. Areas also provide important recreational, watershed, and riparian values. Major disturbances and detrimental effects of construction, mining, grazing, range enhancement projects, activities, climatic conditions, insects and disease have and will continue to reduce or destroy sagebrush areas.
Table 3—Characteristics of subspecies of *Artemisia tridentata* (adapted from McArthur 1983b).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>tridentata</th>
<th>vaseyana</th>
<th>Subspecies wyomingensis</th>
<th>spiciformis</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat and range</td>
<td>Foothills and valley floors. 4,000 to 7,000 ft (1,220 to 2,135 m). British Columbia and Montana to Baja California and New Mexico.</td>
<td>Foothills and mountains. 3,000 to 19,000 ft (915 to 5,790 m). British Columbia and Alberta to California and New Mexico.</td>
<td>Foothills and valley floors. 2,500 to 7,000 ft (760 to 2,135 m). Montana, Washington to Arizona.</td>
<td>High mountain areas. 7,000 to 12,000 ft (2,135 to 3,660 m). Oregon and Montana to Nevada and Colorado.</td>
<td>Beetle and Young 1965; Morris and others 1976; Winward and Tisdale 1977; McArthur and others 1978; McArthur and others 1979a; Dealy and others 1981; Winward 1980; Kelsey 1981.</td>
</tr>
<tr>
<td>Smell</td>
<td>Biter pungent</td>
<td>Pleasant</td>
<td>Biter pungent</td>
<td>Pungent, not bitter</td>
<td>McArthur and others 1974.</td>
</tr>
<tr>
<td>Essential oil</td>
<td>x = 1.4 percent</td>
<td>x = 2.2 percent</td>
<td>x = 1.1 percent</td>
<td>x = ?</td>
<td>Welch and McDonald 1981.</td>
</tr>
<tr>
<td>Leaf shape</td>
<td>narrowly cuneate</td>
<td>Cuneate to spatulate</td>
<td>Cuneate</td>
<td>Cuneate to narrowly cuneate</td>
<td>Marchand and others 1966; McArthur and others 1974; McDonough and others 1975; Winward and Tisdale 1977.</td>
</tr>
<tr>
<td>Common height ranges</td>
<td>3 to 13 ft (0.9 to 4 m)</td>
<td>2 to 5 ft (0.6 to 1.5 m)</td>
<td>1.5 to 3 ft (0.5 to 0.9 m)</td>
<td>2 to 5 ft (0.6 to 1.5 m)</td>
<td>McArthur and others 1979a; Winward 1980.</td>
</tr>
<tr>
<td>Sesquiterpenes compounds</td>
<td>4 to 7</td>
<td>3 to 6</td>
<td>2</td>
<td>5</td>
<td>Kelsey and others 1973.</td>
</tr>
<tr>
<td>Ultraviolet visible coumarins</td>
<td>Trace</td>
<td>Abundant</td>
<td>Trace, but often more than <em>tridentata</em>.</td>
<td>Abundant</td>
<td>Shafizdeh and Melinkoff 1970; Stevens and McArthur 1974; Brown and others 1975; McArthur and others 1981.</td>
</tr>
<tr>
<td>Tendency to layer</td>
<td>None</td>
<td>Mild</td>
<td>None</td>
<td>Very strong</td>
<td>Beetle and Young 1965; Winward 1980; Goodrich and others 1982.</td>
</tr>
</tbody>
</table>
A Simple Field Technique for Identification of Some Sagebrush Taxa

RICHARD STEVENS AND E. DURANT MEARTHUR

Highlight: A technique has been developed that provides an on-the-spot field test to aid in identification of some sagebrush taxa. Seeds, dried or green crushed leaf material, or stem cambium of various sagebrush taxa will produce distinctive shades of blue when wet and placed under longwave ultraviolet light. The technique is particularly helpful in separation of Artemisia tridentata subsp. tridentata from A. tridentata subsp. vasesyana. Subspecies vasesyana extracts are blue, whereas those of subsp. tridentata are not. All taxa producing blue water extracts are preferred by mule deer.

Recent observations have demonstrated that palatability on winter ranges of some sagebrush taxa relates closely to chromatographic patterns (Hanks et al., 1971, 1973; Hanks and Jorgensen, 1973). Taylor et al. (1964) noted the differential fluorescence in moist seeds of Artemisia tridentata subsp. tridentata and subsp. vasesyana under ultraviolet light. Subspecies vasesyana seeds fluoresce and subsp. tridentata seeds do not. We have observed that different shades of blue are apparent in various sagebrush taxa immediately after application of water under longwave ultraviolet light (e.g., black light lamps M-16 for use in the field or UV-21 for laboratory use from Ultraviolet Products Inc., San Gabriel, Calif.). This test is effective on fresh or dried material (crushed leaves, seeds, or broken stems) at any time of the year.

