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# Rangeland Technology Equipment Council

## 1990 Annual Report





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## Arid Land Seeding

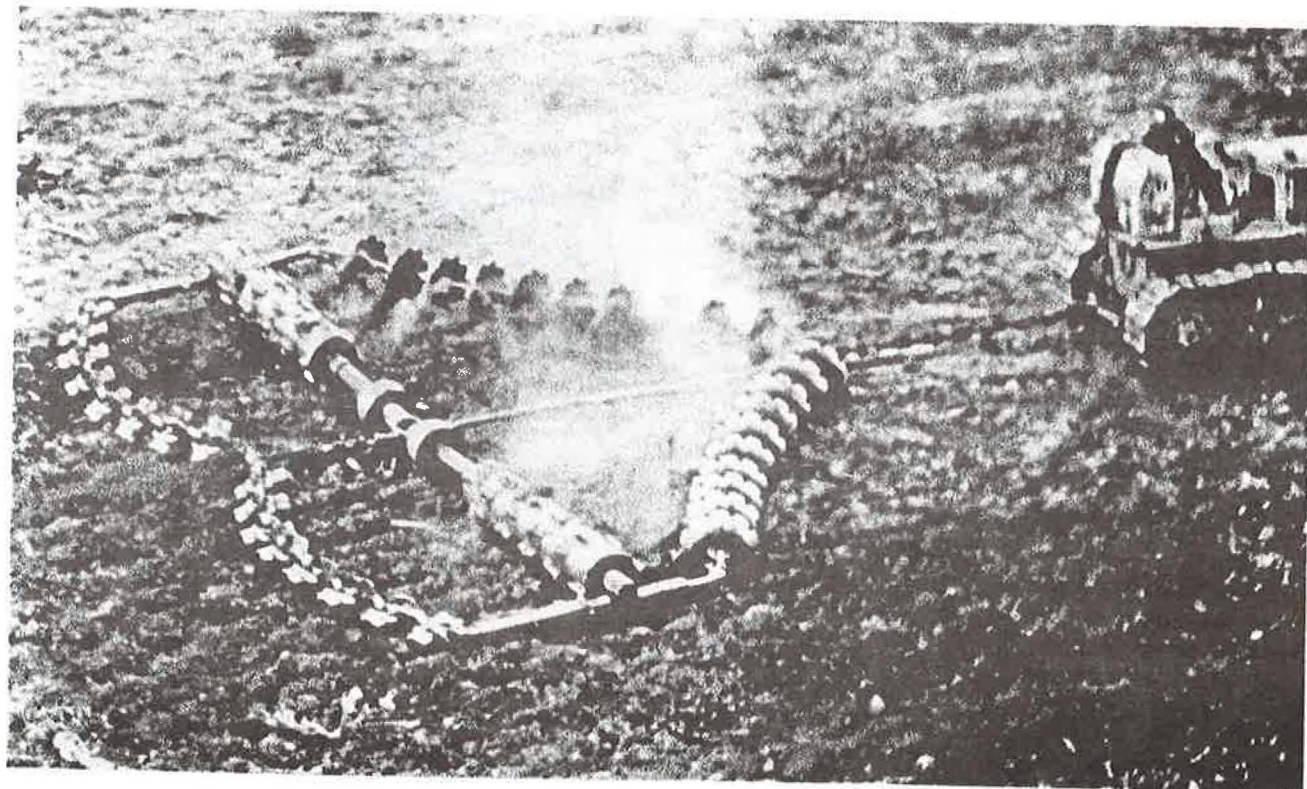
**Harold T. Wiedemann, Professor of Agricultural Engineering, Texas Agricultural Experiment Station Vernon, Texas**

A new tool is under development that forms small basins about 4-inches deep on flat-tilled land to reduce runoff and enhance seeded grass establishment on rangeland. The broadcast diker uses special shaped blades welded to a large anchor chain. As it is pulled over tilled land, the chain rotates and the blades leave a broadcast pattern of 20,000, diamond-shaped basins/acre.

For rangeland seedbed preparation, the chain diker is well suited to be pulled behind a disk-chain. This combination provides tillage, land smoothing and basin formation all in one pass on debris littered land. Attaching the diking chain to the disk chain improved the disking action of the unit significantly. On rootplowed, clay loam soil, which was aerially seeded following diking, there was a three-fold

increase in seeded grass densities compared to non-diked treatments (1988). In our 1989 study, there was no difference in grass densities between diked/non-diked treatment because 9.2 inches of rainfall during the 60 days following seeding masked any seedbed differences. This new tool appears very promising for rangeland seeding especially when moisture is in short supply.

In a wheat production study (1988-89), diking increased grain yield by 11 percent and reduced runoff by 25 percent during the fallow season (1989) compared to non-diked treatments (less than 1 percent slope). Power requirements for the cropland dikers were 0.8 to 0.9 horsepower per foot of width when pulled at 5.0 mph. The chain diker is designed to be pulled behind a primary tillage tool, eg. chisel plow or disk. They cost approximately \$350/foot and can be built in widths up to 90 feet. Additional information is available.



**Disk Chain Diker**

## Timber Bridges

**Lola Mason, Engineer, San Dimas Technology and Development Center, San Dimas, California**

### Introduction

Many times, stream crossings need to be made in remote areas. Culverts are typically used as an inexpensive means for making crossings yet there are times when an alternative is needed. Timber bridges can be competitive with concrete and steel bridges on short spans of less than 50 feet. They are typically less expensive and take little training to build. If treated properly, a timber bridge can have a long, useful life with very little maintenance. Timber has been used as a structural material since the beginning of man. In this country, there are many timber bridges that are still in place and serviceable after 100 years. Timber is a renewable material that is very strong compared to its light weight, making it easy to work with. Timber bridge construction can be performed in any type of weather condition once the substructure is in place. There are three types of timber bridge decks: nail-laminated; glue-laminated; and stress-laminated.

Transverse nail-laminated decks on longitudinal stringers were the original design for timber bridges. Lumber of 2-inch nominal dimension are through-nailed and then toe-nailed to the stringers. There is little reflection due to the closely spaced stringers. This type of design is not used as much anymore because the lumber making up the deck would delaminate. The nails loosen due to traffic deflection and cyclic swelling and shrinking of the wood from moisture

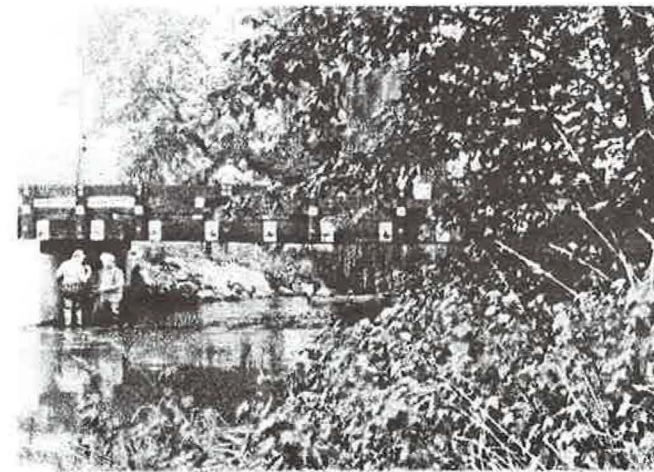
variations. The deck would no longer be a waterproof shield and the excess moisture would promote the decay of the stringers and other timber members of the bridge.

Transverse glue-laminated decks on longitudinal stringers or longitudinal glue-laminated decks have replaced the nail-laminated design. Lumber of 1.5 inches to 2 inches nominal dimensions are glued together using a waterproof, high strength glue. Glue-laminated timber is higher in strength because deficiencies in the lumber can be eliminated or spread out so that there are no major weak points. The panels can be any length and are no greater than 4 feet wide. The panels are then connected using dowels. The problem designers are trying to solve is that the dowel holes cannot be too tight or else the panels will not go together easily. Yet, if they are not tight enough, traffic will deflect the panels separately causing cracks in the asphalt surfacing which will lead to moisture traveling through the deck to the timber below.

Longitudinal stress-laminated decks are a new design. Ontario, Canada, began using this design to rehabilitate existing nail-laminated bridges. Then they began using it for new bridge designs as well. Lumber of 2-inch to 4-inch nominal dimension are drilled with holes along the center spaced at 4-foot intervals. Post-tensioning rods used in prestress concrete are placed through the holes and then through steel plates on both sides. A jack is used to pull the rod to a predetermined tension and nuts are used to keep that tension in the rod. The rods through the plates literally squeeze the lumber together so tightly that the entire deck acts as a solid plate of wood. This design is so new that it is not yet known how long the rods will hold the required amount of tension. At this time, experimental bridges of this design are in place and being monitored and the design is being introduced to AASHTO for acceptance as a valid bridge design.

### Construction and Cost

For all three types of decks, construction is relatively easy. Some carpentry knowledge would be needed for the nail-laminated deck and it would take some time nailing all the lumber together. No heavy equipment would be needed for the deck. A small crane or fork lift would be needed for the glue-laminated deck because the 4-foot wide panels are prefabricated and shaped to the site as individual panels. Construction is simple due to panels being set in place and connected by dowels. The most difficult part is lining up the panels so the dowels can be inserted. A crane is typically used to set the stress-laminated deck into place. The deck can either be prefabricated and shipped to the site as panels or the individual lumber can be shipped to the site and fabricated there. The only difficult part is learning to use the



**Stress-Laminated Timber Deck**



jack to post-tension the bars. Depending on the substructure, all of these bridge types could be constructed by an agency's own crews with very little equipment involved and the deck should take only a couple of days to construct.

The cost will vary depending on the substructure and the type and availability of the preservative treated lumber. Typically, concrete and steel are much more expensive and harder to work with than wood, especially on short spans. Nail-laminated decks have a shorter life expectancy, although the cost would probably be the lowest of the three. The glue-laminated has a very long life expectancy but also a higher cost. There are not that many glue-laminating plants so shipping should be a consideration. The stress-laminated has an unknown life expectancy. Restressing would have to be done about every 10 to 20 years, but because few have been in 10 years and none for 20 years, life expectancy is still unknown. With proper preservation, it should last a long time. The cost should be less than the glue-laminated, closer to the cost of a nail-laminated. Maintenance costs are minimal. Inspections for deterioration need to be performed, protection needs to be applied on cracks, splits, etc., and the wearing surface will need to be reapplied on occasion. Once the stress-laminated deck design is perfected, restressing will need to be performed, but this would only take a couple of hours and two people.

### Preservative Treatment

The main reason wood is not used as much as other materials is because it does not seem to be as durable. Problems such as insects and decay can shorten the life of wood greatly depending on the geological area in which the wood is being used. There are four components that are necessary for fungus, which leads to decay, to grow and these are oxygen, temperature, food and moisture. Little can be done to reduce oxygen. Fungus grows from freezing temperatures to an optimum growth temperature of 80 degrees. It is dormant below freezing and only a wood temperature above 100 degrees is lethal. Little can be done to affect wood temperature in such an extreme way. The two variables that can be affected are the food source which can be made poisonous and the moisture content which can be kept below 30 percent. Preservative treatments are used to poison the food supply. Creosote and penta chlorophenol in heavy oil, penta chlorophenol in light oil, and water born salts such as ammoniacal copper arsenate (ACA) or chromated copper arsenate (CCA) are types of preservative treatments in use. The types in heavy oil are preferred because the oil retards moisture penetration and the water born salts are not used a lot because the salt increases the absorption of moisture. Preservative treatments should be performed on the lumber only after all cutting and drilling have been performed. As few field cuts as possible will

reduce the possibility of exposed raw wood. If field cuts are necessary, there are preservatives that can be sprayed on, the best being copper naphthenate. When checks or cracks occur, especially on guardrail posts, the area should be sprayed with a preservative and then roofing tar can be applied to keep out excess moisture. Any punctures into the unpreserved wood can lead to decay and should be treated immediately. All timber used in the bridge should be placed at a moisture content of 19 percent or less. This is considered the moisture content wood will natural dry out to. There will be variations but it will typically stabilize at 19 percent. The best way to keep moisture out is to use a wearing surface. This protects the surface of the deck from wearing down and can assist in making the deck waterproof so that moisture is not accumulating in the wood members below. The longest lasting timber bridges are covered bridges because there is a roof to keep out the moisture.

### Wearing Surface

There are several types of wearing surfaces. The best type for waterproofing is asphalt or a chip seal. To reduce reflective cracking especially on nail-laminated or glue-laminated decks, an asphaltic backed geotextile material should be placed between the deck and the wearing surface. Both of these types of decks will leak without surfacing and the glue-laminated panels are always dried to 19 percent moisture content so excess moisture on the surface will cause swelling which could cause problems with the guardrails and doweled connections. The stress-laminated do not tend to leak through the deck so surfacing is not needed for waterproofing. But, the lumber making up the deck could swell causing excessive stress on the bars and possibly failure. In all cases, without a wearing surface, traffic will wear down the deck to untreated wood increasing the possibility of deterioration. Inexpensive types of surfacing are wood planks covering the entire deck or wood planks used as running boards. In both cases, nails or screws would be used to secure the planks. The penetration of these into the untreated wood could lead to decay so treatment of the holes would be necessary. A layer of soil could be placed over the deck but the thickness could be as much as 12 inches due to possible rutting which would be a heavy dead load not considered during the design of the deck and the soil could trap moisture at the deck surface which could lead to decay. Solutions to the problems of some of the wearing surfaces are being examined so that a wearing surface of some type can be placed on all bridges.

### Conclusion

The three basic types of bridge deck designs are nail-laminated, glue-laminated and stress-laminated. All three types are easy to construct and relatively inexpensive

compared to concrete and steel with the glue-laminated and stress-laminated having the longest life expectancy. But the life of the bridge depends on the preservation of the wood. Preservative pressure treatment and few field cuts will reduce the possibility of deterioration due to insects and fungus. Placing all wood at a moisture content not to exceed 19 percent and keeping moisture from the wood will inhibit the growth of fungus which leads to decay. The best way to reduce wear on the surface of the deck and reduce the amount of moisture in the wood, is to place one of several types of wearing surfaces on the deck. Timber bridges can be competitive with other materials for short span bridges but they must be treated properly in order to live a long, healthy, relatively maintenance-free life.

### Central Tire Inflation—What's In It For Me?

*Paul Greenfield, Program Leader of Road Technology  
USDA Forest Service, San Dimas Technology and  
Development Center, San Dimas, California*

### History of Reduced Pressure Tires For Logging

In the early years of the current (20th) century, loggers determined that softer tires did much to improve the operation of their logging trucks. Specifically, in the mid-1920's, an attempt was made to provide a softer tire by first thickening the cross section of the solid rubber tire in use at the time and then putting holes through the rubber to produce some "give" in the tire. In the late 1920's pneumatic tires came into use.

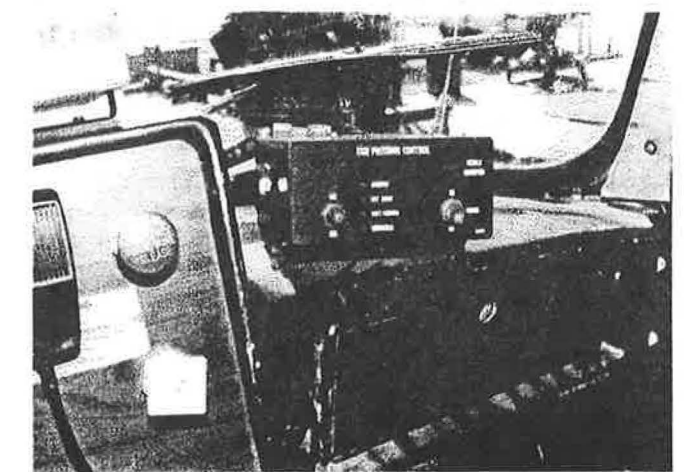
Then, in 1934, Lloyd Christensen (a log trucker who worked in Oregon and Washington) and the Goodyear Tire & Rubber Co. developed the 14-ply 10.00 x 20 tire that became the standard in log trucking for many years. In succeeding decades, tires on logging trucks have had their pressures increased time after time—until these days pressure is in the 90 to 120 psi range. Once again loggers are experiencing the road damage, traction problems, and excessive truck maintenance that they did with early solid rubber tires. A system that is available nowadays to soften tires by reducing tire pressure is central tire inflation.

### What Is Central Tire Inflation?

Central tire inflation (CTI) is the term used for a mechanical system, installed on a vehicle, that allows the driver to adjust tire pressures while the vehicle is in motion. With CTI, tire pressures can be varied to realize the maximum benefit for any given load, speed, and road condition. The fuel efficiency and tire life benefits of using high pressures on high-speed highways can be realized, while—at the same time—also gaining all the benefits of reduced pressure tires on low-speed forest roads.



*Flexible Line to a Rotating Air Joint  
on the Outer Hub of a Wheel.*



*Control Panel.*



## Benefits Of Reduced Pressure Tires On Low-Speed Forest Roads

A reduced pressure tire using CTI results in a longer footprint; this prevents the bouncing that occurs from short contact lengths. "Bounce" causes the tire to hop on paved roads and to "washboard" on unpaved ones. The U.S. Army has utilized CTI since World War II to improve vehicle mobility. Benefits of operating reduced pressure tires on low speed forest roads include:

- Decrease road surface damage
- Decrease road maintenance needs
- Decrease use of road-surfacing material
- Decrease truck maintenance needs
- Decrease tire injuries
- Subdue vibrational inputs to driver, passengers, and cargo
- Increase truck mobility
- Extend haul season

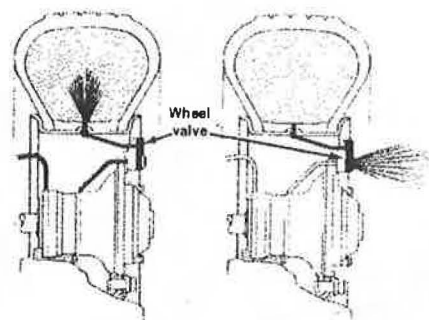
In addition, the Forest Service has learned from tests of reduced pressure tires that they provide additional improvements by:

- Healing rutted and washboarded unpaved roads
- Increasing road pavement life over saturated upgrade condition

Adequate tire pressure must be maintained for highway speeds. CTI systems are being used to attain both high tire pressure for highways and appropriate lowered tire pressure for low-speed forest roads.

## How Does CTI Inflate Rolling Tires?

Several very ingenious methods for inflating and deflating rolling tires have been developed. External systems run the air through a flexible line to a rotating air joint on the outer hub of the wheel. Internal systems route the air from the fixed axle housing or brake plate through a seal to the rotating wheel, axle shaft, or hub.



Internal Valve System.

## Advantages Of CTI

The advantages of using CTI were investigated by the Forest Service beginning in 1983. With 95 percent of the 350,000 miles of Forest Service roads unpaved, a significant portion of the budget is used for road construction and maintenance. The roads are necessary for protecting, producing, and transporting resources of the National Forests.

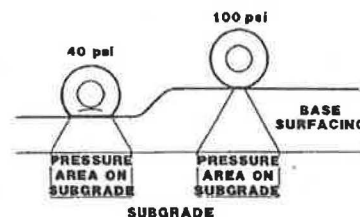
Ways to reduce costs of these roads is an Agency goal. Tests conducted by the Forest Service throughout the United States show dramatic improvements in road conditions brought about by the use of increased tire footprint area made possible by CTI systems. In addition to the benefits already cited, CTI systems can offer the following advantages:

- Constant monitoring of tires to detect leaks
- Inflation of leaking tires to prevent flats
- Devices showing possible high-speed/ low-pressure operation
- Quick inflation/deflation using switch in cab

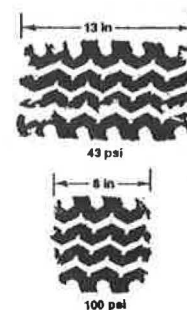
For additional information on CTI, contact:

USDA Forest Service  
San Dimas Technology & Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773

Telephone: 714/599-1267; FAX: 714/592-2309



The Thickness of Road Aggregate Required to Spread the Load to a Pressure Appropriate for the Subgrade Material.



Contact Patch Length Change for Different Tire Pressures.

## Foam As A Fire Suppressant: An Evaluation

*Paul Schlobohm and Ron Rochna, Fire Management Specialists, Boise Interagency Fire Center, Bureau of Land Management, USDI, Boise, Idaho*

The ability of fire suppressant foams to improve ground-applied fire control efforts was evaluated. Foaming agents and foam-generating systems were examined. Performance evaluations were made for direct attack, indirect attack, and mop-up. Foam was determined to suppress and repel fire in situations where water would not. Cost comparisons of mop-up work showed straight water to be significantly more expensive than foam. Foam will replace all current water applications and present new suppression opportunities to the fire management community.

The Bureau of Land Management (BLM) is evaluating the effectiveness of foam as a means of controlling fire. The impetus for this study can be described by the reality of current ground-applied fire control efforts. Wildfire suppression capability is limited where water is scarce and real property values are threatened. Prescribed fires are often difficult to contain. Time-consuming mop-up reduces further burning opportunities.

## The Concept Of Foam

The concept of foam is not new, but the limited use of foam in wildlands warrants a review of its capabilities. Foam extends the life and effectiveness of its water. Foam reduces the surface tension of water molecules enabling greater penetration of the water. Soap-based foam opens the waxy coating of green vegetation, further enhancing wetting ability. Foam inhibits water flow, allowing more of the water applied to be used for cooling. As foam, water becomes a reflective, insulating blanket (3, 4).

## Foaming Agents

Foam systems as recent as 1985 relied on foam-making substances not specifically designed for fire suppression. Pine soap or soap skim, popularized by the Texas Snow Job, is a derivative of the paper-making process. Household dishsoap was also used because of its availability (5).

Since 1985 foaming agents designed for wildland fire suppression have been available. These products combine relatively stable bubble structure, improved wetting ability, and vapor suppressants. They provide the capability of instantaneous extinguishment, construction of an impenetrable barrier to fire, and reduced mop-up time.

## Foam Generating Systems

Foaming agents can be utilized by a variety of means. Synthetic foaming agents have sparked new interest in the foam generating systems made popular by pine soap. Compressed air foam systems (CAFS) have been modified with centrifugal pumps and metering devices, and enlarged with 40 cubic feet per minute (cfm) or greater air compressors. Air aspirating and conventional water systems also have applications for foam.

Foam is produced in the CAFS by mixing compressed air and solution at equal or nearly equal pressures and pumping the mixture through one of three forms of agitation. Hoselays longer than 50 feet (of 1 inch diameter) provide enough space for air and water to mix into foam. Scrub chambers, tubes filled with obstructions, force air and water into foam in 1 to 2 feet. Specialized nozzles combine compressed air and atomized solution as they leave the nozzle. Hoselays are the most common agitation method and this discussion will concentrate on their features.

Compressed air systems which pump foam through the hose flow water at less than normal rates. A 1-inch nozzle may flow 12 gallons per minute (gpm) of water as foam at 150 pounds per square inch (psi), with a discharge distance of 85 feet. Water is expanded about 10 times at agent mix ratios of 0.2-0.3 percent. CAFS has the unique ability to change foam consistency by changing water flow rather than mix ratio.

Extra equipment required for the CAFS include an air compressor and full flow ball valves. Compressor size is dependent on need. Generally, 2 cubic feet of air is necessary for every gallon of water to create quality CAFS foam. The ball valves are used as nozzles to shut off the foam flow.

Foaming agents have also initiated the production of a wide range of air aspirating or expansion nozzles. Low- and medium-expansion nozzles produce quality foam. Low-expansion nozzles are most common. They flow 10 to 30 gpm at 150 psi discharging 30 to 70 feet. The air aspirating system pumps solution through the hose and creates foam at the nozzle. Air is drawn into the nozzle when the solution is atomized and passed through a pressure gradient. Water is expanded 5 to 10 times with agent mix ratios between 0.3 to 0.4 percent.

The third system in which foam agents can be used is as a wetting, extinguishing solute in conventional water systems. Through all apparatus from turbo jet to sprinklers to bladder bags, bubbles will form froth due to low agitation. With the surfactant in the water, wetting and extinguishing will increase over straight water.



Technology offers improvements from conventional equipment for mix methods, hose types, hoselays, and nozzles. The inefficiencies of batch mixing concentrate and water are overcome with eductors or proportioners. Eductors also make possible the use of foam when the sole motive force is a water pump. A portable pump, for example, can draw concentrate into the hose as it pulls water out of a stream. Proportioners, which pump concentrate as desired into the water line, have the accuracy and dependability necessary to be integral engine components.

Hose types are important when foam is pumped through the hose (CAFS). Durable woven rubber hose is used to avoid kinking. Any restriction in a hoselay will breakdown bubbles thus significantly reducing foam quality and discharge capability. Hose which is porous or has an irregular lining will disrupt foam flow and reduce discharge performance (table 1).

Hoselays can be different for the CAFS depending on application. Usually, foam barriers are applied with one or two nozzles. Since foam is compressible, hoses are easily clamped and extended. Hoses filled with foam do not exhibit all characteristics of hydraulics. Greatly reduced head pressure enables foam to be pumped significantly farther above the pump than water (6).

Nozzles vary in performance for aspirated and compressed air systems. Low expansion air aspirated nozzles range in performance for 1.5 inch hose from 7 gpm and 25 feet discharge to 26 gpm and 70 feet discharge at 150 psi. At 35 gpm and 150 psi, a 1 inch CAFS nozzle has a maximum discharge of 70 feet, a sustained discharge of 55 feet; a 1-3/8 inch nozzle: 90 and 70 feet respectively.

Table 1—Hose characteristics important to foam flow.

Hose type	Resistance to Kinks	Resistance to Fire	Porosity w/Foam	Resistance to Flow
Synthetic	poor	poor	high	high
Cotton	fair	fair	low	medium
Rubber	excellent	excellent	none	low

## Applications

The applications phase of the project directly evaluated fire control potential of foam in the field. Where possible, comparisons were made to water performance. Evaluations occurred on prescribed fires and wildfires throughout the West.

### Direct Attack

Visual evaluations of foam's extinguishing capability were made. Flames burning in light, flashy, ground fuels, tall snags, pitchy stumps, red slash concentrations, and desert sage were treated. Extinguishment was instantaneous. For example, two light engines worked the flank of a range fire. The engine using air aspirated foam never had to turn around for rekindled flame. This engine's pumping time was 1/3 greater than the water engine's. The engine using water found some of its flank had started burning again (7).

The compressed air foam system has great extinguishing capability in part because foam can be indefinitely compressed in the hose. The ball valve can be shut off without risk of bursting hose. This creates back pressure in the hose which, when released, produces a fine-bubbled mist and long discharge distances. The fine-bubbled mist is unique to the CAFS. When released the mist puts on a cooling, suffocating performance that has been compared to halon gas. Together with initial discharge distances of up to 85 feet with 1 inch hose, the mist gives the firefighter a deluge initial attack capability. Many prescribed burn spot fires have been extinguished by merely opening and closing the ball valve.

After the initial, fine-bubbled surge, foam produced becomes thicker. It forms large masses of bubbles which cling together. This clinging property is also an important extinguishing feature. Foam can be lofted onto flames, the clinging bubbles forming a vapor suppressing blanket that also separates oxygen from flame. Because it exhibits low head pressures, foam can be injected into the bottom of a burning snag to extinguish fire burning within. The foam will fill any accessible cavity, suffocating fire.

### Protective Barrier

Applications of foam for protection include prescribed burn boundaries, fuelwood piles, snags, wildlife trees, and fragile sites, and backfire wetlines. Twenty firelines adjacent to prescribed fire units have been pretreated with foam. The foam-treated areas adjacent to firelines ranged from 300 feet to 1500 feet in length. Width (25 to 100 feet) and depth (0.25 to 2 inches) depended on the foam generation system and site conditions. The time between application and

ignition ranged from 0 to 45 minutes. Spotting beyond the foam lines occurred on occasion, but no foam line was crossed by moving fire.

Two examples of foam as barrier to fire occurred on the Toad Creek unit in western Montana. Fuel loading was 100 tons per acre of fuel model 13 lodgepole pine/subalpine fir (*Pinus contorta* var. *murrayana* Engelm/*Abies lasiocarpa*) logging slash. The prescription of 40 percent relative humidity, 70 degrees F temperature, and light (1 to 4 miles per hour), favorable winds was met at 2,000 hours. Nevertheless, running flame lengths were 3 to 20 feet high and the fire crowned to 60 feet.

In the first example, a 150 feet by 210 feet by 1 inch foam line was placed across one 1/2-acre corner of the unit. No tools were used, no fuel removed to construct this line. The unit's test fire was lit in the corner. The fire ran quickly to the poles standing adjacent to the line, crowning and producing firewhirls. When the fire reached the foam line, flames leaned over the line, but the fire's forward progress stopped. Time elapsed from foaming to fire contact was 2 minutes.

Lighting of the rest of the unit continued across the foam line. The line was exposed to heating on both flanks for about 5 hours. Inspection the following day showed the line intact, with green vegetation and fine fuels throughout. Two logs greater than 8 inches in diameter which had burned through the line from both ends were the exceptions.

In the second example, a 1,400 foot foam line was placed outside a cut fire trail in an adjacent timber stand. Foam was applied 100 feet wide, 75 feet into the canopy, and 1 to 2 inches thick. Application was 5 to 15 minutes prior to ignition of the adjacent portion of the unit. Two people created this line with one 1 inch hose. Application time was 5-1/2 hours. Fire behavior remained extreme, with long duration, high flame length fire tossing firebrands into the treated stand. Personnel familiar with burning under these conditions expected the fire to escape. The width of the line prevented most firebrands from starting spot fires. One spot that did occur was extinguished with foam from 60 feet away.

### Mop-up

Direct foam versus water performance and cost comparisons were made during mop-up operations. Personnel involved were not informed of the comparison to avoid any changes from standard instructed procedure. In each case, the foam crew was mopping up with foam for the first time.

The first comparison occurred during mop-up of a wildfire in felled and bucked Douglas fir (*Pseudotsuga menziesii*) timber. A four person crew using two nozzles completed 100 percent mop-up of 5 acres in 3 hours with 7,700 gallons

of water. Nearby, on 5 acres of the same fire, this productivity was equaled by two 20 person crews employing 24 nozzles and approximately 55,000 gallons of water.

The foam crew used 15 gallons or \$225 of foaming agent based on 0.2 percent mixture and a price of \$15 per gallon. Assuming the average salaries for the foam and water crews are \$7 and \$5.50 per hour, respectively, the foam operation cost \$309 for labor and foaming agent; the water operation cost \$660 for labor.

The second comparison occurred during mop-up of the Toad Creek unit. A five person foam crew mopped up 100,000 square feet in 4 hours. A 25 person water crew mopped up 25,000 square feet in the same time. Both crews had an unlimited water supply. Total water flow for the foam crew was 30 gallons per minute.

Again, 15 gallons of foaming agent were mixed. Using the same wage assumption in the first comparison, the foam operation cost \$365; the water operation cost \$550.

Foam application technique for both comparisons was designed to let the foam do the work. Foam applied was wetter than the protective foam type. Foam was spread out so that it penetrated and cooled, while the operator moved on. Extra attention to hot spots was given only when heat was well below the surface.

## Discussion

### Foaming Agents

Of all the types of foaming agents presented, the relatively new synthetic products made specifically for Class A fuels are preferred. The 3.0 percent mix ratios of pine soap are 10 times greater than synthetic. Preliminary laboratory tests have shown pine soap to be an inferior wetting agent. Common dishsoap lacks vapor suppressants and durability. The price of the new agents has continued to drop as the demand for them has increased. Some users have experienced 25 percent reductions in suppression costs despite the \$12 to \$15 per gallon prices (8, 9).

The notion that water is free is a fallacy. The BLM fights most of its fires where water sources are miles away. Twelve dollars can make 500 gallons of water into 5,000 gallons of effective water as foam.

