

Physical Weed Control in Potatoes

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My topic for today and for the last number of years is looking at weed control in crops. A lot of the work has been done in conventional production, but a lot of that information is also transferable to organic production.

To give you an overview...I'll talk a little bit about weed competition, I'll mention a program that allows you to do some predictions on applications, when to control weeds, and then some information on the work we've been doing in the last few years in looking at physical weed control systems, and I'll just have a few slides at the end, if I have time, to show you some of the newer equipment that is available as well.

I think everybody is certainly aware that weeds compete with the crops, but the thing is that weeds compete with the crop from emergence. Potatoes are a little bit different in that in a good year we normally have 14 or 15 days from planting to emergence; in a cold year it might even get up to 21 days. But the species of weeds that we have normally tend to germinate quite quickly, so you can get a fairly heavy population. The effect of the weeds will depend on the species, their density, and basically the time that those weeds are removed in relation to the crop. As I said, response can be modified by the growing conditions. There's not much we can do to control that, but we need to recognize it. In some crops we can reduce the weeds by crop management. Potato is not one where we've had a lot of information. Some varieties are a little bit more competitive than others, they grow a little bit faster, but unfortunately not a lot of breeding has been done to develop a variety that is a fast emerger, gives good ground cover, and allows us to get weed control that way.

We've done a bit of work in Charlottetown on our sandy loams. This is work we did a few years ago on wild radish. You can see the difference in the weed levels between the two years. This is keeping the crop weed free from the time of emergence. We didn't worry about the weeds until the crop had emerged, then took the weeds out. If we allow 1 week free, 2 weeks free, 3 weeks free, we essentially don't see a big difference in yield. So that early emergence is the time we need to be concerned with—get those weeds out of there early. If we left it weedy, we didn't see much for only 1 week; 2 weeks weren't bad, and then 3 weeks the yield dropped quite severely this year, and in another year it was down a little bit. But you need to get the weeds out early. That's a broadleaf species.

If we look at a more competitive grass, we have the same sort of thing except at 2, 4, and 6 weeks. Yields are fairly low in these trials but, nevertheless, if you remove the weeds early you don't see a problem. If you delay emergence 2 weeks is not bad, although yield is reduced by the population. We found in this trial a very high quackgrass population. As you delay the emergence, yields will drop off quite severely. So you need to get those weeds out quite quickly.

This is quackgrass, but really you're dealing with the foliage of quackgrass. Barnyard grass, crab grass, any of the annual grass weeds will also do the same thing depending on the population because it's the foliar effects that are the most concern for you.

WeedCast is a program out of the United States that allows you to input temperature, moisture, and soil type on a computer. We did some work with it in looking at prediction of lamb's quarters emergence within the WeedCast program it has about 20 weeds right now, but unfortunately

only 3 that are from this area. This study is being done to look at it in different areas. I'm working with colleagues in Ohio and North Dakota in potato production areas. We find quite a difference in these programs depending on where they're used. In southern states the weeds emerge more quickly; in northern provinces they tend to be a little bit slower. So we're doing some modification. I'm trying to look at temperatures. The trial we did was of Russet Burbank (a long-season variety), not one you would normally be using perhaps, but interesting from the point of large-scale commercial production as well. We did use fertilizer in these trials, which were looking at lamb's quarters. Weed populations were fairly high. A 15% emergence means that the program's predicted emergence of the lamb's quarters was 15%, so each time at 15% we did a cultivation. The next ones were at 30% and 60%, so this is essentially 3 cultivations, 2 cultivations, and 1 cultivation. We didn't change the weed population a lot. The year 2001 was a very dry year so yields were fairly low. Only when we had 1 cultivation did we actually reduce the yield; the other 2 were very good. Three cultivations at 15% emergence gave very good results. With no cultivation, obviously yields were down. If we delayed cultivation we still had a yield reduction. In 2003 there was not much of an effect, but the weed population wasn't quite the same.

We also looked at some various pieces of equipment that we might be able to use in potato production. Traditional potato production in the past has been: plant, come in with a cultivator using a goosefoot or duckfoot or something like that, do two or three cultivations, and then finish up with the hill. Conventional potato production right now on a large scale is one hilling at emergence of the crop, making the large, shaped beds. That in many ways eliminates the ability to do weed management as far as physical control is concerned. This system is a rotavator between the rows. This is a flamer over the top of the row, and this is a flex-tine cultivator. Basically it is a very flexible finger-weeder-type machine. The rotavator only takes weeds out from between the rows. We have a low population, but the yields are down. This is at emergence of the potato, and this is 2 weeks later. The flamer gave very good control and very good yields both years. With the flex-tine there was actually a slight reduction in yield—a couple of tonnes—but that's not too bad with that system.

We followed up with looking at the flamer in a band, did some more work in another trial 2 weeks later, then did some flex-tine. In this one we didn't have too much of a problem. In other years we found that after 2 applications of the flamer we'd get into problems. Here we have early removal at the cotyledon stage of the weeds, the 1-2 leaf stage, or 2-4 leaf stage, and as you delay that emergence, the yield of the crop starts to go down. Combinations of flamer plus cultivation seemed to do fairly well.

