A PRECISION PLOT SEEDER AND FERTILIZER APPLICATOR

by

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INTRODUCTION

A problem in conducting soil fertility research with row crops has been to obtain uniform distribution and placement of the fertilizer in relation to the seed. The problem is magnified when several row widths and fertilizer positions are compared for different crops. The machine described will space seed peas, corn, and all varieties of round seeds, and place fertilizer in side bands. The width between the rows, the side band spacings, and depths of placement are adjustable.

EQUIPMENT DESCRIPTION AND DESIGN

Equipment used initially

The Research Station, Agassiz, B.C., experimented with a modified hoe seeder and fertilizer applicator mounted on a model G Allis Chalmers tractor (Fig. 1); this unit was designed by the Engineering Section, Research Station, Swift Current. The fertilizer applicator (2) was made of an endless belt feeding into double disc openers for placement.

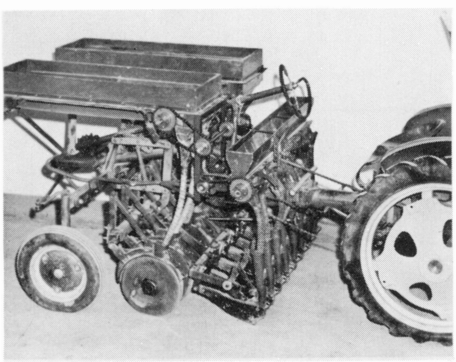

Figure 1. Plot seeder and fertilizer attachment mounted on Allis Chalmers Model G.

After several years of usage the workers at Agassiz concluded that the seeder did not have the accuracy or the adjustment range needed for experimental work. Peas or corn could not be accurately spaced with the fluted feed. Depth control of the seed and fertilizer was difficult to attain. Adjustments for fertilizer spacing between rows and side banding of fertilizer were difficult to make, thus wasting too much field time. The belt fertilizer applicator was found to lack the accuracy required for the experiments. The experience gained in the use of this equipment was used to design a precision seeder and fertilizer applicator for a three-point hitch on a larger tractor.

Figure 2. Plot seeder and fertilizer applicator mounted on a three-point hitch.

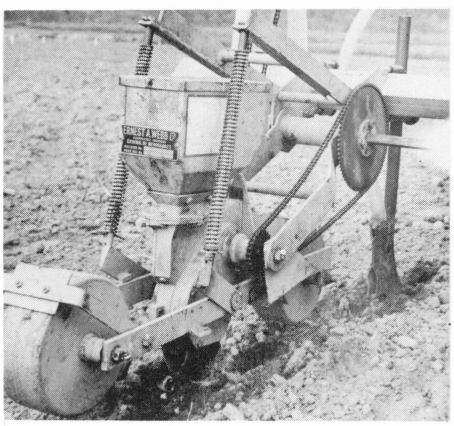

Figure 3. Webb precision seeder.

General Description of the Machine

The redesigned machine consisted of two parts, a seeding unit and a fertilizer applicator (Fig. 2). The seeding unit, purchased from Ernest Webb Ltd., England, consisted of four Webb precision seeders attached to a tool bar with a three-point hitch mounting. The Webb seeders were driven by power take-off (pto) (with a fixed ratio to ground speed) through a gearbox (Fig. 3). The fertilizer applicator consisted of four cone dispensers, tool bar, and four chisel point furrow openers for placing the fertilizer. The machine was 4.5 feet long, 11 feet wide, 6 feet high, and weighed 1100 pounds.

Seeding Unit

The Webb precision seeding unit consisted of a seed hopper from which the seed was passed to a selector wheel which was belt-driven at ground speed by a front drive wheel. The seeds are picked up individually by the selector wheel cups and dropped into a furrow made by a coulter which was adjustable for depth. The soil was replaced over the seed by a covering shoe and was packed by a spring adjusted press wheel.

Selector wheels were available commercially for most round seeds and for some pea and corn varieties. Rows spaced from 14 to 42 inches were seeded with the Webb unit by positioning the clamps on the drawbar. Seeding at 7-inch spacing was accomplished by making a second pass between rows seeded at a 14-inch spacing.