### Foam-generating Systems

Purchasing requirements vary significantly with the three generating systems presented. Foaming agent alone will give one an improved wetting agent with conventional apparatus.



As the minimum initial equipment investment, air aspirating nozzles will assure quality foam production, especially for protection and mop-up. Long-term use of this system is appropriate only if the consistent high use of foam is more tolerable than a high initial investment for the compressed air system.

The CAFS generally requires the greatest initial capital outlay, primarily the air compressor, as well as a retrofitting or new engine package. However CAFS can be assembled on-site from inexpensive components such as rented trailer air compressors, readily available plumbing, and an existing water pump. The high initial cost is quickly returned by increased capability and performance, and reduced volume of foaming agent required.

#### Applications

The success of foam in the examples given of performance can be attributed to two factors. First, the combination of synthetic foaming agents and the compressed air foam system creates a powerful tool for fire suppression.

Second, proper training is necessary to ensure success. Foam can fail and if its properties and uses are not understood, it will. Foam should not be considered a cure for every fire situation. It is simply a very useful tool.

Foam must be of the appropriate consistency: wet, dripping, or dry. It must be applied for the appropriate effect: lofted for intact, clinging, and smothering bubbles; pressure impacted for broken, wetting bubbles.

Foam is designed for short term use when applied as a barrier. Its effective lifetime varies with fuel, weather, and fire conditions. Applications must be adjusted accordingly.

Safety precautions should be understood when using foam. Foaming agents are mildly corrosive to skin and eyes. Protective gear is recommended. The high-pressure lines of the CAFS should be operated with caution. Valves must be opened slowly to prevent nozzle kickback and hose whiplash.

#### The Future

Over the past 2 years foam has developed into a tool for the future. The full potential of foam has yet to be realized. In fact, the technology of Class A foam fire fighting is expanding beyond Class A fires. Cost-effective, successful applications have been demonstrated with hydrocarbon fires, vehicle fires, and structure fires. Methods of delivery are also expanding to fit different needs and resources.

The wildland-urban interface fire protection program may have the most to gain from foam development. Research must increase our understanding of foam processes. Training of application techniques must begin. The days of fighting fire with unrefined water are numbered. Water has served us well in fire suppression over the years. As we move into the twenty-first century, water will serve us even better as foam.

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### Foam Generating Equipment

**Dan McKenzie, USDA Forest Service, San Dimas Technology and Development Center, San Dimas, California**

#### On-Hand Equipment/Aspirating Nozzles/Compressed Air Foam Systems

When fighting wildfire with foam, the foam generating equipment can range from the use of current equipment (tank, pump, and plumbing) on hand to specially developed, high-performance compressed air foam systems (CAFS). To use on-hand equipment, one just pours a foam concentrate into the water tank, to the desired proportion to make foam

solution, and then goes at it. To make improved foam, an aspirating nozzle can be added for a cost of some as low as \$20. CAFS is the next step up from the aspirating nozzle. CAFS is the injection of compressed air into foam solution, generally at the engine, and running the produced mixture through a length of hose or mixing device to produce a uniform foam. The advantages of a CAFS unit over an aspirating nozzle include (1) the foam can be projected further, (2) less foam concentrate is used, and (3) smaller more uniform bubble, longer lasting, foam can be made.

An added advantage of CAFS over an aspirating nozzle is that the aspirating nozzle can only make one type of foam—wet sloppy, while a CAFS unit can make different types of foam—all of which generally last longer than aspirating nozzle made foam. For a number of reasons it is not desirable to add foam concentrate directly to the water tank. Therefore, both when using an aspirating nozzle and CAFS, proportional, direct injection of the foam concentrate into the discharge side of the pump is what one should use.

**Aspirating Nozzles:** Aspirating nozzles create foam by (a) atomizing the foam solution stream, (b) drawing air into the stream, generally by venturi action, to create a froth, (c) mixing the froth in an expansion chamber to enhance and strengthen the bubbles, and (d) discharging the foam. The aspirating nozzle is a low-energy system for making foam; for only the energy in the water stream is available. In general, aspirating nozzles which have long reaches, by using the water stream energy to project the foam, will only produce wet, frothy foam. Aspirating nozzles which use most of the water stream energy in making bubbles, will create a drier, more uniform bubble, foam that is only projected short distances. For there is only a given amount of energy in a water stream—if you want to educt air to create foam, this will require the use of energy for projecting the foam resulting in reduced discharge distance. Aspirating nozzles normally require at least a 0.5 percent foam solution to operate well.

**Compressed Air Foam System (CAFS):** CAFS—at one time known as the "Texas Snow Job"—was first put into service by the Texas Forest Service in 1977. CAFS features the injection of compressed air (or other pressurized gas) into foam solution (foam solution is water and foam concentrate in the correct mix ratio). In CAFS, less foam concentrate is generally used (0.3 percent) than with an aspirating nozzle. CAFS is a brute force method of producing foam; therefore, almost any foam concentrate will "work." Injection of air usually takes place at the engine, mostly at operating pressures of 80 to 100 psi. Higher or lower pressures are also used—depending on hose size and length.

### Direct Injection/Equipment Components

Both the aspirating nozzle and CAFS should use proportional, direct injection of the foam concentrate into the exiting water stream to make foam solution, since adding the foam concentrate directly to the water tank or passing it through the pump (suction side proportion devices) is not desirable for the following reasons:

Corrosion (caused by the foam concentrate clearing the tank, pump, and plumbing)

Pump priming difficulties

Water-level gauge troubles

Foaming in tank

Foam proportion cannot be conveniently changed while operating (It can be increased by adding more foam concentrate to the water tank)

When refilling a partially used tank of water, dip sticking or gauging is required

Fire engine cannot draw water directly from a nurse tanker or hydrant and make foam solution

Foam solution biodegrades over time, tends to lose potency, and does not foam as well

Contamination of the water tank—making water from the tank unusable for other purposes (such as drinking or supplying water for lookout towers)

Use of more foam concentrate than required

Problems with pump and valves caused by the foam concentrate washing out their lubricants

For these reasons and others, proportional, direct injection of the foam concentrate on the discharge side of the pump is very desirable in both aspirating nozzles and CAFS units. There are a number of direct-injection proportioning systems on the market (or under development), for use with both aspirating nozzles and CAFS units, which proportionally inject foam concentrate into the discharge or high pressure side of the pump for use with both new and existing water pumping equipment.

**Pumps:** Both types of pumps used in firefighting can be used with foam generating equipment. Early CAFS used the positive-displacement pump. However, a method of using the centrifugal pump was developed—allowing the centrifugal pump to work very well with CAFS. There are major



advantages to using a centrifugal pump with CAFS, for there is no deterioration of the water handling performance nor of the reliability of the fire engine related to water handling.

**Air Compressors:** There are several types of positive-displacement air compressors—piston, rotary van, rotary helical screw, and rotary lobe. The piston type is by far the lowest cost and simplest. The rotary screw has a major advantage over the piston air compressor in that it can modulate output. Because of this, the rotary screw compressor is becoming popular for use in CAFS, despite its higher cost. Very little if any air storage is required for CAFS, for the system will generally use all the air that is produced and at the rate at which it can be produced. In the larger systems, using the rotary screw type air compressor which will modulate output, no air storage is necessary.

**Power Sources:** When using aspirating nozzles, the power for the foam generating equipment can be a power takeoff (PTO) from the truck transmission or an auxiliary engine. CAFS can also be powered by the truck engine or an auxiliary engine; however, special methods must be used. When using the truck engine to drive a CAFS unit, a hydrostatically driven system should be used to drive the centrifugal pump and air compressor. If CAFS is to be driven by an auxiliary engine, a single auxiliary engine can (and probably should) be used. For, when a single auxiliary engine is used—and engine horsepower, pump gearing, and air compressor gearing are properly selected and well matched—the single-engine CAFS works very well.

#### Equipment Selection/Flowmeters

Major components of foam generating equipment have just been covered; however, the question is what should be used. For aspirating nozzles usually the standard water handling equipment can be used with the addition of a pump discharge, direct-injection, foam concentrate proportioning system. For CAFS, a little more guidance is needed.

For CAFS or aspirating nozzles the pump should be a centrifugal pump because of the major advantage of no deterioration of the water handling performance not of the reliability of the fire engine related to water handling. For wildfire, the pump performance should probably fall in the following ranges 50 to 70, 90 to 120 and 190 to 250 gpm.

The air compressor could be either a piston or rotary screw. The rotary is becoming preferred because it modulates output. For wildfire, the compressor output should fall in the range of a minimum of 40 to 100+ cfm. The minimum flow will operate well a short (up to 200 ft) 1-inch diameter hose; 100 cfm will operate very well a short (up to 200 ft) 1-1/2-inch hose. The power source should be the truck engine or a single auxiliary engine; in either case the unit should be able to make a running attack.

A CAFS unit should have a system that proportionally injects foam concentrate into the discharge side of the pump. This means that no foam concentrate has to be added to the tank nor run through the pump.

One more area of guidance for a CAFS unit is to have flowmeters on the water, air, and foam concentrate lines. When the end of the hose is close to the engine, and the engine operator can see the discharge, these may not be very important. But, when fighting wildfires, frequently the hose ends up going over the top of the hill; then the engine operator cannot see what is happening at the end of the hose. For, when supplying a long hose lay, it is a long time before a change at the end of the hose is seen after an adjustment is made at the engine—sometimes as long as 15 to 20 minutes. For these reasons, flowmeters on a CAFS unit are very important; they show the operator what the unit is doing and, when an adjustment is made, the operator can see whether the adjustment is producing the desired effects. Flowmeters also help in training the operator to produce foam quickly and change the foam on demand.

#### Hurricane Hugo

**Dan W. McKenzie, USDA Forest Service, San Dimas Technology and Development Center, San Dimas, California**

On the night of September 22-23, 1989, the eye of Hurricane Hugo made landfall at the city of Charleston, South Carolina. The Francis Marion National Forest, just north of Charleston, took the severest part of the storm with water surges over 20 feet above mean sea level. About 70 percent or more of the



**Hurricane Hugo - Francis Marion National Forest**

trees over 10 inches in diameter were blown over or broken off 20 to 25 feet above the ground in the 250,000 acre National Forest, with an estimated loss of value of \$95 to \$115 million. The seed orchard on the Francis Marion suffered heavy damage, with an estimated 95 percent of the trees severely damaged or destroyed. Most of the 576 miles of roads within the National Forest were blocked by fallen trees. Special equipment for preparing fuel breaks along the forest roads such as special wide track crawler tractors and foam fire fighting equipment was researched and put into operation where appropriate. Timber salvage operations were also begun.

#### The Effectiveness Of Class A Foams

**Ronald R. Rochna, and Paul M. Schloblohm, Fire Management Specialists, Boise Interagency Fire Center, Bureau of Land Management, USDI, Salem, Oregon**

Suppression of class A fires is dependent on breaking the fire tetrahedron by isolating either (1) air, (2) fuel, (3) heat, or (4) inhibiting the chemical chain reactions. Water has been recognized as a means of suppressing fire since rain was first observed extinguishing the warming fires of early man. It has been used extensively up through the present. The need to apply copious quantities of water has been the driving force in the search to enhance water's suppression capabilities. Currently the answer is the use of a foaming agent. The conversion of water from a liquid to a bubble state imparts new characteristics to the water and results in superior suppression qualities. The foam can affect all four sides of the tetrahedron and also produces side benefits which are an aid to suppression. In some instances a particular function performed by the foam modifies more than one of the fire parameters thereby giving a compound net benefit.

The least complicated relationship is that of the foam and air. The viscosity of water is such that very little adheres to the surface it lands on. It immediately drains off and only a miniscule amount is retained if the surface is not very rough and porous. Foam is semi-fluid in most cases, consequently, gravitational forces are primarily responsible for the gradual flow that is set up after it comes to rest. The result is that a much greater quantity of water adheres and remains on site for a much longer period of time in the foam state. During this interval the foam acts as a durable barrier and excludes the air from the fuel's surface. Vaporized water is trapped at the fuel interface by the foam layer and air pockets in the fuel's proximity attain high relative humidities. Foam impedes the free movement of air and moisture-laden air is not replaced by dry air. When water is

applied to live coal the skin-thin layer of water that adheres is readily evaporated and air is permitted to enter and foster combustion. But, when this same volume of water is expanded ten to fifty times, the resulting foam layer forms a protective envelope.

The heat segment of the tetrahedron is severed by foam in several ways. The opaque surface reflects some of the energy that impinges on it and absorbs the balance. The sphere-like structure of the bubbles causes incoming energy to dissipate laterally and localized pre-heating is minimized. The pathway through the bubble mass is made up of the fluid in the bubble skins and the air within these bubbles. These air cells act as pockets of insulation and, as a consequence, radiant energy becomes highly diffused when it enters the foam. The energy that is absorbed is used to evaporate water trapped in the foam structure. The net result is slower evaporation per unit of surface area and an overall delay in the exposure of the fuel's surface to oxygen and heat. The foam physically insulates burning fuel from the surrounding environment. The energy released at the combustion interface is dissipated, and cooling takes place while this barrier starves the burning fuel of oxygen. These inhibiting factors reduce the potential for rekindling; rekindling only takes place where the energy output exceeds that needed to totally dissipate the foam cover.

The fuel segment of the fire triangle is affected by foam in diverse ways. A heavy application of foam does not drain off instantaneously like water but flows gradually, thereby enveloping the fuel particles on which it lands. This results in much more water being held in the bubble structure per unit of fuel surface. The increase in amount means there is more available water for wetting and more available to absorb heat. The surface-active agent in foam reduces the surface tension of water from approximately 73 dynes/cm at 20 degrees celsius to less than 33 dynes/cm, the level specified for wetting agents. A typical relationship between surface tension and mix ratio is:

Foam Concentrate(%)	Surface Tension(dynes/cm)
0.00	73.0
0.01	43.6
0.10	23.4
0.30	22.3
0.50	22.4

Class A foam concentrate ratios greater than 0.5 percent increase surface tension of water.



Water in its pure form maintains a strong molecular bond, consequently, its surface resists rupture. The addition of a wetting agent to water weakens this molecular bond and the water's ability to wet and to operate porous materials is greatly enhanced. Because foam stops where it lands and releases its liquid component at a regulated rate, wetting of the fuel is achieved much more efficiently. Hard-to-wet surfaces shed water, but foam adheres to them and it wets these surfaces via the wetting agent. Vertical surfaces are also difficult to wet with water even if they are receptive to water but, in the foam state, a substantially greater amount of water can be entrapped and rendered available for wetting and heat absorption of such surfaces.

Note: The amount of foam that can be adhered to a vertical surface is governed by the foam generator employed (Compressed Air Foam System vs. Aspirated Nozzle) and the concentrate mix ratio.

The uninhibited chain reaction (the flame you see) is the fourth piece of the tetrahedron that foam possibly has an effect on. It must be stated that this effect has only been observed when using a Compressed Air Foam system. It is speculated that if a foam bubble can be generated small enough, a bonding of free hydrogen radicals could take place resulting in an incomplete chain reaction, flame disappears. This is what happens when extinguishing agents such as Halon and dry chemicals are used to extinguish a fire. The effect is to black-out the fire without absorbing vapors or heat. This phenomena has been observed but not been documented and supported with research.

The rigidity of the bubble structure depends on bubble uniformity, mix percentage, exposure to sunlight and wind, and the efficiency of the foam generator. The rate at which the bubble mass reverts to liquid depends on these factors. The slow release of fluid from the foam makes liquid water available for a longer period of time to wet the fuel. Changing water from a liquid state to foam state also enhances the suppressant's ability to penetrate fuel complexes. Water travels along the path imposed on it by gravity and that imparted to it by the delivery vehicle. These forces also apply to foam but, once the liquid aerates to form a bubble mass, it becomes buoyant and its descent path is influenced by air movements. The end result is that foam penetrates through openings to envelop fuels which might otherwise not be wetted. This enveloping of fuels results in an isolation of volatiles emanating from the fuel particles or, as a minimum, a dilution of these volatile substances to a level where the ignition threshold is greatly altered i.e. the ignition temperature is elevated. The breakdown of the foam at a controlled rate not only enhances wetting but also modifies the micro-climate within the fuel complex.

Class A foams are currently the best instrument available to fire organizations to break the air, heat, fuel, and uninhibited chain reactions relationship.

## Using The Global Positioning System For Field Location In Forestry Operations

*Richard G. Hallman, Program Leader, Missoula Technology and Development Center, Missoula Montana; Frederick L. Gerlach, Professor, School of Forestry, University of Montana, Missoula, Montana<sup>1</sup>*

### Introduction

The Global Positioning System (GPS) has been under development since 1973. GPS provides precise positioning, timing, and navigation to military and civilian users equipped with GPS receiving instruments. The United States Department of Defense is responsible for the development and control of the system. The navigation component has shown much promise for application in the field activities associated with forestry and other land and water resources.

The first GPS satellite vehicle (SV) was launched in 1978. The SVs or NAVSTARs for Navigation Satellite Timing And Ranging are placed in orbits 20,000 kilometers above the earth. Each SV acts as a precise radio beacon, sending code modulated frequencies which can be interpreted by GPS receivers. The receiver processes the SV signals into two and three-dimensional positions at the receiver's antenna. Two-dimensional positions may be obtained when the signals from three SVs are received, and three-dimensional positions are determined from four SV signals received simultaneously. When GPS is completed in 1992, a receiver equipped user will be able to determine the position and navigate point to point anywhere at anytime.

Positioning capabilities of the geodetic survey level are truly remarkable, producing point position accuracies within centimeters. The capabilities at the navigation receiver level are less accurate but still useful for field surveying of lower order.

The potential for the application of GPS navigation is enormous. In forestry activities, the applications may be as varied as locating forest fires, guiding field crews, finding survey monuments, locating land parcels or digitizing any kind of field information. The USDA Forest Service began the implementation of new field location methods in 1983 because of the many possible uses of satellite navigation methods.

## Development Of GPS Use In The Forest Service

The first step taken toward the implementation of satellite location technology in field operations was the establishment of the field locator project at the national office of the USDA Forest Service. This project overviewed the technology under development reviewing the need for new field location technology. Foresters and other specialists working in the field were questioned concerning the need. Initially, over one hundred separate field tasks were identified as potential uses for satellite location technology.

The field locator project was moved to Missoula, Montana, in 1986 under the administration of the Technology and Development Center.<sup>2</sup> In cooperation with the School of Forestry,<sup>3</sup> a facility was established for the field evaluation of satellite navigation instruments and the training of potential users.

The facility was located at Lubrecht Experimental Forest (School of Forestry) where a controlled, inventoried and mapped test area existed. A number of field evaluation courses were located within this area. The courses were designed to provide typical forest work situations for the evaluation of satellite navigation instruments. The work situations included point to point navigation, plot positioning, traversing, profiling, corner searching, field digitizing, and others. The courses were also planned within a range of slope, aspect, elevation, forest canopy and tree size conditions. A precise GPS survey was completed in early-summer 1987 to provide World Geodetic System 1984 (WGS84) coordinates for base stations in the test area. Subsequent precise ground surveys placed WGS84 coordinates in two of the courses.

GPS navigation receivers became available for field evaluation in mid-summer 1987. Under open sky conditions, the instruments produced positions within 25 meters (X,Y) of the true position in most situations. The means of hand-recorded observations were often within 10 meters (X,Y) of the known position. Mean vertical positions were often more than 25 meters (Z) from the surveyed positions.

The receivers produced positions under a variety of canopy conditions with varying success. Although these instruments were field portable, they were not designed for the rigors of forestry field work.

In the spring of 1988, the Technology and Development Program obtained the first commercially available GPS receivers designed for land navigation. These receivers were the PATHFINDER model manufactured by Trimble Navigation, Ltd. (USA). This receiver including the control/display unit, antenna, power supply and carrying cases weighed less than five kilograms. The instrument, then,

became highly portable. The operating system allowed for several modes of operation. The control/display unit was also a recording unit. This capability provided for the use of two receivers operating simultaneously in a differential mode. The new navigation receiver capability also provided for post-processing of the collected data in a personal computer. One receiver could be set up on a base station of known position to record simultaneously with a second receiver set up on unknown positions. In post-processing the base station record of position errors could be used to correct the observations of the unknown positions. This is a differential mode of operation using navigation receivers. The results of the observations of a single receiver (operating independently) is called an autonomous mode of operation. A reading of position at a moment of time is called a real time observation.

Foreseeing the need for GPS user training, the Forest Service supported the development of field training seminars for resource managers. Four seminars (15 students each) were presented in 1988 at Lubrecht Experimental Forest. The seminars gave the students real experience in using GPS receivers under typical forestry field conditions.

The combined experience of the instrument evaluations and training seminars produced increased confidence in GPS for forestry use. In the open, navigation to a point was nearly always within 25 meters (X,Y). The real time positioning of a point was always within 25 meters (X,Y) of the known position. With the recording of 100 observations, the mean autonomous position was always within 10 meters of the true position. In the differential mode of operation, the position determination was almost always within three meters of the known position without any obstructions to the signals.

The instrument readings of position are in latitudes and longitudes (degrees, minutes, and seconds) and height above ellipsoid (meters) in the WGS84. For comparison to local areas and local maps, these coordinates must be transformed to other ellipsoidal and geoidal references.

The early experience under the forest canopy produced mixed results. Many interruptions occurred in the sequence of observations and accuracies seemed to be affected. This problem was explored in a study of canopy effects during the Fall of 1988. The results show a significant reduction in the efficiency of GPS receiver operation under the existing canopy conditions. In turn, this seriously affects the differential model of operation, and has some lesser affect on autonomous operation. Accuracies are also affected. An important consideration, however, is that good positions were obtained at nearly all of our test points at some time.

Four more field training seminars were presented in 1989 along with continuing receiver evaluation. There is a present



expansion of the development of geographic information systems (GIS) in resource management at the personal computer level. This development is rapidly increasing the demand for better positioning for all kinds of mapped and unmapped information. A GPS navigation receiver is a natural field digitizer. A receiver is capable of producing new positions every 1.5 seconds in the open. Using a recording GPS receiver, field digitizing by walking, riding or driving a vehicle is incredibly fast. Certain types of resource information (like soil or habitat type lines) might be more rapidly and accurately digitized in the field using a GPS receiver. Also, due to rapid changes in the cultural detail on the ground, maps are quickly obsolete. Updating or revising of maps or GIS databases seems to be a logical and immediate use of field digitizing with GPS receivers. Much of our work during 1989 was associated with the problems of field digitizing. We will continue to evaluate new GPS receivers, study canopy effects, study field digitizing, and train GPS users during 1990.

Currently, there are over fifty GPS navigation receivers in operation in the USDA Forest Service. And, there are over 120 trained users of GPS receivers. The reports from these users indicate much success for the applications of GPS receivers in a wide range of forest and rangeland conditions. The applications vary widely for: (1) determining the area of a timber harvest, (2) locating a trail on the map, (3) digitizing a new road for map revision, (4) finding a sample plot location, (5) finding lost survey monuments, (6) registering satellite imagery by digitizing identifiable features, (7) positioning forest pest and disease development centers, and (8) many others. As in any form of data/information production, reliability is a very important consideration. The user must be attentive to quality control of the data.

### Summary

The work so far has utilized the NAVSTARs launched before 1985. These satellites form Block One, the prototype system. The satellites in Block One provided about four to six hours of three-dimensional position coverage for North America. Other parts of the world may have had less coverage due to the orbit stationing of the SVs. For most of the period (1987-89), seven satellites stationed in two orbital planes were available for observation. At any one time, the configuration of the satellites produces a geometric condition affecting the accuracy of the solution for position. Of course, this can vary much for any set of three to four satellites as they move across your view of the sky. The accuracies noted before can only be achieved with the best geometric configuration of satellites. Very often the actual observing periods were less than four hours when quality was considered.

Presently, the operational system (Block Two) is under development. This system will consist of twenty-four satellites with spares. At the expected completion of 1992-93, this system will provide worldwide three-dimensional coverage.

The USDA Forest Service plans to continue the evaluation of the new satellite navigation instruments as they become available. The continued study of various applications given the new Block Two conditions will also be important. The completion of Block two should improve the operating efficiency of GPS receivers in forest conditions.

The following list of publications have been generated since the beginning of this project.

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Gerlach, F.L. 1989. GPS Canopy Effects Study. Coordinate Locator Project Reports, USDA Forest Service, Technology and Development Program, Missoula, MT.

Gerlach, F.L. and A.E. Jasumback. 1989. Digitizing Natural Resources with GPS (Abstract). Proceedings of the 12th Canadian Symposium on Remote Sensing (IGARSS 1989), Vol. 3, p. 1590.

Gerlach, F. L. and A.E. Jasumback. 1988. Evaluation of GPS Instruments for Resource Management Applications. Proceedings of the Institute of Navigation Satellite Division's International Technical Meeting. Colorado Springs, CO., pp 503-510.

Jasumback, A.E. 1987. Evaluation of the NAVCOR 1 Global Positioning system. USDA Forest Service, Technology and Development Program, Missoula, MT.

Sears, N., F.L. Gerlach, and R.G. Hallman. 1987. A Field Facility for Evaluating Satellite-Based Automatic Position and Navigation Instruments. American Society of Agricultural Engineers. St. Joseph, MO.

<sup>1</sup>A paper presented in the Peoples Republic of China for the Citizen Ambassador Program of People to People International, April 1990.

<sup>2</sup>Anthony R. Jasumback, Director. Field Locator Project, Technology and Development Program, USDA Forest Service, Missoula, MT 59801.

<sup>3</sup>Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula, MT 59801.

## Use Of Video-Camcorder To Document Sagegrouse Use Of Sagebrush

**Fred J. Wagstaff and Bruce L. Welch, Range Economist and Principal Plant Physiologist, USDA Forest Service, Intermountain Research Station, Shrub Sciences Laboratory, Provo, Utah**

Use of video-camcorder to document sagegrouse use of sagebrush

### I. Background

#### A. Our problem

1. Multiple birds-multiple plants
2. Plant layout-random placement in rows 6 x 6 spacing
3. Blind spots because of posts and rails on enclosures
4. Low temperatures-December
5. Visible recording of time in seconds
6. Needed total enclosure coverage

#### B. Equipment specifications

1. Long tape time
2. Visible time clock in seconds
3. Good resolution
4. Zoom lens
5. Relatively simple to use
6. Use multiple power sources
  - a. DC auto battery
  - b. Integral-rechargeable power source
  - c. Cigarette lighter in truck
  - d. AC power
7. Low temperature tolerance
8. Large area coverage
9. Affordable <\$1,500

### II. Our Experience

#### A. Equipment

1. Several brands met most of our needs
2. Final selection was based on tests and personal preference
3. No brand would do everything we wanted
4. Found we would need two cameras to give the resolution and coverage
5. A tripod is needed particularly on telephoto
6. Low temperature problem was solved by using camp trailers and trucks as filming blinds. We did have to keep the windows open to prevent frost accumulation. Placing a Coleman lantern on the floor under the camera tripod provided sufficient heat.

#### B. Site and Birds

1. Put colored bibs on the birds
2. Put numbered stakes by every third row of plants

### III. Conclusions and Recommendations

- A. Video-camcorders can be used to document complex but visible activities of birds
- B. A tripod or window mount is needed to insure high quality photography particularly when using Zoom and telephoto.
- C. Use of a 12-volt RV type battery will provide power for several days
- D. Use of audio allows for keeping notes
- E. Use of visible clock is needed where simultaneous actions need to be separated during the reply.

## Rehabilitation Equipment Development In Southern Idaho

**Mike Pellant, Range Conservationist, USDI Bureau of Land Management, Idaho State Office, Boise, Idaho**

The impacts of wildfires are one of the greatest resource management concerns on rangelands administered by the Bureau of Land Management (BLM) in southern Idaho. Equipment development and modifications are needed to implement a "greenstripping" program (establishing strips of fire resistant vegetation) and to improve shrub restoration practices. Described below are modifications recently made to the BLM's disk chain and a new sagebrush seeder and chain harrow.

### Disk Chain Modifications

Idaho BLM has been using a disk chain (Pellant 1988) to prepare seedbed and plant perennial vegetation in cheatgrass dominated rangelands. Several modifications have been made to this original unit to correct deficiencies and to improve effectiveness. The chain link to disk ratio was two to one on the original unit. The distance between disks (36 inches) precluded a full turnover of surface soil, thus competition from undesirable annual species was not adequately controlled. This problem was especially evident on sites where fall germination of annual species had not occurred and the soil was dry. Under these conditions the disk chain was only partially effective in reducing annual species competition.

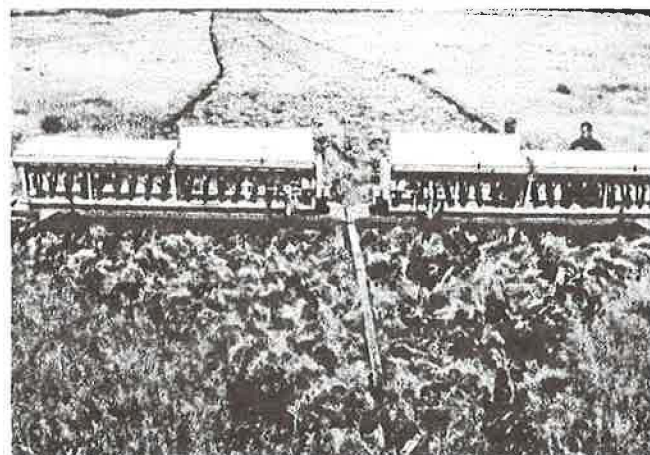
The link to disk ratio has been increased to one to one with the addition of a disk to each chain link. Complete soil turnover is now achieved, improving control of annual species. However, caution must be exercised in using the disk chain under moist soil conditions with abundant litter or shrub cover. Disks accumulate soil and debris to the point where the cutting action is greatly reduced (Figure 13). If the disk chain is used in burned areas without litter or debris, little accumulation of soil or litter occurs.



Other minor modifications to the disk chain have also been made. Wider V-shaped plates have been welded to the roller bar below the seed boxes to increase the area where seedbed compaction occurs. Corrugated seed tubes have been replaced with smooth seed tubes to reduce seed tube clogging. Finally, a "windscreen" has been installed behind the seedboxes to stop seed from blowing behind the roller bar.



*Disk and Chain*

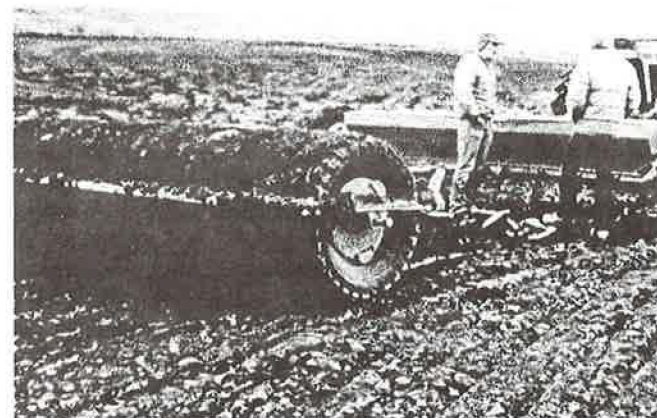


*Chain and Link*

### Jarbridge Sagebrush Seeder

Recent attempts to reseed big sagebrush in critical wildlife habitat areas have been hampered by difficulties in distributing sagebrush seed over large acreages. BLM's Boise District has constructed a sagebrush seeder consisting of three components. An "EZ Flow" fertilizer seeder distributes sagebrush seed over a 12-foot wide strip. This spreader has good agitation, a large seed aperture size (1.75 inches) and no seed tubes to clog. Drag chains are pulled behind the fertilizer spreader to lightly cover the seed. Finally a vine roller cultipacker consisting of truck tires cemented to a solid shaft firms the seedbed.

