MINIMUM TILLAGE POTATOES -- SOME ECONOMICS

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Why Mini-till?

The primary objective of minimum tillage or reduced pre-plant tillage for potatoes is the reduction of wind-erosion without reducing net income.

Spring-time wind erosion in the light sandy soils of the Columbia Basin presents not only visibility problems but loss of top soil, fertilizer and herbicides. The minimum tillage concept for potatoes does indeed reduce spring-time wind erosion. There are cases where 70 mile an hour winds with gusts to 90 miles an hour did not cause wind erosion on minimum tillage potato fields.

The key to wind erosion control is to keep plant residue from the previous crop on or near the soil surface. Exactly how much residue must be kept on the surface depends upon a number of factors such as soil texture, kind of residue, anchoring of residue, and tillage method. As might be expected, less residue is required on the surface of heavier soil than on lighter soil to stop erosion.

Reduced Preplant Tillage Method

One grower-developed method of minimum pre-plant tillage uses one or two light diskings to work the residue into the top three or four inches of the soil. He is able to plant using a conventional planter and can keep the plant residue away from the seed pieces. The amount of residue remaining on the surface appears to be rather small but is sufficient to stop erosion in the moderately light soil that he farms.

Table 1 shows the estimated costs of this reduced pre-plant tillage method. This table includes the machine and labor costs of seed hauling, but does not include costs of fertilizer, pesticides, herbicides, and other hauling. At the bottom of Table 1 are shown the costs for hilling and plowing which were not used in this system but when added in would give the approximate cost of conventional culture of potatoes. The table shows the cost of disking once, but two diskings may be needed if residue is excessive. The field is fall fumigated when necessary. In the spring, the field is swept, fertilized, and marked for planting all in one operation. The planting is accomplished with a conventional six-row planter with the planter tractor following in the wheel marks left by the marker on the fertilizer applicator. The planter is operated and adjusted to keep the plant residue away from the seed pieces.

Generally one cultivation is used after planting. Total machine cost per acre for this method using one disking and one cultivation is approximately $201 per acre.

There are many other ways of reducing the amount of preplant tillage and leaving more plant residue on the soil surface to control erosion, Many growers are developing their own methods. Approximately 12,000 to 14,000 acres of potatoes were planted with some form of modified preplant tillage to reduce wind erosion in 1977 in the Columbia Basin.

The WSU Mini-till Method

The extreme of plant residue on the soil surface occurs when planting is done directly into a cover crop with no previous tillage. This approach is used in the WSU mini-till method.

Approximate machine costs for this method of potato culture, using the WSU Lockwood mini-till planter, are given in Table 2. Disking is not used and other operations are done

in a slightly different way compared to the method of Table 1. Fumigation and digging costs are the same for both methods.

Table 1. Costs of Grower-Developed Reduced Pre-plant Tillage Potato Culture

Operation	Acres/hr	Machine cost/acre[a]	Labor cost/acre[c]	Total Machine & Labor cost/acre
Disking	7.8	$ 3.55	$ 0.45	$ 4.00
Fumigation	4.7	19.26	0.74	20.00
Fertilize, sweep, mark	4.4	19.20	0.80	20.00
Planting[b]	4.1	29.45	2.55	32.00
Cultivation	4.1	4.15	.85	5.00
Digging[b]	1.4	112.75	7.25	120.00
Total	---	$188.36	$ 12.64	$201.00
Hilling[d]	6.1	3.43	0.57	4.00
Plowing[d]	2.5	12.12	1.38	13.50

[a] Hauling, chemicals, seed, fertilizer not included except seed hauling. Pesticides applied through sprinkler.

[b] Down time, filling, or waiting time not included.

[c] Computed at rate of $3.50/hour.

[d] Hilling and plowing were not used, but are included here for cost-comparison to conventional methods.

Table 2. Costs of WSU Mini-till Potato Culture

Operation	Machine & Labor cost/acre[a] [c]
Fumigation . . . . . [b]	$ 20.00
Clear, ½ sweep, plant[b]	52.00 (estimate)
Fertilize, ½ sweep, cultivate.	5.00
Hill	120.00
Dig[a]	$ 197.00
Total	

[a] Hauling (except for seed hauling), seed, chemicals, fertilizer, pesticides not included.

[b] Down time, filling or waiting time not included.

[c] Labor rate: $3.50/hour.

