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AGRICULTURAL SEEDING EQUIPMENT

Paper presented
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INTRODUCTION

The basic textbook definition for the function of seeding equipment is to uniformly distribute seeds into moist soil at a prescribed rate and depth, and cover these seeds with a compacted soil layer, without damage to the seed. A large number of seeding units have been designed and built to accomplish this function, and it is our intention to review some of the various units available for agricultural practices.

Before proceeding with seeding, however, one must prepare a seedbed in a soil media suitable for plant support. Over the years, you have all heard a range of topics on soil properties, characteristics, and a good seedbed for satisfactory germination? Simply put, they are: good fertility, sufficient warmth, sufficient air, adequate moisture and an adequate layer of soil between the seed and the surface which will allow penetration by the sprout of the particular seed.

Seeds vary widely in their soil-moisture requirements for germination and their sprout energy. Grass seeds must be planted close to the surface as they have low sprout energy, but they also require sufficient moisture. If planted deep enough to stay moist, they may not be able to penetrate the surface. A light mulch is valuable in securing a stand of grass because it retains moisture but does not offer resistance to the sprouts. Good soil tilth, the degree of aggregation of the soil, is the most important rootbed factor. A high degree of aggregation in a soil provides: freedom of root development and penetration, maximum water storage capacity to supply plant needs, and resistance to breakdown of surface particles under rainfall, and prevention of sealing over, allowing maximum water intake and therefore reducing erosion due to runoff.

CHARACTERISTICS OF SEEDERS

Most seeders have some method of accurate seed metering, which comes in a variety of forms. They must have furrow openers which will place the seed at a desired depth, and some type of device which will cover the seed and compact it into the soil to allow maximum soil-seed contact.

Many different methods are used to meter seeds for planting, and their use depends on the characteristics of the seed and the spacing desired. Metering mechanisms in common use are:

a) agitator with adjustable hole
b) fluted or external force feed

c) double run or internal force feed
d) cup feed
e) vertical plate feed
f) inclined plate
g) horizontal seed plate.

The mechanisms most commonly used for grass seeding are the fluted and double run force feed systems, primarily because they can accommodate a variety of seed sizes and can meter the seeds at different rates with relatively easy adjustments.

Furrow openers must place the seed at the desired depth with minimum dispersion. Many types are used, the most common being:

a) hoe or shovel openers
b) single disc openers
c) double disc openers
d) shoe openers
e) wheel openers.

The single disc or double disc openers are most frequently used in grass seeding equipment. They can be operated at relatively high speeds and depth can be accurately controlled by gauge wheels.

For proper germination, seed must be in contact with moist soil and covered with a layer of soil which the seed sprout can penetrate. Some of the devices used to provide the proper seed environment are:

a) drag chains
b) covering blades
c) covering shovels
d) disc covers
e) press wheels.

The press wheels have been found to be most effective as they gauge opener depths as well as firm the soil around the seed, so as to optimize soil-seed contact and moisture retention.

SEEDING EQUIPMENT

Forage stands can be established by using a variety of seeding techniques. Some are successful only during short periods when specific soil and climatic conditions exist, while others are reliable

over a wide range of conditions. Hydroseeding and helicopter seeding have been discussed in earlier papers. These methods are very expensive for most agricultural enterprises.

Seeding by airplanes however, can have a place in agriculture. This method can be used effectively in rather rough terrain conditions or when fields are too muddy for vehicles. It should be anticipated that not all seed spread will germinate, as no proper seed placement or compaction occurs and therefore aerial seeding requires application of more seeds per hectare. Wind can seriously effect the even distribution of the seed. In range conditions, the seed is usually broadcast on snow. As the snow melts, the seed is carried down to the ground, and with some frost action, will be carried into a suitable environment for germination. There is a danger of seeds being carried away with the runoff and the practice is therefore prone to spotty forage establishment.

Spinner spreaders have a similar problem of seed placement and soil compaction, but they can be effective in well-prepared seedbeds. The seeds will drop into openings of a rough seedbed, and wind and raindrop splash action will cover these seeds to stimulate germination. Again, a higher rate of seeding per hectare is required. As a method of seeding, broadcasting is not as efficient as drilling because of the variable depth of coverage, some seeds being too deep and others too shallow.

Small farm operations have used and are still using the Brill ion type seeder. An excellent seedbed must be prepared. The first set of rollers breaks up large clots and creates small ridges and depressions. The seed is then dropped and a second set of packer rings presses the seed into the ground. The ridge formation from the first packer rings is displaced by the second set of rings. This will ensure that some soil covers the seed and good seed-soil contact is achieved.

A more advanced step in seeding equipment is one in which the equipment does some of the soil tillage, drops the seed in a well-tilled soil, covers the seed with a second set of discs and ultimately packs the soil with press wheels. This ensures that the seed is positively covered and well compacted into the soil. The field is left in a smooth condition for subsequent harvesting operation. The small ridges created can catch any moisture that becomes available due to rain.

The Australian hoe drill, after primary tillage and seed placement, firms the seed into the soil and then loosens the surface soil layer

with hoes to allow the young seed sprouts to penetrate the soil surface more easily. This leaves the soil surface very loose and can become a soil erosion problem under windy conditions.