This seeder can be pulled by a two-wheel drive tractor at a cost of \$5 per acre for operation. Acceptable sagebrush establishment (1,900 and 17,000) plants per acre at an application rate of 0.7 pounds PLS per acre) was obtained on two projects seeded in the fall of 1987 (Boltz 1989).



*Jarbridge Seeder*

### Chain Harrow

Harrows are an effective technique to lightly cover seed on rangelands free of obstructions. However in areas with rock outcrops, conventional harrows are easily damaged and of limited value. BLM's Boise District has constructed a chain harrow to solve this problem. This unit consists of a 54-foot wide elevated frame with 8-foot segments of 5/8-inch diameter chain attached at 4-inch intervals. The frame is mounted on truck tires and has sufficient clearance to pass over surface rocks up to 24 inches in height.

It can be pulled with a two-wheel drive tractor (60 to 80 horsepower) at operation speeds ranging from 2 to 6 miles per hour, depending on the amount of rock in the area. On a project with moderate amounts of rock outcrops, an average of 20 acres per hour was treated with the chain harrow. Soils were gravelly loams and dry at the time of treatment. A 1/2-inch deep furrow was created by each chain. On sites with soddy soil conditions, surface soil disturbance is minimal.



*Chain Harrow*

Total cost of labor and materials to construct the chain harrow was \$8,500. Weight of the unit is 7,500 pounds. The chain harrow should have the greatest application on coarse soils or when light seed coverage is required.

### Literature Cited

- Boltz, Michael. 1989. Dual seeding to establish grass and shrubs on burned sites in southwestern Idaho. In: Abstracts, 1989 Society for Range Management Annual Meeting, Billings, MT
- Pellant, Mike. 1988. Use of disk chain on southern Idaho's annual rangeland. In: Vegetative Rehabilitation and Equipment Workshop: 42nd Annual Report, Corpus Christi, TX, p. 40.

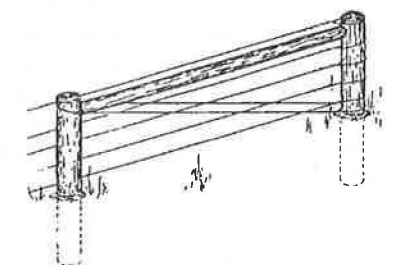
### Fence Brace Designs

*Dan W. McKenzie and Jeffrey White, Mechanical Engineer, USDA Forest Service, Technology and Development Center, San Dimas, California and formerly with USDA Soil Conservation Service, Lassen Gold Mining, Susanville, California*

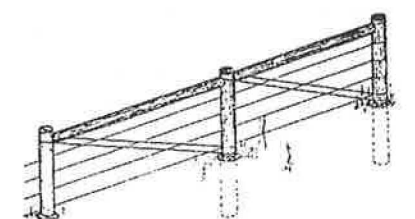
#### Horizontal Braces

Corner, line, gate, and fence end braces are a very important part of any fence. With the use of high tensile smooth wire, braces are of even greater importance—for when using this where, the complete fence must be maintained at the recommended tension to be effective. In recent years, the horizontal fence brace and the double horizontal fence brace have been accepted as the standard and strongest fence brace design. These braces are very good; however, there are other brace designs that are as good or better, and cost less for materials and installation.

Even the cost of a double horizontal fence brace can be lowered by using a single, longer horizontal brace. Calculations show that on a 4-foot high fence, a single-panel horizontal fence brace 11 feet long is as good or better than a 16-foot double horizontal fence brace constructed from two 8-foot panels.



*Horizontal Fence Brace*

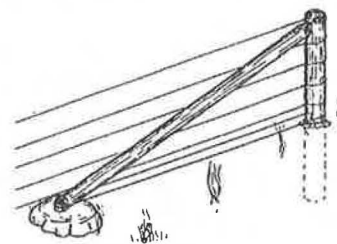


*Double Horizontal Fence Brace*



## Diagonal Brace

The diagonal fence brace (figure 18) is structurally equal to the horizontal fence brace and is less costly for materials and installation, since one less hole has to be dug, one less post has to be purchased, and no measuring or fitting is required to install it. When used on a 4-foot high fence, a single diagonal brace, 11-feet long along the ground, is equal or better than a double-panel horizontal fence brace 16 feet long. A diagonal fence brace is equal in strength and holding force to a horizontal brace because it has the same lifting force on the corner post and the same soil reaction forces as a horizontal brace of the same size (i.e., length of brace on the ground).



Diagonal Brace

In the design and installation of a diagonal brace several principles should be kept in mind:

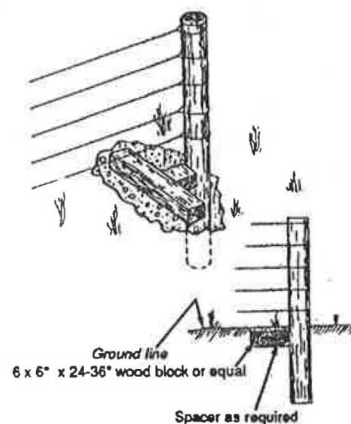
1. Make the diagonal brace—as is also true for the horizontal brace—as long as possible; up to about 11 feet along the ground for a 4-foot high fence. This is approximately 5.5 times the average wire height. Lengths of a diagonal beyond about 11 feet for a 4-foot high fence adds very little, and are not necessary. The brace will be as effective as necessary with an 11-foot diagonal.
2. Be sure that the end of the diagonal brace in contact with the ground is free to move in the direction of the fence pull; it must not be blocked by a stake or fence post. (Reason: When the end of the diagonal bears against a stake or fence post and is not free to move in the direction of fence pull, one-half to two-thirds of the total fence tension can be transmitted to the stake or fence post. This greatly reduces the ability of the corner post of the brace to resist pullout (failure).)
3. The diagonal brace can bear against the corner post in any location from the middle of the post to the top. However, probably the best place to have the diagonal brace contact the corner post is at the top. (Reason: The maximum bending movement of the corner post—located at ground level where the brace wire is attached to the corner post—is the same

whether the diagonal brace bears at the top or the middle of the corner post. However, the loading in the diagonal brace (compression) and lower brace wire (tension) will be double when the diagonal brace bears against the middle of the corner post as of the corner post.)

## Block Braces

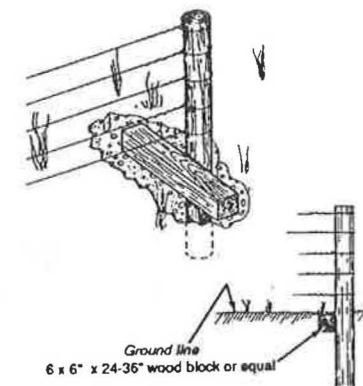
The block brace is another good brace. It's very simple, lower cost, and easy to install—but requires some skill and judgment in where and when to use it. The block brace uses a single post with a block just below ground level to reduce soil bearing loads to acceptable limits. The block has to be large enough so the bearing area of the block reduces the soil loading to that which the soil can carry over a long period of time without movement, even under very heavy moisture conditions. The maximum bending moment (the load or forces trying to break the post in bending) of the vertical post of the block brace is approximately the same as that of the horizontal or diagonal fence brace and located in the same place—at ground level.

The block brace works well in heavy soils and will work well in lighter soils, if the block is made large enough. Also the block brace works best if the block is wedged in place and the block presses against undisturbed soil. If the block is loose, a compression spacer can be wedged between the post and the block to make the block tight against undisturbed soil. Other things that can help make the block brace strong is to set the post down to 36 inches (or more); and cut a wedge out of the block to help hold the post upright. The post can be blocked by any size or shape of block, provided it is large enough. Blocks can be 6- by 6-inch wood blocks, large rocks, a small amount of concrete, or concrete "bars" (such as used for car stops).

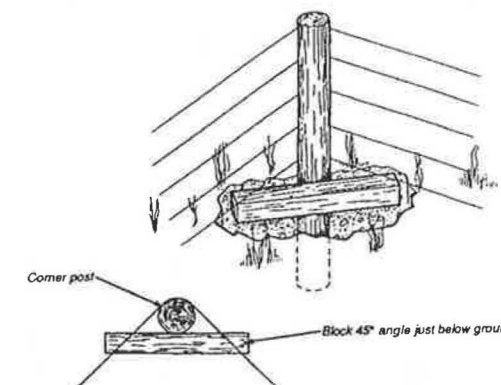


Post and Block Brace

Also the block can be placed away from the post and a compression spacer placed between the post and block. This compression spacer can be as long as necessary—6 or 8 feet, or even longer. The block brace can also, like the diagonal brace, be used effectively at dog legs or 90-degree corners to keep the post from pulling over. The block brace has a major advantage over the horizontal or diagonal brace in that there is no force trying to lift the post out of the ground.



Block Brace



Corner Block Brace

## Summary

The horizontal and diagonal fence braces are equal in strength and holding power. A single horizontal or diagonal fence brace 11 feet long is equal to a double horizontal fence brace 16 feet long for a 4-foot high fence. In the design and installation of a diagonal fence brace several principles should be kept in mind:

1. Make the diagonal brace (as well as the horizontal brace) as long as possible.
2. Be sure the end of the diagonal in contact with the ground, is free to move in the direction fence pull, and is not blocked by a stake or fence post. This is important!
3. The diagonal brace can bear against the corner post in any location from the middle of the post up.

The block brace is a very good, low cost, easy to install, simple brace—but requires knowledge and judgment in where and how to use it.





## 1980 Vegetative Rehabilitation and Equipment Workshop 34th Annual Report

San Diego, California

*The following abstracts have been taken from annual Vegetative Rehabilitation and Equipment Workshop reports from 1980 through 1989. The selection was made to show the scope and breadth of VREW related activities. For more information see the original article in the appropriate volume.*

### Arid Land Seeder

**Carlton H. Herbel, Science and Education  
Administration, Agricultural Research Jornada  
Experimental Range, Las Cruces, New Mexico**

The Science and Education Administration-Agricultural Research at the Jornada Range has demonstrated that more favorable conditions exist for germination and seedling establishment when uprooted vegetation is placed over seeded rangeland. The Agricultural Engineering Department at New Mexico State University, in cooperation with SEA-AR, designed and built the arid land seeder to create the micro-climate needed for seeding arid land. It was originally pulled by a crawler-tractor equipped with a rootplow. The seeder picks up the plowed brush from the ground, forms basin pits, firms the soil, plants seed, and then deposits the brush on the seedbed as cover.

In 1979, the arid land seeder was separated from the crawler-tractor and equipped with the rootplow. The rootplowing was done separately; the arid land seeder pulled by a large four-wheel drive tractor followed. This arrangement, rootplowing and seeding separately, was more efficient and faster.

The effectiveness of the mechanical treatment is being compared to chemical control with the herbicide tebuthiuron. The two methods are also being compared with an untreated area.

### Seeding and Planting

**J. Ross Wight, Science and Education,  
Administration-Agricultural Research, Northwest  
Watershed Resource Center, Boise, Idaho**

Mr. Wight summarized the workgroup activities since the 1979 meeting.

A paper entitled "Automatic Bandoleer Feeder for Transplanters," by Modern and Brewer, was presented at the December 1979 meeting of the American Society of Agricultural Engineers. Work continues on the automatic feeding systems.



A Tye rangeland seeder mounted in front of a rangeland imprinter was used to seed 2,000 acres of rootplowed brushland in southwest Texas.

The Utah Division of Wildlife Resources continued to work with the rangeland interseeder and tree and shrub transplanter.

## Disturbed Land Reclamation

**Ron Younger, USDI-Bureau of Land Management, Salt Lake City, Utah**

Jim Smith, professor, Department of Agricultural and Chemical Engineering at Colorado State University, Fort Collins, described a vertical-axis rotary tiller they are using.

Cal Kuska of Roscoe Brown Corporation described the operation of a pipeline backfilling machine that minimizes vegetation and soil disturbance.

Bob Knudson, project engineer at the Forest Service Missoula Equipment Development Center, gave an update on the sprigger for native shrubs, the small diameter water sampler, the dryland plug planter, and the dryland sodder.

## Vertical-Axis Rotary Tillers

**James L. Smith, Professor and Jon P. Workman, Research Assistant, Department of Agricultural and Chemical Engineering, Colorado State University Fort Collins, Colorado and Kent A. Crofts, Manager of Reclamation and Environment, Energy Fuels Corporation, Steamboat Springs, Colorado**

This paper describes the vertical-axis rotary tiller and presents test results where the tiller was used for anchoring mulch and preparing a seedbed on topsoiled, recontoured mine spoil.

The vertical-axis rotary tiller produced superior results in field tests compared to the mulch crimper and horizontal-axis tiller. The vertical-axis tiller has many applications for reclamation and revegetation tillage and mulching. Redesign of some tiller components would improve their suitability for reclamation or revegetation work.

## Minimizing Vegetation and Soil Disturbance in Pipeline Construction

**Clavin Kuska, Roscoe Brown Corporation, Lenox, Iowa**

A horizontal earth auger has been developed by Roscoe Brown Corporation that minimizes vegetation and soil

disturbance along a pipeline right-of-way. The auger also minimizes damage to the anticorrosion wrap and the cathodic wires used to reduce failures from corrosion in the line. The auger requires only one-third the width that a dozer requires to perform a backfill operation and is 10 times faster than conventional shuttle backfilling with a dozer.

The auger is also effective in constructing berms and terraces, for borrow aeration, for removing silt from ditches, and for some grading.

The auger is hydrostatically propelled. Its speed can be set higher for shedding wet material and set slower for sandy and rocky conditions. The machine is simple in design and maintenance is minimal. The parts that wear (the replaceable and adjustable places on the leading edge of the auger) are under manufacturer's patent.

## Equipment Development Projects For Disturbed Land Reclamation

**Robert Knudson, USDA-Forest Service, Equipment Development Center, Missoula, Montana**

The Equipment Development Center at Missoula is funded by the Bureau of Land Management for four projects related to disturbed land revegetation. A brief outline describes the problem to be solved, the project goal, prior work done, and project objectives. Discussed are: a sprigger for native shrubs; a small-diameter water-well sampler; a dryland plug planter; and a dryland sodder.

## Mulching Machine Conversion From A Rotary Feed Grinder

**Bob Anderson, Lo-Co Equipment Company, Windsor, Colorado**

The need for a mulching machine capable of handling 1,500-pound bales of straw and hay motivated two mechanics at an Ohio coal mining company to modify a rotary tub grinder that normally is used for grinding cattle feed. The machine, called a Roto-Grind-Mulch Master, is now commercially available.

The Roto-Grind-Mulcher is a simple machine with two operating parts—the feeder tub or hopper and the beating machine. Mulching material is dumped into the hopper with a front-end loader. The mulcher handles large round bales, square bales and loose straw, and hay. Strings can be left on the bales. The mulcher will also spread bark, wood chips, composted municipal wastes, and all types of crop residues. Mulch is applied evenly and can be stopped from the tractor by stopping the tub.

One person can run the entire mulching operation if necessary, but two people increase efficiency—one person on the loader and one operating the mulcher. The unit requires a 100-horsepower tractor with a 1,000-rpm PTO.

## Seed Harvesting

**A. Perry Plummer, Chairman, Seed Harvesting Workgroup**

Specialized equipment is needed to better harvest seed from plants in their native habitat. A successful seed vacuum harvester was built with two 6-inch hoses. The machine weighed about 1 ton, was mounted on a two-ton truck, and was custom built. A major handicap to the machine is that its use was confined to relatively flat land where a truck could operate.

In recent years the development and perfection of a backpack harvester has been underway, and some important progress has been made. Two of these machines have been manufactured. Additional changes are necessary to make them useable.

The Oklahoma State University grass seed stripper strips seed from the plants with a rotating drum with nylon flails. Because the seed canopy is not cut by a sickle, only a small amount of stems and leaves are taken into the harvester. This results in fairly clean seed. The unit is now commercially manufactured by the Kincaid Equipment Manufacturing Corporation, Haven, Kansas.

## Steep Slope Stabilization

**Lou Spink, USDA-Forest Service, Baker, Oregon**

In 1979, at the request of the Willamette National Forest, the San Dimas Equipment and Development Center modified the steep slope seeder to be used either with a Gradall, as originally designed, or towed behind a tractor. The "towed" option was desired for seeding ski slopes. The modification also includes a set of pneumatic-tired wheels that can hydraulically lift the seeder so it can be towed on roads or other hard surfaces. This towing modification worked well at San Dimas. Data on its use will be gathered in 1980, and included in the next report.

The tree/shrub planter digs a hole with an auger, drops a seedling from a carousel-type container, and then compacts the soil around the planted seedling. To increase the planting rate, the planter was designed with two sets of planting equipment—auger, carousel and compactor—one at each end of the frame. However, the pre-prototype planter was equipped with only one set of planting equipment for demonstrating the concept.

The pre-prototype was tested on the Willamette National Forest in 1979. These tests showed that the concept was satisfactory, and further refinement is unnecessary. However, the final fabrication drawings for the "double" planter were not completed by the end of FY 1979, and no funds were allocated for this project in FY 1980. No work will be done or planned on this project until funds are available.

## Assessment of High Voltage Electricity For Brush Control

**Thomas H. Shrader, Water and Power Resources Service, Rio Grande Project, El Paso, Texas**

To obtain better control without chemicals and soil-damaging mechanical methods, the Rio Grande Project of the Water and Power Resources Service (formerly Bureau of Reclamation) contracted with a private company during 1977 to demonstrate the potential effectiveness of high voltage alternating current (AC) to control woody plant species.

In addition to growth-stage and species, other variables in the evaluation of the ac systems were application speed, number of passes over the same plants, voltage delivered to the plants, and power density. Combinations of these variables were used to evaluate treatments. Check plots were mowed for comparison.

Based on a visual evaluation of both treatments, the high voltage ac treatments, except for the kill of a few young and solitary seepwillow plants, caused results that were comparable to an effective searing with LPG. Of the variables evaluated, the combination of application speed (greater treatment time), high voltage, double passes (two passes over a plant in opposite directions), thin stands of vegetation, and young succulent growth resulted in the most complete top kill of saltcedar, mesquite, screwbean, and older, denser stands of seepwillow plants that received the full or nearly full dosage of the ac charge. Established plants of the four species resprouted and displayed normal growth following the death of treated foliage and branches.

The high voltage treatments were least effective in dense homogeneous or mixed stands of the species and in individual, dense, shrubby plants.

## Madge Rotoclear Machine

**William E. (ed) Dick, Sales Manager, Can-A-Mex Manufacturing, Limited, Calgary, Alberta**

Can-A-Mex Manufacturing, Limited, of Calgary, Alberta, manufactures a heavy-duty rototiller and land clearing machine called the Rotoclear. The Rotoclear is powered by



a 365-horsepower diesel engine and weighs 21,000 pounds. It is not self-propelled and must be pulled by a D-6 size crawler-tractor or large-wheeled tractor such as a John Deere 540 log skidder. The treatment width is 17-1/2 feet and the machine can mulch to a depth of 9 inches.

As a rule of thumb, if material can be cut with an ax, the Rotoclear can mulch the material. When clearing land, trees up to 5 inches in diameter do not have to be removed or cut before mulching. The Rotoclear has also been used to grind soap stone lime for fertilizer and grind volcanic rock for construction applications. The machine is not designed to crush rock, but if rock is encountered, it will not hurt the machine. It will cause more rapid teeth wear, however.

### Dryland Sodding—A Summary

Jane Bunin, *Science Application, Incorporated Boulder, Colorado* and Joann T. Hackos, *Colorado School of Mines, Golden, Colorado* and Michael Harthill, *Water and Power Resources Service, Denver, Colorado*

Dryland sodding (DLS) may prove a useful reclamation method for sites that show unsatisfactory results with seeding or have serious erosion problems.

The authors define sodding as a reclamation method in which a unit of soil and its associated vegetation is removed intact from an area about to be mined, transported to a mined area readied for revegetation, and redeposited intact on graded and suitably prepared soil. The method is further labeled dryland sodding because no irrigation is required past the initial week of establishment.

Biological and environmental factors favor the use of DLS. However, current economic and logistical considerations may make DLS far more expensive than seeding in terms of direct initial costs. On the other hand, if indirect or delayed costs are taken into account, DLS may still prove advantageous.

### New Prescribed Burning/Backfiring Tool Tested In Brush

Denny Bungarz, *Fire Management Officer, USDA-Forest Service, Mendocino National Forest, Willows, California*

The helitorch, a backfiring device slung under a Bell 206B helicopter, was tested by USDA Forest Service Personnel on the Grindstone Chaparral Management Area, March 21 to 24, 1979.

The helitorch originated in Canada. Western Helicopter Services, Inc., of Newberg, Oregon, improved the design

and added the gelled fuel concept, with the assistance of the Forest Service Missoula Equipment and Development Center. Improvements in the original design include mixing fuel thickener with gasoline, which forms a flammable substance the consistency of unset gelatin.

The helitorch consists of an aluminum frame that holds a 55-gallon barrel, a small electric motor that drives a small positive displacement gear pump, and an ignition device. The pump and ignition source are activated by a switch controlled by the pilot.

This tool has definite applications for prescribed burning. It will allow land managers to burn in wet weather. Difficult areas to reach are accessible to the helitorch. This tool should allow land managers to burn when smoke dispersal is good and should increase the acres-per-day of burning.

Its application for backfiring is also excellent. Accessibility is almost unlimited. If a land manager needs a great amount of heat to cause a wildland backfire, the helitorch should do the job.

### Rare Plant Propagation

Phillip L. Dittberner, *Plant Ecologist, Fish and Wildlife Service, Fort Collins, Colorado*

Numerous authors have written papers related to threatened and endangered plants. Suggested management activities included:

1. Compiling an inventory of threatened and endangered species and their habitats;
2. Establishing refuges for protecting populations of threatened and endangered plants and their habitats;
3. Implementing special environmental practices that may be used in managing endangered plants and their habitats; and
4. Identifying techniques for propagating or growing and producing threatened and endangered species under cultivated conditions.

There are three major areas of information and research needs for rare, threatened, or endangered species. These include developing:

1. Complete understanding and descriptions of life histories;
2. Complete descriptions of habitat requirements; and

3. Complete population dynamics pictures for each species.

Additionally, distinction needs to be made between "reintroduced" and "introduced" plants in a habitat.

The state-of-the-art for propagating, growing and managing rare, threatened and endangered plant species is very immature. Few people have done research on these topics. Some examples of this past research are discussed.

By carefully examining the management strategies and expanding research programs relating to threatened and endangered or rare plant species, we can increase our resource management options in many areas. We may also find that there are special equipment needs for germination, planting, and maintenance of some of these populations.

### What's New In Seed

Art Armbrust, *Sharp Brothers Seed Company, Healy, Kansas*

Mr. Armbrust lists the primary sources for new varieties of seed and germplasm, the primary areas of private breeding efforts, and some areas of public practical breeding efforts. Thirty-two new varieties of conservation plants cooperatively released through the Soil Conservation Service (SCS) are listed as well as proposed releases by SCS plant materials centers in the years 1980-85.

Mr. Armbrust also discussed some ramifications as SCS looks into the possibility of transferring some or all of the plant materials program activities to non-federal control.

### New Forage Plants for Rangeland

Douglas R. Dewey, *Research Geneticist Science and Education Administration—Agricultural Research, Logan, Utah*

During the past five years, a five-scientist, USDA-SEA-AR range-forage improvement team has been assembled at Logan, Utah. The team includes a plant cytogeneticist, a plant physiologist, two plant breeders, and a range scientist.

This paper focuses on two aspects of the range-forage improvement project at Logan:

1. The recent introduction and description of new range-forage germplasm from the USSR; and
2. The development potential of new grass species arising from wide hybridization.

### Using Solar Energy in Range Watering Systems

Charles E. McGlothlin, *Range Staff Officer, USDA-Forest Service, Custer National Forest, Billings, Montana* and Roy Lockhart, *USDI—Bureau of Indian Affairs (retired), Albuquerque, New Mexico*

This report describes the first solar-powered water well built in the US for livestock at the Isleta Indian Reservation near Albuquerque and a similar project installed near Roswell, New Mexico. Advantages and disadvantages of the systems are given.

### Chaparral Vegetation Management Alternatives

J. L. Hickman, *Program Manager, Chaparral Vegetation Management R & D Program, Pacific Southwest Forest and Range Experiment Station, Riverside, California*

Chaparral-covered lands are highly productive. Chaparral vegetation constitutes tons of bio-mass, is important as wildlife habitat and as productive rangeland, has esthetic value, and is also a potential source of energy.

Protection is the objective in managing chaparral lands. Management must realize the vegetation production potential and prevent catastrophic fires. In general terms, managers of chaparral lands have four treatment choices for developing a manageable mosaic of even-aged stands of vegetation:

1. Protection;
2. Changing the density, species composition, and/or age class;
3. Type conversion; and
4. Removing all vegetation to bare soil.

Tools for accomplishing these tasks can be grouped in four treatment areas:

1. Mechanical;
2. Chemical;
3. Biological; and
4. Fire.



Mr. Hickman summarizes treatment choices and methods and comments on the idea of using chaparral as a potential energy producer.

## Mine Reclamation Costs And Systems

**Michael J. Cwik, President, Intermountain Resources, Limited, Spokane, Washington**

Accelerated mineral production at a time when restrictive environmental statutes and regulations are being passed has placed the miner in the position of having to be environmentally accountable for mineral exploration. As a result, the mining industry is asking two basic questions:

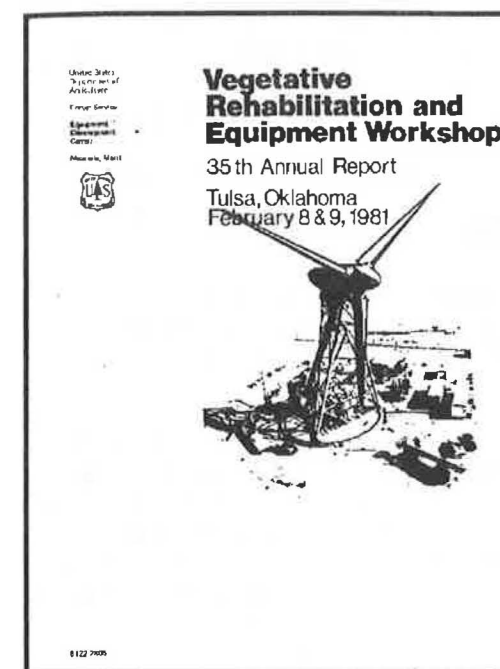
1. "What can be done to rehabilitate the surface of my mine in a way that will be consistent with environmental regulations promulgated by jurisdictional authorities?"; and
2. "How much will this reclamation cost?"

Current available research has resulted in a warehouse of data on surface stabilization. The careful review and interpretation of this data can support experienced judgment on recommended and defensible methods of landscape rehabilitation.

The little available data on surface stabilization costs usually appear in costs-per-acre. Reclamation costs discussed in this article segregate mine reclamation into four general practices: earth moving, earth shaping, cultural inputs, and vegetation planting.

Research on costs in all reclamation fields, and particularly in the area of acquiring and operating reclamation equipment is needed so the mine reclamation plan interface can allow meaningful decisions in extracting and processing vitally needed fuel and non-fuel mineral resources.

A reclamation "schematic" is also presented.



## 1981 Vegetative Rehabilitation and Equipment Workshop 35th Annual Report

Tulsa, Oklahoma

### Truax Native Grass Drill

**Jim Truax, Truax Company, Minneapolis, Minnesota**

The Truax native grass drill was designed to fill the need for a dependable, continuous-duty grass drill to plant the fluffy native grasses, as well as the smaller legumes and similar seeds. This was accomplished by structuring the drill design in such a way as to achieve ideal soil-to-seed contact of even the most difficult to handle seed.

The Truax drill is also designed to be used either on a three-point hitch or as a tongue drill by removing a single pin. An optional third seedbox is available that is designed to handle all the cereal grains and wheat grasses. This unit is clutched and driven separately from the other two boxes.

### One-Operator Mulching System

**Bob Anderson, Lo-Co Equipment Company, Windsor, Colorado**

The Lo-Co Equipment Company has just completed field trials of a new one-operator mulching system. This system, which is operated from a standard farm tractor, allows one person to spread mulch at the rate of one 1,500-pound bale every five minutes. The system has a low initial cost (under \$5,000).

Two hydraulic controls (the system can be operated with just one) are required. One hydraulic control lifts and loads the round bale, the other hydraulic control unfolds the bale and moves mulch to the flails (powered by PTO), which break it up and throw it out. This machine uses less horsepower than the tub rotogrind mulcher because there is less mulch reduction.

The system, when using the round bale, allows the operator to remain seated on the tractor while loading the bale and controlling the direction (up or down) of throw.

### Mechanically Harvesting Plains Pricklypear Cactus For Control And Utilization

**Dennis M. Mueller, Science and Education,  
Administration-Agricultural Research, Fort Collins,  
Colorado**

Plains pricklypear cactus (*Opuntia polyacantha* L.) is locally abundant on the Central Plains. Harvesting studies indicated dry matter yields up to 1,600 pounds per acre. Pricklypear is undesirable because it is a barrier that prevents cattle from grazing a considerable portion of the herbage. However, chemical analysis and feeding trials at



the Central Plains Experimental Range showed that plains pricklypear is highly nutritious and relatively palatable when the spines are singed.

The possibility of simultaneously controlling and feeding plains pricklypear led to development of harvesting and spine removal machinery because hand methods are extremely time consuming.

A front-mounted International Harvester No. 8 high-speed, side-delivery rake was modified to uproot and windrow the pricklypear with little turf or soil disturbance. Design and prototype work is underway on equipment to pick up and singe pricklypear after it is windrowed.

### Transplanting Using The Bandoleer Concept

**Victor Hauser, Science and Education Administration-Agricultural Research, Grasslands Soil and Water Research Laboratory, Temple, Texas**

Establishing grass from seed is often unsuccessful in the Southern Plains and other areas. A new grass establishment method is being investigated by the Science and Education Administration-Agricultural Research (SEA-AR) at Temple, Texas. Instead of planting seeds directly in the field, grass plants are produced in the greenhouse and transplanted to the field. The system is based on the bandoleer concept devised by H. L. Brewer. The bandoleer is made of plastic and has pockets much like those in a machinegun bandoleer. Young grass plants are grown in the pockets under optimum conditions in the greenhouse. The growing medium, seeds, and young plants are readily available for machine handling at all stages of growth and during transplanting in the field. The planting dibbles of the SEA-AR transplanter were adapted from a transplanter developed by the Forest Service.

### Development Of A Rangeland Interseeder For Rocky And Brushy Terrain

**Dan W. McKenzie, Mechanical Engineer and Range Scientist, USDA-Forest Service, Equipment Development Center, San Dimas, California and Richard Stevens, Utah Division of Wildlife Resources, Ephraim, Utah and Walter L. Moden, Jr., University of Idaho, Moscow, Idaho**

This report focuses on an effort by the Forest Service San Dimas Equipment Development Center to develop a demonstration interseeder that could operate in rocky and brushy terrain. A five-component interseeder was developed in 1977. Over the past three years the interseeder has been

tested near Ephraim, Utah, and near Boise, Idaho; modifications to the device have been made as needed.

Also presented in this report are descriptions of the equipment and details of the approach used to test the feasibility of transplanting shrubs to improve range habitat.

### Arid Land Seeding

**Carlton H. Herbel, Science and Education Administration-Agricultural Research, Jornada Experimental Range, Las Cruces, New Mexico**

A newly designed grubbing blade developed for front-mounting on a rubber-tired tractor and patterned after the low-energy grubber's blade (crawler-tractor) appears very promising for controlling junipers 2 to 5 feet tall. Preliminary data indicate only a slight reduction in acre-per-hour performance. The total investment will be approximately one-half. Fuel consumption is 72 percent less than that of a crawler-tractor.