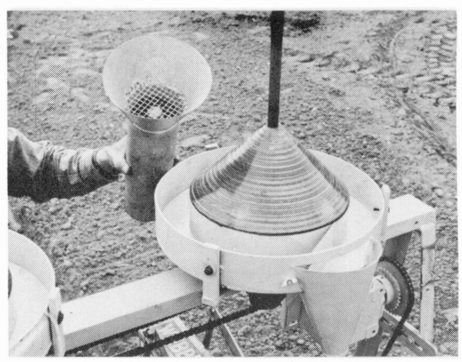

Figure 4. Cone for distributing fertilizer.

During preliminary tests, the slippage of the belt driven selector wheel caused the in-row spacing of seeds to be very irregular. This was corrected by substituting a pto operated chain drive. Using a 36 cup selector wheel for peas, one seed was delivered every 2.4 ± 0.2 inches which was considered satisfactory. Corn seed was quite variable in size and shape. Therefore, it was necessary to use a selector wheel with a cup size that suited the variety. Selector wheel cups for the corn variety Mellogold were machined 0.5 inch deep by 25/64 inch in diameter. These cups worked quite well for Mellogold but did not perform satisfactorily for other varieties which were larger in size and different in shape. Selector wheel cups for other varieties must suit the size and shape of the seed.

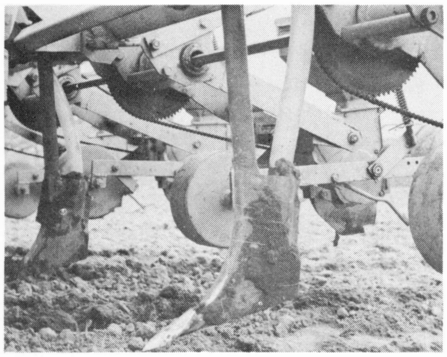

Figure 5. Chisel point furrow opener for placing fertilizer.

Fertilizing Unit

Fertilizer cones, as described by Futral, Reid and Butler (1), were used to meter the fertilizer for row placement (Fig. 4). Gear ratios were designed for row lengths of 20 and 30 feet. Plastic tubes 1 inch in diameter delivered the fertilizer to the opener furrows; the furrow openers were positioned on a second drawbar welded to the seeder framework (Fig. 5). A simple clamp arrangement on the drawbar allowed the furrow openers to be adjusted horizontally and vertically.

Laboratory Test

Fertilizer placement in earlier tests (30-foot row) indicated an initial lag for the first 2.5 feet, acceptable distribution to 27.5 feet and then a decreasing rate beyond this point. Using the previous tests as a guide, more detailed tests were conducted. Two containers lined with paper were used to catch the fertilizer between 0 and 2.5 feet and between 27.5 and 30 feet in the row. Containers 12 inches wide were centered at 14 locations in the row between 3 and 27 feet to sample the fertilizer application rate in a 25-foot section of the row. Two fertilizer cones were compared in three separate runs using ammonium nitrate at three application rates.

Results

The low S.E., determined from the performance tests of the cones in metering fertilizer, indicated an acceptable uniformity of distribution within rows and between rows (table 1).

TABLE I. UNIFORMITY OF DISTRIBUTION (GRAMS) OF FERTILIZER WITHIN 14 ONE-FOOT SECTIONS OF A 25-FOOT ROW.

Cone No.	Total fertilizer applied per cone	Fertilizer applied to 25-foot row	Fertilizer in 14 one-foot sections in a 25-foot row		Fertilizer for initial lag and end loss*
			Mean	S.E.	
	200	171.0	6.8	.07	29.0
1	400	337.7	13.5	.08	62.3
	800	685.2	27.4	.23	114.8
	200	173.4	6.9	.11	26.6
2	400	342.9	13.7	.16	57.1
	800	680.4	27.2	.24	119.6

*added to the amount required in the 25-foot row to give total applied per cone.

