AIM Research Trial Report: **Subsoiling Trial**
Working Group: Science & Technology
Crop Year: 2020
Author: Ryan Barrett

Project Rationale:

Starting in 2019, the Science & Tech Working Group wanted to examine the effect that deep tillage (or subsoiling) has on potato yield and quality. We know that potato production in PEI is dependent on tillage and soil disturbance and that many fields suffer from soil compaction, particularly the formation of compaction layers (plow pans) at between 10 and 16 inches of depth. One of the only ways to break up these compaction layers is through deep tillage to fracture these layers. The timing of this deep tillage appears to be important, as well as soil conditions. Deep tillage/subsoiling is suggested to be done under dry soil conditions, preferably in the year before potato planting and with a minimum of tillage/traffic on the field after subsoiling. In this project, we wanted to assess whether subsoiling directly ahead of potato planting would have an impact on marketable yield and quality. Two fields were analyzed in this way in 2019 and showed variable results. For 2020, we increased the trial to five fields.

Project Overview:

In the spring of 2020, AIM staff visited selected trial fields to assess whether significant soil compaction was present and to ascertain the depth of the compaction layer. Not every field that was initially selected was chosen to proceed due to a lack of severe compaction.

Based on a number of observations using a penetrometer when the field was at field capacity for moisture, the depth of the compaction layer was recorded for each field. The grower/equipment operator was then asked to perform subsoiling operations at 2-3 inches below that compaction layer in an effort to fracture the layer. The depth of compaction layer varied from 10 inches to 13 inches. Therefore, the depth of subsoiling varied between 13 and 16 inches of depth. It was difficult to get exact depth of subsoiling due to equipment limitations; however, AIM staff were in the field during subsoiling to confirm the depth of tillage and advise the operator on setting the appropriate depth.

In the fall, four or five 10-foot harvest samples were taken in each of treatment (subsoiled) and control (not subsoiled) areas of the field. Samples were then graded at Cavendish Central Grading according to the late February 2021 contract for the appropriate variety.

Results:

Table 1: Yield and quality data from Field A (Frito-Lay 1879 variety) in 2020.

Treatment	Total Yield cwt/ac	% defects	% smalls	% 10 oz	Specific Gravity	M. Yield cwt/ac	Crop Value $/acre
Check (no subsoiling)	183.5	1.1	**4.8 a**	0.9	1.085	173.1	2001
Subsoiling at 15 inches	179.9	1.8	**10.0 b**	0.0	1.088	158.7	1891
difference	-3.6	0.7	**5.2**	-0.9	0.003	-14.4	-110

Note: while this was a chip variety, grade and crop value is based on French fry contract specifications. Crop value would be higher with chip grade, but relative difference between treatments should be similar.

In this field, the only variable which showed statistically significant differences at 90% confidence level (p=0.10) using a two-tailed t-test was the percentage of small (higher in subsoiled treatment). As noted, a true chip stock grade was not used for these calculations, and that may have impacted the marketable yield, as some chip contracts use a different definition of "smalls" than the Cavendish Farms French fry contract. There was not much different in total yield or marketable yield, and definitely not any evidence of advantage to subsoiling. In this field, the subsoiling equipment was not done according to GPS and the width between shanks did not correspond with the width between potato rows.

Table 2: Yield and quality data from Field B (Russet Burbank variety) in 2020.

Treatment	Total Yield cwt/ac	% defects	% smalls	% 10 oz	Specific Gravity	M. Yield cwt/ac	Crop Value $/acre
Check (no subsoiling)	227.1	3.4	14.3	2.9	1.084	188.0	2125
Subsoiling at 15 inches	210.6	1.5	19.0	1.9	1.081	169.0	1893
difference	-16.5	-1.9	4.7	-1.0	-0.003	-19.0	-232

In this field, none of the variables were statistically significant at p=0.10 using a two-tailed t-test. Differences were quite small between the treatments for each metric and can not be judged different from zero. This was a long, narrow field with the subsoiling treatment placed in the middle of field and samples taken near the front part of the field in an effort to control in-field variability. In this field, subsoiling was not done on the same day as potato planting, and there was a tillage pass between subsoiling and potato planting performed. Subsoiling was not done according to GPS and the width between shanks did not correspond with the width between potato rows.

Table 3: Yield and quality data from Field C (Russet Burbank variety) in 2020.