Because of the technique's simplicity and ease of use, it should prove useful for identifying sagebrush taxa. Taxa cannot be distinguished solely by color differences of water extract, but the color differences conveniently dovetail, so that taxa most likely to be confused on the basis of morphological criteria are in different color groups (Table 1). Subspecies Artemisia tridentata extracts show little color, whereas those of subsp. vasesyana are an intense blue. The third subspecies, wyomingensis, is recognized by a light-blue water extract. Extracts of a larger statured ecotype of subsp. wyomingensis from north-central Nevada (Brunner, 1972) show more blue than those of subsp. wyomingensis collections from western Wyoming. Artemisia tridentata subsp. tridentata and A. tridentata subsp. wyomingensis cannot always be separated by the color test, but the short stature and spatulate leaves of the latter subspecies contrast with the taller stature and narrow leaves of subsp. tridentata.

Color extracts are helpful in identifying some palatable species and ecotypes; e.g., two forms of A. nova have been identified (Tables 1 and 2) and designated as forms (a) and (b). Artemisia nova (a) tends to be more palatable and produces a bluer extract than A. nova (b). Beetle (1960) and Winward and Trudale (1969) also noted two forms of A. nova.

High preference is shown by mule deer for all taxa producing blue extracts. The intensity of the blue can be taken as a palatability indicator with two notable exceptions: A. tridentata subsp. wyomingensis, which exhibits little color, is highly palatable and A. bigelovii, which lacks color, is also palatable.

Table 1. Qualitative water soluble extract color groups of some Tridtatae taxa.

<table>
<thead>
<tr>
<th>Intense blue</th>
<th>Light blue</th>
<th>Pale blue to colorless</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. arbuscula</td>
<td>A. vasa</td>
<td>A. bigelovii</td>
</tr>
<tr>
<td>A. longiseta</td>
<td>A. rigida</td>
<td>A. nova (b)</td>
</tr>
<tr>
<td>A. nova (a)</td>
<td>A. tridentata wyomingensis</td>
<td></td>
</tr>
<tr>
<td>A. rothrockii</td>
<td>A. tridentata tridentata</td>
<td></td>
</tr>
</tbody>
</table>
Black light used to find deer feed

Ephraim, Sanpete County — The black light used by rockhounds has become the newest tool in scientific game management, thanks to the Utah Division of Wildlife Resources biologist and a U.S. Forest Service geneticist.

Richard Stevens of Wildlife Resources and Dr. E. Durrant McArthur of the Forest Service have worked out a method of detecting which of about "flavors" of sagebrush is palatable to deer.

Deer like only about half of the varieties, "with a distinct preference for the Vasey big sagebrush," said a Forest Service official. Up until now, game managers have had to take samples of brush back to the laboratory and do a series of tests to find out whether a deer herd is likely to graze in a particular area.

But Stevens and McArthur, both stationed here, discovered a lightweight, $30 mineral light used by rockhounds can provide on-the-spot analysis. The lamp, available in most lapidary supply stores, emits "black light," an ultraviolet wavelength, to show which minerals fluoresce.

The game manager crushes some sagebrush leaves in a small dish or his palm and adds a little water. Then he finds a dark place and turns the light on the leaves. If the color is an intense blue, he has found one of the deer's favorites.

The smell of sagebrush is also a "pretty good indicator," Forest Service officials add. What smells good to a man smells good to a deer. But this method of identification is considerably less accurate than the mineral light technique.

The new technique, published recently in the Journal of Range Management, is expected to be of tremendous help in game management planning.

The potential use of an area can be checked quickly. The game manager can decide if some sagebrush should be destroyed and the area seeded with more tasty species. He can also check seed to determine palatability in advance.

A proper sagebrush diet is critical to mule deer in winter, when it is their chief source of food.

Utahns Develop Way to Tell Value of Sagebrush to Deer

Sagebrush is just sagebrush to most Intermountain area residents, but to mule deer and game managers, it comes in 20 or more flavors.

Deer eat only about half of two dozen types in the Intermountain area — with a distinct preference for a few species. An inexpensive mineral light, lightweight and easy to carry, is the only piece of equipment the game managers use.