Tests in 1979 compared disk-chaining to smooth chaining for low-cost seedbed preparation on rough, log-littered, rootplowed rangeland where heavy-duty offset disks and grass drills would have been unable to operate successfully. Several types of chains were tested. Results of disk-chaining follow more closely the results of offset disking but costs and energy use appear to be reduced half.

### Plant Materials

**Wayne Everett, USDA-Soil Conservation Service, Washington, D.C.**

The Plant Materials Workgroup has revised its committee membership, developed 1980-82 objectives and activities, and initiated development of a cultivar source listing of plants currently recommended for range, critical areas, and reclamation plantings.

The plant materials program has been funded and retained as an SCS program with provisions for maintenance and replacement of equipment and facilities for FY 1982.

Tables are given listing the SCS cooperative cultivar releases to December 1980 and the commercial seed and plant production of these releases to July 1979.

### Need To Develop Alternative Methods To Judge Revegetation Success

**Ken Brakken, ERT, Incorporated, Fort Collins, Colorado**

The coal industry is currently experiencing a difference of opinion with the Office of Surface Mining (OSM) over parts of Federal coal mining regulations. The controversy is over methods of judging success of revegetation prior to bond release of reclaimed coal mined lands. Public Law 95-87 was signed into law August 1977. Two sets of regulations were promulgated to implement the law. Regulations allow the use of reference areas or technical standards published by the US Department of the Interior or Agriculture. Since there are no published USDI or USDA technical standards that can be immediately applied to judging success of revegetation on surface mines, there is now only one OSM-sponsored method to evaluate revegetation reference areas.

The law and regulations permit post mining land-use changes to higher and better uses. In this case, different vegetation types would be substituted for those previously existing, and a pre-mining reference would not be appropriate since a change in vegetation would be intended.

An ad hoc committee, the Committee to Develop Alternative Methods to Judge Success of Revegetation of Coal Mined Lands, has been formed. Observations and suggestions have begun. Committee participation is solicited.

### Inoculation Of Tubelings With Mycorrhizae To Aid Plant Establishment

**Claire Gabriel, Native Plants, Incorporated, Salt Lake City, Utah**

Most native plants have adapted to growth on low-fertility soils through a mutually advantageous association with certain beneficial soil fungi, called mycorrhizae. The fungus obtains an energy source from the plant in the form of fixed carbon, and the plant may benefit from enhanced soil uptake of phosphorus. These advantages invariably yield increased plant growth and survival.

Soil disturbances resulting from severe erosion, long-term clearing, topsoil stockpiling or fumigation can reduce the natural complements of mycorrhizal fungi in soils. Revegetation can be slowed, unless efforts are made to reintroduce and manage these important microbes.

### Transplant Machine For Transplanting Vegetation

**James L. Smith, Professor and John P. Workman, Research Assistant, Department of Agricultural and Chemical Engineering, Colorado State University Fort Collins, Colorado and Kent A. Crofts, Manager of Reclamation and Environment Energy Fuels Corporation Steamboat Springs, Colorado**

A study was made concerning the productivity of a front-loader used to transplant approximately 60,000 square feet of mature vegetation. The vegetation was transplanted in pads using a modified front-loader bucket with an effective area of 75 square feet.

Analysis indicated that over 80 percent of the time involved in transplanting was used to travel between the plant source and the transplant area. It was evident that transporting costs could be significantly reduced and production increased by a machine to transplant and place several pads of vegetation in a single trip.

An experimental transporter was fabricated by modifying a Hesston Model 20 Stackmover. Two modes of operating the transporter were evaluated. In general, operation of the transporter was very satisfactory. Suggested improvements are given.

### Land Reclamation Methods And Plant Materials For Arid Sites

**C.M. McKell, Logan, Utah and Gordon Van Epps, Utah State University, Ephraim, Utah**

Disturbance of harsh sites in the arid southwestern United States requires methods and plant materials unique from those employed in areas of more favorable climate. The authors' work at the Henry Mountain Coal Field in southcentral Utah and on a processed oil shale disposal pile at Anvil Points, Colorado, features the use of container-grown plants to avoid the hazards in establishing seedlings and growing plants in a topsoil-filled trench in the shale disposal pile. Greatest success is experienced with plant species adapted to drought, salinity, and wide temperature extremes. Some of the most favorable species tested were *Atriplex confertifolia*, *Atriplex coneata*, *Kochia prostrata* and *Elymus junceus*.



## A Reclamation Contractor's Experiences With Equipment

*Don Calhoun, D & C Reclamation, Lander, Wyoming*

D & C Reclamation performs contract revegetation work for mining companies, oil companies, pipeline contractors, highway contractors, and private landowners. Mr. Calhoun describes his positive and negative experiences with the rangeland drill, the Hodder gouger, the hydroseeder, the Case Skidster, and various backhoes.

## Disturbed Land Reclamation (Eastern "Sub" Group) Report

*Willis Vogel, USDA-Forest Service, Berea, Kentucky*

This report discusses some concerns with establishing woody plant species on surface mined lands in the eastern United States and speculates on the needs for equipment and procedures that may be helpful in establishing woody plants.

Several actions are needed to improve chances of successfully establishing and growing woody species, including changes in those earth-moving practices that obviously hinder survival and growth of seedlings, and developing new techniques for successfully establishing woody plant seedlings.

The author believes existing seeding equipment, with modification where necessary, can be successfully used for most of the applications on surface-mined lands. In most situations that require specialized equipment, it is first a matter of informing potential users and agencies that advise the users that equipment suitable for reclamation work exists and is available. In some cases, users must be informed that plans for construction are available. In some situations VREW participants may be able to help a potential user borrow and test an appropriate piece of equipment.

## Seed Harvesting

*Stephen B. Monsen, USDA-Forest Service, Boise, Idaho*

Field testing has been conducted to evaluate three new seed collectors. These hand-operated units are designed to harvest seed from native plants in the wild. All three machines use a vacuum to extract and collect seeds.

Machines tested included an injector seed-collecting head (air amplified) powered by a trailer-mounted air compressor constructed by the San Dimas Equipment Development

Center; an adapted version of a commercial back-pack type air-blower built by Solo Kleinmotoren Company of West Germany, and a 370-pound gasoline-powered Elephant-Vac marketed by Evans Sales and Marketing, Inc. Successful applications as well as drawbacks of each machine are discussed.

## Adaptation Of The Steep Slope Seeder For Mine Land Reclamation Work

*John Graves, Native Reseeders, Windsor, Colorado*

The method of using a Gradall steep slope seeder was too expensive for Mr. Grave's operation as a mined site reclamation contractor in Colorado and Wyoming. The modification made for towing the unit made by the San Dimas Equipment Development Center did not work with contractor-owned equipment. The contractor also believed several changes were necessary to work on the tougher sites of Colorado and Wyoming.

Changes made by the contractor are:

1. A two-point hydraulic over-cable hitch was made to adapt the seeder to use on the contractor's D-2 Caterpillar tractor;
2. The rake assembly was changed to use Danish S cultivator tines for easier replacement and to open crusted soils;
3. The packer wheel arms were beefed up by building them with three-inch channel iron instead of the specified strap steel;
4. Finger weeder tines were used to support the conveyor chain drags; and
5. The wheel hubs of the original design were not readily

available, so they were replaced with automotive hubs bolted on the front frame leg.

These changes met the majority of the contractor's needs. He would also like to see the installation of an articulation device for continuous towing use where the orbital hydraulic motor is normally mounted to benefit the seeder.

## Thermal Plant Control

*Bill Davis, USDA-Forest Service, Ogden, Utah*

The helitorch is a reliable aerial ignition system for setting prescribed burns and controlling wildfires. The helitorch uses gasoline thickened into a gel by a powder similar in

texture to laundry detergent—either Alumagel or military fuel thickener. Unlike gasoline-diesel fuel mixtures, which tend to burn out or break up before reaching the ground, the gelled gasoline holds together and keeps burning as it falls through the air.

The helitorch consists of a 55-gallon barrel, igniter, and electric pump that pumps out the gelled gasoline. The helicopter pilot controls the flow and ignition of the gel. The new gel enables pilots to drop fire with greater accuracy from higher altitudes and faster speeds, which increases safety and efficiency.

Fire on the ground can be obtained from a height of 200 feet at an airspeed of 40 mph. This produces burning gel/gasoline globules the size of golfballs that burn 8-to-10 minutes. Drop heights of 150 feet and airspeeds of 30 mph produce burning globules the size of baseballs with a burn time on the ground of 12 to 17 minutes.

Operations within prescribed burning windspeeds will not affect the drift of gelled gasoline during ignition.

## Rangeland Use Of The Mercedes Benz Unimog

*Loren Brazell, USDI-Bureau of Land Management, Reno, Nevada*

The Unimog is a versatile diesel-powered, all-terrain vehicle that BLM has used year around in Nevada for fire suppression, and by force account work using a backhoe attachment and a dozer blade.

As a firetruck, the Unimog will out perform a standard four-by-four firetruck. It will traverse rougher terrain with less vehicle damage because of high ground clearance and low operating speeds. When equipped with a backhoe and dozer blade, the Unimog can be used for digging soil pits or performing range development work. Advantages of the Unimog include the ability to traverse rougher terrain than a farm-type tractor and to travel at highway speeds up to 40 mph for rapid movement between work areas.

Disadvantages of the Unimog include: Mercedes Benz dealers are the only suppliers of equipment and parts; parts are not readily available, and an inventory of parts must be kept on hand; the two-person cab is too small to carry firefighting crews; and the highway speed of 40 mph is too slow for long distance movement considering the truck must be used for distances of more than 150 miles.

## Methods Of Mechanical Plant Control At The Energy Fuels Mine In Northwest Colorado

*Kent Crofts, Range Scientist, Energy Fuels Corporation, Steamboat Springs, Colorado*

Regulations issued by the Office of Surface Mining under 30 CFR 816.22 require that all vegetative material that might interfere with the use of topsoil shall be removed before topsoil removal. Attempts at resolving the problems of disposal of the woody vegetation cleared ahead of the surface mining operation resulted in less than satisfactory outcomes.

In 1980, a Madge Rotoclear machine was ordered. Mechanically and operationally the machine performed well. The mechanical components of the machine are proven and dependable. Some minor modifications are necessary to improve the machine. Operational limits as to the slopes the machine will effectively treat are limited only by the slope a dozer can traverse. Analysis of cost data reveals an immediate savings of operating the Rotoclear over using a production dozer average \$444 per acre.

## Range Water Systems Improvements

*Dan W. McKenzie, Mechanical Engineer and Range Scientist, USDA-Forest Service, Equipment Development Center, San Dimas, California*

The project goal is to improve range water supplies and systems for pumping and handling range water. The objectives are to:

1. Investigate and develop systems for preventing stock watering tanks from freezing; and
2. Investigate and develop solar water pumping systems as alternatives to the standard windmills.

Mr. McKenzie summarily addresses circulation systems, a propane bubbler, the Walden Pondmaster, mass insulating systems and solar systems for preventing freezing.

Summarized also are three categories of equipment that offer potential for improving range water pumping systems:

1. Photo-voltaic-powered systems;
2. Solar-thermal powered systems; and
3. Improved or new windmills.



## BLM's Equipment Development Program For Revegetating Disturbed Lands

**Richard Hallman, Range Program Leader, USDA-Forest Service, Equipment Development Center, Missoula, Montana**

In 1975 MEDC personnel began working with the Bureau of Land Management (BLM) to develop equipment and techniques to revegetate lands under arid and semiarid conditions where establishing vegetation is difficult and expensive. Six pieces of equipment were eventually built to accomplish six specific revegetation tasks. The six pieces described are: the dryland plug-planter, the tree transplanter, the dryland sodder, the sprigger, the basin blade, and the modified Hodder gouger. Function, description and specifications for each is given.

## Forest Service Equipment Development Center Activities

**Ken Dykeman, USDA-Forest Service, Equipment Development Center, San Dimas, California and Richard Hallman, Range Program Leader, USDA-Forest Service Equipment Development Center, Missoula, Montana**

A review of current activities of the Equipment Development Center activities were presented. Those reviewed are: an intermittent, containerized, and bareroot tree planter; a hill-climbing machine; a forestland residues machine; a tree shaker for western conifers; cone-and-seed collections system; a reefing system for cargo parachuting; a lightweight cable yarder; a mini cable yarder; a rock rake; a planting-handtool study; a mechanical nurserybed thinner; a hand thinner; aerial spraying effectiveness; a spawning gravel cleaner; and a tree planting slide/tape.

## Sun-Powered Water Pumping

**Kenneth A Ude, ARCO Solar, Incorporated, Chatsworth, California**

This is a summary on solar electric power, specifically water pumping, now under development by ARCO Solar, Incorporated.

The major components of a solar water pumping system are the solar array, the electric motor, and the pump. Centrifugal water pumps can be directly connected to the solar array with no battery or electronics. When batteries and controller are added to the system, the motor is allowed to operate at a relatively constant rpm. This means that

when the system operates, you are guaranteed water, or if you have a positive displacement pump, you can overcome the initial high starting torque.

ARCO Solar believes the most cost-effective approach is to use a small amount of battery storage and a controller that allows the system to operate about the same number of hours per day as peak sunlight hours. It is also more economical to store water than it is to store electricity. So in the system design, ARCO tries to pump all the water that is needed for a 24-hour period during peak daylight hours and store it in an elevated tank, then allow gravity to supply pressure to the application.

Because solar cells are still expensive, today application areas must be picked carefully. The major components that effect the cost effectiveness of the system are sunlight and the availability of fuel maintenance.

## Solar Photovoltaic Irrigation Pumping Plant

**Neil Sullivan, Thomas L. Thompson and P. E. Fischback, Agricultural Engineering Department, University of Nebraska, Lincoln, Nebraska and Ray F. Hopkinson, Massachusetts Institute of Technology, Lincoln Laboratory, Lexington, Massachusetts**

The direct current output of a 25-kW (kilowatt) peak output 520m<sup>2</sup> photovoltaic array was used to run an irrigation pump for a 32-ha cornfield. The battery storage requirements for different methods of pump operation were compared. With 30 kW/h of power storage, constant load operation of the pump was able to utilize over 90 percent of the power produced by the array for irrigation. On clear days the step-load operation of the pump could reduce the battery strait requirements of the system to less than 2 kW/h, but up to 20 kW/h of storage was required to operate the pump with step-loading on cloudy days. However, when the power storage was reduced, the step-load operation could use only 60 percent of the power produced by the array. Of the remaining 40 percent, 33 percent was dissipated in the power dump and 7 percent was lost in reduced system operating efficiencies.

## Reclamation Techniques

**Allan M. Hale, Dames & Moore, Cincinnati, Ohio**

In any discussion of reclamation technology, a thorough understanding of the specific nature of the individual site problems is the key to successful rehabilitation efforts. Distinctly different reclamation techniques are used when reclaiming active or abandoned mined lands. This

discussion gives an overview of some of the major problem areas, limiting factors and reclamation techniques that have been successful.

## Harnessing The Wind For Irrigation Pumping

**R. Nolan Clark, Science and Education Administration-Agricultural Research, Bushland, Texas**

A wind energy project for irrigation pumping was started at USDA-SEA-AR, Conservation and Production Laboratory, Bushland, Texas, in 1977. The pumping system uses both a wind turbine and an electric motor to power a conventional vertical turbine irrigation pump. The electric motor is sized to operate the pump on a stand-alone basis and runs continuously. The wind turbine is coupled to the pumping system through an over-running clutch and combination gear drive, and furnishes power to the pump only when the windspeed exceeds 13 mph. When the wind turbine operates, it reduces the load on the electric motor, rather than replacing the motor.

The wind-assisted pumping system effectively utilized the unsteady power output of the wind turbine. The system has operated satisfactorily, and the concept has proved to be sound. All components are readily available and proven, and the mechanical drive is simple. The over-running clutch has proved to be a simple and reliable method of synchronizing the two power sources.

The wind-assisted concept can be used in any rural or remote area where a second power source is available. Practical use will depend on whether wind energy is more economical than existing energy sources.

## Wind Energy—An Industrial Perspective

**Gene C. Valentine, Windfarms, Limited, San Francisco, California**

Windfarm Limited has a goal to demonstrate the feasibility, through application, of wind technology. Mr. Valentine gives a history of the development of Windfarms, from concept through steps required to establish an 80-megawatt wind farm for the Hawaiian Electric Company.

## Seed Production Techniques

**Robert M. Ahring, Science and Education Administration-Agricultural Research, Stillwater, Oklahoma**

Seed from good forage grasses is very difficult to produce and seeds that produce well often present unique and difficult harvesting problems. High seed yields can be achieved with many grasses with the proper combination of variety (strain or species) with environmental and agronomic practices (cultural, management, and harvesting). Much more is known of growth and crop development of the cool-season grasses than of warm-season grasses. The influence of the physiological processes associated with the complex relationships of environmental and genetic factors and cultural conditions on crop seed yields need to be determined. Optimum combinations of these factors are fundamental to establishing grower-efficient seed production techniques.

## Kincaid Grass Harvester

**Delmar Kincaid, KEM Corporation, Haven, Kansas**

Continuous testing has been done on the grass harvester designed by Oklahoma State University. Improvements to the harvester include a mechanical bagging system with a "y" discharge, so bags can be changed while harvesting. An extended hood has also been added to decrease seed loss.

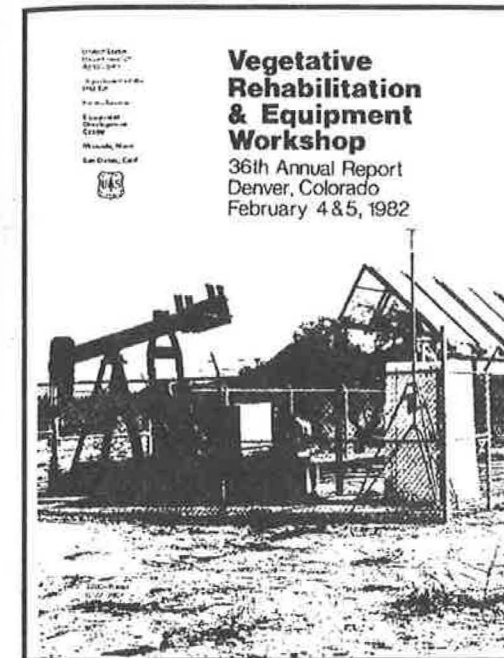
Purity of seed can be affected by header height, reel speed, and forward travel. By achieving the correct ground speed and reel, very little unripened seed is removed from the grass stalk, and unwanted debris is left on the field. Ground speeds of 4.5 mph were used and the results were acceptable. Seed purity and seed removal were well within the expected range.

Other advantages of the harvester include:

1. It is less expensive than the conventional means of harvesting;
2. It is easy to transport, set, and clean out; and
3. It can normally cover more acres and harvest at higher moisture levels than a regular combine.

Grasses that have been harvested with successful results are: little bluestem, big bluestem, side oats Grama, indiagrass, Old World bluestem, caucasian bluestem and buffelgrass.





## 1982 Equipment Workshop 36th Annual Report

Denver, Colorado

### Examining VREW's Mission

*Ted Russell, USDA-Forest Service, Washington, D.C.*

During the formative meetings of the Reseeding Equipment and Development Committee (1945), the functions of the group that would eventually become VREW were outlined. The committee would consider, evaluate, and assign priorities to the equipment problems that were suggested for attention by several Forest Service Regions, and each year they would draw up a program of work for the Equipment Laboratory to follow. Additionally, the committee would draw up specifications for the most desirable makes and models of equipment to be used in range reseeding.

In 1949, the purpose of the committee was enlarged to keep abreast of commercially developed equipment and to develop equipment not commercially available.

### Private Industry's Viewpoint of VREW Equipment

*Kent A. Crofts, Range Scientist, Colorado Yampa Coal Company, Steamboat Springs, Colorado*

A straw poll concerning revegetation equipment knowledge of the reclamation representatives from 21 coal mines in six western states was conducted by the author. While there

were inherent weaknesses with the poll, it was a valuable starting point to quantify the viewpoint on VREW equipment

There were some surprising findings in this poll. Approximately three-fourths of those polled initially learned about VREW from the Society of Range Management (SRM). It might be appropriate to strengthen the ties between VREW and SRM and broaden the foundation upon which VREW has evolved.

The second finding deals with the reluctance on the part of the industry reclamation specialists to utilize most of the recently developed pieces of equipment. Two interesting points are raised by this finding: there is a need for new reclamation equipment; however, any future development of new equipment must have more input from the user group if it is going to be accepted by those responsible for using the equipment.

### How Do We Market Products Of VREW? (from manufacturer's viewpoint)

*John Laird, Laird Welding and Manufacturing Works, Merced, California*

Special-use equipment causes problems for the manufacturer because of the low volume of sales. The ability of a manufacturer to produce a product at a



reasonable price with a low unsure volume is difficult to achieve. Problems include warehousing minimum orders necessary for parts, finding multi-skilled workers, advertising and technical literature costs, difficulty with bank letters of credit, and overseas freight prices.

Small manufacturers have to rely on, and make use of, the Forest Service Equipment Development Center's technical output and guidance in research and development. The necessity for the Development Centers to perform this function is vital to VREW and the small manufacturer. Without it, specialized revegetation equipment would be too expensive for the users, and the small manufacturer would not make this type of equipment.

### Lely Vertical-Axis Tiller

**Bill McGinnies, USDA-Agricultural Research Service, Fort Collins, Colorado**

Tests of the Lely vertical-axis tiller have continued in Colorado and Wyoming. James L. Smith, University of Wyoming, has attached ripping-teeth ahead of the tiller and found that this improves efficiency considerably, particularly in hard ground. In Colorado, W. J. McGinnies has been using the Lely vertical-axis tiller to incorporate mulch. For effective mulch incorporation, the front of the tiller must be raised to give the tilling tines a down-and-into-the-soil action. The tiller will incorporate 1,000 pounds per acre of straw or hay mulch in one pass, but for 3,000 pounds per acre, two passes were required. Shear pin breakage was encountered when buried logs (left by a Rotoclear tree shredder) jammed the tines. Lely manufactures an automatic shear pin replacer and one of these has been obtained for testing.

The vertical-axis tiller produced better seedbeds than the more conventional horizontal-axis tillers or seedbeds prepared by the plow-disk-harrow procedure.

### Development Of An Articulating Planter For Seeding Rough Lands

**Jim Truax, Truax Company, Minneapolis, Minnesota**

To achieve proper planting on the typical disturbed, contoured site laden with rocks and other debris, the Truax Company has under development an articulating planter that folds and bends with the contour as it is pulled across the site. The seedboxes, seedbox agitators, and seed-metering devices are the same as those on the standard Truax drill. Field cultivators or chisel plows replace the double disk-openers. In place of the seed tubes, rubber belting is used to guide the seed to the ground from the seedbox. A rolling

harrow or drag is used to cover the seed. The seedboxes, chisel plows, rubber belting, and rolling harrow are all carried by an articulating frame. This results in uniform depth control, constant ground contact of the seedbox drive wheel, and elimination of "bottoming out" when crossing swales and other sharp contours.

### High Rate Mulch Spreading Equipment

**Bob Anderson, Lo-Co Equipment Company, Windsor, Colorado**

The Lo-Co Equipment Company has two models of high-rate mulch spreading equipment for sale, lease, or custom mulch spreading—the Mulch-Master and the Big Bale Buster.

The Mulch-Master is a modified arm tub grinder that will spread any type of mulch or mulch bale as well as loose material such as bark and wood chips. The machine works from the power takeoff (PTO) of the towing tractor and requires a tractor of at least 100 horsepower.

The Big Bale Buster is a self-loading machine, powered by the towing tractor's PTO. It requires about 30 percent less power than the Mulch-Master. However, there is less mulch reduction with the Big Bale Buster. Small bales do not work well with the Big Bale Buster and are not recommended for use with it.

Both machines can dispense wet moldy hay without plugging. Field production rates depend on the efficiency of handling and loading the mulch material. Strings or wires do not need to be cut or removed, increasing production. Either machine will spread large round bales of 1,000-to-1,500 pounds at the rate of one every 3 or 4 minutes.

### Rangeland Imprinting In Utah

**Thane J. Johnson, USDI-Bureau of Land Management, Utah State Office, Salt Lake City, Utah**

Many of the Great Basin rangelands in Utah are characterized by a variety of soils varying in depth, texture, and salinity, but usually limited in production by low precipitation. The moisture-collecting capability resulting from imprinting appears to be very feasible for revegetating these rangelands following fire or other land disturbance such as pipeline construction.

This article describes a comparison study of the revegetation effectiveness of a locally constructed land imprinter and a conventional rangeland drill. An unseeded comparison was also included.

### Arid Land Seeding

**Harold T. Wiedemann, Agricultural Experiment Station, Texas A & M University, Vernon, Texas**

A rubber-tired loader-grubber (920 Caterpillar) with foam-filled tires, currently under study by the Texas Agricultural Experiment Station, Vernon, Texas, appears to hold excellent promise for a practical method to control sparse stands of small trees such as mesquite on rangeland that has become reinvaded after rootplowing. Test data indicate the wheeled loader-grubber can average 9.7 acres per hour in an infestation of 22 trees per acre + seven.

The testing indicates a rubber-tired loader-grubber has the potential to maintain over 7,000 acres a year of rough rangeland.

### Establishing Range Seedings By Irrigation

**Brice E. Boesch, Bishop Associates, Denver, Colorado**

(formerly with the USDA-Soil Conservation Service, Denver)

It has been suggested that supplemental moisture could be applied during the first growing season to enhance the emergence and survival of seeded grasses in areas of low annual rainfall. From a technical standpoint, irrigation may overcome, or help overcome, the problem of having to reseed rangeland two or more times to get a satisfactory stand of grass. However, it is not cost-effective, as it is estimated that irrigating rangeland one time to help establish a grass stand would cost \$80-to-\$140 per acre.

### Revegetation Of Pipeline-Disturbed Land

**Harry Somme, Tye Company, Lockney, Texas**

After laying a pipeline, the disturbed area along the right-of-way must be reseeded with the specific species and population determined by extensive environmental impact studies. Special equipment is often needed for the seeding because of the terrain and the difficulty in metering the many different species of native grasses. Where terrain permits, drilling is the preferred method. A drill manufactured by the Tye Company has three seedboxes that can seed three kinds of seeds (medium heavy, small dense and light fluffy) and also dispense fertilizer all in one pass when equipped with fertilizer attachment. To seed the Alaskan pipeline, the unit was also equipped with opening coulters that insure a seedbed in areas of poor seedbed preparation.

Procedures for revegetation of land disturbed by strip mining differ from those of pipeline revegetation in that topsoil is

usually added and prepared into a loose seedbed. Drill seeding of these areas is preferred where terrain permits, but requires a machine to meter many different types of seeds at a shallow depth. A machine manufactured by the Tye Company is designed for shallow planting of three different seeds (medium, small dense, light fluffy) while also dispensing fertilizer at the time time.

### Land Imprinting Activities

**Robert M. Dixon, USDA-Agricultural Research Service, Tucson, Arizona**

Reduced to its fundamentals, land imprinting research has shown that:

1. Rainwater infiltration can be controlled by manipulating surface macro-porosity and micro-roughness;
2. These two properties interact to funnel rainwater into the soil and to funnel displaced air out of the soil;
3. The collapse of these naturally occurring fluid exchange funnels is both cause and effect of man-induced land degradation or desertification;
4. To reverse desertification, these funnels have to be rebuilt;
5. Land imprinting is a cost-effective mechanical method for artificially rebuilding these funnels;
6. Imprinter-formed funnels not only provide a good surface configuration for infiltrating water, but also provide excellent seedbeds and seedling cradles for revegetating barren desertified land; and
7. Vegetation established in the imprints then maintains the fluid exchange funnels through natural processes in the absence of overgrazing and overcropping.

A box-type land imprinter is being developed that is more versatile in design than the conventional cylindrical types. Several hand-operated imprinters were designed.

With the successful adaptation of a commercial broadcast seeder, the rangeland imprinter has been elevated to an Imprinting Revegetation System (IRS). Standards for testing procedures in southern Arizona have been established. Research plans are being developed for comparative analyses of IRS and the rangeland drill. Treatment effects to be contrasted will include the categories: mechanical, microhydrological, microclimatological and biological.



## Seed Coating "Hard to Drill" Seeds

**Wendall R. Oaks, USDA-Soil Conservation Service, Los Lunas Plant Materials Center, Los Lunas, New Mexico**

Economics is only one factor that might support recommending seed coating. Other advantages include: more accurate seed placement, better seed mixing, use of conventional equipment, inclusion of nutrients, fungicides or herbicides in the coatings, and reduced seeding rates.

The objective of the project activities at the USDA Soil Conservation Service Los Lunas Plant Materials Center (PMC) is to reevaluate the feasibility of coating trash seed. To date, only preliminary work has been done. However, this work has shown it is possible to coat the most trashy seed, but coating costs are higher for such seed. More extensive studies will be carried out in 1982.

## Transplanting Attachment For Front-End Loader For Use In Mine Reclamation

**Kenneth E. Carlson, Colorado State University, Fort Collins, Colorado and James L. Smith, University of Wyoming, Laramie, Wyoming and Kent A. Crofts, Colorado Yampa Coal, Steamboat Springs, Colorado and Earl Frizzell, Bureau of Mines, Spokane, Washington**

Transplanting mature, native vegetation is a new and much needed development in mined land reclamation. However, design and utilization of equipment to transplant mature vegetation has not kept pace with the development of equipment capable of creating disturbed mined lands. This paper describes a research program on the design and use of a front-end loader attachment that removes, transports, and places mature, native vegetation on graded mine spoil. The attachment was designed for a Terex 72071A front-end loader, but can be adapted to most large front-end loaders used in surface mining operations. The data indicates a substantial increase in aspen survival with the transplanting attachment. The results of this study suggest that transplanting of mature native trees and shrubs is a viable and cost-effective addition to accepted reclamation practice.

## Disturbed Land Reclamation

**Willis Vogel, USDA-Forest Service, Berea, Kentucky**

A few years ago, the project engineer at the Forest Service reclamation research project in Berea, Kentucky, experimented with wood chips as an alternative method for controlling dust on a coal haul road in eastern Kentucky. The results strongly suggest that wood chips could significantly reduce the day-to-day use of water sprinkler

trucks for controlling dust. The long-term effectiveness of the wood chips was not determined. There was, however, noticeable deterioration in the chips themselves and in the continuity of the chip blanket after 6 hours of traffic-imposed stress. Over an extended period the day-to-day advantage of the chips is unlikely to be as great as the ten-fold advantage noted during the period of the experiment.

## Seed Harvesting

**Stephen B. Monsen, USDA-Forest Service, Boise, Idaho**

Two backpack seed collectors have been designed, built, and tested. A backpack seed harvester should not be built incorporating the desirable features from each unit. Workgroup efforts have centered on locating commercially available equipment that may have some potential for collecting wildland seed. The Echo PB-400 power blower shows some promise. This unit performs as either a blower or vacuum by moving an internal baffle. Seed can be vacuumed into a bag without going through the fan. Sufficient air velocity (6,500 up to 7,000 feet per minute) is produced in the 1.5-inch inlet to pick up and harvest many types of seed. A representative of Echo showed the PB-400 with the PBAV-400 (vacuum attachment) at the VREW meeting. The Echo PB-400 with vacuum attachment incorporates many desirable features of a backpack seed collector—lightweight (22.5 pounds), sufficient inlet velocity, no seed damage (seed does not pass through fan), fair amount of seed storage, and easy to operate. Two of these machines have been purchased for evaluation as backpack seed collectors.

