

Slide Number	Notes
1	None
2	Richard Stevens – UDWR Retired
3	This small seed is what we are here to discuss. The history of the sagebrush industry is and will continue to be based on research.
4	The sagebrush industry deals basically with three big sagebrush subspecies: <i>Artemisia tridentata tridentata</i> (Basin big sagebrush), <i>Artemisia tridentata wyomingensis</i> (Wyoming big sagebrush), and <i>Artemisia tridentata vaseayna</i> (Mt. big sagebrush).
5	These three subspecies account for well over 95% of the sagebrush seed that is seeded with Wyoming accounting for up to 70% of seed that is seeded. Small amounts of seed of black, silver, low, sand, fringed, bud and Louisiana sage are also seeded.
6	From the time of settlement big sage brush was looked at a something that needed to be removed. Considerable research and effort was put into its elimination. Prominent ecologist Perry Plummer said “I spent the first half of my carrier working on ways of killing big sagebrush and the last half promoting and developing means and ways of establishing and managing big sagebrush.  In the late 1940s and 50s the significant role big sagebrush plays especially to mule deer started to be recognized. Today we know that it is the single most important species for mule deer. Over the years it has also been recognized for its value as forage for livestock and big game. It is important in reclamation, fire rehabilitation, soil stabilization, and in plant and animal community restoration. It is also recognized for its importance to small and large mammals, birds and insects.
7	Pioneering and continuing research with big sagebrush has been centered at the Great Basin Research Station in Ephraim, Utah and later the Shrub Science Laboratory at Provo, Utah. The Utah Fish and Game and US Forest Service in 1955 began a joint research project that was centered on big game range restoration. This publication summarized the first 10 years of research.
8	I (Richard Stevens) started working on the project in 1959 and continued working on the project until my retirement in 1998 and have been associated with the project to this day. These remarks will be centered mainly on work conducted at Ephraim and Provo. Our 2004 3 volume publication brought together over 50 years of research with considerable emphasis on sagebrush.
9	One of the early studies we conducted was to find out which species will grow where. This involved collecting seed and establishing species trial plots throughout the state.
10	Over the years species trial plots were established at over 70 locations ranging from the sub alpine to the Mojave desert. Most were established on deer winter range, primarily in Wyoming big sagebrush and pinyon/juniper communities.
11	Sagebrush was included in most trials with seed being hand collected. From species plots we obtained a better understanding of where and how sagebrush could be successfully seeded. By the early 1960s small amounts of big sagebrush seed was being included in a few larger scale seed mixtures.
12	Big sagebrush seed collection and use has ranged from less than 500 lbs per year in the mid 1960s to over ½ million lbs in 1999-2000 and ¼ million lbs this season. Price has varied from \$0.50 in the 60s - \$140 per pound in 1999-2000. This year prices have ranged from \$40-45 per bulk pound.
13	Major factors that have influence the acceptance of sagebrush and the development of the seed industry includes:
14	None
15	In 1965 I participated in a field day on the Fishlake National Forest, Salina Ranger District. When the ranger recognized me as one associated with the Ephraim Experiment Station, he told me to get off his district. He would not have anyone on his district that seeded and promoted sagebrush. The Forest Supervisor rescued me.