RICHARD STEVENS, game biologist for the Utah Division of Wildlife Resources, and Dr. E. Durrant McArthur, research geneticist for the Intermountain Forest and Range Experiment Station at Ogden, both men are stationed near Ephraim, Utah.
C. Seed Collection, Cleaning and Storage
RANGELAND SPECIES GERMINATION THROUGH 25 AND UP TO 40 YEARS OF WAREHOUSE STORAGE

Richard Stevens
Kent R. Jorgensen

ABSTRACT

Germination results are presented from seed stored in an open warehouse in Sanpete County, UT, for 19 shrub, 16 forb, and three grass species for 25 years, and 12 shrub, 20 forb, and 29 grass species for 0 to 40 years. Germination, longevity, and afterripening are discussed for each species and group of species through various periods of storage. Each species exhibited its own unique germination characteristics that varied with source and age of seed. Some species' viability increased with increasing age while others decreased with age.

INTRODUCTION

In 1981 Stevens and others published seed germination data for 32 shrub and forb species stored in an open warehouse through 15 years. These data along with 20 and 25 years germination data for seed of the same species and sources and six additional species are included in this report. In addition, germination results are given for 61 shrub, forb, and grass species with 0 to 40 years of storage.

A limiting factor to range rehabilitation can be the availability of quality seed of desired species at affordable prices. With most wildland species good seed crops are not produced every season: seed needs to be obtained in good years and stored until needed. It is not uncommon to store commercially produced seed. Seed may have to be stored for a few months to many years. Utah State law requires that marketed grass seed be tested every 16 months, and forb and shrub seed every 9 months. These requirements can differ by State. Rules and procedures for testing seed have been established for many wildland species (Stevens and Meyer 1996). Stored seed is generally not tested on a regular basis or prior to seeding when used by the person or agency storing it. Some species possess considerable afterripening, with maximum germinability not reached for a number of years following collection. Some species do not retain viability well, while others experience little change over long periods of storage. To obtain maximum seeding results and maximum return of dollars spent, it becomes imperative to know germinability over years and how long a species can or should be stored. Germinability of each species will affect the seeding rate.

Germination data of some range grasses stored a number of years have been reported (Hafenrichter and others 1965; Little 1967; Tiedemann and Pond 1967). However, longevity germination studies of wildland shrubs and forbs have been somewhat limited. Springfield (1968, 1970, 1973, 1974) worked with germination and longevity of stored winterfat (Onopordum acanthium) and fourwing saltbush (Atriplex canescens) seed. Longevity reports on germination of stored winterfat (Stevens and others 1977) and antelope bitterbrush (Purshia tridentata) seed (Giunta and others 1978) have been made. Plummer and others (1968) listed the duration of good viability for 44 shrubs, 24 forbs, and five grasses. Plummer and others (1970) also reported germination results after relatively short periods of storage on seed of a number of native shrubs and forbs. Two works from the U.S. Department of Agriculture, Forest Service (1948, 1974) included information on germination and longevity studies for native trees and shrubs. Van Haverbeke (1959) reported on viability of 20-year-old ponderosa pine (Pinus ponderosa) seed. Kay and others (1984) reported on germination of seed of 22 Mojave desert shrub species following 9 years of storage. Kay and others (1988) ran germination tests on seed of 115 desert grasses, forbs, and shrubs that had been stored for up to 14 years.

Seed of rangeland species in the Intermountain West are commonly stored in open, unheated, and uncooled warehouses and granaries, sometimes for extended periods. Little information is available as to the length of life of many warehouse-stored rangeland seeds.

METHODS

Study 1: Germination Through 25 Years of the Same Seed Sources—During the fall of 1963, current seed of 19 shrub, 16 forb, and three grass species (table 1) were hand-collected from native stands or purchased from commercial sources. Seed was commercially hand-cleaned to 85 percent purity or higher, placed in cotton bags, and deposited in metal file cabinets in an open warehouse in Ephraim, Sanpete County, UT, for the duration of the study. Over 25 years (1963-88), temperature in the warehouse ranged from a low of -29.9 to a high of 38.3 °C. Mean daily temperatures during winter, spring, summer, and fall periods were -5.3, 6.7, 20, and 7.2 °C, respectively.

D. Seed Quality
Seed Quality Testing for Range and Wildland Species

Richard Stevens and Susan E. Meyer

The seed bag label provides assurance as to the identity and quality of the seed. Each lot of seed offered for sale is required by law to be properly and truthfully labeled. Label information comes from two sources. The seed producer or dealer provides the common and scientific name, variety, and class (such as foundation, breeder, certified, registered, and experimental) designations where appropriate, along with the number, seed origin, date of harvest, and name and address of the seller. The laboratory performing the seed quality test provides the seed quality information.