## Woodward Flail-Vac Seed Stripper

**C. L. Dewald, USDA-Agricultural Research Service, Woodward, Oklahoma and V. A. Beisel, Aarons Engineering, Fargo, Oklahoma**

A mechanical seed stripper has been invented and tested in Woodward County, Oklahoma, that proved to be an effective seed harvester for chaffy seeded grasses such as plains, caucasian, and ganada bluestem. The effectiveness of this new mechanical seed harvester results from a revolutionary design combining the following principles:

1. A flail-action stripper brush rotating upward on its exposed and leading edge;
2. A curved shroud positioned above the brush to create a high velocity, low-pressure airflow above and behind the rotating stripper brush resulting in a vacuum beneath the leading edge of the rotating stripper brush; and

3. A unique triangular shaped seed bin which retains the seed and turns the airflow 180 degrees where it escapes above the shroud.

Air-flow pulls the seed heads into the rotating brush where seeds are removed by the flailing action of the brush. Seeds are lifted into the airstream as they are removed and propelled into the seed bin. This new seed harvester is simple, effective and versatile. Ten 7-foot machines are being built on order and they will cover 2 to 3 acres per hour, collecting 200 pounds of seed per acre. Cost of these 7-foot units is \$4,700 each.

## Mechanical Plant Control Equipment

**Stan Brown, Roscoe-Brown Equipment Corporation, Lenox, Iowa**

The Roscoe-Brown Equipment Corporation has developed a versatile, all-terrain rubber-tired tractor capable of operating a variety of brush control and rehabilitation equipment. Some of the features of the Bear Cub tractor include: hydrostatic implement (chipper) drive; ROPS and FOPS canopy with cab enclosure option with-or-without pressurization and heater; front only, crab or coordinated 4-wheel steering and turbocharged engine for operation at high altitudes. The machine is powered and geared so that it can climb a 52 percent slope continuously and a 78 percent slope intermittently in any direction (contour, downhill, uphill).

Various interchangeable front and rear mounted attachments include: chipper, trencher, auger, back filler, backhoe, brush cutter, brush rake, brush shredder, dozer blade, snow blower, drop hammer and forklift.

The Eager Beaver front-mounted chipped will chip material up to 1 foot in diameter and is not limited by material length. Production rates range from 50 to 75 tons per day, depending on material, terrain and the rate at which the chipper can be loaded. A knuckle-boom loader for the tractor chipper combination is available that allows the operator of the tractor to handle bigger and heavier loads than a man could possibly lift. The chipper can be mounted or unmounted from the tractor in about 15 minutes or less, and features curbside feeding and automatic feed wheel system.

## Federal Photovoltaic Utilization Program

**Albert C. Lawson, Federal Photovoltaic Utilization Program, Jet Propulsion Laboratory, Pasadena, California**

The Federal Photovoltaic Utilization Program (FPUP) is part of the continuing federal support to the development of solar energy, specifically photovoltaics technology. The Department of Energy (DOE) anticipates FPUP to assist in accelerating the market development of photovoltaic technology and reduce the cost of photovoltaic applications.

Industry response to the program has been very good. There has been a steady increase in the number of companies that have developed capabilities and are seeking to provide photovoltaic systems.

Benefits of FPUP are:

1. Federal agencies are gaining experience in RFP's (Requests for Proposals), in evaluating proposals, contracting and operating photovoltaic systems;
2. System suppliers are learning how to design, install, operate, warranty photovoltaic systems, and learn how to respond to RFP's;
3. Federal agencies are procuring photovoltaic systems with their own funding;
4. Battery suppliers are placing increasing attention on development and application of batteries for the photovoltaic systems; and
5. A marked increase in the number of suppliers of photovoltaic systems has been observed.

## Feasibility Of Direct Seeding Trees On Surface Mines In Kentucky

**T. W. Richards, R. F. Wittwer and D. H. Graves, Department of Forestry, University of Kentucky, Lexington, Kentucky**

Successful direct-seeding trials on mine soils have renewed interest in this reforestation method. Application of direct seeding to large-scale plantings requires the development of a planting machine capable of planting large seeds on variable topography and in rocky soils. Adaptation of an existing agricultural planter was investigated. Modifications met with reasonable success. Mine soils present no major problem for mechanical planting. Seed size limitations can be extended to plant most large-seeded species.



Modifications to plant variable slopes are the most difficult. Redesign and further development are needed to supply the mining industry with a dependable planting machine suited to the variable site characteristics encountered on mined land.

## Solar Waterpumping Systems

**Ronald W. Matlin, TriSolar Corporation, Bedford, Massachusetts**

Over the past several years, a number of photovoltaic powered water pumping systems have been installed around the world. Several systems are described.

The design of a photovoltaic waterpumping system and the selection of components depend on many factors. The selection of the pump and motor greatly affects the system design. Centrifugal pumps have reasonable efficiencies down to the 20 to 25 gallons per minute pumping range. Below this their efficiency drops off rapidly. Volumetric pumps maintain good efficiencies at low pumping rates, especially at high heads, and therefore allow photovoltaic waterpumping systems to be cost-effective over a wider range than centrifugal pumps would allow. The two types of pumps have different load characteristics and hence present different problems.

In waterpumping systems of less than 10 kW (kilowatts), direct current (DC) motors are more efficient and cost effective than alternating current (AC) motors. Experience has shown that when energy storage is required, it is more cost-effective to store water in tanks than it is to store chemical energy in batteries. It is also desirable to use high voltage systems because efficiency of control electronics is considerably lower when low voltage systems are used.

## Forest Service Equipment Development Center Activities

**Ken Dykeman, USDA-Forest Service, Equipment Development Center, San Dimas, California**

Some projects of interest to workshop participants are discussed: a mountain climbing backhoe with a unique design that allows individual control of each leg and wheel, with additional attachments available to increase versatility; an on-site chipper/conveyor for fire hazard reduction and residues reduction; a tractor with special suspension, gearing, and brakes that performs all the functions of an ordinary farm tractor, yet travels 50 mph on the highway; use of magnesium chloride for dust control; and a mobile hammermill that can efficiently reduce in-place oversize rock into a useful wearing course for an existing road.

## Improvements To The Modified Hodder Gouger

**Randall Chappel, R. W. Chappel Planning and Management, Calgary, Alberta, Canada and Bernie Jensen, Western Reclamation, Bozeman, Montana**

Over the past year the Alaska Project Division of NOVA, an Alberta corporation, has been redesigning and building a modified Hodder gouger for its reclamation program on a major international pipeline. To make the modified Hodder gouger, designed and built by the Forest Service Missoula Equipment and Development Center, more suitable for high-production use, an independent ground wheel was designed. The wheel would drive the seedboxes and regulate a redesigned depression excavation control system.

Over-all machine operation control is achieved with a second small-diameter short-stroke hydraulic cylinder connected to a trailing-wheel elevating arm to lift the wheel off the ground. Blade arms and blades were redesigned to achieve greater clearance and a more effective basin shape for seed-holding, and the hitch was replaced with one from the rangeland drill.

The new machine was field tested in Alberta in the summer of 1981. NOVA's conclusion is that the control system is functional and allows complete adjustment of basin size and shape. It achieves the goal of producing consistent, predictable basins that are not directly affected by tractor hydraulics. There were problems, however, related to machine design that became apparent because of the actual machine use and the priorities of the user.

## Electric Fencing – A State-of-the-Art Review

**Ronald Jepson and R. Garth Taylor, Colorado State University, Fort Collins, Colorado**

Electric fences have historically been used as temporary fencing. With recent innovations, electric fencing has been used as permanent fencing and as a method of upgrading existing fences. The chief advantages of electric fencing are low cost and ease of erection and removal. Like most fences, electric fences employ line posts and wire strands. However, they do not necessarily require corner braces. Disadvantages are that the fence must be kept in operation full time to be completely effective, livestock must be trained when first exposed, and frequent inspection and maintenance are required. A discussion reviewing the materials used in constructing an electric fence follows.

## Grass Establishment—New Directions

**Victor L. Hauser, USDA-Agricultural Research Center, Grassland, Soil and Water Laboratory, Temple, Texas**

Current seeding and establishment methods frequently fail to produce adequate stands of grass. Three new grass establishment systems are discussed and available research data on their performance are evaluated.

Punch-planting is a method that places the seed in the bottom of an open, small-diameter hole deep in the soil where soil moisture is available longer than with conventional planting. Punch-planting established more plants than conventional planting in both greenhouse and field studies. However, two problems limit the use of punch-planting: rainfall fills the holes with soil, and available punch-planting machines are too slow and too weak for commercial use.

Live grass plants set into the field usually produce vigorous fast-growing plants. A new method for automating all phases of transplanting for grass employs the plastic bandoleer to permit mechanization of all phases of growing and transplanting grass plants. Transplants perform well in the field, but machinery to accomplish all phases of work is incomplete.

Grass seeds that were germinated before planting dramatically improved grass establishment both in the greenhouse and in field trials. Practical field use of germinated grass seeds should be easier to achieve than the other two methods because equipment is available now to plant germinated vegetable seeds.

This research demonstrates that substantial improvement in grass establishment technology is possible.

## Savory Grazing Method

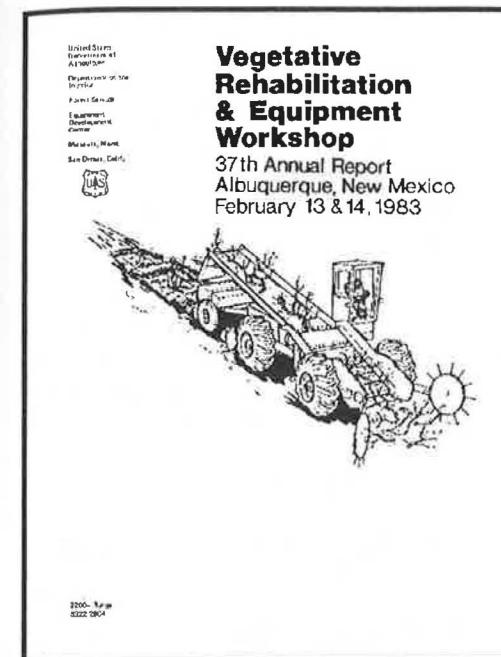
**Noel Marsh, USDI-Bureau of Indian Affairs, Albuquerque, New Mexico**

The Savory Grazing Method (SGM) derives its name from its originator, Allan Savory. SGM is a flexible grazing method that maximizes stock density for a minimum time and best can be defined as: "A method of managing the range and livestock through the optimization of four ecological phenomena by manipulating four range influences through a series of grazing management principles."

SGM has proved effective in improving rangelands in three continents over the past 17 years ranging from 2 to 100

inches of annual precipitation. The full understanding of SGM cannot be grasped without attending one of the courses that Allan Savory conducts. Savory is also completing a textbook on SGM titled, "The Savory Grazing Method of Holistic Grazing Management."





## 1983 Vegetative Rehabilitation and Equipment Workshop 37th Annual Report

Albuquerque, New Mexico

### Introductory Address: The Sahelian/ Sudanian Zones Of Africa: Profile Of A Fragile Environment

*Dr. Gerald W. Thomas, First Vice President, Society for  
Range Management, President, New Mexico State  
University, Las Cruces, New Mexico*

This report focuses on a study for the Rockefeller Foundation of the food production potential of the marginal lands and semiarid regions of Africa, from Senegal to Somalia, south of the Sahara Desert. The study was approached with an ecological perspective—emphasizing the resource base for livestock grazing and rainfed crop production. Periodic drought, such as the major one during the period 1968 to 1974 that caused political upheaval and widespread starvation of livestock and people, must be considered as a basic component of the environmental complex. This major drought focused the world's attention on this fragile environment. Since this drought, substantial amounts of food aid and development assistance have been sent to the area. The dual challenge for the area is to increase food production for a population that will double in about 25 years and, at the same time, reverse the process of desert encroachment and resource development.

Overall food production is now keeping pace with population growth. To increase food production and slow down or reverse the desertification process the following eight categories are considered essential to a "holistic approach" to progress:

1. Responsible government programs and policies;
2. Proper use of resources—land, water, vegetation, energy;
3. Education and research as an investment in progress;
4. Focus on the farmer and pastoralist to create the incentive to produce;
5. Application of science and appropriate technology;
6. Balanced family nutrition;
7. Effective development assistance; and
8. A consideration of the ecological balance.

Adaptations of this formula must be made to fit individual country situations.



## Vertical-Axis Tiller

**Bill McGinnies, USDA-Agricultural Research Service, Crops Research Laboratory, Fort Collins, Colorado**

Field tests of the vertical-axis tiller continued in 1982. The model tested was the Lely RH200-20, which has a working width of 80 inches and is designed for tractors of 40 to 75 PTO horsepower.

On a saltgrass meadow in northcentral Colorado, the tiller was effective if the sod was first loosened with a chisel plow. In mulching studies in northcentral and northwest Colorado, the tiller could effectively incorporate 1,000 pounds per acre of either straw or grass-mulch with one pass over the area. The seedbed produced by the tiller is not as loose as that prepared by conventional rotary tillers.

The tiller produced a satisfactory seedbed when the soil was too wet to be worked with the usual plow and disk procedures. On hard, dry soils tilling is much more efficient if the soils are first loosened with a ripper or chisel.

The only operation problem encountered with the Lely tiller is the sharp angle of the PTO U-joints that result from the input shaft of the tiller being much higher than the tractor's PTO shaft. In 1982 a "Lelymatic Shearpin Automat" automatic shearpin replacer was installed on the tiller. The replacer was reliable in all aspects; shearpins consistently broke when heavy obstructions were encountered, but no shearpins broke unless there was an obstruction.

## Mulch Spreading Equipment For Steep Slope Revegetation And Mine Reclamation

**Carol S. Taylor, Colorado State University, Fort Collins, Colorado**

The presentation is a summary of a state-of-the-art review report on mulch spreading equipment for steep slope revegetation and mine reclamation that is being completed by Colorado State University and the Forest Service Equipment Development Center, San Dimas, California.

To better evaluate the different types of mulch spreaders, they were divided into several categories. Criteria were developed from equipment user input, literature review and researchers' recommendations. For each category, the criteria were used to evaluate the equipment and rank equipment based on satisfying the criteria.

Equipment used for spreading and incorporating mulch were placed in the following four categories: mulch spreaders,

power mulchers, hydraulic mulcher-seeders, and mechanical mulch incorporators.

## Triangular Disk-Chain For Rangeland Seedbed Preparation

**Harold T. Wiedemann, Texas Agricultural Experiment Station, Vernon, Texas**

A new triangular disk-chain, requiring only one tractor for pulling, developed by the Texas Agricultural Experiment Station, has reduced pulling requirements by 30 percent and increased operating width by 22 percent, compared to the standard two-tractor, diagonal pulling techniques.

## Land Imprinting Activities

**Robert M. Dixon, USDA-Agricultural Research Service, Tucson, Arizona**

Land imprinting and desertification control research were accelerated in 1982 because of increased support. A new device called the brush-barrel seeder was developed and successfully used with the land imprinter to impose treatments on lands recently retired from irrigated cotton production.

New experimental sites were selected to represent various stages of desertification resulting from prolonged overgrazing and overcropping. Revegetation treatments included:

1. Ripping, seeding, and imprinting;
2. Seeding and imprinting;
3. Hand-seeding;
4. Drill-seeding; and
5. Untreated.

Treatments were laid out with long continuous borders to facilitate paired comparison analyses.

Stand density and forage production under the imprinting treatment were superior to the drill treatment. Compared with drill furrows, imprints were observed to stay wet several days longer after winter rains.

Other activities included the testing of different sized teeth under both simulated and natural rainfall in an effort to improve seedbeds and seedling cradles. Preliminary results were consistent with expectation.

## Modification Of Chaffy Seeded Grasses With Air

**C. L. Dewald, USDA-Agricultural Research Service Woodward, Oklahoma and V. A. Beisel, Aarons Engineering, Fargo, Oklahoma**

Aerodynamic methods to modify chaffy grass seed by removing awns, hairs, fuzz, and chaff shows promise in early trials. The air compressor-driven power unit uses a venturi-shaped nozzle to propel air through a mixing chamber and into a venturi-shaped discharge muzzle. As the pressure decreases, due to increased velocity in the venturi constriction, the resulting vacuum formed in the mixing chamber pulls air, entrained seed into the power unit. Seed is expelled from the venturi muzzle. The air and chaff exits through the opening opposite the classifier air nozzle and momentum of the heavier seed propels them forward against a slight vacuum through the second opening in the "y" to achieve separation.

## Seed Coating "Hard To Drill" Seeds

**Wendall R. Oaks, USDA-Soil Conservation Service, Los Lunas, New Mexico**

The objective of the project activities at the USDA Soil Conservation Service Los Lunas Plant Materials Center (PMC) is to reevaluate the feasibility of coating trashy seed. Preliminary work continues on this project with additional seeds being coated and field studies planned for 1983. Initial tests show no detrimental effects from coating.

## Plant Materials Progress In Texas

**Richard B. Heizer, USDA-Soil Conservation Service, Temple, Texas**

Since 1978 eight new plant materials have been released and two are in review from Texas by the Knox City Plant Materials Center, Knox City, Tex. in cooperation with the Texas Agricultural Experiment Station and various other state and federal agencies.

Included are: Alamo switchgrass (*panicum virgatum*), Shoreline common reedgrass (*phragmites communis*), T-587 old world bluestem (*Dichanthium* spp.), Yellow Puff littleleaf leadtree (*Leucaena retusa*), Aztec maximilian sunflower (*Helianthus maximilliani*), Loneta indiagrass (*Sorghastrum nutans*), rainbow wild plum (*Prunus* spp.), Saltalk alkali sacaton (*Sporobolus airoides*).

Plant materials to be released spring 1983: Haskell sideoats grama (*Bouteloua curtipendula*) and Sabine Illinois bundleglower (*Desmanthus illinoensis*).

Also the Texas SCS cooperated in four additional releases principally by ARS and/or Texas AES during this same period. These releases are: Nueces buffelgrass (*Cenchrus ciliaris*), Verde kleingrass (*Panicum coloratum*), Llano buffelgrass (*Cenchrus ciliaris*) and Brazos bermudagrass (*Cynodon dactylon*).

## Colorado Environmental Plant Center

**Sam Stranathan, USDA-Soil Conservation Service, Meeker, Colorado**

The Upper Colorado Environmental Plant Center's first plant release is a cooperative one. The newly released Rincon saltbush is a product of collection and selection efforts by the Forest Service Shrub Science Lab (Provo, Utah) and field trials and orchard efforts by Utah Division of Wildlife Resources, Soil Conservation Service, and Meeker Plant Center.

The Meeker Plant Center provides foundation and registered seed to growers for nine other popular plant materials. New products in advance testing are: Utah sweetvetch, Louisiana sagewort, Slender wheatgrass, Antelope bitterbush and Serviceberry.

## Old World Bluestem Release

**Dr. William A. Berg and C. L. Dewald, USDA-Agricultural Research Service, Woodward, Oklahoma**

Old World bluestems (*Bothriocloa* spp.) from southwest Asia have high forage and beef production potential when seeded and managed as monocultures on the Southern Plains. These introduced bluestems also offer potential for warm season pastures on the hilly lands of the southeast where tall fescue pastures are used during the cooler season. WW Spar bluestem (*Bothriocloa ischaemum*), a new release from the Southern Plains Research Station has high forage production potential under less than optimum soil moisture conditions and is more palatable than many other old world bluestem selections. WW Spar has shown excellent persistence and spring vigor in test plots in Oklahoma, northern Texas, central Kansas, and southern Illinois. WW Spar, like Caucasian bluestem, is susceptible to iron deficiency when grown on soils that are calcareous to the surface. Seed of WW Spar bluestem is available through the Oklahoma Foundation Seed Stocks, Inc.



## Seed Harvesting

**Stephen B. Monsen, USDA-Forest Service, Boise, Idaho**

To date, the Seed Harvesting Workgroup has developed and field tested various backpack harvesters. All have usefulness in collecting seed of various species. No machine is universally adapted to harvest seeds of all plants. However, the "Elephant-Vac," a large commercial vacuum, has performed satisfactorily. The unit has sufficient suction to remove and draw large seeds of fourwing saltbush and other related seeds into the collection unit.

This collector must be transported on a pickup truck, which somewhat limits its usefulness on steep or inaccessible sites. The machine does not damage collected seeds because the seed does not pass through the blower. The machine is easy to operate. The unit has potential in harvesting seeds from shrubs grown under cultivation. It is particularly useful in collecting light-weight seeds. It has also proved useful in harvesting seed from shrubs such as shadscale saltbush and spiny hopsage.

## Woodward Flail-Vac Seed Stripper-Update

**C. L. Dewald, Agricultural Research Service, Woodward, Oklahoma and V. A. Beisel, Aarons Engineering, Fargo, Oklahoma**

During 1982, the first year of commercial use, 29 Woodward Flail-Vac seed strippers were manufactured and sold. These strippers harvested more than 60,000 pounds of pure live seed of Caucasian, WW Spar, plains, and ganada bluestem during the first season of use. Most of the harvesters manufactured were 7 to 10 feet in width for mounting on a front-end loader. Two 14-foot wide strippers were adapted for and mounted on cotton stripper chassis.

The success achieved by the Woodward Flail-Vac seed stripper is a result of its simplicity, effectiveness, and versatility.

## Western Reclamation Group Progress Report-1982

**Wayne E. Sowards, Trapper Mining, Incorporated, Craig, Colorado**

The Western Reclamation Group was formed in 1981 by representatives of the coal mining industry, environmental consultants, state regulatory agencies, and universities. The group formed in response to existing and incipient regulations, guidelines, and policies for the standards of revegetation for coal mined lands.

The group has evaluated the regulations, policies, and guidelines for revegetation success standards of six western states and the Denver Office of Surface Mining. The evaluations were made by four working subgroups to consider four major topics:

1. Land use determinations and classification;
2. Management of reclaimed lands;
3. Quantitative evaluations procedures; and
4. Concepts of reclamation standards.

The subgroups presented their preliminary findings at WRG workshop held in Denver in April 1982. The comments elicited from the workshop were used to finalize the findings and conclusions of the group. These materials are directed to all persons involved in planning, studying or administering standards of revegetation success for mined lands.

## Land Imprinter Results In Utah

**Warren P. Clary, USDA-Forest Service, Provo, Utah and Thane J. Johnson, USDI-Bureau of Land Management (retired), Salt Lake City, Utah**

At the 1982 VREW, Thane Johnson described a study to be conducted by the Intermountain Forest and Range Experiment Station and the Utah State Office of the Bureau of Land Management. This study was a comparison of the revegetation effectiveness of a locally constructed land imprinter and a conventional rangeland drill. An unseeded comparison was also included in the test.

Initial results from the Little Oak Creek burn in central Utah suggest significantly better establishment of seeded forage species planted by the land imprinter as compared to the more conventional rangeland drill under our conditions of severe wind conventional rangeland drill under our conditions of severe wind erosion. Further measurements and observations will be made before final conclusions are reached regarding relative seeding success and native plant response.

## Land Treatment By Chaining On The Dixie National Forest

**Frank R. Jensen, USDA-Forest Service, Dixie National Forest, Cedar City, Utah**

Much of the 145,000 acres seeded on the Dixie National Forest were prepared for seeding with modified anchor chains, aerially seeded, then chained a second time to cover the seed.

A number of different chain lengths, chaining patterns, types of digger teeth, swivels, and clevises have been tried in the Dixie National Forest. From these experiences, the following is recommended:

1. Total chain length of approximately 250 feet and weighing about 15,000 pounds;
2. Pull the chain in a "U" pattern with tractors no more than 75 feet apart. Tractors can be moved to 50 feet for a more complete job, but the narrower the swath, the greater the degree of vegetation uprooting and seedbed scarification; and
3. Approximately 175 chain links should have digger teeth. There should be approximately 45 feet of smooth chain on each. The swivel should be placed at the connection between the smooth chain and the digger teeth equipped chain.

## Ground Sprayers For Sagebrush Rangelands

**James A. Young, USDA-Agricultural Research Service, Reno, Nevada**

Using herbicides to control brush and weeds, release forage species, or seed desirable forage species is a valuable range improvement technique. Herbicides usually are applied aerially on rangelands because of their extensive and often rugged terrain. For small acreages in remote locations it is often impossible to obtain aerial applicators. This report describes modifications of power-ground sprayers to permit their use on rangelands. The modifications to booms, boom supports, and suspension can be done in typical farm shops. Techniques for calibration and tips for operating rangeland sprayers are also given.

## Structural Range Improvements

**Billy H. Hardman, USDA-Forest Service, Region I, Missoula, Montana**

This year the structural range improvements workgroup has field tested a new type of posthole digger called a Can-Do Digger. With this new posthole digger a posthole can be dug 42 inches deep with only a 6 inch diameter from the top down. This is made possible by the double crossover design of the handles. The cost is about \$75. The digger is manufactured and marketed by Can-Do Diggers, Inc.

## Boom For Pneumatic Fencepost Driver

**James A. Young and Richard Madril and Victor Rashelof, USDA-Agricultural Research Service, Reno, Nevada**

The pneumatic post driver is a useful tool for driving steel fence posts; however, the 65-pound weight of the driver makes it very tiresome and difficult for a single operator to handle. To make the driver more convenient for one operator, a counterbalanced boom was designed to suspend the driver at the correct height for driving posts.

The relatively inexpensive counterbalance boom greatly enhances the usefulness of the pneumatic post driver. Use of the modified boom makes the driver a one-person tool. Design and specifications given.

## High Performance, Counterbalanced Wind Machine Development

**Floyd C. Sutz, Executive Vice President, Sind Baron Corporation, Phoenix, Arizona**

A high performance waterpumping wind machine that begins operation in winds of only 3 to 5 miles per hour is now available from Wind Baron Corporation. The 21-foot diameter Mark IV Wind Machine incorporates a patented counterbalancing system that eliminates 100 percent of the sucker rod weight and 50 percent of the water column weight and allows operation in light winds. Additionally it has sensitive wind "tracking" features that further enhance its performance.

In a 7 month, side-by-side test certified by Texas A&M University, a Wind Baron wind machine delivered over 13 times more water than a conventional windmill in winds below 10 mph, and over 32 percent more in winds above 10 mph.

Wind Baron has also developed several well simulators to assist in performance testing. With the use of these well simulators, any reasonable well depth can be simulated, which allows windmill performance testing at various simulated water depths without the need for a well. The company will readily make this technology available to other wind system manufacturers and outside parties interested in its use.



## Accomplishments Of The VREW—History

*Richard Hallman, Range Program Leader, USDA-Forest Service, Equipment and Development Center, Missoula, Montana*

The Vegetative Rehabilitation and Equipment Workshop, VREW, is a forum to provide exchange of ideas to enhance the development and dissemination of technology used in improving rangelands and surface mined soils. The work of VREW can be broadly divided into four categories:

1. plant control;
2. ground preparation;
3. seeding and planting; and
4. publications.

Major projects in each of these fields are reviewed.

"Anchor Chains, Projects 602 and 1790" evaluated combinations of cables and light chains, and then continued to work on improving the effectiveness of chains on brush control. Two distinct chains were developed, the Ely, by BLM in Ely Nevada, and the Dixie Sager by Dixie National Forest, Utah. Drawings of chains are available from Missoula Equipment Development Center (MEDC). A handbook on chaining, "The Ely Chain," was also prepared.

The objective of "Brushland Plow, Project 328" was to design a rugged plow patterned after the Australian "Stump Jump Plow," for use on rangelands. The results of this effort produced a most durable and effective plow for wildland situations. Drawings and a service parts manual are available from San Dimas Equipment Development Center (SDEDC).

The purpose of the "Browse Seeder, Project 502" was the development of an appropriate means of seeding browse, forbs and grasses for wildlife habitat improvement. A satisfactory seeder was developed in cooperation with the Walter Hanson Machine Company. Drawings are available from SDEDC.

VREW is increasing the effort to provide land managers with pertinent, up-to-date information. Much of this information is published in newsletters, Equip Tips, Project Records, VREW annual reports, service and parts manuals, operations handbooks, and the "Catalog—Revegetation Equipment." A growing emphasis is also being placed on collecting and distributing current information about equipment and techniques for rangeland improvement and disturbed land revegetation.

## Accomplishments Of VREW—Development Of The Rangeland Drill

*Dan W. McKenzie, Range Scientist and Mechanical Engineer, USDA-Forest Service, Equipment Development Center, San Dimas, California*

The rangeland drill is VREW's most successful project. It has been used for over 30 years in the rangelands of the western United States and in several foreign countries. In recent years, the rangeland drill has also been used extensively for strip mine reclamation. It is an excellent example of cooperation between government and private enterprise.

The rangeland drill progressed through four phases:

1. Conceptual, carried out by the Range Seeding Equipment Committee;
2. Demonstration and validation, carried out by the Freemont National Forest;
3. Full-scale engineering development by the San Dimas Equipment Development Center (SDEDC); and
4. Production, use and product improvement phase which was carried out by several groups. Production was by private enterprise under contract, the use portion was carried out by the Forest Service, Bureau of Land Management, Bureau of Indian Affairs, Soil Conservation Service, various states and private firms. Project improvement has been carried out by SDEDC, the equipment fabrication contractors and the user.

## BLM's Rangeland Rehabilitation Equipment Pool, Vale, Oregon

*Cliff Hiatt, USDI-Bureau of Land Management, Vale, Oregon*

The Bureau of Land Management's (BLM) Rangeland Rehabilitation Equipment Pool, operated by the Vale District of BLM, Vale, Ore., contains 70 rangeland drills and 19 brushland plows. These drills are available on loan to any BLM district on a first-come, first-served basis. After BLM needs are met, this equipment is available to other US Government agencies. The equipment can also be loaned to farmers and ranchers through agreements with the Soil Conservation Service.

Vale will provide a training seminar on range rehabilitation equipment to BLM Districts on request. These seminars are designed to familiarize range conservationists and supervisors with range rehabilitation equipment.

## Ecological Considerations In Designing And Selecting Reclamation Equipment

*Willis G. Vogel, USDA-Forest Service, Northeastern, Forest Experiment Station, Berea, Kentucky*

It has been recommended that the Vegetative Rehabilitation and Equipment Workshop identify and promote a better understanding of the ecology of the land to be treated as a first step in designing and modifying equipment. The precept is also applicable to the selection of existing equipment. This paper describes where and how ecological principles may relate to and be considered in the design, modification, and selection of equipment for reclaiming and vegetating disturbed lands.

Ecology seemingly has been considered, either consciously or unconsciously, in designing and modifying many of the pieces of equipment used in reclaiming disturbed lands. Failure to consider ecological factors seems to occur most often in the selection of equipment that is already available. Reasons for this are most often related to economics and convenience and familiarity to the user. Some of the revegetation problems related to equipment selection result directly or indirectly from the requirements of reclamation laws and regulations that were not based on ecological considerations. Some of these problems can be overcome with better selection and more judicious use of existing equipment.

## The Savory Grazing Method

*Allan Savory, SGM Range Consultants, Albuquerque, New Mexico*

The Savory Grazing Method (SGM), or holistic resource management, is a way of managing all of the resources in any ecosystem to produce a desired goal. When you apply SGM, you will manipulate the various components that make up the range ecosystem to achieve a desired end result on the whole. Where conventional range management is based almost entirely on plant management, SGM is based on the management of the "whole," including precipitation, sunlight energy, soils, plants, animals of all forms, biological succession, financial and labor resources, seasonal and daily changes in growing conditions and a host of other factors. It cannot be applied as a system as it has to be tailored to each situation and each season, and yet it is universal in its application.

## How Can VREW Tie With MARC?

*Lauri Zell, Mining and Reclamation Council of America, Washington, DC*

The Mining and Reclamation Council of America (MARC) and VREW share an important common goal: providing a forum for exchanging ideas to enhance the development and dissemination of technology used in improving coal mining and reclamation. MARC was established in 1977 as the national trade organization representing the surface coal mining community.