16	In an effort to change attitudes and understanding toward sagebrush we had field days, workshops, and presented papers at meeting such as these where we reported on our research and discussed the desirable attributes of sagebrush. In the early years we at Ephraim were often referred to as the weed farmers. I took this as a complement. You can imagine what we were called when we started to promote rabbit brush. Over the years those individuals with unchangeable stubborn attitudes either retired or died. Changes in personnel, continuous research and results from seedings all helped in changing attitudes and improved understanding of sagebrush. There are still however a few uniformed ignorant individuals.
17	None
18	It became apparent that there was a real problem in distinguishing and identifying sagebrush species and subspecies and their seed. Without proper identification productive management could not occur. Vegetative keys were available but few could use them or were unwilling to use them. It must be remembered that keys are written by those who don't need them for those who can't use them. To better identify species and subspecies we collected seed and plants throughout the west and brought them together at various locations. It was here that we were able to compare species and identify and recognize differences.
19	From these and other studies we were able to prepare field keys based on morphological characteristics that most people could use. Distinguishing characteristics included size and shape of plants.
20	Shape color and smell of leaves, and when flowering and seed maturation occurred.
21	We next published papers that described areas of occurrence of the subspecies based on soil types and characteristics, elevation, associated species and palatability to livestock and deer.
22	In 1974 we published a paper that describes a simple technique for identifying subspecies of big sagebrush using black or ultraviolet light.
23	This technique was readily accepted and used widely in laboratories and especially in the field. This technique provided managers with a tool that they were confident with.
24	None
25	None
26	In the early years seed was collected by hand and hand screened. Seed collection has not changed much over the years. Seed is still collected by beating the seed off of the plant into a container.
27	Once collected the volume of the collected...
28	...material has to be reduced and refined for further handling and seeding.
29	Seed cleaning equipment has progressed from hand screening to single screen M2B fan cleaners...
30	...to large multi screen machines.
31	Hammermills and choppers have been modified to accommodate sagebrush seed.
32	Collected sagebrush seed can be cleaned to close to 100% purity. This however, is not recommended. Purity requirements today vary from 12-16% by the BLM to 30% by the Utah DWR. (Left; seed screened to remove stems and debris. Right; cleaned seed to 20% purity)
33	Seed of sagebrush are not known for retaining viability over extended periods of time. It is not uncommon for some seed lots to loose up to 75% of its viability with one year of storage. While other lots only loose up to 20% viability with up to 4 years of storage. Considerable research has been conducted on ways to retain viability. Additional work is needed.
34	Various types of storage are used to slow down the loss of viability. These include frozen storage, cool storage, cool dry storage, and open and closed warehouse storage. There are different opinions and successes.
35	Some dealers and agencies however maintain viability is best maintained where dry seed is stored in a cool moisture controlled environment. (special storage area at Ephraim DWR warehouse) Moisture content is currently determined by hand squeezing a seed sample. If it makes any type of ball, moisture content is too high and it is rejected. There is a need for research in this area.

36	None
37	As the seed industry developed it became apparent that seed quality was a big concern. Seed collection dates, germination and longevity studies were conducted along with seed cleaning and storage studies. It became apparent that collection date, extent and type of cleaning and storage affected germination and retention of viability. Seed samples were eventually sent to state seed laboratories for quality evaluations. Results from different laboratories were highly variable.
38	Dealers and many users had no confidence in the results of these tests. The reason for the variability was the absence of standardized testing procedures and standards.
39	We joined with the Utah Department of Agriculture seed testing laboratory in developing and having accepted by the Association of Official Seed Analysts, rules and procedures for evaluating seed quality of the three big sagebrush subspecies and other sagebrush species. By federal law, these rules are used by all seed laboratories both state and private. The use of these rules has significantly reduced variability between laboratories.
40	Seed companies' preference for seed laboratories varies. For a number of years actual seed germination was required. This resulted in delay of obtaining results. Rapid reliable chemical tests know as TZ is now used in determining viability in the sagebrush industry.
41	All marketed seed must now be tagged with quality seed testing results from certified laboratories. The use of standardized testing and enforcement in tagging has provided credibility to the seed industry and has significantly increased confidence by users of the seed.
42	None
43	Species trial plots, seeding studies, and actual field seeding studies demonstrated that seed from specific locations perform best when seeded in locations possessing site characteristics similar to the collection site. It became apparent that knowledge of source of seed collection was needed to make proper site seeding decisions. In cooperation with the Utah Crop Improvement Association we developed procedures for identifying and documenting seed collection location and identification of species or subspecies being collected. Previously developed species identification techniques are used to identify species and subspecies being collected. Seed is collected off state, federal and private land. For many years seed was collected wherever it was available. Agencies and landowners became concerned with this practice. Eventually seed collection permit procedures were developed and employed.
44	Agencies, crop improvement associations, law enforcement and companies worked together to develop seed collection permit procedures. Reputable seed companies now require all wild land seed to be accompanied by a valid collection permit from the concerned agency or landowner. The permits identify the area of seed collection and the species or subspecies being collected.
45	Most companies keep records of seed source and collections.
46	Utah Crop Improvement Association has a field inspector that verifies collection location and species being collected. Following proper compliance the inspector issues source identified tags that are attached to each bag (top) along with the seed quality testing tag (bottom). One major problem with the required permit policy is that some agencies will require seed from a particular source and will not issue permits to allow seed collection at the site.
47	None
48	Years of research and actual seedings have demonstrated that big sagebrush seed does best when surface seeded especially on a disturbed surface. Seeding has to occur in the fall to late winter to be successful.
49	Big sagebrush subspecies have very weak seedlings and can not be successfully seeded in conjunction with species that have competitive seedlings and mature plants. Four grasses that have been proven to be very competitive as seedlings and mature plants are detrimental to big sagebrush establishment and maintenance are crested wheatgrass, intermediate wheatgrass, smooth brome and hard sheep fescue.