People who buy seed for range, wildland, and disturbed land restoration often use nontraditional species that present problems in seed quality evaluation. The seed may be sold at low purity or may not be readily germinable under commonly used test conditions. Seed of nontraditional species is often expensive, making an accurate evaluation of quality even more important.

Government, commercial, and private seed-testing laboratories in the United States and Canada are required to use standard procedures as outlined in Rules for Testing Seeds, published by the Association of Official Seed Analysts (AOSA 1988). State seed laboratories perform standard seed tests on request and can answer questions (Table 1).

Quality evaluation for agricultural crop seed is usually a straightforward process. Rules for testing crop species have been standardized and in place for many years. This is not the case for many species used in range and wildland rehabilitation. Accurate and repeatable seed quality evaluation procedures have only recently become available for many of these species.

When a laboratory receives a seed sample of a species not in the AOSA Rules, the analyst uses procedures developed from experience and best judgement. Under these circumstances, results can vary substantially from laboratory to another, resulting in confusion as to the actual meaning of the label information. This problem is worsened by the fact that standard purity and germination procedures often do not work well on wild-collected native seed, and labeling conventions do not permit adequate explanation. The seed buyer must be educated to understand the implications of label information.

A survey of intermountain range and wildland species in Rules for Testing Seeds showed that some of the grasses and most of the forbs and shrubs commonly used in rehabilitation were without official procedures for seed quality evaluation. In 1985, the Utah Department of Agriculture, the Utah Division of Wildlife Resources, and the Forest Service, Intermountain Research Station, U.S. Department of Agriculture initiated a project to develop seed quality evaluation procedures for significant species. The project researchers have cooperated with the AOSA in securing adoption of the procedures as official Rules. Official testing procedures for 21 species have been developed to date (Table 2). The project has also generated insight into some communication problems in the wildland seed marketplace that are better addressed through education than through regulation.

Seed testing is generally a two-step process. The first step, the purity test, determines what fraction of the sample, by weight, consists of pure seed (species being sold) other crop seed, weed seed, and inert material. The second step, the viability test, determines what percentage, by number, of the pure seed is viable.

Purity Testing

The AOSA Rules define the weight of approximately 2,500 seed units as the minimum sample for purity analysis. A major problem in purity testing is obtaining a representative subsample for analysis. Mechanical seed sample dividers are used to assure that the bulk sample is adequately mixed for subsampling. This works well only for free-flowing seed. In general, the lower the sample purity, the more difficult it is to obtain a representative subsample.

Seeds and seed units are not always synonymous. For example, if intact one-seeded fruits (whether or not they contain a seed) are defined as the seed unit, all unfilled fruits must be included as pure seed. This results in an increase in purity values but an accompanying decrease in viability percentage. If only visibly filled fruits are included as pure seed, purity values decrease but viability percentages increase. These changes in purity and viability are not necessarily proportional. Unfilled fruits are lighter than filled fruits, so then tend to "count" more in the viability test (based on numbers) than in the purity analysis (based on weight).

From the point of view of the seed analyst, high purity is always desirable because it improves the accuracy and ease of testing. Most agricultural crop seed is sold at high purity. This is not the case for many wildland seed crops (Table 2). The cost of cleaning seed of many wildland species to high purity is not justified, because the seed...
Seed Testing Requirements and Regulatory Laws

Federal and State seed laws require that seed used on range and wildland sites be officially tested and appropriately labeled or tagged. It is the responsibility of the seed distributor (who may be the producer, collector, or broker) toward the end user to properly tag each container of seed to comply with these laws. An analysis tag is always required. If seed has been Certified, a seed certification tag will also be attached.

Seed-testing laws and truth-in-labeling laws require that all commercial seed be tagged with the appropriate analysis tag, and that each tag has minimum statements about seed quality and origin. Improperly tagged seed may be subject to legal actions that stop sale movement and use. Violation of State and Federal laws can result in considerable fines.