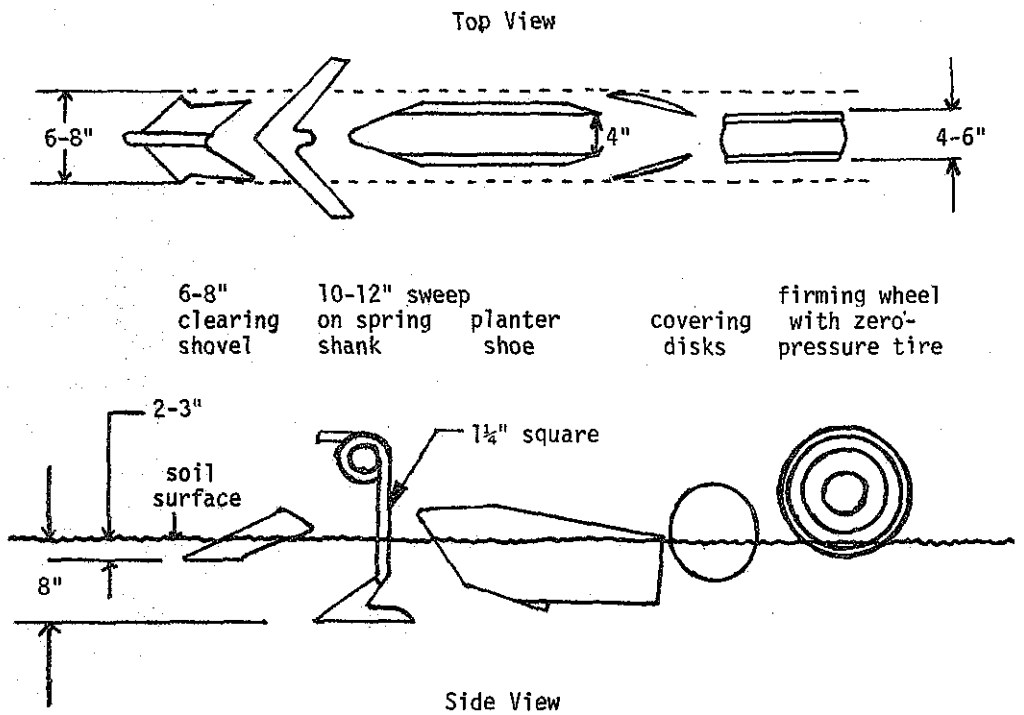
The planter sweeps part of the field during planting. Then, during the first cultivation, the remainder of the field is undercut by sweeps and fertilizer is applied. Thus, the planting and first cultivation operations under mini-till accomplish approximately the same tasks as the fertilize-sweep-mark and planting operations used in the reduced preplant tillage method of Table 1. The cost of accomplishing these tasks under either system is approximately the same, $52.00 per acre.

One hilling operation at $4.00 to $5.00 per acre may be needed after the first cultivation (Table 2).

The total cost for the mini-till method is approximately $197 per acre, or $4 less than the reduced preplant tillage method. The $4 difference is the cost of one disking.

The mini-till method eliminates plowing and disking, but it requires planter modification. Figure 1 shows the implements used on the WSU-Lockwood mini-till planter.

Figure 1. Mini-till Planter Implements



The arrangement of the implements and their functions are important. The front clearing shovel is a Lister shovel that clears away plant residue and sod, leaving a 6 to 8" wide residue-free path. The sweep loosens the soil to a depth of 8 to 9" and 5 to 6" on either side of the potato row. The narrow planting shoe lines up the seed pieces in single file to facilitate later cultivation. The small covering disks pull residue-free soil from the path left by the clearing shovel so that no plant residue is placed in contact with the seed piece. The rubber-tired press wheel firms the soil over the seed.

If the cover crop has not been killed with herbicide, the first cultivation after planting requires use of sugar beet knives next to the potato row to undercut the cover crop and pull it away from the potatoes. A sweep is used to undercut the remaining area between rows and to

apply fertilizer. It is very important that the beet knives be ahead of the sweep on the cultivator so that cover crop is not transplanted into the potato row. Long shanks are required on the knives and sweeps to allow room for the residue to pass between implements without causing plugging.

Economic Comparison of Mini-till and Conventional Methods

Table 3 gives a comparison of conventional potato fields with three mini-till fields, all on one grower's farm. The table gives yields, size and quality information, and cost of production compared to conventional.

