cepts and objectives. GAO's findings concerning grazing and cropland outleases were: (1) plans were sometime nonexistant or inadequate at many bases; (2) there is a lack of management emphasis from DOD down to the base level; and (3) DOD is not maximizing the benefits of the various Services leasing programs. Their recommendations are summarized as follows: (1) plans should be developed on a continuing basis, (2) there should be periodic reviews to assess leasing value, (3) management plans should require a maximum leasing of military property, and (4) DOD should investigate the possibility of establishing a grazing-cropland management fund similar to the Air Force forestry fund. The current Air Force regulation and recent change in public law greatly improves the Air Force's ability to comply with all four GAO recommendations.

In summary, Air Force installations are required to participate in proper and effective land management practices. Grazing and cropland management plans are required by Air Force Regulation 126-1 if land is available for such use and the military mission does not specifically preclude this use. The results we expect are conservation and/or improvement of the natural resources; improved value of Air Force property; and reduced maintenance costs. We expect to accomplish proper land management with the help of the USDA-Soil Conservation Service, USDI-Fish and Wildlife Service, state universities and state Agricultural Cooperative Extention Services.

It is our desire that this introduction to the Air Force Grazing and Cropland Management Program will help you, the reader, understand Air Force goals, objectives, and requirements as they pertain to land under control of the Air Force.

'Rincon' Fourwing Saltbush—Proven for Better Forage and Reclamation

E. Durant McArthur, Sam E. Stranathan, and Gary L. Noller

A superior strain of an Intermountain West shrub—a plant used for wildlife and livestock range and disturbed land reclamation programs—was recently released to the commercial market, climaxing 25 years of cooperative research by State and Federal agencies.

The improved strain, 'Rincon' fourwing saltbush (*Atriplex canescens* [Pursh] Nutt.), was selected for its vigorous upright growth, sustained forage production, nutritive value, palatability, wide adaptation, and tendency to be evergreen.

'Rincon', which is well adapted to much of the Intermountain area (see map), was developed by the Agricultural Experiment Stations of Colorado State University and Utah State University, the Utah State Division of Wildlife Resources, the USDA Forest Service's Intermountain Forest and Range Experiment Station, the USDA Soil Conservation Service, and the Upper Colorado Environmental Plant Center.

Description

'Rincon' fourwing saltbush is a facultative evergreen shrub, woody throughout, 3 to 6 feet tall, much branched, often globular or dome shaped. It is often more leafy and full canopied than other sources of fourwing saltbush (McArthur et al. 1983). Its three gender states are constant male, constant female, and labile. The latter state may be male, female, or bisexual depending on environmental conditions (McArthur and Freeman 1982). The male bushes produce flowers on spikes, and female bushes produce large quantities of four winged utricles on many branches (see photos). Seeded 'Rincon' populations have a slightly biased (approximately 55%) female sex ratio, fewer (approximately 35%) male plants, and the balance (approximately 10%) bisexual in any particular flowering season.

Origin, Development, and Use

'Rincon' fourwing saltbush originated when, in fall of 1957, Paul E. Hansen and Homer D. Stapley collected seed at Rincon Blanco on the Carson National Forest, about 3 miles from Canjilon, Rio Arriba County, New Mexico. The natural stand at Rincon Blanco was recollected in 1960. The site is at 7,800 feet elevation and has a mean annual temperature of about 45°F. Winter temperatures regularly get as low as -15°F, with summer high temperatures 90°F or higher.

'Rincon' was selected from a half-sib population of some 700 plants based on sustained annual biomass production, an erect uniform leafy growth habit, and a tendency toward evergreenness or early spring greenup. In common with other fourwing saltbushes, its leaves, stems, and utricles provide browse in all seasons for livestock and wildlife. Crude protein content measured 17.9% in November and

Dr. McArthur is a principal research geneticist of the Intermountain Forest and Range Experiment Station, USDA Forest Service. He is located at the Shrub Sciences Laboratory, Provo, Utah, 84601 and is an adjunct professor of Botany and Range Science at Brigham Young University. Mr. Stranathan of the USDA-SCS is manager and Dr. Noller is assistant manager of the Upper Colorado Environmental Plant Center, Meeker, Colorado 81641.