Information on the analysis tag comes from two sources: 1. The seed producer or dealer provides the common and scientific name, variety (if applicable), lot number, State of origin, year of harvest, and name and address of seller. 2. The laboratory performing the seed test reports percent purity, inert matter, other...
Wyoming Seed Analysis Laboratory  
749 Road 9  
Powell, WY  82435  
Laboratory Report of Analysis

<table>
<thead>
<tr>
<th>Account No.</th>
<th>Date Received</th>
<th>Date Completed</th>
<th>Lab Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>224</td>
<td>12/09/11</td>
<td>12/13/11</td>
<td>11-1579</td>
</tr>
</tbody>
</table>

**Sender's Information**
- **Product:** VNS  
- **Kind:** Sagebrush, Wyoming big  
- **Genus/Species:** Artemisia tridentata wyomingensis  
- **Lot Number:** ARTW-K-SP  
- **Class:** Source Identified

*The information provided here is that of the sender and not of the laboratory.*

### Purity Analysis

<table>
<thead>
<tr>
<th>Pure Seed Components</th>
<th>Purity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagebrush, Wyoming big</td>
<td>24.82%</td>
</tr>
<tr>
<td><em>Artemisia tridentata wyomingensis</em></td>
<td></td>
</tr>
</tbody>
</table>

**Purity Grams Required:** 0.75  
**Noxious Grams Required:** 7.5  
**Grains Submitted:** 338.44  
**Inert Matter:** 75.18%

### Viability Analysis

<table>
<thead>
<tr>
<th>Germination</th>
<th>Dormant</th>
<th>Hard</th>
<th>Total Viable</th>
<th>PLS%</th>
</tr>
</thead>
<tbody>
<tr>
<td>-N-</td>
<td>-N-</td>
<td>-N-</td>
<td>-N-</td>
<td>-N-</td>
</tr>
</tbody>
</table>

### Other Crop Seeds
- **None Found**

### Noxious Weed Seeds
- **None Found**  
- **States:** WESTERN  
- **In 7.5 Grams:** (P)Prohibited Noxious (R)Restricted Noxious

### Weed Seeds
- **None Found**

### Other Determinations
- **Sagebrush, Wyoming big TZ test:** 83%

**Additional Sender's Information**
- **Sampled by:** Wayne Anderson of the Utah Crop Improvement Assoc.  
- **Vendor:** The Maple Leaf Company

**Remarks:**  
No AOSA seed testing rules for Sagebrush, Wyoming big.  
Inert Matter: Chaff and final parts.

**Tests Requested:** Purity, Noxious exam, TZ test. No other tests requested.

**Services Requested:** Rush.

---

**WARRANTY:** We warrant that the purity and germination test results reported on this form have been carried out in accordance with AOSA rules unless otherwise specified. Test results reflect the analysis of the submitted sample and may not reflect the condition of the seed lot from which the sample was taken.

**DISCLAIMER OF WARRANTIES:** We make no other warranties of any kind, expressed or implied, including but not limited to the implied warranties of merchantability or fitness for a particular purpose.

**Signature:**  
Registered Seed Technologist Seal #45  
Page 1 of 1  
Printed: 12-13-11 17:08:41
Wyoming Big Sagebrush, VNS

Pure: 24.82 %  
Crop: 0.00 %  
Inert: 75.18 %

Germ: 83.00 %  
Hard: 0.00 %  
Weed: 0.00 %  
Origin: UT

No Noxious Found  
Test Date: 12.13.2011

ARTRW-K-SP  
Net Weight 40 Lbs.

450 South 50 East  
Ephraim, UT 84627  
435.283.4400
E. Identifying Source of Seed Collection and Collection Permits
SOURCE IDENTIFIED SEED

Species Name: Artemisia tridentata/wyomingensis
Common Name: Wyoming Big Sagebrush
G0 County, State, Elev.: Sanpete, UT, 4800-6000 ft.
G0 Indigenous? No
G0 Natural Track? No
Cert. #: WC-4611
Lot #: ARTRW-K-SP

The seed in this container, with label properly affixed thereto, was produced in compliance with the Seed Certification Requirements and Standards established by the Utah Crop Improvement Association for the SOURCE IDENTIFIED CATEGORY of certified seed. No warranty is expressed or implied as to the fitness for particular purpose or performance of the seed. This tag must be accompanied by a seed analysis label to comply with state and federal seed laws.

