FIELD VACUUM SEEDER

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INTRODUCTION

From the establishment of the first nursery in 1896 to 1956 the sowing of tree seed was by hand at all the Ontario nurseries. This was a slow but very efficient use of tree seed by the highly competent persons used for this purpose.

The expansion of reforestation in the postwar years and the replacement of horses with tractors brought about a search for the high-capacity, inefficient seed drill adapted from agriculture to meet the demand for the annually increasing seedbed areas at the 10 provincial nurseries. The range of seeders varied from the Gandy to the highly recommended Oyjord seeder of today in the constant search to cut down the waste of tree seed with these mechanical dispensers, which require two to nine viable seeds for every shippable seedling.

The first operational vacuum seeder to make its appearance in Ontario, and possibly in Canada, was a crude design put together by two Canadians of Japanese origin in the late 50s or early 60s near the town of Chatham. This seeder eliminated the labor required to thin and space mechanically drilled sugar beets and turnips by spacing the seed with the aid of a household vacuum running off the 12-volt system of the tractor.

The next vacuum seeder was built by E.O. Nyborg (Nyborg 1972) in 1970 at the University of British Columbia in connection with the "Kinghorn Blocks" containers. It is now produced by the Vancouver Bio-Machines Systems Ltd.

It was Nyborg's invention and the Vancouver Bio-Machines Systems Ltd. that enabled us to produce the first prototype precision vacuum seeder and the subsequent operational model.

OBJECTIVES AND REQUIREMENTS OF NURSERY SEEDERS

The ultimate objective of each nurseryman is the production of a tree seedling from each viable seed sown. Unfortunately, even in the controlled environment of a greenhouse, the best we could achieve at the Swastika Nursery from 1964 to 1972 was a shippable tree from 2% to 6% below viability for jack pine and the two spruces. This situation cannot be repeated out-of-doors, where three viable seeds are required to produce a living tree, since both the seed and the seedling are at the mercy of the elements. Nurseries (Brown 1973) with a partially controlled environment should therefore be able to produce a better ratio of seedlings per viable seed by making better use of the available tree seed through the use of a precision seeder.

On April 26, 1979 we provided Vancouver Bio-Machines Systems Ltd., with a sketch and the following information concerning our requirements:

1. The vacuum cylinder would have to be 42 inches between the first and the last seed drop, with a spacing of 4 inches between the rows, for a total of 10 rows per bed.

2. The linear drop would have to be 1.5 inches between seed to give us 20 seeds per square foot and, it was hoped, 18 shippable trees (Armson and Sedreika 1979).

3. The seeder would have to be preceded by a soil packing drum and the seeder would have to be supported on low-pressure tires because we sow our soil on raised beds.

4. The seeder would have to be enclosed to protect both the seed and the vacuum cylinder from dust.

5. The seed drop from the vacuum cylinder to the soil surface would have to be 1 inch, with a drill depth of 0.25 inch for a total of 1.25 inches.

THE PROTOTYPE

The seeder we received was an adaptation of the Vancouver Bio-Machines head attached to a carrying frame that resembled the Oyjord seeder.

The machine was P.T.O. driven for both the vacuum pump and the compressor. After a few modifications to these items, we tested and demonstrated the seeder at our Dryden Nursery from June to September 1979 and compared its performance against the Oyjord and the Dryden hybrid.

Some of our findings and observations were as follows:

1. The seeding device would deposit a single seed 98% of the time, as stated by the manufacturer.

2. The depth of the drills could not be maintained at the desired 0.25 inch due to their independent suspension.

3. The drills would pick up any wood fiber in our high-organic soil and drag it and the seed along with it, as indicated by the clumping of the germinants.

4. Due to the 42-inch height of the seed drop, much of the seed would bounce right out of the drill grooves subsequently welded to the packing drum instead of 0.25-inch drills on our first trial.

5. During the second trials, we decided to mulch our seed with

   (a) nursery soil,
   (b) peat, and
   (c) beach sand, to control the seed covering more precisely. Beach sand proved to be the most stable covering, with nursery soil next, and peat soil the least stable.

6. Finally, we sowed all of our jack pine with the vacuum seeder in the spring of 1979 for the 1982 planting season, with a 40% chance of attaining our 18 to 22 trees per square foot because of the aforementioned problems.

THE PRODUCTION MODEL

After the 1979 trials we were convinced that our objective of reducing the ratio of viable seed per shippable seedling could be met after further modifications to the

seeder. We therefore decided to build the seeder to our original specifications by salvaging those parts that we could use from the prototype and manufacturing those that we required locally.

1. The first item of consideration was the replacement of belt and pulleys on the compressor and the vacuum with hydraulic motors.

2. We next built the frame to our original specifications along with the vacuum cylinder.

3. We decreased the lateral spacing from 4 to 2 inches, thus increasing the number of rows on the bed from 10 to 20.

4. We can also reduce the linear spacing between the seeds from 1.50 to 0.50 inch to adjust for viability and to allow the seedlings to support each other linearly in a solid row, since widely-spaced seeds were hammered into the ground by heavy rain drops.

5. The angle iron on the packer and in front of each seed drop was reduced from 1.0 to 0.75 inch for better depth control.

6. The seed covering would be sand to a depth of 0.25 inch or less, applied with the Swastika sander.

7. After sanding, the bed would be gently rolled with a smooth packer.

OPERATION OF THE SEEDER

Anyone familiar with the Vancouver Bio-Machines Systems Ltd. seeder can operate the nursery seeder.

1. The vacuum pump has a minimum capacity of 40 c.f.m. per minute at 0 pounds of mercury and 10.8 c.f.m. at 20 pounds of mercury. We have discovered that 31.5 c.f.m. at 4.5 pounds of mercury will hold the seed on the vacuum cylinder.

2. The compressor has a displacement of 15.4 c.f.m. at 0 pounds and 7.4 c.f.m. at 90 p.s.i. Our requirement to operate the air brush, the seed release, and the vacuum purge systems is 11 c.f.m. at 20 p.s.i.

3. The sequence of operations consists of (a) the vacuum-operated seed pickup, (b) a compressor-operated air brush to limit the pickup to a single seed, (c) a compressed-air seed drop, and (d) the compressed-air vacuum hole purge or cleaner.

CONCLUSIONS

We have tested the production model of the precision seeder and are satisfied that it will help us attain our original objectives at least in part by:

1. reducing the tree seed required to grow a shippable seedling,

2. adjusting the linear seed drop to compensate for seed viability, thus enabling us to produce close to the desired density of 18 to 22 trees per square foot,

3. eliminating the thinning and spacing of seedling stock, and

4. facilitating better use of small and improved seed lots through the elimination of waste seed.

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