This is a chart taken from a publication out of Quebec which is a very good publication. It's in both French and English. They looked at all of the potential equipment that is available and rated it as to when they're most effective in removing weeds. The spring-tine or flex-tine cultivator is only effective at the cotyledon stage. The rigid-tine cultivator is the same, as is the rotary hoe. The basket weeders, which can go between the potato rows working at some speed, are fairly effective up until the 2-leaf stage of the weeds. The torsion, Danish, and Roto-tiller, which are very aggressive-type weeders, will go right out up to the 4-leaf stage. What happens with these four pieces of equipment in here is that it looks like you've taken the weeds out—you've knocked them down, they look like they're lying over but, invariably, at the 1-leaf stage and later, the root is still attached. That root will take up moisture, the plant will look crooked, but it will come back on you and you haven't gotten control at all—you just felt good.

For those who may not be sure...In lamb's quarters this is the cotyledon stage, first leaves, second leaves. On the wild radish here is the first leaf and second leaf. So when you're looking at a weed plant for those early flex-tine-type cultivators, you're looking at a plant who has only 2 cotyledons in the case of lamb's quarters. That's the stage where you need to be doing the cultivation. As we tell some of the guys with the larger tractors, you have to get off the tractor to see that weed. You look at a field and it's just a little bit of a cast. That is weeds at the cotyledon stage. There are no weeds there; you can't see them, but they are there.

This is the flex-tine or spring-tine weeder. We dragged it over the potato fields. We were concerned about whether or not that aggressive flex-tine, which vibrates very quickly, would cause any problem with the hill that resulted from the planting operation. We could not find any. I didn't put a picture in, but we did it after the potatoes were up and we didn't really see any problem on the potatoes. We damaged them, but they came back.

This is the Buddingh rolling basket. These baskets are available in different widths. They're mounted on a bar, and they're 2 gangs chained together so you go at about 8 or 10 miles an hour if you can get up to that speed. You can set the baskets to the width that you need for the potato row or crop row or whatever you want to do, and away you go down the field. But you still have to worry in the row; that's been where the major problems are.

We used one of these Roto-tillers as well. This one was set up for 2 rows only; you come back on the next 2 rows to get the full width. Again, this is very aggressive. It does a good job between the rows.

The flamer was originally set up for taking the tops off with this system. In the early trials we tried to flame the whole width, but gave up on that. We now have the heads set up to just do the top of the potato row.

The rotary hoe is mostly used in field crops—corn, soybeans, grain, that sort of thing. It goes 15-20 km/hr if you use it in those crops. We haven't tried it yet in potatoes, but it may have some possibility. If you use it, just look straight ahead. Don't look back.

Something is being developed now which has precision flexible rubber fingers or plastic fingers. This one is from the Netherlands. Some are very effective, but they are very costly machines. They are effective in very valuable vegetable crops, for example. They're probably too expensive to be doing much in potatoes.

This is a vertical brush system. The row is here, and the little brushes rotate to take out the weeds. Again, with these systems, the weeds have to be small—in the cotyledon stage. There's even one which blows high-pressure air between the rows, and there are also other machines out there.

In summary, there are lots of things out there that you might be able to use; however, many of them are expensive. Each one works best at its own specific time, and it's no good to try to use it later—it won't do the job. As I said, the trick is to get the timing right. Best results are at the cotyledon or first leaf if the conditions are right. I recommend cotyledon. Weeds compete with the crop from emergence of the crop. Potatoes can recover from foliar injury with the equipment. We've seen a fair bit of injury on potatoes but not seen too many problems. But they

cannot recover from early competition, 2 or 3 weeks' competition. They just don't come back from that sort of thing.

Q: How do you use flammers in small plots?

A: These large ones wouldn't. But there are a number of hand-held flammers that are available and are basically just a small propane tank carried on the belt on in the hand to flame along the row. The timing issue is the same; it has to be done early. Each crop responds differently. It doesn't seem to do very well on some of the really sensitive small vegetable crops. Carrots are pretty sensitive to it. We tried to do it on carrots and basically lost the carrots. The other option, if the crops are slow emerging, is to flame the weeds before the crop comes up. A third option is a so-called old stale seedbed system where you prepare the field, leave it for a few days to a week, and plant your crop in before the weeds come up. The weeds will then come up well before the crop, and you can flame and then cultivate between the rows.

Q: Do you flame above the soil or on the soil?

A: It looks like a flame thrower. The trick is to have heat, not flame. As long as there is sufficient heat to raise the temperature above about 60° C, the weeds are killed. It may not look as though anything was done. We drive fairly quickly with the flamer now, and basically we're just moving along at 2 or 3 miles an hour and we're not burning it; we're heating it up so that the weed is killed.

Q: Does it have any effect on the soil?

A: No, not at that rate where you're just trying to kill weeds. Obviously, if you hold it on the soil then you have a problem. I would certainly never recommend that.