One of MARC's primary strategic objectives is to aid in the development of relevant research and transference of results of coal mining studies to the industry as expeditiously as possible. Recently, MARC endeavored to determine the research needs of the industry through a nationwide assessment. The results of the assessment provide a documented frame of reference for federal and private decision making regarding priority research needs.

Two policy recommendations were frequently addressed by participants nationwide. The first is the need for more efficient technology transfer; the second concerns the need for developing a regulatory environment that encourages the use of experimental practices during mining and reclamation activities.

Specific production and reclamation technology suggestions focus on five major topics: hydrology, sediment control, reclamation, air quality and blasting.

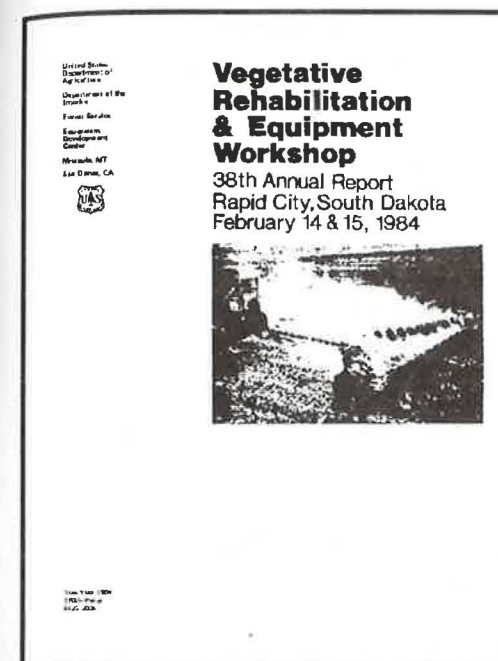
## Coordination Of Mined Land Reclamation On National Forest System Lands

*Wayne Patton, Minerals and Geology Staff, USDA-Forest Service, Washington, DC*

It is critical for minerals specialists to coordinate with those having expertise in reclamation. Mineral specialists have the job of coordinating reclamation efforts with the other disciplines. However, plant materials and soils specialists should contact minerals experts at least two-to-three years before expertise is needed. Topics to consider include on-going and future mineral projects and future reclamation needs as well as plans to supply the needed knowledge.



The time for plant materials and soils experts to become involved in the reclamation effort for a mineral project is at the first phase when baseline information is collected and plants are made (jointly with industry) regarding post-mining land use. Reclamation expertise is built into the plan of operation for the mineral project. The reclamation specialists carry out operational supervision and monitor operating plan compliance. The final involvement comes during reclamation field work at the end of a mineral project and management of the post-mining landscape for the selected end land use. The key to this whole process is early involvement in the reclamation planning process.



## 1984 Vegetative Rehabilitation and Equipment Workshop 38th Annual Report

Rapid City, South Dakota

### The Changing Role Of VREW In Rangeland Management

*Jack Bohning, Past President, Society for Range  
Management, Prescott, Arizona*

VREW's objective was to provide an exchange of ideas to enhance the development and dissemination of technology used in improving rangelands and surface-mined soils. A maturing in the philosophy of range improvement work is strongly evident in the statement that to better identify an equipment project, VREW may promote an understanding of the ecology of the land to be treated as a first step in modifying or designing new equipment.

VREW achieves its objectives in a variety of ways. A prime factor in its success to date. VREW provides a catalyst for stimulating ideas and proposals from a wide array of sources and provides a vehicle for publication of information with an in-place distribution net.

In the future VREW members should consider the critical need for continuing VREW programs, the need to emphasize energy-efficiency in developing tools for range improvement and mine rehabilitation and the need to sell rangeland and mine rehabilitation work as necessary for both economic and social benefits.

### A Partner In Equipment Development

*Farnum M. Burbank, Mechanical Engineer, Equipment  
Development Group, Washington, DC*

VREW has been a true partnership between resource managers and engineers in equipment development over the past 37 years.

The broad objectives of the VREW have been to keep abreast of the field of commercially developed equipment, to make modifications as required for adaptation to wildland use, and to develop equipment not commercially available.

With the rapidly growing interest in, and demand for, rehabilitation of disturbed lands in the 1970's, the VREW program has become quite heavily oriented toward the stabilization of disturbed lands, although project work continues on range improvement equipment.

The results of VREW have been significant. Perhaps the cooperative spirit engendered by the Workshop is as important as any of its achievements. It is a classic example of what can be accomplished if no one is too concerned about who gets the credit!



## Panel Discussion: Chemical, Thermal, And Mechanical Control Of Noxious Weeds—Progress And Prognosis

**Russell J. Lorenz, USDA-Agricultural Research Service, Mandan, North Dakota**

Leafy spurge (*Euphorbia esula* L., *E. virgata* Waldst. & Kit, and closely related *Euphorbia* species) is an introduced weed that has become a major problem in the United States and Canada, particularly on rangelands in the northern Great Plains. Consequently the panel speakers address the topic of noxious weed control primarily in terms of leafy spurge. The same general principles apply to other perennial weedy forb problems given some fine tuning for the specific problem.

No single research or extension group has received enough funding to carry on an independent program that would in itself be effective. However, by redirecting efforts between federal, state and provincial units, sizeable gains have been made in control technology.

## Leafy Spurge On The Northern High Plains—Characteristics, Site Requirements And Concerns

**Ardell J. Bjurstad, USDA-Forest Service, Rapid City, South Dakota**

Physical description and characteristics of the leafy spurge (*Euphorbia esula* L.) plant are given, including leaves, roots and seeds.

Birds are considered the primary disseminators of spurge seed. Lowland range sites and bottomland topographical positions on the northern High Plains have been described as sites where leafy spurge dominates over other herbaceous vegetation in the community. Efforts to control the noxious weed on this site will also affect hardwood species on these sites or prohibit regeneration of hardwood species. The data suggest that management closely monitor lowland and sandy range sites for infestations of leafy spurge and immediately investigate control efforts at initial infestation.

## Evaluation Of Original And Repetitive Herbicide Treatments For Control Of Leafy Spurge

**Harold P. Alley, University of Wyoming, Laramie, Wyoming**

An extensive repetitive herbicide treatment program for leafy spurge (*Euphorbia esula* L.) was initiated in 1978, and the effect of original and retreatments on leafy spurge shoot and root control has been evaluated since the initiation of this study.

The most consistent and effective original-plus-repetitive treatment included picloram as a component of each of the treatments.

## Biological Control Of Noxious Weeds—Progress And Prognosis

**Lloyd A. Andres, USDA-Agricultural Research Service, Albany, California**

The fact that most studies of biological control to date have focused on the collection, testing, and release of new natural enemies against introduced weeds makes people often think of biological control as the substitution of "bugs" for chemicals to solve weed problems. More appropriately, biological control should be considered as the use and management of natural enemies to stress weeds and that the natural enemies are only one part of the weed management program. The release of exotic insects or pathogens is but a first step in the management process. To achieve a balanced range system, each manager should be aware of the capabilities and shortcomings of the control organisms and how to enhance their impact on the weeds.

The biological control process has become increasingly complex. A number of steps are now required to clear exotic potential control of organisms in the United States. Concern over the fact that these organisms may attack and impact on native plants has complicated testing and decisionmaking processes immensely. On the positive side, there has been increased recognition of the role that biological control might play in the control of weeds in the United States and the need for this approach.

We must be aware of the far-reaching consequences that the release of an insect (or chemical molecule) into the environment might have on the target weed as well as other weeds. Some hard choices will have to be made. We must be aware of the motives behind our actions and that the economic balance sheet is only one factor to be considered.

## Progress In Biocontrol Of Weeds Of Southwestern Rangelands

**C. J. DeLoach, USDA-Agricultural Research Service, Temple, Texas**

At Temple, Tex. we have selected weeds amenable to biological control based on three criteria:

1. The weed (or its close relatives) occurs as a native species somewhere else in the world where we can find natural enemies;
2. The weed (or its close relatives) does not have overriding beneficial values to either man or the ecosystem; and
3. The weed causes sufficient losses to be worth the cost of research.

This selection revealed that most of the major problem weeds of the Southwest that might be controlled biologically are native plants. A summary of the following target weeds is presented: snakeweed (*Gutierrezia sarthorae*, *G. microcephala*), baccharis (*B. neglecta*, *B. glutinosa*, *B. halimifolia*), mesquite (*Prosopis glandulosa* and *P. velutina*), creosotebush (*Larrea tridentata*), tarbush (*Flourensia cernua*), Whitebrush (*Aloysia gratissima*), bitterweed (*Hymenoxys odorata*) and Pinque (*H. richardsonii*), loco weed (*Astragalus* spp.) and salt cedar (*Tamarix* spp.)

Biological control of introduced species appears to be technically feasible, economically sound and not harmful (and may even be advantageous) to the ecosystem. The biocontrol of certain native weeds also seems feasible, though it is more difficult and requires more careful consideration of the effects on the ecosystem than does the control of introduced weeds.

## Biological Control Of Noxious Weeds In Montana

**Norman E. Rees, USDA-Agricultural Research Service, Bozeman, Montana**

Thirteen biocontrol agents have been released on seven major problem weed species in Montana with varying results. In addition, a fourteenth agent has recently immigrated from a Canadian release site and is becoming established throughout much of the state.

Discussed are: *Chrysolina quadrigemina*, *Agrilus hyperici*, *Zeuxidiplosis giardi*, *Rhinocyllus conicus*, *Trichosiocalus horridus*, *Ceutorhynchus litura*, *Urophora cardui*, *Calophasia*

*lunula*, *Urophora affinis*, *Sphenoptera jugoslavica*, *Urophora quadrifasciata*, *Metzneria paucipunctella*, *Hyles euphorbiae* and *Obeira erythrocephala*.

## Arid Lands

**Earl F. Aldon, USDA-Forest Service, Albuquerque, New Mexico**

The speaker presents some of the latest findings from research conducted in the Southwest and presents his ideas for needed future reclamation research.

Recent findings include:

1. Increased surface mining of coal in the Four Corners area of the United States has caused concern as to whether cast overburden (spoil), due to runoff, contributes significant sediment to the already high levels in area streams. After sixteen runoff events in 8 years, runoff plot data are well correlated and show runoff and sediment production from graded but otherwise untreated spoils are within tolerable limits;
2. Mining reclamation specialists and government regulators need sound criteria for judging when reclamation is complete and bonds can be released. Three common and easily measured parameters are cover, density, and diversity;
3. Western wheatgrass (*Agropyron smithii*) will survive and spread when broadcast seeded on raw mine spoil receiving some additional moisture as a result of topographic shaping;
4. After reclamation was complete, plantings on northwestern New Mexico raw mine spoils from 1973, examined for establishment (1975) and survival (1979) showed 75 percent survival of fourwing saltbush (*Atriplex canescens* (Pursh) Nutt) and Alkali sacaton (*Sporobolus airoides* (Torr.) Torr.) cover was four percent;
5. A study by Cress (1982) found three native plant species—fourwing saltbush, galleta (*Hilaria jamesii*), and western wheatgrass—responded to varied watering regimens by producing greater amounts of proline as moisture stress increased. A comparison of the three species showed a trend toward greater survivability at lower soil moisture levels as the proline content increases; and



6. Studies suggest that selected organic amendments to mine spoils may achieve reclamation goals faster than the more expensive topsoil/mulch procedures currently used in reclamation procedures.

### Seedbed Preparation—The Forgotten Step In Range Seeding

**William J. McGinnies, USDA-Agricultural Research Service, Fort Collins, Colorado**

Seed of most species used for range seeding is small, and seedling vigor is low. Planting seed of most species below 1 inch results in seedlings failing to reach the soil surface, and there is a great reduction in seedling emergence. Because of surface soil drying, much of the seed planted less than 0.5 inch deep will fail to germinate. Thus, careful control of seed depth is essential to range seedling success.

Seedbed firmness also has a great effect on soil moisture relations. Soil firmness affects capillary pore space, and the amount of moisture that a seedbed can hold is directly related to the amount of capillary pore space. The ideal seedbed will be sufficiently firmed so that there is adequate capillary pore space, and yet is not so compacted that the reduced pore space prevents water infiltration.

The methods used to prepare a seedbed depend on the previous treatments. The tillage operations used to produce a smooth firm seedbed are an additional expense to be added to the already high cost of range vegetation. In many cases, however, the better seedbed will permit lower seeding rates which in turn will reduce seeding costs. It is also anticipated that the failure rate will be lower and costs of replanting reduced.

Better seedbed preparation will also reduce the need to develop and purchase specialized range seeding equipment because a smooth, firm, seedbed can be readily planted with commercially available farm and pasture drills, and this can be a considerable savings.

### Triangular Disk-Chain Activities

**Harold T. Wiedemann, Texas Agricultural Experiment Station, Vernon, Texas**

The triangular disk-chain developed by the Texas Agricultural Experiment Station for low-cost seedbed preparation on log-littered rangeland has functioned well in field tests during 1983. In kleingrass establishment studies, there was no significant difference in plant densities between seedbeds prepared by the triangular and diagonally pulled chains. Plant densities were increased by smooth chaining following both disk-chaining techniques.

In draft requirement studies using 24- and 28-inch diameter disk blades, the triangular disk-chain reduced draft by 36 percent and increased operating width by 23 percent compared to the diagonally pulled chain. Differences were significant at the  $p=0.001$  level. The optimum size, 24-inch disk-blade and two-inch chain, required 150 pounds per blade draft in freshly disturbed soil. These and other data are covered in ASAE Paper No. 83-1609 available from the author.

### Woodward Laboratory Air-Seed Shucker For Rapid Quality Determinations Of Chaffy Seeds

**C.L. Dewald and V.A. Beisel, USDA Agricultural Research Service, Woodward, Oklahoma and Aarons Engineering, Fargo, Oklahoma, respectively**

The Woodward Laboratory air-seed shucker gives rapid extraction of caryopses (grain) from chaffy seed for a quick and accurate determination of pure seed content. The air-seed shucker is powered with compressed air which enters the power unit nozzle and travels through the mixing chamber to exit through a venturi muzzle at supersonic speeds. Air-entrained chaffy seeds enter the mixing chamber and are subjected to an impelling air blast and acceleration force that strips subtending appendages from the grain. When the grain is shucked, its density (mass/volume) is increased and it drops from the shucker against a vacuum resistance in the classification cylinder. Seeds not shucked on the first pass through the power unit exit the venturi muzzle, travel with the air through a recycling tube and re-enter the system by means of a cyclone air separator until shucking is complete.

Determination of pure seed content of chaffy seeds by standard methods is slow, tedious and subject to much human error due to a large volume per weight ratio and extraneous materials to contend with. Two-to-four hours are required for a single purity analysis by standard methods. Whereas comparable determinations can be done in less than two minutes with the aid of the air-shucker. More accurate as well as more meaningful results are obtained when the extracted grain method is used. In addition to the seed analysts, seed producers and processors will benefit by the rapid extraction method in timing of operations and monitoring pure seed content with the Woodward laboratory air-seed shucker.

### "Native" Versus "Exotic" – The Dilemma Of Ecologically Sound Mine Waste Revegetation

**Stuart A. Bengson, ASARCO, Incorporated, Shuarita, Arizona**

ASARCO has had over 15 years experience in creating viable "naturalistic" ecosystems in the arid Southwest utilizing both "native" and "exotic" plant species. This experience has proven that species selection must be based on the specific site requirements and not limited to the few native species that may be endemic to the site. The mixture of native and exotic species creates a productive ecosystem that enhances the land resource values and harmonizes with the adjacent undisturbed "natural" areas.

### Merritt Island Brush Burning

**Richard Hallman, Range Project Leader, USDA Forest Service, Equipment Development Center, Missoula, Montana**

A truck-mounted boom-burner was evaluated by personnel at the Merritt Island National Wildlife Refuge near Titusville, Florida. The refuge is unique in that fire control must accommodate thousands of acres of land that is intermingled with marshes, rivers and lakes, and approximately 260 miles of dikes. Refuge personnel found that the boom can easily cover the fuels on both sides of the dikes and that they could ignite fuels on one side of a dike while driving over four mph. The Fish and Wildlife Service will continue to evaluate this ignition equipment in an attempt to perfect a rapid system for managing the vegetation on the many miles of dikes on the Merritt Island Refuge.

### Foam Marking Systems For Rangeland Sprayers

**Maurice R. Gebhart, USDA Agricultural Research Service, Columbia, Missouri; Allen Torell, Utah State University, Logan, Utah; James A. Young and Raymond A. Evans, USDA Agricultural Research Service, Reno, Nevada**

Numerous foam marking systems are commercially available and are in general use in intensive agriculture in the Midwest and Great Plains. When applying herbicides to rangelands with a ground sprayer, a marking system helps avoid skips and overlaps in spraying, especially in undulating terrain or tall brush.

Skips or overlaps in herbicide application resulting from loss of orientation by the sprayer operator are a concern because

of poor brush control in the skipped areas and added costs of herbicides and spraying time when double coverage occurs. Soil-active herbicides used for controlling cheatgrass (*Bromus tectorum*) require that there be no overlaps in application since excessive residues in the soil can prevent forage seedling establishment and plant growth.

The foam marker system is an economical way to improve sagebrush kill while spraying. Just as importantly, the needed investment is relatively small.

### Low-Cost Diagonal Fence Strainer

**Dan W. McKenzie, Range Scientist and Mechanical Engineer, USDA Forest Service, Equipment Development Center, San Dimas, California, and W.F. (Bill) Currier, USDA Forest Service (Retired), Albuquerque, New Mexico**

Corner, line, and gate or fence end braces (or strainers) are an important part of any fence. With the use of high tensile, smooth wire, these strainers are of even greater importance because of the necessity of maintaining the complete fence at the recommended tension. In recent years, the horizontal fence strainer (or the double horizontal fence strainer) has been accepted as the standard and strongest fence strainer design. However, another fence strainer design, known as a diagonal fence strainer, is structurally equal to the horizontal fence strainer, but is much less costly to install. It requires one less post and only about half the labor to install. A diagonal fence strainer is equal in strength and holding force to a horizontal strainer. It has the same lifting force on the corner post as a horizontal strainer of the same size. On a high-tensile, smooth-wire fence, one diagonal strainer can be used for a corner in place of the currently used two horizontal braces.

### Solar-Powered Pumping Systems

**Mike Easterly, Grundfos Pumps Corporation, St. Louis, Missouri**

Photovoltaics, the science of converting sunlight into electrical voltage, has been used for many years. Photovoltaics are taking an active role in groundwater pumping with complete solar-powered pumping systems now available. This new approach to pumping offers an innovative energy-saving alternative for many applications.

Solar-powered pumping systems are a viable alternative to conventional pumping systems. While the sizing, selection and installation of these systems are different from conventional systems, the pertinent data and complex calculations have already been compiled and are now available in an easy-to-use selection and installation manual.



## Progress In Nonstructural Range Improvements In The Northern Great Plains—Future Needs

*F.R. Gartner, South Dakota State University, West River Agricultural Research and Extension Center, Rapid City, South Dakota*

Mechanical treatments of rangelands are popular in the northern Great Plains because they conserve water—a direct benefit to native plants. Non-structural, or mechanical, range improvement methods have been under study by federal and state researchers for several decades.

There is an apparent link between effective precipitation, soil characteristics, forage production and livestock performance. The latter is specifically a function of forage quality and quantity. In over 25 years of examining various range inputs, most of which were spent in the northern Great Plains, mechanical treatments appear to be the most consistent range improvement for assuring the stability of forage quantity and improvement of forage quality. Further, mechanically treated range provides the best "grass insurance" during dry cycles.

## Range Improvement Machine

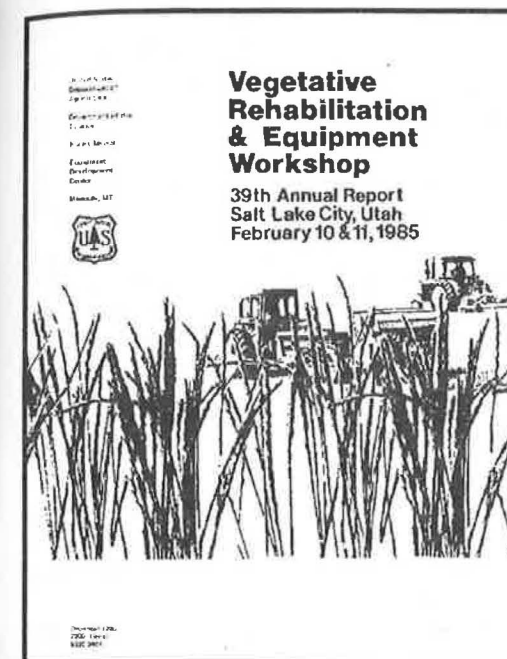
*P.O. Currie and R.S. White, USDA Agricultural Research Service, Miles City, Montana, and L.R. Erickson Montana State University, Bozeman, Montana*

A prototype rangeland improvement machine (RIM) was developed for interseeding rangeland or renovating problem marginal farmland. The unit tills the soil, forms a vee-trough seedbed and plants in a single-pass operation. Soil tillage is accomplished with a rototiller. A packing wheel assembly forms continuous, packed furrows on farmland. On rangeland, the furrows have intermittent check dams for water retention and control. Furrows are large enough to retain water and remain intact for a number of years but small enough to minimize field traffic problems. Various types and combinations of seed and fertilizer can be planted and applied with the modified all-purpose drill.

To date, field work has been an effective test of machine concept and machine components. The machine performs according to initial concept when soil moisture conditions are good. A number of rototines have been worn out, but breakage has generally not been a problem even in the rocky test site in western Montana. Mechanical components of the field generation prototype machine were rigorously

tested in establishing the research treatments. Several structural components were damaged or failed during field tests and have been modified, strengthened, or replaced in the current RIM.

A prospectus has been developed for VREW for a third generation machine suitable for use by individual ranchers, agencies, or conservation districts. This machine would be less complex and of lower cost than the prototype research machines.



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## Panel Discussion: Soil Conservation Service

*H. Wayne Everett, USDA Soil Conservation Service, Fort Worth, Texas, and Wendall R. Oaks, USDA Soil Conservation Service, Los Lunas, New Mexico*

The Soil Conservation Service (SCS) operates a coordinated network of 24 plant materials centers in the United States to assemble, evaluate, select, cooperatively release and provide for the commercial increase of native and introduced plants for the conservation and improvement of soil, water, and related resources.

Standardized procedures have been developed and are being used for this comparative plant testing program. Evaluation data can be retrieved from an automated data processing system through standardized or user-designed reports.

Over 150 SCS-released varieties of conservation plants are available commercially for range, pasture, and other land improvement to reduce sediment movement and improve wildlife habitat. These improved plants can also solve other erosion problems, including the reclamation of surface mined land, roadside development and sand dune and shoreline stabilization. A number of new varieties for use in grassland plantings are now available.

## Acquisition, Storage, And Distribution Of Plant Germplasm

*Louis N. Bass, USDA Agricultural Research Service, Fort Collins, Colorado*

Plant germplasm in its broadest sense consists of all living species, subspecies, and their genetic variants. In recent years, interest in conservation of available plant germplasm for use in future plant breeding programs has increased steadily worldwide. Throughout the world, the major emphasis in germplasm conservation programs has centered around the most commonly used food, feed, fiber, and industrial crops of the country acquiring the germplasm. The best organized and most comprehensive system in the world for germplasm acquisition, multiplication, evaluation, storage and distribution is the one developed in the United States. Mr. Bass discusses each of these areas in detail.

The presentation's conclusion is: Acquisition, storage, and distribution of a broad base of genetically diverse plant germplasm is critical to future agricultural development worldwide.

To preserve the generic variability of germplasm collections, great care must be taken to apply storage and regeneration procedures that will maintain the genetic integrity of each accession.



Cryogenic storage and tissue culture could be valuable preservation methods in the future provided suitable procedures can be developed for individual species.

### Seed Laws, Certification And Testing For A Developing Native Seed Industry

*Rodger Danielson, Oregon State University, Corvallis, Oregon*

This paper reviews the areas of seed laws, seed certification and seed testing for the purpose of identifying needs of a developing shrub and forb seed industry. The current status of labeling requirements for seeds other than agricultural or vegetable seeds is explained. Recently developed tree seed certification programs are described. A progress report is made on developing seed testing rules for shrubs and for seeds.

### Commercial Seed Production And Sales Of Species For Revegetation

*Art Armbrust, Sharp Brothers Seed Company, Healy, Kansas*

This is a historical review addressing native species of grasses and forbs, beginning with the origins of the revegetation industry during the dust bowl era on the Great Plains. At that time plant materials were collected and established without consideration for species or ecotype adaptability or desirability.

Since that time the industry has developed techniques for the controlled production of some forbs and flowers, and continues to make advances daily. It is, however, still dependent on "wild land" harvests of several species of grasses and many of the shrub plants utilized in vegetation today.

Because of heavy government involvement, seeds for revegetation are sold in a different manner than are most other crop seeds. Today, much of the seed sold continues to be sold to agencies and industry on a bid or contract basis. Major changes are not seen in this approach.

### Seeding Rangelands With A Land Imprinter And Rangeland Drill In The Palouse Prairie And Sagebrush-Bunchgrass Zone

*M.R. Haferkamp, R.F. Miller, and F.A. Sneva, USDA Agricultural Research Service, Squaw Butte, Oregon*

The land imprinter developed by Robert M. Dixon, USDA-ARS, appears to be an effective implement for covering broadcast seed as well as producing micro-depressions in the soil that improve water infiltration. Results have been good in the southwestern United States, where much of the precipitation occurs as intense summer rains. In the northern sagebrush-bunchgrass zone, where over one-half of the precipitation falls as snow and spring rain and most seedings are fall planted, the rangeland drill has traditionally been used. Data comparing the imprinter versus the rangeland drill in the northwestern United States have been lacking. This study, initiated in 1982, compares the effectiveness of the land imprinter versus the rangeland drill for establishing Nordan crested wheatgrass (*Agropyron desertorum*) in the fall.

Imprinting for fall seeding did not improve seeding success in these studies. However, the practice produced stands comparable to drilling on loose seedbeds. The method may be a viable alternative to drilling on loose seedbeds produced by disking and other disturbances or where drill rows are viewed as aesthetically unappealing. Economic differences between seeding by the two techniques were not fully evaluated, but the water-filled land imprinter probably requires more horsepower than a comparably sized rangeland drill.

### Depth Of Interseeding Scalps Can Affect Growth Of Seeded Mountain Big Sagebrush

*Richard Stevens, Utah Division of Wildlife Resources, Ephraim, Utah*

One means of establishing desirable species into grass stands interseeding, which includes removing competitive vegetation from selected areas or spots and seeding in desirable species. Removal or reduction of vegetation allows for establishment of seeded species.

Studies including three types of scalpers and various species showed that the size differences in big sagebrush (*Artemisia tridentata* ssp *vaseyana*) plants became evident after 5 years. Height and crown of mountain big sagebrush plants varied with scalp depth within each row. The smallest

shrubs occurred in the deepest and most abundant part of each row. The largest plants occurred where the scalps were only one-to-two inches deep. Shrub size decreased as scalp depth increased. The largest seeded sagebrush plants were those established on top of the scalp berms. Moisture was not a limiting factor, but nitrogen may have been.

### Felxing Roller For Disk-Chains

*Harold T. Wiedemann, Texas Agricultural Experiment Station, Vernon, Texas*

The research disk-chain developed by the Texas Agricultural Experiment Station for the preparation of seedbeds on rangeland used 2-inch anchor chain, 24-inch disk blades, and was 24 feet wide. Research to determine the influence of operating mass on draft and soil penetration necessitated the use of two-and-one-half and three-inch chains. These larger chain sizes resulted in widths of up to 41 feet using the same number of disk-blades (20) as the original research unit. A flexing roller that would telescope to different widths was designed using a 20-inch diameter roller to overcome the breakage problem of the original 12-inch (pipe) roller. A ridged pipe brace with clevis connections was necessary between the flexing joint and the triangular tow plate for proper operation. The flexing joint was constructed from 1-inch plate and D-6 track carrier rollers. Preliminary pulling results indicate that the draft of the larger disk-chains will average between 250 and 500 pounds per blade. The new roller will allow extensive evaluation of different size disk-chains. This project has been funded in part by VREW.

### Plants For Western Colorado, Eastern Utah And Southwest Wyoming

*Sam Stranathan, Upper Colorado Environmental Plant Center, Meeker, Colorado*

Some new plants for agriculture are discussed.

The Forest Service Lab, headed by Dr. Durant McArthur, initiated some revolutionary concepts in fourwing saltbush selection and production with "Rincon" (*Atriplex canescens*). Rincon is a mixture of six separate female lines and four male lines. A proportionate number of males and females are used to establish new orchards.

In 1984, the Meeker Plant Center released a slender wheatgrass named "An Luis." This *Agropyron trachycaulum* is to be used primarily on disturbed sites at higher elevations. It was selected for its performance on high altitude sites associated with hard rock mining where it displayed longer than average span.

Based on good performance at some pretty tough planting sites a strongly spreading type of Louisiana sage (*Artemisia ludoviciana*) called "Summit" was selected for the first ecotype to be released.

The plant center at Meeker is growing the hottest new Crested wheatgrass since "Nordan." This *Agropyron desertorum*-*Agropyron cristatum* cross called "Hycrest" has a track record that is quite exciting.

### Recent Plant Releases For Western Wildlands

*Richard Stevens, Utah Division of Wildlife Resources, Ephraim, Utah, and Stephen B. Monson, USDA Forest Service, Provo, Utah*

Recently, some useful broadleaf herbs and shrubs have been released for range and wildland plantings. These items have been under study for 25 years and provide additional species useful for planting disturbed wildlands. This is an in-depth report of the features, uses, and areas of adaptation of three more recently released cultivars. More specific information on the three selections, "Hatch Winterfat" (*Ceratoides lanata*), "Cedar" Palmer Penstemon (*Penstemon palmeri* var. *palmeri*) and "Immigrant" Forage Kochia (*Kochia prostrata*) is available from any of the cooperative agencies involved in the release program.

### Seed Harvesters—An Evaluation Of Existing Machines And Projected Needs

*Stephen B. Monson, USDA Forest Service, Provo, Utah; Richard Stevens and Kent R. Jorgensen, Utah Division of Wildlife Resources, Ephraim, Utah*

Seed harvesters are needed that can be operated on wildland sites, cultivated fields, seed orchards, or nurseries. To date, most seeds have been hand collected from wildland stands. Seeds of many species can and are being grown in nurseries, yet costs remain high as mechanical harvesters are not available for seed collection.

Information presented in tabular form summarizes the features and operational capacity of the nine collectors that have been most widely tested. These include: truck-mounted, jeep-mounted, Mec Tighe backpack, DSI backpack, air-amplifier, Echo PB400 Blower, Solo Power Blower, Insect Collector, and Elephant-Vac.



In 1984, a survey was conducted to better determine the needs and type of seeds being harvested. In addition, it was determined which seeds are in demand but are not being supplied due to the lack of adequate seed harvesting equipment.

### Fourwing Saltbush Seed Harvester Development—Progress Report

**J.L. Halderson, University of Idaho, and C.G. Howard, USDA Soil Conservation Service, Aberdeen, Idaho**

During November 1984, seed harvesting trials were conducted near Bliss, Idaho, to evaluate three harvesting methods. Mature fourwing saltbush plants, with an abundance of mature seed, were found along the interstate highway right-of-way. These plants were the result of dry seeding of drillbox mixture of seeds in the early 1970's. The plants had considerable variation in seed maturity, were intergrown with weeds, and had considerable dead wood around the skirt of the plant. The site did not entirely represent orchard conditions, but provided useful preliminary information for development of a seed harvester.

While harvester experiments in fall 1984 gave beneficial information, they were not tested in a seed orchard, so direct comparability could not be done. Vacuums of any size appear to lack power at the nozzle for authoritative seed detachment. Shaker performance can definitely be improved, and it could be adequate as a replacement for hand harvesting. If shaker development can progress to a sufficient degree, it could lead to a self-propelled, over-the-row type harvester. Combines appear unsuited for direct-cut harvesting while leaves are still green and heavy. Windrowing or later direct-cut harvesting give promise of improve results since seed-straw separation would be facilitated.