UTAH CROP IMPROVEMENT ASSOCIATION
Utah State University, 4855 Old Main Hill, Logan, Utah 84322-4855 (435)797-2082 • www.utahcrop.org

MEMBER OF ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES
STATE: Utah

Field Office/District: Richfield

Date of Sale: 11-30-11

Name of Purchaser: [Redacted]

Address (include zip code): 450 S. 50 E, Ephraim, UT 84627

Phone: 283-4400

KIND OF PRODUCT

<table>
<thead>
<tr>
<th>Product</th>
<th>Units</th>
<th>EST. QTY</th>
<th>RATE/UNIT</th>
<th>PRICE ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Redacted]</td>
<td>125</td>
<td>30000</td>
<td>0.09</td>
<td>270.00</td>
</tr>
</tbody>
</table>

ROAD MAINT. FEE or MAT SITE REC. FEE

TOTAL PURCHASE PRICE: 270.00

Purchaser is liable for total purchase price shown above. There will be no refunds. Additional payment, if any, will be made in accordance with Sec. 1(c). This contract is made under terms of Sec. 1(c) and the stipulations indicated.

CONTACT Expires: 11-30-11

Location of Sale (Contract Area):

ALL MATERIAL MUST BE REMOVED FROM THE CONTRACT AREA BY MIDNIGHT OF THIS DATE.

RECEIVED AS PAYMENT IN FULL

<table>
<thead>
<tr>
<th>ACCOUNT</th>
<th>COUNTY</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
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<td>[Redacted]</td>
<td>[Redacted]</td>
</tr>
<tr>
<td>O &amp; C (5882)</td>
<td>[Redacted]</td>
<td>[Redacted]</td>
</tr>
<tr>
<td>CBWR (5897)</td>
<td>[Redacted]</td>
<td>[Redacted]</td>
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<tr>
<td>PEHRP (5900)</td>
<td>[Redacted]</td>
<td>[Redacted]</td>
</tr>
</tbody>
</table>

Road Maintenance Fee

Material Site Reclamation

Purchaser certifies that he/she is twenty-one years of age or older and if purchasing timber is a citizen of the United States. Purchaser acknowledges that he/she has read and understands the terms and conditions of this contract and any attached provisions.

Signature of Purchaser:

Signature of Authorized Officer:

(PURCHASER)

FORM 5450-3 (January 2002)
SEED SOURCE LOG & COLLECTION INFORMATION

Date: 11/15/11

Collector Information:

Name/Nombre: Shannon Sterner
Address/Direction: 3259 S 675 W
City/Ciudad: Bountiful UT
ZIP/Codigo Postal: 84010
Phone#: (801) 295-2529 Plate #:

Seed and Collection Site Information:

Species: Rose hips R. reglans
Description of Collection Site: Davis Count
State: UT County: Davis Elevation: 2900
Ownership: Permit Info:

I certify that this information is accurate and true. By signing the line above, the collector testifies that he/she has legal rights to sell the seed on this collection log.

Signed/Firma Date/Fecha

Right-Hand Thumb Print:
Impresión derecha del pulgar.
SOURCE IDENTIFIED SEED

Species Name: Artemisia tridentata/wyomingensis
Common Name: Wyoming Big Sagebrush
G0 County, State Flow: Sevier, UT, 5900-6800 ft.
G0 Indigenous: No
G0 Natural Track: No
Cert. #: WC-1047
Lot #: 07112

The seed in this container, with label properly affixed thereto, was produced in compliance with the Seed Certification Requirements and Standards established by the Utah Crop Improvement Association for the SOURCE IDENTIFIED CLASS of certified seed. No warranty is expressed or implied as to the fitness for particular purpose or performance of the seed. This tag must be accompanied by a seed analysis label to comply with state and federal seed laws.

- UTAH CROP IMPROVEMENT ASSOCIATION -
Utah State University, 4855 Old Main Hill, Logan, Utah 84322-4855 (435)797-2082 • www.utahcrop.org

MEMBER OF ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES

Weed% 0.00
PLS Weight (lbs): 
Customer Order Number: 56005000000017

NOTICE TO THE BUYER: Stevenson Intermountain Seed, Inc. guarantees its seed to be of promised quality and true to name as specified, within recognized tolerances. No other warranty is made, expressed or implied. Our liability to the buyer or others is limited to the amount of the purchase price of the seed. Seed not accepted on the above terms and conditions must be returned within 10 days in the original unopened containers.
F. Seeding Sagebrush
G. Seed Companies
CERTIFIED SEED DIRECTORY

Membership and Officers
Acres Applied for Certification
Summary of Certification Regulation

UTAH CROP IMPROVEMENT ASSOCIATION
H. Seed Purchase
Conclusions
Contributors

Stevenson Intermountain Seed

Plummer Seed

Maple Leaf Company

Utah Division of Wildlife Resources

USDA Forest Service Shrub Science Laboratory

USDI Bureau of Land Management