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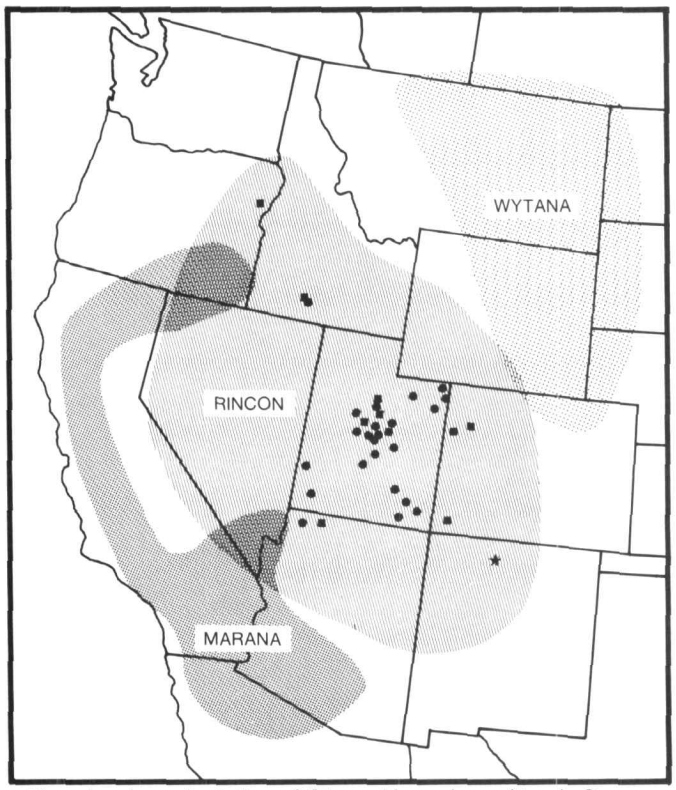
PESTICIDE PRECAUTIONARY STATEMENT: This paper reports research involving pesticides. It does not contain recommendations for their use. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

26.5% in June in the leaves, with intermediate values for other seasons. The crude protein of stems varies seasonally from 6.9 to 20.0%.



Map showing adaptation of 'Rincon' fourwing saltbush. Successful 'Rincon' plantings: • seedings, ■ transplants. Original collection site: ★ Areas recommended for planting cultivars are outlined.

In addition to providing forage and cover, 'Rincon' is valuable for rehabilitating depleted rangelands and for stabilizing soil. A potential use is on mineland reclamation on arid and semiarid lands of the Intermountain region. 'Rincon' may be propagated easily by direct seeding, by transplants, and by stem cuttings. The estimated seed yield is 350 pounds clean seed per acre, with specified orchard design using foundation stock cuttings (McArthur et al. 1978).

Area of Adaptation

Fourwing saltbush grows in a variety of soil types from the Great Plains to the Coast Range and from Canada to Mexico at elevations from below sea level to 8,000 feet. 'Rincon' is well adapted to a wide range of soil textures: sandy areas, gravely washes, loamy soils, heavy clay soils, and moderately saline soils. The new strain is best adapted to big sagebrush and pinyon-juniper zones, but it also does well in the more mesic portions of salt desert shrub areas. It appears to have salt tolerance similar to other fourwing saltbush ecotypes. Because of its high elevation origin, 'Rincon' has shown adaptation in more northern climates than might be expected (see map). It has performed well at 3,000 to 8,000 feet elevation and with average annual precipitation of 9 to 23 inches.

The shrub is more cold tolerant than the release 'Marana' fourwing saltbush from California. 'Marana' is recommended for Mediterranean-type climates below 5,000 feet. 'Wytana', the only other cultivar, is a low growing form recommended for eastern Montana and Wyoming.

'Rincon' is relatively free of disease and insect problems. However, a low incidence of vascular wilt symptoms and some mortality have occurred on plants grown on former agricultural ground at the Snow and Nephi Field Stations in Utah. Suspected causal agents are *Rhizoctonia* and *Verticillium*. The case-bearing bagworm, *Coleophora atriplicevora*, is a defoliating pest that causes only minor problems on natural stands but can be a serious problem in closed stand plantations. It can be easily controlled with the application of Malathion.

Germplasm Maintenance and Availability

Parent plants will be maintained by the Intermountain Forest and Range Experiment Station, Utah State Division of

'Rincon' breeder plants at the U.C.E.P.C., Meeker, Colo. Upper photo is a male plant, lower one a female.

Wildlife Resources, and the Aberdeen, Idaho, Soil Conservation Service Plant Materials Center.