### Reclamation Equipment And Techniques In Southwestern Wyoming

**Fred E. Parady III, Bridger Coal Company, Rock Springs, Wyoming**

Bridger Coal Company operates a surface coal mine 35 miles northeast of Rock Springs, Wyoming. Approximately 20,000 acres are under permit, with disturbance over the life of the mine projected to reach 10,000 acres. Located on the western rim of the Continental Divide, the mine receives less than 9 inches of precipitation annually. Soils in the area are coarse-textured, and problems associated with elevated salinity and sodicity are encountered.

A variety of common reclamation techniques have been modified to reflect these conditions. Soil horizons are segregated during salvage operations (the surface 6 inches as topsoil and the balance as subsoil). Unsuitable materials are not salvaged. Direct application of soil is used to maximize native plant regeneration and conserve soil fertility. Interseeding of seeding failures has proved to be significantly more successful than chisel plowing and reseeding. Broadcast seeding has been ineffective because of strong winds, and a no-till drill has been modified to handle diverse seed mixes and rock conditions. The utility of fertilization under typically xeric moisture regimes is being evaluated.

Many of the initial concerns over reclamation feasibility in a semiarid desert environment have been laid to rest. Improvements have occurred in soil management, shrub establishment, and farming operations. Reclamation has been successfully achieved in areas receiving less than 10 inches of precipitation.

### A Colorado Regulatory Perspective On Reclamation Of Lands Mined For Non-Coal Minerals

**Mark S. Loye, Colorado Mined Land Reclamation Division, Denver, Colorado**

The Colorado Mined Land Reclamation Act of 1976 established a statutory framework mandating reclamation of lands mined for non-coal minerals, while allowing for the continue development of mining in Colorado.

Emerging issues for the Minerals Program include the continuing growth in the number of active mines while staffing levels for the section remain essentially constant; the growing clash between increasing urban sprawl and mining; and the growing number of defaulting mine operators that results in the forfeiture of reclamation bonds by the Mined Land Reclamation Board. The division must make arrangements to reclaim those lands covered by the forfeited reclamation bond monies.

Despite the tasks to be accomplished, there are signs that the Mineral Program is succeeding in its mission of reclaiming all lands mined for non-coal minerals in Colorado. The eventual goal is for mining and reclamation to be integrated into one process.

### Western Reclamation Group Update

**Thomas A. Colbert, Intermountain Soils, Incorporated, Denver, Colorado**

The Western Reclamation Group (WRG) was formed by a small group of people at the VREW meetings in Tulsa in 1981. These people shared a common concern about problems with regulation of coal mine reclamation under what was then a still relatively new federal law called the Surface Mining Control and Reclamation Act of 1977.

Early accomplishments of WRG were the identification of current technological issues surrounding western coal reclamation and of shortcomings inherent in the new regulatory system that sometimes hindered attempts to find or use better methods in reclaiming mined lands. The effort culminated in a symposium in Denver in 1983. Copies are available of the proceedings.

At this time, four general areas of concern have been identified, and most WRG efforts will probably focus within these areas:

1. Determination of overburden quality;
2. Characterization and use of topsoil;
3. Plant species establishment; and
4. Reclamation success standards.

Interested VREW participants are encouraged to contribute by working on technical papers or serving on a committee.

### Terra-Torch

**Glen Secrist, USDI Bureau of Land Management, Boise, Idaho**

Field tests indicate that the Terra-Torch is an efficient and cost-effective device for use in fire management where access is limited or where particular burn patterns are desired. The 60-to-100 foot arc capability makes burning slash piles or log decks on steep roads possible. Fuels can be pretreated with the Alumagel, then ignited, producing 20-foot flame heights and generating heat of 2,000 degrees F. Two people can blackline an area that would require the efforts of a large crew. Conceivably, costs could be recovered in one or two missions.

### Mechanical Equipment For Brush Cutting And Slash Treatment

**Dan W. McKenzie, Range Scientist and Mechanical Engineer, USDA Forest Service, Equipment Development Center, San Dimas, California**

This article gives sources of mechanical brush cutting and slash equipment, and gives field equipment selection criteria for mechanical brush cutting and slash equipment.

Additionally, the Forest Service San Dimas Equipment Development Center has prepared an update to the 1978 publication on mechanical equipment for brush cutting and slash treatment entitled "Field Equipment For Precommercial Thinning And Slash Treatment." This update lists current information on mechanical brush cutting and slash treatment equipment.

The first section lists mechanical slash equipment and a second section gives criteria to consider when selecting heavy-duty equipment for brush cutting and slash treatment. The third section lists, in tabular form, one-line summaries of 75 field projects in which equipment described in the first section was used.

### Dry Herbicide Pellet Application

**Robert Gaylord, Elanco Products Company, Flagstaff, Arizona**

There is a continuing need for some type of ground equipment that can be used to broadcast pelleted herbicides at low rates (0.5-1.0 lb/ac) and still provide uniform distribution at reasonable cost. Advantages of aerial and ground application of pellets are given and, to illustrate the present state of equipment development, Gaylord reviews the Model F1 Forestry Pelleted Material Applicator from Omni Spray, Inc., Prattville, Alabama.

### Sheep Bridge On A Budget

**Paul J. Butler, USDA Forest Service, Twin Falls, Idaho**

In 1983, when it was determined the Rock Creek sheep bridge would have to be replaced, a conventional bridge design was selected using 36-foot steel bridge stringers and a center support. To hold down costs, best buys were sought on the two steel "I" beams that were 6 inches high, 4 inches wide, and weighted 16 pounds per foot, as well as the prefabricated steel parts such as lateral braces, center supports, bolts. The wooden decking, abutment material, and railing were obtained from salvaged materials. All materials were pressure-treated when new.



The new Rock Creek Sheep bridge cost \$2,323 compared to a prefabricated bridge which costs a minimum of \$5,100-to-\$6,000. The article gives explicit information.

## Fence Failures At Dog Legs And What To Do About Them

**Dan W. McKenzie, Range Scientist and Mechanical Engineer, USDA Forest Service, Equipment Development Center, San Dimas, California, and Bret Elsminger, KIWI Fence Systems, Inc., Waynesburg, Pennsylvania**

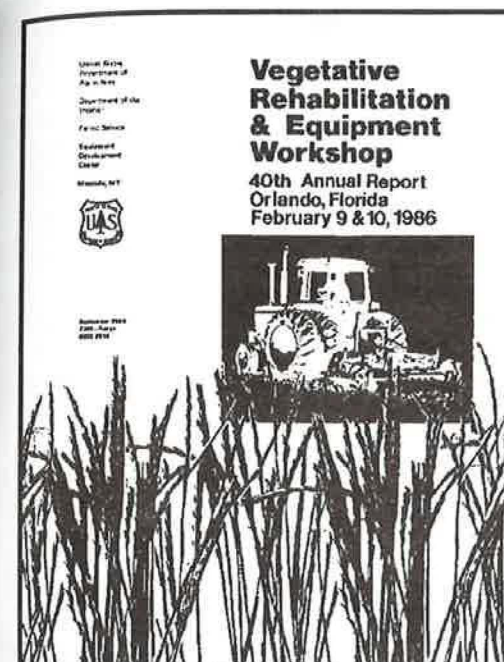
Standard barbed wire fence failures at dog legs are not as critical as with high-tensile smooth wire fencing, which requires the complete fence to be maintained at the proper tension to be effective.

Fence failures at dog legs are caused by the strainer length being less than critical length. The pull-out problem at dog legs can be eliminated by placing a diagonal strainer bisecting the dog leg angle with an actual length greater than the critical length. If the dog leg is 60 degrees or less, signed to Forest service Nationwide Forestry Applications Program, Houston, Texas

The Agricultural and Resources Inventory Surveys through Aerospace Remote Sensing (AgRISTARS) Program was initiated in 1980. The program goal is to determine the usefulness, cost, and extent to which aerospace remote sensing data can be integrated into existing and future USDA systems to improve the objectivity, reliability, timeliness, and adequacy of information required to carry out USDA missions.

One of the program's major efforts has been to improve the capability of using high-altitude photography for applications in resource management. These applications deal primarily with the use of color infrared (CIR) aerial photography.

The major emphasis in the Nationwide Forestry Applications (NFA) Program has been on applications for using high altitude photography (flown over 50,000 feet). High altitude photography is one approach that has been cost-effective not only for rangeland applications, but for other resource applications. Some of the elements that have the potential for being extracted through the interpretation of high-altitude aerial photography are: land cover, biomass, landform, vegetation, and condition (e.g. stress mortality), detection of springs and other areas for potential water development, mapping of manmade features, and monitoring change over time.



## Reclamation Status—Past, Present And Future

**Dr. David J. Robertson, Florida Institute of Phosphate Research, Bartow, Florida**

Phosphate mining in the Pebble District of central Florida began about 1880 and has had a history of almost continuous growth since then. Mining began with dredging operations in the Peace River, then moved on-shore to exploit the rich land pebble deposits. Land pebble was first mined hydraulically until the 1920's when electricity draglines supplanted high-pressure water. Since the turn of the century, central Florida has assumed world leadership in the production of phosphate rock. Land disruption has paralleled the rate of mining and has become increasingly visible.

Two additional developments contributed to reclamation problems, the introduction of hydroclones to separate clay-sized particles from sand-sized particles, and the universal adoption of flotation to recover sand-sized fine fraction of the phosphate matrix that had formerly been discarded.

There is an increasing interest in re-establishing native rangeland instead of improved pasture on reclaimed land. Other options to be examined for reclaimed lands include row-cropping, and establishing citrus groves and pine

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plantations. Wetlands, streams and lakes are being studied to determine the possibilities of rehabilitation.

## Phosphate Mine Reclamation—Laws, Regulations and Policy

**Jeremy A. Craft and James W. (Bud) Cates, Florida Department of Natural Resources, Tallahassee, Florida**

The phosphate industry is regulated by a variety of state, regional and local agencies in Florida. The Department of Natural Resources Bureau of Mine Reclamation is responsible for the review and regulation of all reclamation activities. The Department of Environmental Regulation regulates mining and, for mitigation purposes, the reclamation and restoration of wetland areas. The regional water management districts are beginning to implement regulation for the management and control of surface waters. They already regulate the consumptive use of groundwater. The regional planning councils, in conjunction with the local governments, review new mines and large expansions of existing mines through the development of regional impact programs. Local governments also require annual mining and reclamation approvals.

The Bureau of Mine Reclamation is divided into three sections. The mandatory section is responsible for the review of reclamation programs on those lands mined after



July 1, 1975. Lands mined since that date are subject to a mandatory requirement for reclamation. The mandatory rules address land use in much more limited and defined terms than under the non-mandatory program.

The non-mandatory section allocates a portion of the non-mandatory land reclamation trust fund each year to provide incentive grants to reimburse landowners for the reclamation of those lands mined previously to July 1, 1975.

The technical support section was recently created to study problems within the mining industry, such as clay consolidation, surface water, and groundwater hydrology, and to provide support to the other two sections in the evaluation and analysis of reclamation programs.

### Use Of Fire As A Tool To Manage Vegetation

**Bill Lennhouts, US Fish and Wildlife Service, Titusville, Florida**

The Merritt Island and St. Johns National Wildlife Refuge has been expanding its prescribed fire operations since the 1970's. Since that time, prescribed fire has expanded into a complex program involving over 50,000 acres and encompassing many vegetation types, some of which are fire adapted and some that are not. The objective of this report is to illustrate the response that different vegetation types have to fire and how this knowledge is used in management decisions.

The vegetation types of Merritt Island and St. Johns National Wildlife Refuge can be subdivided into those which have frequent fire intervals: flatwoods, grass marsh, palm savannah; those which have infrequent fire intervals: scrub, coastal strand, coastal dune; and those that are non-fire types: hammocks, swamp, ruderal. The report gives descriptions, summaries of the fire response and management options for each of the vegetation types.

### Wetland Grazing Management And Improvement On The National Forests In Florida

**William C. Bodie, USDA Forest Service, Tallahassee, Florida**

This report gives an overview of the wetlands situation on the National Forests in Florida, particularly as it applies to the program of range management. Bodie describes the general wetlands resource management situation in Florida as affected by laws and regulations, gives the National Forest perspective of its wetlands, and explains a few

resource management practices favorable to grazing on, or adjacent to wetlands.

Methods addressed include prescribed fires, site preparation for forest regeneration, and soil conditions.

### New Seed Drill

**Robert A. Teegarden, USDI Bureau of Land Management, Billings, Montana**

A new seed drill is in its later stages of development. BLM is testing two of the drills designed and built by the Truax Co., Inc. of Minneapolis.

The machine can be generally described as a nine-tooth, heavy-duty chisel plow with the chisels placed on 10 inch centers. Mounted on each chisel shank are 4.5 inch spades. This gives 40 to 50 percent soil disturbance. Approximately one-half of the disturbed soil is thrown over the undisturbed sod strip. The seed drop tubes and the packer wheels are in line with the chisel shovels. This allows the seed to be dropped in the furrow and the packer wheel to then press the seed into the soil.

### Coated Seed As A Tool For Revegetation

**Stu Barclay, CelPril Industries, Incorporated, Hermiston, Oregon**

Coated seed provides a useful tool to the revegetation manager. It allows creative seeding and can achieve results that can be accomplished in no other way. It offers a medium for any number of materials to be included in, and carried with the seed, to increase the odds for its survival and vigor.

CelPril has ongoing testing programs with state departments of transportation, Forest Service, Bureau of Land Management, and seeding contractors (USDA). Results are still pending.

### Disk-Chain Performance

**Harold T. Wiedemann, Texas Agricultural Experiment Station, Vernon, Texas**

Studies have been conducted to project the optimum size disk-chain for use on native (undisturbed) rangeland infected with shrubs. Six disk-chains with two different disk blade diameters were used to evaluate the effect of mass on draft and depth of disk penetration. Operation widths were also varied. The disk-chain with 3-inch chain and 24-inch disk

blades (204 pounds per blade operating mass) had the best overall performance based on the broad range of soil conditions encountered in this study.

### Establishment Of Range Grasses On Various Seedbeds At Four Creosotebush Sites In Chihuahua, Mexico, and Arizona, USA

**M.H. Martin and F.A. Ibarro, Centro de Investigaciones Pecuarias del Estado de Sonora, Hermosillo, Sonora, Mexico; J.R. Cox and H.L. Morton, Agricultural Research Service, Tucson, Arizona**

Three creosote bush study sites were selected in northern Mexico and one in southeastern Arizona. Treatments included mechanical, chemical, and untreated check. Seven varieties of grasses were hand broadcast and seeded.

Successful plantings were obtained in Arizona in both 1981 and 1982, and at the site in Mexico in 1981. Plantings were unsuccessful in Mexico in 1982 because of extremely low rainfall.

In 1981 seedling establishment and forage production at the four sites were superior on disk-plowed and disk-plowed and contour furrowed seedbeds, intermediate on chemical seedbeds and least on two-way railed and land imprinted seedbeds. Kleingrass and sideoats grama were most abundant at sites that received summer precipitation, while Catalina and Cochise lovegrasses were most abundant at sites that received both summer and winter precipitation. Because of very dry conditions in 1982 and 1983, most of the species planted in two Mexican sites died. Plant establishment was greater when seeds were broadcast on the surface of mechanically prepared seedbeds.

### The Use of Fire, Grazing Livestock, Insecticides, And Plant Gerplasm To Control Spittlebug In Buffelgrass Pastures Of Northern Mexico

**I. Cazares, M.H. Martin and F.A. Ibarra, Centro de Investigaciones Pecuarias, del Estado de Sonora, Hermosillo, Sonora, Mexico; and J.A. Morales Instituto Tecnológico y de Estudios Superiores de Monterrey, Monterrey, Nuevo Leon, Mexico; and H.L. Morton and J.R. Cox, Agricultural Research Service, Tucson, Arizona**

Buffelgrass (*Cenchrus ciliaris*), a perennial bunchgrass, was introduced into Sonora, Mexico from the United States in 1954. Spittlebug (*Aeneolamia albofasciata*) feeds on

buffelgrass and its populations have dramatically increased in Sonora as a result of above average precipitation. Feeding spittlebugs can significantly reduce the quality and quantity of buffelgrass forage and may, in some instances, kill plants.

The following studies were initiated in 1984-85 to determine their effects on the spittlebug populations and the productivity of buffelgrass: application of fire, grazing management, application of insecticides and development of buffelgrass accessions resistant to spittlebug.

Preliminary results indicate that:

1. Burning before the rainy season or in the early stages of the spittlebug life cycle has caused the most damage to both eggs and nymphs;
2. A rotation grazing system that removed about 60 percent of the biomass during the summer growing season has destroyed the environmental conditions required for the spittlebug development;
3. Early application of insecticides between the first and fourth instar stages are more effective than application in the adult stages; and
4. One or two accessions that are easily established will be selected later to determine if they are more resistant to spittlebug feeding and reproduction than common buffelgrass in Sonora.

### Chemical And Mechanical Brush Control And The Response Of Native Grasses In The Chihuahuan And Sonoran Desert

**F.A. Ibarra and M.H. Martin, Centro de Investigaciones Pecuarias del Estado de Sonora, Hermosillo, Sonora, Mexico; and H.L. Morton and J.R. Cox, Agricultural Research Center, Tucson, Arizona**

Creosotebush (*Larrea tridentata*), either alone or in combination with other shrubs, infests from 18 to 26 million hectares in the southeastern United States and 45 million hectares in northern Mexico. Chemical and mechanical treatments were applied during the summer of 1981 and 1982 at three field sites in Chihuahua and one in Arizona. Treatments were evaluated for creosotebush mortality and forage production for three growing seasons after treatment.

Data obtained for both brush mortality and forage production were varied within locations, between locations and years of application due to different soils, vegetation and climate. Creosotebush infested rangelands in the southwestern



United States and northern Mexico can be converted back to productive semi-desert with chemical and mechanical practices.

### Mechanical Plant Control

**Gus Juarez, USDI Bureau of Land Management, Grand Junction, Colorado**

The Beckwourth and Quincy Ranger Districts of Blairsden and Quincy, California on the Plumas National Forest operated a Madge Rotoclear land breaking machine under contract this last summer. The machine was pulled by a Caterpillar D-6 tractor. Operating speed was just over one mile per hour, which resulted in a production rate of one-half to three-fourths of an acre per hour. The unit was able to operate in ground containing a fair amount of rocks surprisingly well.

Problems with the machine were: the great amount of dust; loss of teeth; and the machine operator's lack of preventative maintenance before being placed into operation. After a heavy rain the dust problem did not exist. A US contractor is operating three of the units, and cost of operation, depending on location and size of job ranges from \$100 to \$200 per hour, or \$100 to \$175 per acre.

### Avery Stroke-Control Device For Windmills

**Robert G. Childress, USDA Forest Service, Hot Springs, South Dakota**

An ingenious device that increases the capability of a windmill to pump water has been invented by Don Avery, Professor Emeritus of Mechanical Engineering, University of Hawaii. It automatically controls the length of a windmill's stroke to increase the amount of water pumped when windspeed increases. The device uses the additional power of increased windspeed to change the length of the windmill stroke, increasing the amount of water pumped to about four times that of a conventional windmill under the same amount of wind.

A prototype made by Dempster Industries of Beatrice, Nebraska, produced about 17 gallons per minute in a 15 mph wind, versus four gallons per minute without the device. The stroke varied from 2 to 16 inches with the unit.

It should be possible to install a commercially manufactured kit for considerably less than \$1,000.

### Diagonal Fence Strainer Use And Other Fence Developments

**Dan W. McKenzie, Range Scientist and Mechanical Engineer, USDA Forest Service, Equipment, Development Center, San Dimas, California**

The diagonal fence strainer, which is equal in strength and holding force to the horizontal fence strainer but is lower in cost to install is gaining in use. When using the diagonal fence strainer two important rules should be followed:

1. Be sure that the end of the diagonal brace in contact with the ground is free to move forward and is not blocked by a stake or post; and,
2. Make the diagonal brace as long as possible (at least 8 feet; 10 feet is better, and if possible, go 12 feet). This rule applies to the horizontal strainer also.

Good use can be made of the diagonal strainer to prevent failures at dog legs by placing the strainer so that it bisects the dog leg angle.

The need for double horizontal and diagonal strainers appears to be unnecessary if soundly constructed 10 to 14 feet long, thus eliminating their added cost.

A design of line strainer that allows a significant reduction in the amount of construction labor and material is the tension member line strainer. It requires only one post hole to be dug, and the use of only one post; the bottoms of the next posts are used to anchor the tension members.

Recently the Aligned Fiber Composites Co. of South Chatfield, Minnesota, completed the development of a fencing system using fiberglass posts and specially designed hardware. A very good installation manual can be obtained upon request.

Volumes include: "Handling, Sheltering, and Trailing Livestock"; "Fences"; "Water-Pumping and Piping"; and "Water-Damming and Storing."

### Vegetative Rehabilitation & Equipment Workshop

41st Annual Report  
Boise, Idaho  
February 8 & 9, 1987



## 1987 Vegetative Rehabilitation & Equipment Workshop 41st Annual Report

### Low-Volume Irrigation Pumping With Wind Power

**R. Nolan Clark, Agricultural Engineer, Southern Plains Area Conservation and Production Research Laboratory, USDA Agricultural Research Service, Bushland, Texas**

Water-lifting windmills may serve as an alternative to engine-driven pumps for low-volume irrigation systems. A recent research approach to improving the over-all efficiency of the American windmill is the variable stroke mechanisms.

A comprehensive laboratory and field study on the American multi-bladed windmill has been started November 1986 by the Agricultural Research Service at the USDA Conservation and Production Research Laboratory, Bushland, Texas with the following objectives:

1. To develop pumping and efficiency curves of the conventional windmill under different windspeeds and loads;
2. To test different variable stroke mechanisms in an effort to improve over-all efficiency and to increase total volume of pumped water;

3. To model the windmill performance and study the feasibility and cost effectiveness of the improved units; and
4. To evaluate the potential of pumping water for low-volume irrigation systems, particularly drip systems.

### Range Structural Improvement Handbooks

**Richard J. Karsky, Agricultural Engineer, USDA Forest Service, Equipment Development Center, Missoula, Montana**

As part of the continuing effort to provide information to land managers about suitable revegetation techniques and equipment, the Vegetative Rehabilitation and Equipment Workshop has consolidated structural improvement handbooks, now scattered through several federal agencies, into four volumes. Each volume describes a facility's components, uses, advantages and disadvantages. It presents information on costs, safety, and environmental concerns and construction features. Where applicable, suggestions for redesign or new concepts for future development are included. Pertinent books and articles are cited.



## Common Sense Fencing

**Billy H. Hardman, Range Implementation and Special Programs, USDA Forest Service, Region 1, Missoula, Montana**

New design and materials have made possible a concept in fencing that out-performs barbed wire and woven wire by a factor of at least four-to-one in all areas of animal control, maintenance, effective product life, installation requirements and cost. The Common Sense Fence (TM) is the first permanent, multiple wire, long distance electric fence capable of providing 20 to 30 years of reliable, low-maintenance service.

Four major advancements have been designed for this fencing system. They are:

1. A complete fiberglass self-insulating wire support system;
2. Latest solid-state electric technology controller;
3. Heavily galvanized 12.5 gauge high-tensile wire; and
4. Free-flowing spring-clip for attaching wire to posts.

## Fence Developments

**Dan W. McKenzie, Range Scientist and Mechanical Engineer, USDA Forest Service, Equipment Development Center, San Dimas, California**

Two new fence developments affect dog containment and double fence braces.

The Invisible Fence Company of Wayne, Pennsylvania, markets a fencing system that is not visible and is designed to contain dogs within a given area. Elements of the system include a thin wire buried in the ground, a small radio transmitter, a lightweight leather dog collar and a conditioning or training program for the dog.

In constructing either a diagonal or horizontal fence brace, calculations indicate that a single brace 11 feet long (5.5 times average wire height) or longer is as strong or stronger than a double brace with two 8-foot panels. These calculations indicate that the need for double fence braces is unnecessary and their added cost is not justified provided that the members of a single brace are strong enough to carry the applied loading.

## Portable Data Collection Field Terminals: Selecting The Best One For Your Needs

**Meg Frantz, Applications Engineer, Omnidata International, Incorporated, Logan, Utah**

Electronic recording devices remove the difficulties encountered with traditional methods of collecting data in the field. The portable models, when housed in suitably rugged cases, can withstand the rigors of the outdoors. Since the data is recorded in digital form, it can be transferred directly to computer through a cable. This capability means that no one has to digitize from charts or keypunch from field sheets, which results not only in savings of time, but also increased data quality.

## Mechanical Control

**Mark Mosely, Range Conservationist, USDA Soil Conservation Service, San Angelo, Texas**

Texas offers a stage for using a variety of mechanical brush control practices. Different brush that requires different methods of control occurs on each major land resource area of Texas. The most important consideration for planning brush control is the desired objective. The needs of wildlife, kinds of livestock to be run, production goals, future land values and financial resources influence the managers decision.

Explored are: rootplowing, treedoing, chaining, rollerchopping, shredding, low-energy grubbing, and treatment, carpet rolling, and disk-chaining.

## Chemical Control

**Pete W. Jacoby, Professor, Texas Agricultural Experiment Station, Vernon, Texas**

Despite many restrictions limiting their use, herbicides remain a key method of controlling unwanted plants in range and pastureland.

Herbicides are popular with landowners because they are cost effective, quickly applied, selective in the plants controlled and non-disturbing to the soil surface. The purpose of this presentation is to discuss the more prevalent herbicides available for rangeland use and their status and attributes.

## Seeding Chaffy Grass Seed And Grass Seed Mixtures

**Harold T. Wiedemann, Texas Agricultural Experiment Station, Vernon, Texas**

A chaffy grass seed metering device developed by the Texas Agricultural Experiment Station has largely overcome the severe dispensing problems associated with these grasses. The semi-circular seedbox, auger agitator and pickerwheel metering system has easily metered 97 percent of seed from the seedbox at relatively uniform, predictable rates for seven notoriously hard-to-seed grasses. To seed mixtures with both chaffy and slickseeded grasses, two separate seedboxes and metering systems are required.

## How To Provide Range Improvement Information To Users

**John Vallentine, Utah Division of Wildlife Resources, Great Basin Experiment Station, Ephraim, Utah**

A general list of available information concerning special treatments, structures, and developments for rangeland that needs to be presented to range technicians, ranchers, public land managers and administrators, agribusiness personnel, service/support, educators, and students. Suggested continuing and future activities are given for VREW.

## Equipment Development Needs

**Harold T. Wiedemann, Texas Agricultural Experiment Station, Vernon, Texas**

Much of the equipment developed for range improvement on federal lands, and more especially equipment design project, were undertaken with little regard to economics. Consequently, range improvement practices were gradually de-emphasized, especially during the high inflation period of the 1970's and the cost accounting emphasis of the 1980's. As a judgmental factor, we must ask ourselves, "How much of the equipment designed by VREW has ultimately been utilized by the private sector?"

The key to VREW's survival is innovative approaches. These include development of both equipment and techniques for effective rangeland improvements. Short-term action may necessitate publication of current technology, but long-term stability will require new technology. Many new demands will be placed on federal lands by the public and cost accounting will be ever present; however, this will open many new opportunities. We should be considering challenging new alternatives for future rangeland improvements from a wholistic viewpoint.

## Develop And Test Disk-Chain Implement

**Harold T. Wiedemann, Texas Agricultural Experiment Station, Vernon, Texas**

The objectives of this study were:

- 1.(a) To compare the disk-chain draft requirements of the triangular and diagonal pulling techniques;
- (b) To improve the design of the triangular systems;
2. Determine the draft requirements and depth of cut of six disk-chains of different operating masses in disturbed rangeland soil and undisturbed, native rangeland of clay loam and sandy loam types.

The angle of pull selected as optimum for the triangular pulling technique was 60 degrees with a flexing joint centrally located in the rolling brace to allow necessary vertical movement on rough land surfaces.

Draft per blade was significantly different for each disk-chain and was positively correlated to operating mass per blade for each soil condition. Based on the broad range of soil strengths encountered in this study, the disk-chain with 3 inch chain and 24 inch disk blades would give the best overall performance. Expected depth of operation of a broad range of conditions can be predicted most accurately by equation.

## A Progress Report On The Disk-Chain For Revegetating Rangeland

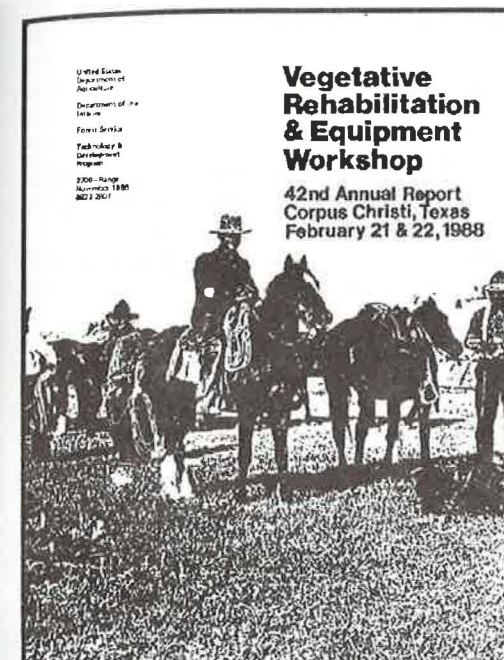
**Robert Knudson, USDA Forest Service, Equipment Development Center, Missoula, Montana**

The Missoula Equipment and Development Center (MEDC) began evaluating a disk-chain in 1984. The same year a contract was awarded to the Texas A&M Experiment Station to continue development on the disk-chain.

Knudson's report traces steps in development of a disk-chain device built by MEDC, tested by Intermountain Station in Utah, Nevada, and Idaho, and subsequently modified by MEDC. The implement was further tested for greenstripping in southern Idaho. Disk breakage and weld breakage were continual at this point.

In FY 1987 BLM Boise district funded MEDC to build a different disk-chain. The Boise District shop is building the implement, and delivery is expected in October 1987.





## 1988 Vegetative Rehabilitation And Equipment Workshop 42nd Annual Report

Corpus Christi, Texas

### Range Research In Texas

**Joseph L. Schuster, Professor, Head of Department of Range Science, Texas A&M University, College Station, Texas**

The goal of the Texas A&M University's range management program is to generate basic biological information and management practices useful in rangeland production systems.

Long-term management research objectives are:

1. Develop technologies that will increase production efficiency, reduce risk, and conserve the range resource;
2. Effectively integrate range management systems into operation objectives of the ranch firm; and
3. Develop practical, ecologically sound, and economically viable management alternatives for major range production areas of the state.

The strategic planning process used by the Texas Agricultural Experiment Station calls for development of prioritized research needs utilizing producer, extension, and

other service agency inputs. The current research plan identifies the following major needs in range research:

1. Develop technologies for improving range plants and communities;
2. Develop flexible strategies for multiple use of rangeland resources;
3. Improve water conservation and erosion control on rangeland watershed;
4. Manage brush, weed and toxic plants on rangeland;
5. Develop technologies for optimizing livestock and wildlife production on rangeland; and
6. Develop improved methodology for resource classification and inventory.

The research approach adopted to meet these needs utilizes:

1. A systems approach to rangeland management;
2. Insures integration of range management systems into operational objectives and capabilities of the ranch firm; and



3. Includes all products and uses of the range in an interdisciplinary effort.

Information generated by the research teams is filtered through economic analyses to isolate economically sensitive variables and identify economically viable technologies. Viable alternatives emerging from this process are made available to ranch owners and managers in the context of new technology and management decision aids.