The bottom line of Table 3 shows that for two of the three mini-till situations, the cost of production was $2.38 and $3.16 less per ton than for the conventional method. The mini-till operation that cost more than conventional suffered from both sprinkler breakdown problems and fertility problems.

It is important that water and fertilizer management be given special attention under mini-till early in the season because of the use of nutrients and water by the cover crop.

Note that the quality of the mini-till potatoes (Table 3) is as good as or better than the conventionally-grown potatoes.

Table 3. Comparison of Conventional and Mini-till Potatoes for One Grower

Field Method	1 Conventional	1 Mini-till	2 Mini-till	3 Mini-till
Previous Crop	Corn	Corn	Wheat	Wheat
Soil	light, sandy	light, sandy	heavy	light, sandy
Yield	28.9 Tons/A	33.4 Tons/A	32.2 Tons/A	24.3 Tons/A *
No. 1's	71%	69%	76%	79%
Bruise Free	76%	80%	77%	89%
10 oz.	29%	37%	34%	24%
Cost compared to conventional	--	$-2.38/Ton	$-3.16/Ton	$+5.85/Ton

* Water problems and fertilizer management problems.

Energy Requirements

Very limited data are currently available on energy requirements for mini-till versus conventional practice. However, in one instance a grower planted half of a field using a plow plant operation and the other half of the field using mini-till. Table 4 shows estimated fuel consumption data for the two methods.

The plow-plant operation required two gallons of diesel per acre or nearly three times the fuel required by the mini-till planter.

Table 4. Fuel Requirements for Plow-plant and Mini-till Planting (estimates, gallons per acre)

	Plow	Planter	Total
Plow-plant operation	1.4	.6	2.0 gal/A
Mini-till planter	---	.7	.7

Mini-till Results in General

The WSU Lockwood mini-till planter was used to plant over 300 acres of potatoes during the spring of 1977. Although there were some disappointments in the results with some growers, in general the results were as good or better with mini-till than with conventional practices. Except in two instances, one of which is represented in Table 3, mini-till yields ranged from 27 to 33 tons per acre. In the situation where half of a field was plowed and then planted while the other half was mini-till planted, the entire field was fertilized late in the August of the summer before and sprayed before plowing or planting with Dalapon and 2, 4-D at an applied cost of $18.00 per acre. There was no wind erosion in the mini-till section of the field. Yields of both parts of the field were approximately 30 tons per acre. The potatoes in the plow-plant part of the field may have been slightly larger but the mini-till potatoes had less internal browning. The grower felt that he would not have needed to use Dalapon and 2,4-D on the plow-plant section of the field. The plow-plant part of the field required a ridge-dragoff operation but the mini-till part of the field required an extra cultivation. It appears that the cost of the herbicide on the mini-till ground would be mostly offset by the saving in plowing costs.

Two problems in the mini-till section of the field were first, that it was difficult to get sufficient water on that section of the field early in the season without over-watering the plow-plant section of the field, and second, cultivation of the mini-till the first time through was more difficult because of the hard ridge of soil between the rows that was not undercut at planting time.

Of the four growers who used the planter in 1977, three were reasonably well satisfied and are interested in working further with either minimum tillage or some sort of modified pre-plant tillage using either the WSU-mini-till planter or planting methods of their own. The fourth grower was disappointed in the results and plans to use other methods for wind-erosion control.

Summary and Conclusions

The economic data represented here is admittedly rather limited; however, it does show that minimum and reduced tillage methods of growing potatoes can produce net returns comparable to, or even better than, conventional potato growing practices. There are now documented cases where reduced tillage techniques have produced potato yields on old potato ground that were comparable to the yields obtained on that ground when it was new to potatoes. This has occured both in experimental situations and in a commercial grower's field.

Intrinsic values of minimum and reduced pre-plant tillage methods over conventional methods include the possibility of planting in high wind conditions when conventional planting cannot be done, elimination of the need to re-hill after high spring winds, and reduction or elimination of plant damage due to blowing soil.

One definite benefit of either mini-till or reduced pre-plant tillage over conventional potato culture is redistribution of the spring field-work load. Since plowing is eliminated, the

amount of spring machine time in the field is greatly reduced. This may mean elimination of need for one tractor as well as the plow.

The results show that minimum and reduced tillage methods have achieved the objective of controlling soil wind erosion without loss of net income.