Recognized classes of plants will be Breeders, Foundation, and Certified. Breeder plants will be maintained at the Upper Colorado Environmental Plant Center (U.C.E.P.C.) in Meeker, Colorado.

The U.C.E.P.C. will provide Foundation cuttings from sexually constant plants to establish Certified seed orchards (Noller et al. In Press). Certified containerized plants can be produced from Certified seed. Request for Foundation 'Rincon' plants should be directed to the Colorado Seed Growers

Association, Department of Agronomy, Colorado State University, Fort Collins, Colorado 80523; or the Utah Crop Improvement Association, Utah State Agricultural Experiment Station, Utah State University, Logan, Utah 84322 or the Crop Improvement Association for your state. Commercial seed growers will need 275 female and 55 male plants for a one-acre 'Rincon' orchard. Planting stock varies from 6 to 12 inches in height and cost $1.50 each plus shipping charges. Plants should begin producing seed in about two years. Cultural information is available from the Forest Service Shrub Sciences Laboratory or the U.C.E.P.C.

References

McArthur, E.D., and D.C. Freeman. 1982. Sex expression in *Atriplex canescens:* genetics and environment. Bot. Gaz. 143:476-482.

McArthur, E.D., A.P. Plummer, G.A. Van Epps, D.C. Freeman, and K.R. Jorgensen. 1978. Producing fourwing saltbush seed in seed orchards. p. 406-410. *In:* Proc. First Internat. Rangeland Cong. Hyder, D.N. (ed.) Soc. Range Manage, Denver, Colo.

McArthur, E.D., R. Stevens, and A.C. Blauer. 1983. Growth performance comparisons among 18 accessions of fourwing saltbush *(Atriplex canescens)* at two sites in central Utah. J. Range Manage. 36:78-81.

Noller, G.L., S.E. Stranathan, E.D. McArthur. (In press). Establishment of a 'Rincon' fourwing saltbush *(Atriplex canescens)* seed orchard. *In:* U.S.D.A. For. Serv. Gen. Tech. Rep. INT-. Proceedings of Wildland Shrub Symposium, The Biology of *Atriplex* and Related Chenopods.

Selenium Poisoning in Livestock

Lynn F. James and James L. Shupe

Selenium has long been recognized for its toxic effect on farm animals. Historically, Marco Polo, in 1295, may have been describing chronic selenium poisoning when in his account of his travels in western China he wrote that a poisonous plant growing there, if eaten by their beasts of burden, caused the hooves of the animals to drop off.

The first account of selenium poisoning in the U.S. was given by Dr. T.C. Madison in 1856 when he described a condition that afflected cavalry horses situated near the Missouri River in the Nebraska territory. Although the cause of the problem was not known at that time to be selenium poisoning, research done years later gave that indication. Various reports were made during the next 75 years of situations that were later recognized as due to selenium poisoning. In the early 1930s, cooperative research between the U.S. Dept. of Agriculture and the South Dakota and Wyoming Experiment Stations demonstrated that selenium in the forage in certain areas was responsible for such conditions.

After considerable research in the 1930s, little additional research was done on selenium until the late 1950s, when this element was shown to be an essential nutrient. Nothing more will be said of selenium as an essential nutrient except to point out that an essential nutrient may cause a toxic effect by its absence. Hence, the justification for the term deficiency disease.

Authors are with USDA, Agricultural Research Service, Poisonous Plant Research Laboratory, 1150 East 1400 North, Logan, Utah 84321; and Animal Dairy and Veterinary Science Department, Utah State University, Logan, Utah 84322.

Selenium in Soils

The earth's crust is estimated to contain an average of 0.1 ppm selenium. Some soil may contain less and some considerably more, to a level that plants growing on them may be toxic.

In the United States, soils high on selenium are usually derived from sedimentary rocks having a high selenium content.

Selenium occurs in the soil in various forms. In unweathered rock and some soils in arid regions it may occur in its elemental form or as iron selenide. In both of these forms, selenium has a low availability to plants. Small amounts of organic selenium, derived from decaying plants, may occasionally be available to growing plants. However, the most soluble and most important for insofar as plant availability is concerned, is inorganic selenate.

The distribution of the available forms of selenium in the soil profile has an important effect on plant uptake. In arid regions, the soluble (and thus the more available) forms may leach into the deeper soil profile, where deeper-rooted plants such as shrubs and plants with long tap roots may absorb it. These plants may act somewhat as a selenium