Attempts have been made over the years to reduce the pre-seeding tillage required; not only to reduce the overall cost of seeding, but also to retain some of the trash cover to improve soil surface tilth and help to prevent soil erosion. Disc tiller seeders were developed that mounted conventional seed hoppers on a one-way disc tiller with the seed-delivery tubes dropping the seed between the discs at a location where it will be covered at the desired depth. Seed depth placement, however, is not very accurate and no provision was made for compaction.

A similar method was developed by John Deere and Company using two sets of discs, one to rough-till the soil, the other to cover the seed. Again, accurate seed placement and compaction were not dealt with. This equipment would be applicable in grain seeding where the seeds have considerable energy to germinate and grow under more adverse depth-of-placement conditions; however, for grasses, results are questionable.

Minimum tillage was pursued as time went on and the introduction of the Versatile-Noble hoe drill achieved this. The coulters are widely spaced on three separate rows to prevent trash build-up. Approximately 20 kg of downward force is required to penetrate the soil. The hooked toe on the coulters assists in keeping the shanks in the ground. Seed is metered out and firmed into the ground by press wheels which are in-line with the coulters.

The Amazon Zero-Till, an experimental model from Germany, has angled cutting coulters that disturb the soil. Seed and fertilizer are dropped on the back side of the coulters. Two ranks of coulters and packer wheels firm the seed into the soil. There is considerable soil disturbance and the term zero-till seeding is rather misleading; however, it is a once-over operation and the residue is left at the surface.

Triple disc zero-till requires up to 100 kg downpressure to penetrate the soil and establish a seedbed. The advantage of this unit is that it can cut through field residue, place fertilizer below the seed level, and distribute the seed at a desired depth in the soil that will enhance seed germination.

The introduction of John Deere's Power-Till seeder brought minimum tillage or zero tillage to its highest point. A set of spinning discs cut a very narrow slot in the sod or soil. This creates an excellent seedbed. The seed is dropped into this tilled soil and pressed into the soil. Since only a limited amount of the vegetation is disturbed, it is necessary to apply a herbicide to spray the unwanted vegetation. When only inter-seeding for pasture renovation, no chemical sprays are required. It was found, however, that the spinning discs would wear very quickly and had to be hard-surfaced frequently. Secondly, the discs would almost self-destruct in rocky soils.

Air seeders are a relatively new introduction to seeding equipment. Forced air delivers the seed from a seed box and distributes it to the seed delivery tubes. The seedbed is prepared with the equipment, seed is placed into the soil with special coulters and by running a short diamond harrow behind the unit, the soil is partially compacted and the field is left in a very smooth condition. A liquid fertilizer tank can be pulled behind the whole unit. The fertilizer is injected before seed placement and deeper than the seed. In this way, a once-over operation in stubble fields can be achieved; that is, it achieves soil cultivation or seedbed preparation, fertilizer application and seed piacement.

B.C. RANGELAND SEEDING EQUIPMENT

In 1975, the B.C. Ministry of Agriculture and Food embarked on a program to develop seeding equipment that could work in some of the rough, rocky range conditions of B.C. To effectively renovate some of the depleted range, the equipment would have to have the capability of:

- providing good tillage of the top 8-to-15 centimetres of soil,
- eliminating undesirable vegetative competition such as sagebrush,
- placing seed accurately at no more than 1 to 2 centimetres below the soil surface and
- providing adequate packing to firm the seed into the soil for maximum contact and moisture retention.

A great deal of equipment has been developed in many parts of the world. In most cases, the conditions in which that equipment had to work were not as difficult as those existing on B.C.'s rangeland.

One of the more promising pieces of equipment was the U.S.D.A. Rangeland drill. The unit would do a fair job on relatively easy going ground, however, the heavy sagebrush could not be effectively killed and severe plugging occurred. It was almost impossible to ask one machine to provide the four main feeding requirements, namely, soil tillage, elimination of vegetation competition, accurate seed placement and packing.

The range seeding equipment developed by the B.C. Ministry of Agriculture and Food consists of two units: a flexible, heavy-duty double offset disc to provide vegetation control and soil tillage, and a free-floating seeder-packer to compact the soil and place the seed accurately. The two units are pulled in tandem for a once-over operation.

The unique features of the 10 tonne disc are in the design of the sub-gangs that are individually controlled and loaded by a hydraulically-operated cylinder. This individually variable loading of the sub-gangs gives good flexibility on uneven terrain and obstacles such as boulders and outcroppings, as well as improved durability by having each sub-gang absorb the impact loads, rather than trying to lift the entire machine.

The 11-tonne seeder-packer consists of two sets of four specially-designed cast rollers which can travel up and down to follow the contour and traverse obstacles. Seed is broadcast between the rollers from a standard seed box. The second set of rollers is positioned in such a way that shallow ridges formed by the front rollers are split and the soil is formed around the seed for maximum soil-seed contact. In most cases, one pass is adequate, however, on heavy sods, double discing is sometimes necessary. One thing that cannot be over-emphasized is the fact that the equipment must be built strongly. Constant pounding over rocky soils and undulating terrain is probably the most severe operating condition any machine can be subjected to.

Germination is uniform and because the soil surface is left in a ridged fashion, any moisture, either through snow or rainfall, can be effectively used by the new seedlings. The success in establishing a uniform stand of grass is directly related to good soil tillage, seed placement and packing. Over the last five years over 10,000 hectares of range have been seeded. Yield data were taken on many of these sites and a four to five-fold increase over native production was recorded.