50	Examples: 1) This is a photo of a 3 year old seeding with grasses forbs and shrubs. Note sagebrush seedlings.
51	This is the same seeding 2 years later sagebrush is not very abundant.
52	2) In 1975 this area was chained with only the back area being seeded with grasses forbs and shrubs
53	3) In 1974 we chained a pinion/juniper area, areal seeded a mixture of grasses forbs and shrubs and back chained. On an adjoining area we removed the grasses from the mixture and only seeded the shrubs which consisted of 4-wing saltbush, Wyoming big sagebrush and rubber rabbit brush. In 2012 the area that was seeded with shrubs and grasses is now dominated by crested wheatgrass with very few shrubs and forbs.
54	The adjacent shrub only seeded area is dominated by Wyoming big sagebrush and a few forbs. Similar results are common.
55	Agencies have had a tendency to seed mixtures of non-compatible species. These mixtures are often put together to satisfy multiple management goals, political consideration, agency requirements and personal desires.
56	These seedings are most often those that have produced less than favorable results in relationship to sagebrush and other less competitive species. Over the years many seeding failures have been contributed to poor seed quality. There are however, multiple factors that contribute to less than favorable results. The most common being poor, uninformed administrative decisions and actions.
57	None
58	The Utah Fish and Game was the first to collect, purchase and seed big sagebrush seed. Many students worked on the research project in Ephraim. A good number of these students saw potential in the sagebrush seed industry. At one point in time every seed company that handled sagebrush seed had worked at the Ephraim station. Seed companies have come and gone however, successful, reputable seed companies have accepted and implemented changes in seed cleaning, storage, seed quality testing and tagging, source identified requirements and tagging and insisting on collection permits on all purchased seed. Those companies that continue to incorporate changes and requirements will continue to succeed.
59	None
60	The procedures and regulations used to purchase sagebrush seed have evolved over the years, especially with state and federal agencies. In the early years seed was purchased with little knowledge or interest in identifying species, extent or type of cleaning, or purity. With the development of the ability to identify seed of the various sub species, development of quality testing, and source identification purchasing requirements have changed considerable to the benefit of the agencies and seed companies. With increasing amounts of sagebrush seed being purchased the agencies turned purchasing of seed over to purchasing agents that had little knowledge of the seed industry and in some cases had little to no direction from agency personnel. This resulted in bid requirements that were unrealistic. Because of these unrealistic requirements agencies were not able to purchase the seed they needed. Projects were canceled or put off until planting occurred on undesirable dates and unadapted species were used. Seed companies lost time, seed viability and income. Today there are seed companies that will not deal with federal agencies. To rectify this problem, agencies now employ purchasing agents who are well trained and understand the seed industry. Seed companies have also adapted to realistic requirements. Today most agencies and the seed industry work well together. The private sector has adapted most of the seed purchasing requirements of the various agencies. As more companies have entered the seed industry, competition for sales has lowered seed prices and increased seed quality and compliance.
61	None

---

62	<p>There have been substantial changes in the sagebrush seed industry from the 1950s and 60s to today. The industry has developed into a multi million dollar industry. Hundreds of thousands of acres have been seeded with sagebrush. Results have varied from complete failures to very acceptable results. Sagebrush seed was originally seeded in an effort to improve deer winter range. It is now used extensively in the restoration and revegetation of disturbed, burned and deteriorated wildlands. The greatest amount of sagebrush seed has been seeded into burned over sagebrush communities. Fires will continue. There are still many depleted wildlife and livestock ranges and watersheds. Emphasis on sage grouse habitat has increased significantly. The future of the industry is bright. However, continued research and evaluation is necessary. One area that needs concerted effort is evaluation of sites that have been seeded with sagebrush. Most times evaluation of seeded sites only occurred the first few years following seeding. We need to look at seedings 5, 10, years and older to better understand and further enhance success in seeding sagebrush. Two additional areas that need continued research are seed storage and seeding practices and techniques. The sagebrush seed industry is dependent on continued research and adaptation of results.</p>
63	None

---