FIELD OPERATION

Seeder and Fertilizer Applicator

The seeder and fertilizer applicator were used to seed and fertilize peas and corn. Uniformity of the seed spacing in the row, depth of seed and fertilizer in a level seedbed, and the distance between the seed and fertilizer were readily reproducible. A three-man crew required three minutes to seed and fertilize an 8-row, 25-foot plot of peas, and two minutes for a 4-row, 25-foot plot of corn. When all adjustments had been made on the seeder and fertilizer unit, the time required to change from seeding corn (42-inch row spacing) to peas (7-inch row spacing) or vice versa was 45 minutes.

Seeding Depth

The seeding depth was readily maintained on a firm seedbed after the seeding shoe and the spring tension had been properly adjusted. However, the bearing area of the seeder wheels was not sufficient to maintain uniform seeding depths under loose seedbed conditions. Additional adjustment for depth control to compensate for loose seedbed conditions was obtained by adjustment of the hydraulic height control on the three-point hitch.

General Observations

Small clods, 0.5 to 0.75 inch in cross-section frequently blocked the outlet of the seed tubes. This was usually avoided by preventing the tractor from rolling backwards until the machine was lifted at the end of the row. The operator should check the outlets for obstructions before the seeding of each plot.

The cone was loaded more uniformly by locating the machine on a level spot and tapping the fertilizer receptacle above the cone several times to level the fertilizer before releasing it.

This equipment may be used on any tractor equipped with a three-point hitch which has a pto with a fixed ratio to ground speed. The pto of the tractor used in this experiment rotated at a speed of one rpm per 28 inches of forward travel. It will be necessary to determine the fixed ratio of the pto to ground speed of other tractors and when this differs from that used in the experiment, a gear box or changes in sprocket ratios will be required.

The laminated cone dispenser on the fertilizer applicator showed signs

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"Food and Peace," and the speakers will be:

Dr. Norman Z. Alcock (President, Canadian Peace Research Institute), speaking on "The Nature of Modern Conflict," and Dr. Ralph W. Cummings (Associate Director, Agricultural, Sciences, The Rockefeller Foundation), speaking on "Rural Development and Food Production in Developing Countries."

C.S.A.E. Program Coordinator, Walt. Bilanski, reports that, in addition to the general sessions, there will be several technical sessions featuring some 24 papers covering a wide range of subjects of interest to C.S.A.E. members. Walt. extends an invitation to all members to visit Hamilton, in the "Centre of Ontario's Golden Horseshoe," June 23 through June 27.

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of weathering after a period of one year and the plate steel cone base was corroded severely by the fertilizer. The authors suggest that the cone be made from a plastic material whereas the metal base could be covered with a thin layer of polyester body filler and then sanded to a smooth surface.

The costs of parts and materials used in this seeder and fertilizer applicator, exclusive of the tractor, was $1100.00. Approximately 200 man-hours were required for construction.

Detailed plans for the plot seeder and fertilizer applicator are available from the Research Station, Swift Current, Saskatchewan.

REFERENCES

1. Futral, J. G., Reid, J. T. and Butler, J. L. Precision metering device for fertilizers and other materials used in field plot work. Mimeo. Series N.S. 34. Georgia Agr. Expt. Sta., Univ. of Georgia, College of Agr. March 1967.

2. Jackson, T. L. and Cushman, H. E. Oregon fertilizer spreader. National Joint Committee on Fertilizer Application, National Food Institute, Washington, D.C. p. 52. 1956.

AN ANALYSIS OF TRACTOR . . .

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4. The investigation showed wide variations in cost per unit power, in cost per unit weight, and in efficiencies.

5. The investigation showed wide variations in cost and efficiency between different models marketed by each manufacturing company, as well as between companies.

6. There was no correlation between cost and efficiency.

7. The utilization of larger conventional power units reduces capital expenditure per unit of performance by 3-4%, without influence on the efficiencies.

8. Diesel-engined tractors required approximately 10% more capital per pto horsepower, as compared to gasoline models, but the average engine efficiency was 13% higher and the difference in cost per drawbar horsepower was shown to be only 6%.

9. The tandem arrangement of 2WD tractors having average cost/performance values can effect comparable tractive power supply with less expenditure than in the case of the 4WD sample.