Treatment	Total Yield cwt/ac	% defects	% smalls	% 10 oz	Specific Gravity	M. Yield cwt/ac	Crop Value $/acre
Check (no subsoiling)	186.8	4.0	12.9	9.7	1.081	155.0	1790
Subsoiling at 15 inches	198.5	3.0	14.9	4.8	1.078	164.6	1831
difference	11.7	-1.0	2.0	-4.9	-0.003	9.6	41

In this field, none of the variables were statistically significant at p=0.10 using a two-tailed t-test. Differences were quite small between the treatments for each metric and can not be judged different from zero. This field was geographically close to Field B and experienced the same hot, dry growing

conditions. In this field, subsoiling was not done according to GPS and the width between shanks did not correspond with the width between potato rows. It was also not performed on the same day as potato planting, and there was a tillage pass between subsoiling and potato planting performed.

Table 4: Yield and quality data from Field D (Russet Burbank variety) in 2020.

Treatment	Total Yield cwt/ac	% defects	% smalls	% 10 oz	Specific Gravity	M. Yield cwt/ac	Crop Value $/acre
Check (no subsoiling)	259.6	1.5	14.7	**0.0 a**	**1.081 a**	**217.6 a**	**2405 a**
Subsoiling at 14 inches	290.1	1.3	9.9	**7.4 b**	**1.085 b**	**260.0 b**	**3103 b**
difference	30.5	-0.2	-4.8	**7.4**	**0.004**	**42.4**	**698**

This field showed the greatest response to subsoiling of any of the five fields. This field also had the shallowest depth of compaction layer, with the depth of compaction being found at as little as 10 inches deep. In this field, the subsoiling equipment was following GPS guidance to till when the potato planter was to travel, with the ripper shanks spaced at 36 inches and following directly where the rows would go. Also, there was no additional tillage performed between the subsoiler and the potato planter. This may explain the increased response that we saw.

In this field, there was a statistically significant difference at p=0.10 using a two-tailed t-test for the percentage of 10 oz, specific gravity, marketable yield and crop value, all to the advantage of the subsoiled treatment.

Table 5: Yield and quality data from Field E (Clearwater variety) in 2020.

Treatment	Total Yield cwt/ac	% defects	% smalls	% 10 oz	Specific Gravity	M. Yield cwt/ac	Crop Value $/acre
Check (no subsoiling)	192.3	1.3	26.4	0.0	1.091	141.3	1800
Subsoiling at 16 inches	221.6	2.8	33.3	1.2	1.090	141.8	1785
difference	29.3	1.5	6.9	1.2	-0.001	0.5	-15

In this field, none of the variables were statistically significant at p=0.10 using a two-tailed t-test. Differences were quite small between the treatments for each metric and can not be judged different from zero. A small benefit to total yield for the subsoiled treatment was counter-balanced by a higher percentage of smalls in the subsoiled treatment, resulting in almost identical averages for marketable yield. This field had a compaction layer primarily at 13 inches, resulting in subsoiling at approximately 16 inches; however, this equipment had a difficult time going much deeper than 15 inches consistently. In addition, there was a tillage pass performed between subsoiling and planting, but all operations were performed within hours of each other.

Summary:

At four out of the five fields in this study, there was no significant difference between subsoiling before planting and the control. Only one field showed a significant response from subsoiling ahead of the planter. What is intriguing that this field (Field D) was the only field where subsoiling was performed on the same A-B GPS lines as the planter, with ripping shanks spaced at 36 inches (the same as potato row

width). In addition, there was not another tillage pass performed between subsoiling and potato planting.

These results indicate that there may not be any value to deep tillage ahead of the potato planter until the shanks are spaced at the same width as the potato rows and unless it is performed on the same GPS lines as the potatoes will be planted. This could possibly be explained by the relatively shallow root system of the potato plant not branching out much horizontally to reach decompacted soil yet taking advantage of decompacted soil directly under the seed piece. It may also be the case that traffic/tillage between subsoiling and planting undoes some of the value of subsoiling.

It should also be noted that all five of these fields were located in Eastern Prince County, the epicentre of drought conditions in Prince Edward Island in 2020. All of these fields experience significant drought and did not receive supplemental irrigation.

2021 project plans:

In 2021, one grower has already provided two fields which were subsoiled in the summer of 2020 (with a non-tilled check) to be planted to potatoes in 2021. This will be used to assess the value of subsoiling the year ahead of potatoes.

In addition, there may be value to following up with a couple of fields where the subsoiling operations can be performed in a similar way to Field D in this trial to see if these results can be replicated in another year on multiple fields.

Thank you to the farms who participated in this trial:

- Dunk River Farms
- Klondike Farms
- MWM Farms
- Victoria Potato Farms