### Garrison Seed & Company, Incorporated

**Art Stoy, Sales Representative, Garrison Seed & Company, Incorporated, Hereford, Texas**

Mr. Stoy gives an overview of the seed business and discusses present seed supplies to the CRP programs.

In the past two or three years, there have been plantings of grasses with the sole purpose of producing seed for the CRP programs. In addition to the native and domestic harvests of 1986-87, there was quite a stockpile of certain grass seeds that had accumulated in the several years preceding the advent of the CRP program. As a result of this stock pile and a good many lean agricultural years (economically), the grass seed prices were extremely low, selling at or below cost in many instances. But with the sudden demands on the industry, this soon changed and the prices sky-rocketed with the demand. Also in the confusion of getting supplies together, many new names and faces began to show up in the seed business. These people added greatly to the supply of seed, but also to the confusion.

According to the author, two factors are involved with those who have recently entered the seed business. First of all, the demand by the CRP for seed is great, creating a supply and demand that has temporarily escalated prices to a very high level. These newcomers to the business have helped to make it even higher. Secondly, the agencies involved in seed law enforcement have not been able to keep pace with the increase in demand for their services. As a result, it is doubtful that many of these new people in the industry have been subject to any amount of policing, if any at all. This creates an unfair seed law enforcement situation in the author's opinion and he feels something needs to be done to provide fairer enforcement of the seed laws, both federal and state. The author feels everyone involved in the process of accumulating and marketing of seed for the CRP (or any other program) should have to operate under the same set of rules.

### Impact Of CRP On The Seed Industry

**Art Armbrust, Representative, Sharp Brothers Seed Company, Healy, Kansas**

The impact of the CRP program on the seed industry is very significant. It has had a dramatic impact on the grass seed industry in particular. The program has increased the demand for perennial grass, both warm and cool season, native and introduced, dramatically.

With no more than 6 months lead time, this program would have had a significant impact on animal crop seed supplies, but the demand has been for perennials and it takes the seed industry a minimum of two years to respond to an increase in demand of this magnitude.

There are several reasons that the seed industry is not in a position to handle these large demand increases. The grass seed industry tries to produce for market demand, and over the past 10 years there were no economic incentives to increase production. Other reasons for the response were that it is a politically conceived program and industry learned long ago not to react until it sees something concrete and properly funded. The industry also received poor "reads" from the early sign-up. Government employees and people in charge of programs could certainly stabilize their specifications so that we know how to respond.

Another factor for the early confusion on the part of the industry was that species and variety requirements and amounts were unknown. Continued funding of the program was uncertain. If people who develop these programs could study them out a bit, be specific on specifications and requirements, and develop dependable funding, you would not see the sharp price fluctuations currently happening.

### New Caterpillar Tillage Tractor Combines Features Of Wheels And Tracks

**Bill Reno, Sales Representative, Caterpillar Incorporated, Peoria, Illinois**

Caterpillar, Inc. recently introduced the Challenger 65, a 270 gross horsepower all-purpose farm tractor with a unique traction system.

The Challenger 65 combines the speed and mobility of wheels with the improved traction and flotation of tracks. The machine rides on flexible rubber belts, reinforced with continuous strands of steel cable bonded into the rubber. Rubber lugs on each belt provide higher traction than tires on comparable four-wheel drive tractors.

The traction system spreads the tractor's weight over more area, so it compacts less. At the same time, the broad, rubber belt surface gives better traction than wheels, slipping less. The Challenger's ride is comparable to a wheel tractor due to the bogie-type suspension. Power to the tracks is never interrupted, allowing the operator to maintain complete control for smooth, even turning.

The field-proven direct injection engine is turbo-charged and after-cooled. The Challenger comes with a full power shift planetary direct drive transmission with a single lever shift.

Shifting is done in a straight-line pattern, and can be done on-the-go, without clutching, to meet changing load and speed conditions without losing tractor momentum.

The tractor also has load-sensing hydraulics that reduce strain on engine power when implements aren't being raised or lowered.

### Sourcing Seed For CRP: Panel Discussion

**Vendall R. Oaks, USDA Soil Conservation Service, Los Lunas, New Mexico**

One of the most important impacts on plant materials the past 2 years and potential for years to come is USDA's Conservation Resource Program (CRP). The goal of CRP is to remove from production for 10 years highly erodible cropland and re-establish these areas to permanent cover.

Charts are given showing the statutes of the CRP program through the six sign-ups on February 19, 1988.

After introductory remarks, the panelists answered questions. A synopsis of answers addressed the following areas: carrying out and sustaining a quality and affordable seed program given the crisis atmosphere today; imposing more stringent regulations concerning seed quality; cultivated production of improve plant materials versus native harvest; long and short term impacts of CRP on the availability of certified seed; guaranteeing seed availability to established seed buyers, and expected changes in seed availability, seed prices and seed quality as we move into the later stages of CRP.

### Benavides Ranch-Range Improvement In Mexico

**Trinidad Benavides, Rancher, Nuevo Laredo, Tamaulipas, Mexico**

Current Mexican ranchers began working their ranches with cow-calf operations and a continuous grazing system. The resultant loss of grasses, forbs and bushes year-by-year to undesirable weeds and brush drastically lowered carrying capacity for beef-cattle.

A vegetative rehabilitation program was begun using the best introduced grass species. An important goal was to look for the best grasses adapted to the region.

Common buffel was established which resulted in increased carrying capacity for cattle at an important rate, but destroyed a wildlife habitat. For total management of the ranches, the best alternative was felt to be multiple-use of the forage resources to reach optimum carrying capacity for both cattle and wildlife.

A cell grazing system was started. Additionally, a rootplow was used to sow strips of rangeland to benefit both cattle and wildlife. The grazing system rehabilitates and fortifies the most nutritious and palatable grasses, forbs, weeds and brush by using the cattle as the best tool to prune desirable species in certain parts of the ranch and allows the same cattle and wildlife to seed the desirable plants over the whole ranch.

The cattle men of Mexico feel that a most important step for Mexico was achieved on May 26, 1987, when the National Cattlemen Confederation instituted an association for the management, conservation and profit of wildlife, which will begin the process of repopulating wildlife all over the country.

### Greenstripping: A Proposal To Reduce Wildfires In Southern Idaho

**Mike Pellant, USDI Bureau of Land Management, Idaho State Office, Boise, Idaho**

Idaho BLM has initiated a fire pre-suppression program, greenstripping, to reduce the increasing economic and resource losses caused by wildfires. Strips of fire-resistant vegetation are placed at strategic locations to reduce the size and frequency of wildfires.

Greenstrips will slow down the spread of or stop wildfires before they reach catastrophic size. Plant materials used in



greenstrips retard the spread of wildfires because the strips stay green longer than annual vegetation and reduce the amount of fine fuels (annual species).

This report summarizes projects completed to date and methodologies, equipment and plants used. There are many unknowns in this effort. Only a small number of the potentially useful plant materials have been utilized in greenstrips. Equipment modifications and development could improve greenstrip establishment.

Idaho BLM is proposing a cooperative five-year research and development project called the "Intermountain Greenstripping Research Project" to develop greenstripping and shrub restoration practices.

### Seeding Using The Disk-Chain And Forage Nurse Crops

**B.T. Cross, Texas Agricultural Experiment Station, Vernon, Texas**

Successful establishment of stands of perennial grasses on semi-arid rootplowed rangeland following aerial seeding is difficult because of the effect of erratic rainfall patterns. It was hypothesized that the detrimental effects of limited rainfall events could be buffered by seeding into a cool season cover crop (wheat) during grazing season. Our underlying hypothesis was that the cover crop, in combination with the trampling effect of cattle, would enhance seedling establishment of the aerially seeded perennial grasses by firming the seedbed and improving the seed/soil interface. Disk-chaining has been a feasible method for seedbed preparation on log littered rangeland.

Tests using various disk-chaining and aerial seeding combinations achieved good to excellent stands of wheat (>2plts/ft<sup>2</sup>) on debris-littered land. Hulled WW Spar bluestem, a warm season grass, was aerially seeded (0.5 or 1 lb PLS/ac) into grazed stands of wheat. Study results indicate the concept is feasible.

### The Impact Of The Conservation Reserve Program On The Farm Equipment Industry

**John M. Tye, The Type Company, Lockney, Texas**

The impact of CRP varies by area. In the Northeast and in the far Southwest, CRP has had very little impact on farm equipment. Areas where there has been minor impact on the farm equipment industry include the Pacific Northwest, generally the Southeast and in the corn and soybean belt of the Midwest. The area of greatest impact has been an area we might loosely refer to as the plains states. In these areas

the first sign-ups have taken large volumes of acreage out of production and generated tremendous short-term interest for seed, planting equipment and some operational knowhow.

The impact of CRP will be not only one of requiring new equipment to produce seed, plant the CRP acreage, and care for it, but also a dramatic reduction in the need for equipment when this land goes out of crop production, perhaps forever.

In the short term there has been a demand for cutters, shredders, mowers sprayers, and seed harvesting equipment. There has also been an increased interest in drills for planting.

Long-term, the equipment business is still facing a number of question marks. We know that 40 million acres removed from production will make a significant dent in the need for equipment to farm that acreage. Many of these CRP acres will remain in grass after the program ends, which may mean more cattle-related equipment.

### Chaparrosa Ranch-Range Improvements In South Texas

**Patrick O. Reardon, Chaparrosa Ranch, LaPryor, Texas**

Approximately 10,000 acres of the Chaparrosa Ranch in the northern part of south Texas have been cleared and reseeded to Buffel, Kleberg Bluestem, Kleingrass, and other introduced species during the past 30 years. Nearly every conceivable range improvement method has been tried and during the years much has been learned.

Ranch managers have learned that range improvement is not cheap. It is a never-ending battle and it should be followed by good grazing management. Since there are many more dry than wet years in south Texas, range improvements should be done as a means of surviving drought rather than increasing stocking rate. Range improvements can and must be designed to improve wildlife habitat, hunter success and ranch income.

Based on 30 years of trials, the rootplow has proven to be the best brush-clearing tool and the carpet roller is the best treatment tool. Land cleared and developed for cattle or deer habitat improvement is done in alternating, long, narrow strips to create more "edges". Land developed to be quail habitat is treated with a roller-chopper that leaves areas of selected brush plants 10-to-30 feet in diameter. Both of these methods have proven to be best in improving the habitat and increasing hunter success, which in turn increases ranch profits.

### USDA Conservation Reserve Program

**Wendall R. Oaks, USDA Soil Conservation Service, Los Lunas, New Mexico**

VREW has for many years, to help fulfill its mission, sponsored special workshops in conjunction with the main VREW program. In February, 1987, one such workshop titled "Plant Materials Workshop—The Influence of CRP On The Range" was held. (Agenda given.)

One of the most important impacts on plant materials began last year following the passage of the Food Security Act of 1985, which authorized the USDA's Conservation Reserve Program (CRPP). The goal of CRP is to remove from production for 10 years highly erodible cropland and reestablish areas to a permanent cover of grass, forbs, shrubs, or trees.

No program in over a decade promises to have such a widespread effect on plant materials and range programs.

### Conservation Reserve Program (CRP)

**Jim Meuman, USDA Soil Conservation Service, Washington, DC**

Responding to the Secretary's request to have CRP operational within 60 days of being signed into existence, a joint Department of Agriculture training session was conducted during February 1986. CRP interim rules were published in March, and the first three sign-ups were conducted in March, May, and August of that year.

The net cost of the CRP depends on many variables including the market price of commodities, program participation, and level of production. Considering both the direct and indirect commodity program savings, the CRP is approaching a no net cost status.

The final CRP rules are expected to be published in early 1987. A major rule change being considered is a change in the definition of highly erodible cropland to make it consistent with that being used for implementing the conservation compliance provision of the Act.

Accompanying charts show the status of the CRP in each state and SCS National Technical Center for the end of fiscal year 1986.

### New Plant Materials For Conservation Reserve

**Jack R. Carlson, Regional Plant Materials Specialist, USDA Soil Conservation Service, Portland, Oregon**

Cropland retirement programs have stimulated the development of grassland seed industry over the past 60 years. Today, landowners have a wide variety of grass, legume, and shrub species and cultivars to fit their particular needs. Accompanying is a list of plant materials available for grassland plantings for major Conservation Reserve areas.

### The Type Paratill

**A.O. Smith, Representative, The Type Company, Lockney, Texas**

The Paratill, a soil loosener manufactured by the Type Company, utilizes uniquely designed and patented legs. The Paratill is furnished with spring swivel coulters in front of each leg that cut through trash and residue.

Compacted soil flows over the angled leg and is lifted, bent, and fractured. No mixing of subsoil and topsoil occurs; no clods are brought to the surface; and surface residue remains undisturbed to prevent erosion. Paratilled ground will stimulate root development and improve water infiltration/absorption. Deep fertilizer placement can also be achieved with the loosener.

### Evaluation Of Effectiveness Of Pneumatically Seeding Slopes For Erosion Control

**John Haynes, Landscape Architect, Transportation Erosion Specialist, Erosion Control and Geotextiles Unit and Thomas P. Hoover, P.E., St. Materials and Research Engineer, Erosion Control and Geotextiles Unit, State of California, Business, Transportation and Housing Agency, Sacramento, California**

This research project was to evaluate new equipment that allows seed to be applied to slopes pneumatically. This equipment may also provide an alternative for seeding and fertilizing small areas without hydromulch.

The equipment is called a Ferti-Blast gun and is manufactured by Chowning Regulator Corporation of Corning, New York.



The Ferti-Blast gun has very good potential application in Caltrans. It will be of limited use in applying lightweight grass seed because of the short distances the seed is blown. The gun could also be used in situations where dry-applied legume seed is specified. When pneumatically applied, the seed must still be covered with mulch.

The optimum use of the Ferti-Blast gun is for refertilization of erosion control or landscaped areas. Many times the original erosion control treatments applied are satisfactory for only a few years. They decline as the fertilizer is utilized. Except for the gun itself, maintenance has all the required equipment to apply fertilizer. With the use of the Ferti-Blast, many acres could be fertilized in a very short period of time.

### Goats, Their Control And Use As A Biological Agent Against Leafy Spurge

*Vincent T. McElliott, Student, Montana State University, Charles N. Sundt, USDA Forest Service, Gallatin National Forest; Pete F. Kay, Professor, Weed and Plant Soil Science, Montana State University; and Kris Harstead, Professor, Range Management, Montana State University*

Leafy Spurge (*Euphorbia esula*) currently infests more than one million hectares in North America. While goats utilize leafy spurge, they are difficult and expensive to contain. The effectiveness of electric shock collars for containment of goats was tested. The degree of use and preference of leafy spurge by goats was tested in plots consisting of brush, grass and various forb species. Goats did effectively utilize leafy spurge, but their use as a control agent is questionable. The use of radio collars was proved to be effective in containing the goats.

### New Resource Tools And Equipment

*Richard Hallman, Resource Planner and Range Program Leader, USDA Forest Service, Technology and Development Center, Missoula, Montana*

A variety of new tools designed to make reforestation tasks more efficient and economical have recently been developed by Missoula Technology and Development Center (MTDC) engineers. The improvements are part of the continuing cooperative effort to help resource managers solve problems inherent in wildland reforestation.

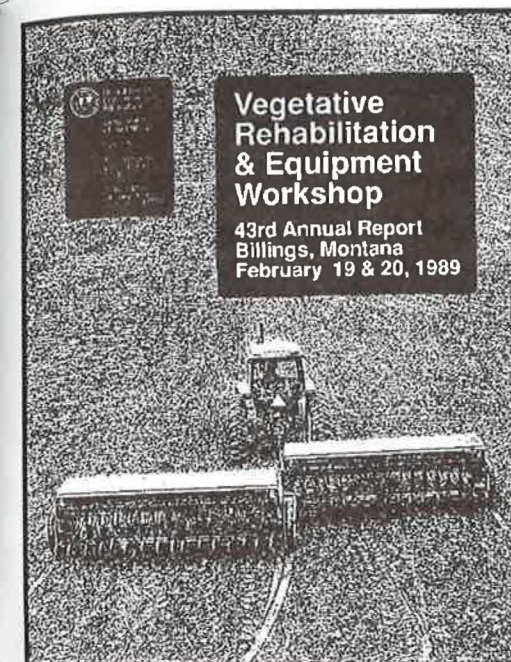
The Salmon Blade is an improved tractor-mounted blade designed for wildland site preparation. Treatment with the blade effectively kills unwanted vegetation. The Salmon Blade produces a series of furrows that catch and hold seed and water and provide an ideal microsite for regeneration. The blade rescatters slash or piles it.

The Anchor Chain Scarifier, a rugged inexpensive scarifier that features anchor chain, has been adapted for site preparation in post-logging operations by MTDC engineers. The heavy anchor-chain effectively treats light to moderate slash and prepares the ground for natural regeneration.

The Iron Horse Wood Caddy tractor is an off-road vehicle that transports equipment and supplies and provides a lightweight power source for operating implements and hand-held tools. The machine is easily operated by one person and costs about \$5,500. MTDC engineers will conduct field tests in 1988 to evaluate the machine for forestry work.

A hammer-action hand planter has been designed to plant seedlings in rocky soil. Although commercial hand planters perform well in ideal soil conditions, the operator continuously absorbs the shock while operating the auger in rocky soil. Hammer-action uses an inner staff with a tool head attached. The force generated by the hammer head against the staff stop drives the tool head into the ground to create a suitable planting hole.

A cone-shaped, power driven auger has proved effective in planting seedlings in rocky soils. MTDC's improved cone-shaped auger design was compared to a commercial straight-bit auger during the 1987 field season. The auger performed well, but was heavier than the commercial straight-bit augers. User comments led to a final auger that is comparable in weight to a commercial auger. Commercial production of the cone-shaped auger is anticipated.



## 1989 Vegetative Rehabilitation & Equipment Workshop 43rd Annual Report

Billings, Montana

### Rangeland Drill

*James A. Young, Range Scientist, USDA Agricultural Research Service, Reno, Nevada and Dan McKenzie, Range Scientist and Mechanical Engineer, USDA Forest Service, Technology and Development Center, San Dimas, California*

Beginning as early as the 1880's, heavy concentrations of cattle and horse grazing in certain areas of the west had noticeably affect range productivity. Perennial grass depletion allowed nonpreferred shrubs to increase causing various groups to investigate techniques for rehabilitating sagebrush rangelands.

By the mid-1940's, the Forest Service claimed a 90 percent successful pilot seeding program, but equipment breakage was still a major problem. Other land management agencies with similar problems eventually led to a committee for Range Seeding Equipment of federal interagency composition.

Among the first projects undertaken was evaluation of current brush control equipment. If sagebrush ranges were to be successfully reseeded, a workable mechanical means of control had to be developed. Extensive testing and refining resulted in the brushland plow. The plow increased

the effectiveness of a seed drill by reducing competition from both new and old growth brush.

The development of a rangeland drill which resisted breakage and could be used anywhere a small crawler could be driven was the next goal. The original drill developed from an "idea-that-was-practical" stage through full-scale engineering and development. The prototype was not perfect, and over the years many modifications and attachments have been added.

The results of applied post-World War II technology in range improvement was startling in its results. Early spring is especially valuable to the livestock industry and is the period when native forage species are most susceptible to damage by excessive grazing. The successful seeding of wheatgrasses on degraded sagebrush ranges helped stabilize the livestock industry and added a new dimension to range management in the Intermountain West.



## The Rangeland Drill

**John R. Laird, President, Laird Welding and Manufacturing Works, Merced, California**

Listed are the modifications and improved attachments for the Rangeland Drill from 1955-1981 as made by the Laird Company, one of the first commercial members to attend VREW meetings.

The cost of building the Laird Rangeland Drill has increased dramatically the last three to five years, with no significant increase in the price of the drill and its options. This will probably not be the case much longer, as the cost of component parts, product ability and labor are extremely high and continue to rise.

The Rangeland Drill is a low volume product, and the company has a large capital outlay for purchased components for two to three years in advance. This situation limits the amount it has been able to spend on experimentation.

## Garrison Seed

**Key Crawford, Garrison Seed & Company, Incorporated, Hereford, Texas**

During the past couple of years, the seed industry has been under heavy pressure trying to furnish seed for the needs of the Conservation Reserve Program.

Grass seed prices have risen dramatically to new highs because of large demand and short supplies. These lucrative markets have given birth to any new small grass seed companies and independent suppliers.

At this time, the rush of CRP planting is over, and the demand has decreased to a point where the high prices of a year ago are showing some signs of erosion.

If prices decline to pre-CRP levels, it is not known how many of the newer grass seed companies and independent suppliers will remain in business. As the CRP demand decreases, it is anticipated that the additional planting will revert to other irrigated crops, but the company will maintain its original production which came from foundation seed.

## History of Ag-Renewal

**Weldon Miller, President, AG-Renewal, Incorporated, Weatherford, Oklahoma**

AG-Renewal, Inc., provides goods and services to forage producers to help them better manage their forage businesses. The company markets plant materials and equipment that research facilities have developed.

Equipment handled by the company includes the Pneumatic Seed Shucker, the Hi-Intensity Scalper Seed Cleaner with Fluidic Seed Classifier and the Woodward Flail-Vac Seed Stripper. The seed shucker is used as a tool to determine within several minutes if fields are worth harvesting, if seed offered is at claimed purity level and to monitor the cleanout.

The seed cleaner is air operated, providing a safety factor against dust explosion. Seed with low seedling vigor and poor germination is isolated and removed by the classifier.

The Flail-VAC is a rotary brush stripper which attaches to a tractor's front-end loader. The brush creates a vacuum, drawing in the seed head while stripping the ripe seed and depositing it in the hopper. Immature seeds are left for late harvesting.

AG-Renewal also markets five varieties of Old World Bluestem Grasses; Plains Bluestem, Ganada, Spar Bluestem, T-587 and Ironmaster. Miller believes that a higher percentage of land that is planted to these OWBs will stay in grass compared to land planted to other grasses, based on the excellent grazing results and wide acceptance of these grasses before CRP. The use of these plant materials has been significant and with profitable commercial application.

## Arid Land Seeding

**Harold T. Weidemann, Texas Agricultural Experiment Station, Vernon, Texas**

A promising new device has been built to enhance grass establishment using the basin tillage (pitting) concept. The chain-diker was designed to conserve moisture and reduce runoff for dryland wheat; however, it appears well-suited for range seeding. Preliminary results have shown significantly better grass stands for the disk-chain-diker than disk-chaining or smoothing chaining alone.

The Unita Rangeland Drag was designed for small acreage sites where it is uneconomical to utilize heavy equipment. It is highly versatile, can be pulled by a standard pick-up and has been successfully used on sites such as tarweed flats,

heavily dispersed recreation areas, abandoned drill pads, campgrounds, old building and corral sites, and sheep bedgrounds. An average seedbed preparation of two-to-three inches of topsoil is generally achieved after dragging and then crossed again with the drag to cover the seed.

Instructions and a materials list for constructing the inexpensive, one-man unit are included.

## Prescribed Fire Ignition-Blowgun

**Phil Range, USDI Bureau of Land Management, Boise Interagency Fire Center, Boise, Idaho**

Three years ago, the BLM contracted with a company called Wildland Resource Management of Walnut Creek, California, to develop a new ignition device for use on prescribed fires. The contract was for a proof of concept. Their device is called a Blowgun and was tested with great success. The Blowgun is composed of a launcher, fin-stabilized projectile containing the ignition system, and a compressed air source. Projectile propulsion is obtained from a standard air compressor.

The lightweight launcher will send the projectile over 300 yards. The launcher assembly consists of a pneumatic miniature cannon. The projectiles contain sawdust, wax and potassium permanganate. Ethylene glycol is added to the potassium permanganate. Ignition takes place in 20 to 40 seconds and ignites the entire projectile. It burns for less than 10 minutes and has a flame height less than 15 inches. Projectiles are non-explosive and non-toxic, and easy to transport. When the unit is fully developed, the BLM expects to reduce the number of employees required to light a burn, cut some costs and improve safety.

## Rehabilitation Equipment Development In Southern Idaho

**Mike Pellant, USDI Bureau of Land Management, Idaho State Office, Boise, Idaho**

Recent equipment development and modifications needed to implement a "greenstripping" program (establish strips of fire resistant vegetation) and to improve shrub restoration practices after wildfires has been reported by Idaho BLM offices.

A disk-chain has been used to prepare seedbed and plant perennial vegetation in cheatgrass dominated rangelands. Several modifications have been made to this original unit to correct deficiencies and to improve effectiveness.

The link-to-disk ratio has been increased to one-to-one with the addition of a disk to each chain. Complete soil turnover

is now achieved, improving control of annual species. Wider V-shaped plates have been welded to the roller bar below the seed boxes to increase the area where seedbed connection occurs. Corrugated seed tubes have been replaced with smooth seed tubes to reduce seed tube clogging. A "windscreen" has also been installed behind seedboxes to stop seed from blowing behind the roller bars.

A sagebrush seeder has been constructed to reseed big sagebrush over large acreages. The seeder consists of three components, a fertilizer spreader, drag chains and a vine roller cultipacker. The Jarbridge Sagebrush Seeder can be pulled by a two-wheel drive tractor. Acceptable sagebrush establishment was obtained on two projects seeded with the unit in the fall of 1987.

The Boise district also has constructed a chain-harrow to solve the problem of damage that occurs to conventional models in areas with rock outcrops. It can be pulled with a two-wheel drive tractor at operating speeds of two to six miles per hour, depending on the amount of rock in the area. The chain-harrow should have the greatest application on coarse soils or when light seed coverage is required.

## A Variable Stroke Mechanism For Mechanical Water-Pumping Windmills

**F.Z. Kamand and R.N. Clark, Agricultural Engineers, USDA Agricultural Research Service, Conservation and Production Research Laboratory, Bushland, Texas**

Research at the USDA Conservation and Production Research Laboratory, Bushland, Texas, indicates that when a standard windmill is equipped with a variable stroke mechanism the water pumped could be doubled. Positive displacement pumps which are used with mechanical windmills have a fixed stroke length and require constant operating torque from the windmill rotor. The available torque from the windmill rotor increases with windspeed squared. When the available rotor torque exceeds that of the load, the windmill rotor overspeeds almost in proportion to windspeed, thus not taking full advantage of the extra power available at the high windspeeds.

To better take advantage of the cubic relationship between windspeed and available power in the wind, the pumping load should be varied with windspeed. This can be accomplished by either varying the stroke length of the piston pump or by varying the gear ratio between the rotor and the pump. The most promising and practical approach to increase the pump discharge is to vary the stroke length of the pump in proportion to windspeed squared, thus improving the wind to water pumped conversion efficiency.



## Independent Wind Electric Water Pumping

*R. Nolan Clark, Agricultural Engineer, USDA Agricultural Research Service, Conservation and Production Research Laboratory Bushland, Texas; and William E. Pinkerton and Joe W. McCarty, Alternative Energy Institute, West Texas State University, Canyon, Texas*

An independent wind electric system to provide the energy for pumping water offers several advantages over mechanical wind systems and solar systems. The wind turbine does not have to be located directly over the water source, thus allowing the selection of the best site for both the water supply and wind generator. Standard electric motors and pumps can be used with the electrical generating wind turbine.

Experiments have been conducted by the USDA, Agricultural Research Service and the West Texas State University, Alternative Energy Institute to evaluate the performance of independent wind pumping systems. A wind turbine with a permanent-magnet alternator was used to power standard three-phase induction motors connected to water pumps. Three pumping conditions were examined during the experiments: a low head, high volume pump; a high head, low volume pump and a medium head, medium flow pump were all tested at various capacities.

The use of a variable-frequency, variable voltage system expanded the useful operating range of the wind turbine and provided more water than mechanical systems.

## Preventing Livestock Water From Freezing By The Use Of Insulated Watering Tanks

*Dan W. McKenzie, Range Scientist and Mechanical Engineer, USDA Forest Service, Technology and Development Center, San Dimas, California*

The Technology and Development Center has become aware of a commercial insulated livestock watering tank that appears to reduce the freezing of livestock water at low temperatures. The manufacture of the tank is:

*Miraco  
P.O. Box 686  
Grinnell, Iowa 50112  
(515) 236-5822 or (800) 541-7866*

The watering tank is supplied in two configurations and in a number of sizes. The two configurations are a large ball float opening and a lift-up design, primarily for use with hogs, sheep and small cattle. Ten sizes are available ranging from 6 to 100 gallons. The test report from the US Bureau of Standards states that the Miraco insulated tank will work as stated anywhere in the Continental United States with as little as six head of cattle drinking every other day.

## Attendance at Annual Meetings

Date	Place	Meeting	Participants				
			Federal Gov't	State Gov't	Private	Foreign	Total
Dec 1946	Portland <sup>1</sup>	Joseph F. Pechanec	6	0	0	0	6
Dec 1947	Ogden <sup>1</sup>	" "	9	0	0	0	9
Jan 1949	Denver	" "	15	0	0	0	15
Dec 1949	Ogden <sup>1</sup>	" "	22	0	0	0	22
Jan 1951	Billings	" "	34	5	0	0	39
Jan 1952	Boise	A.C. Hull	45	9	0	0	54
Jan 1953	Albuquerque	" "	75	15	9	1	100
Jan 1954	Omaha	" "	63	8	3	5	79
Jan 1955	San Jose	W.W. Dresskell	62	10	4	1	77
Jan 1956	Denver	William D. Hurst	86	12	1	2	101
Jan 1957	Great Falls	" "	95	10	4	0	109
Jan 1958	Phoenix	Frank C. Curtis	87	9	3	0	99
Jan 1959	Tulsa	" "	84	5	2	0	91
Jan 1960	Portland	" "	98	10	3	3	114
Jan 1961	Salt Lake City	" "	123	11	14	2	150
Jan 1962	Corpus Christi	Frank Smith	58	5	7	1	71
Jan 1963	Rapid City	" "	52	6	1	0	59
Jan 1964	Wichita	John Forsman	61	10	5	0	76
Jan 1965	Las Vegas	" "	77	8	6	0	91
Jan 1966	New Orleans	" "	47	8	5	1	61
Jan 1967	Seattle	A.B. Evanko	58	10	4	0	72
Feb 1968	Albuquerque	" "	84	16	13	1	114
Feb 1969	Great Falls <sup>1</sup>	" "	46	3	13	0	61
Feb 1970	Denver	" "	81	8	11	0	100
Feb 1971	Reno	" "	74	6	15	2	97
Feb 1972	Wash., D.C.	" "	48	3	6	0	57
Feb 1973	Boise	" "	60	7	7	4	78
Feb 1974	Tucson	Bill F. Currier	61	12	10	14	97
Feb 1975	El Paso <sup>1</sup>	Stan Tixier	49	9	11	1	70
Feb 1976	Omaha	" "	50	17	12	0	79
Feb 1977	Portland	Vern L. Thompson	63	26	31	10	130
Feb 1978	San Antonio	" "	68	26	35	6	135
Feb 1979	Casper	Ted Russell	74	35	72	12	193
Feb 1980	San Diego	" "	97	44	88	21	250
Feb 1981	Tulsa	" "	56	35	111	16	218
Feb 1982	Denver <sup>1</sup>	" "	60	18	68	5	151
Feb 1983	Albuquerque	" "	119	82	96	9	306
Feb 1984	Rapid City	Randall R. Hall	95	22	49	7	173
Feb 1985	Salt Lake City	" "	110	46	85	13	254
Feb 1986	Orlando	Gerald Henke	41	31	29	13	114
Feb 1987	Boise	" "	94	35	34	5	168
Feb 1988	Corpus Christi	" "	42	14	23	8	87
Feb 1988	Billings	" "	65	19	23	2	109
Feb 1989	Reno	" "	19	11	13	3	46

<sup>1</sup> Meeting not in conjunction with Society for Range Management meeting.