

Keeping Your Soils Covered: Environmental and Economic Benefit!

by Ryan Barrett, Research & Agronomy Coordinator, PEI Potato Board



Annual ryegrass in October, planted following green peas.

In the last few years, there has been more research and new information available on the benefits of cover crops in rotation. For a number of years, the industry has looked at cover crops primarily for fighting soil erosion. Fields planted with a cover crop in the fall following potato harvest or following summer/fall tillage have been shown to reduce the risk of soil erosion from both water and wind. However, what is becoming increasingly clear is the added benefits to soil health and subsequent crop yield by integrating cover crops into your rotation.

Cover Crop Research in Canada

One of the leading researchers in cover crops in Canada is Dr. Laura Van Eerd at the Ridgetown College campus of the University of Guelph. Dr. Van Eerd and her team have been investigating the agronomic and soil health benefits of cover cropping for a number of years across a series of different trials. One trial that started in 2007 looked at the impact of fall cover crops on the levels of soil organic matter. She found that after seven years of rotation, the use of cover crops following crops such as corn, soybeans, wheat and tomatoes led to significant increase in soil organic matter levels when compared to no cover crop usage. Increases of up to 0.4% soil organic matter were demonstrated in that time frame. Fall rye was the

most consistent performing cover crop, but other covers such as oats, oilseed radish, or radish and rye combined were also shown to be effective cover crops. They also compared the impact of retaining or removing straw from a field on soil organic matter. In 2015, they saw a 0.1% increase in soil organic matter where straw was left on the field, but saw no statistical difference in 2016.

Another trial looked at the effect of planting a cover crop following winter wheat on processing tomato yields the following year. Cover crops were planted after wheat harvest in late July, and their sandy loam soil had average soil organic matter of 3.8% and 6.5 pH. They experimented with a series of different cover crops which had different levels of biomass in both the spring and the fall. The key finding was that no matter the cover crop, there was a significantly higher marketable yield in tomatoes following a cover crop than without. In 2016 trials, this ranged from a 14% increase in yield following fall rye to a 38% increase in yield following oilseed radish. In addition, treatments where cover crops were used generally had better scores for soil health tests, including a measurable increase in soil organic matter after only one year for some cover crops.

Dr. Van Eerd's research into effects on other crops has also shown improvements on marketable yield following a cover crop. She has seen snap bean yields

increase by 0.37 T/acre following a cover crop, and has seen corn yields increase by as much as two tonnes per acre following a cover crop. Her team has also looked at the total economic impact of integrating cover crops into rotation. When comparing a four year rotation of sweet corn, wheat, field tomatoes and grain corn with cover crops each year against the same rotation without cover crops, the net profit from using cover crops was \$104 per acre, including all costs of cover crop management. Therefore, establishing a cover crop is not only environmentally beneficial but also economically justified as well!

Here in Prince Edward Island, the Board has been funding research with Agriculture & Agri-Food Canada at the Harrington Research Farm to assess the merits of different species for late season establishment, particularly following potato harvest in October. The most consistent establishing cover crop in these trials has been fall rye, which has been shown to establish quickly at lower temperatures and develops a strong root mass in a short time period. Fall rye will of course aggressively regrow in the spring, so needs to be managed appropriately if planning to plant a commercial crop the next year.

Selecting a Cover Crop:

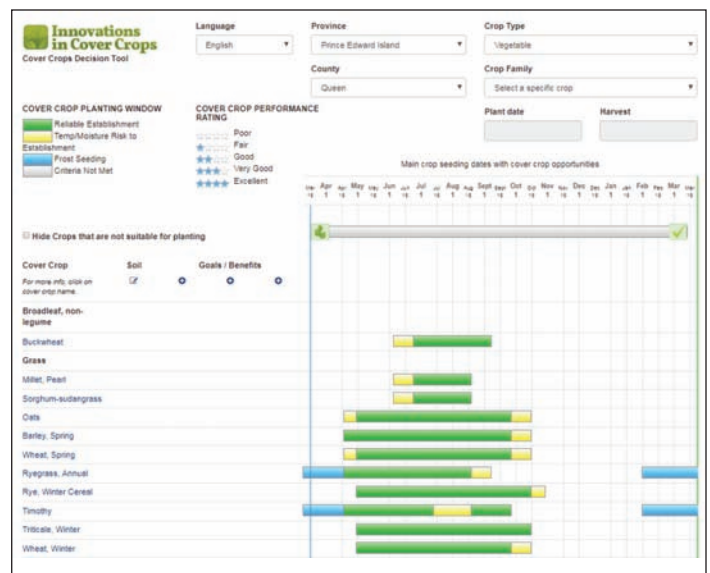
Many factors have to be weighed when determining what cover crop species or mixture to use. Your choice should be dependent on your crop rotation, timing of establishment, and the relative benefits of that crop/mixture on soil health, nutrient availability, and diseases and pests.

A commercial crop such as winter wheat can act as its own cover crop. It can be planted following early potato harvest or following an early harvested field crop like green peas. In this case, you get the benefit of having your soil covered for the winter as well as planting a commercial crop to be harvested the following year. Due in part to this dynamic, winter wheat acreage has increased in Prince Edward Island in recent years.

As mentioned above, a crop that is harvested late in the fall such as potatoes or grain corn can reduce the options for fall cover crops. As shown in PEI research with AAFC, fall rye has been shown to be a quick establishing cover crop in cold conditions. It can be grown out as a

commercial crop the following year if you have a market for rye; otherwise, it can be killed in the spring and then another crop can be planted, either no-tilled into the dead rye or planted after tillage. If planting a cereal crop such as barley, wheat or oats, be alert for volunteer rye to avoid multi-species contamination of your crop at harvest.

For crops that are harvested in the mid to late summer or early fall, the options for cover crop establishment increase substantially. One tool that may prove very useful for growers in making decisions on cover crop choices is the Eastern Canada Cover Crop Decision Tool, which can be found online at <http://decision-tool.incovercrops.ca/>. This tool shows the crop establishment window under PEI growing conditions for a range of different cover crops and mixtures, as well as factsheets for each crop providing seeding rates, management profiles, and additional beneficial properties for the crop.



Screenshot of cover crop selection tool, available at <http://decision-tool.incovercrops.ca>

Taking Aim at Wireworm and Early Dying

Is wireworm a major consideration for you? Research by Dr. Christine Noronha at AAFC Charlottetown and others has shown that growing brown mustard and buckwheat before potatoes can lead to reductions in wireworm damage. Some studies have focused on two years of double cropping these crops under heavy wireworm pressure. Some other trials have shown reduction in damage after just one year of usage. To get the biofumigation effect of brown mustard on say Verticillium or nematodes, it must be incorporated as a green manure



Incorporating brown mustard at peak flowering



Sorghum sudangrass after one cutting, mid-September.

before it goes to seed. However, Dr. Noronha has seen evidence that the glucosinolates present in brown mustard roots still has some positive effect on reducing wireworm damage. She has also determined in recent studies that buckwheat can have a beneficial impact on wireworm just by growing in the field without needing to be incorporated.

Both mustard and buckwheat establish quickly in warm soil conditions and can go to seed in as little as 60 days. However, both crops planted late in the summer will not normally have enough hours of sunlight to go to seed and can act as cover crops with the potential to assist with wireworm suppression as well as improving soil texture and weed suppression. Buckwheat is also known as a phosphorus scavenger, making P more available for crops the following growing season.

Are you more concerned about *Verticillium* and nematodes causing early dying in your potatoes? As mentioned previously, mustard crops are being used in many places around the world as a biofumigant crop to battle soil-borne diseases and pests. It should be incorporated a peak flowering as a green manure in the presence of adequate soil moisture (ideally just after a rain) to get the maximum effect of the biofumigation.

At local AIM meetings in February 2018, Dr. Mario Tenuta from the University of Manitoba shared with growers that sorghum sudangrass has shown to be effective as a trap crop for *Verticillium*. It is a non-host that triggers the *Verticillium* spores to germinate, helping to reduce populations in the field. In a similar vein, forage pearl millet has been shown to reduce populations of root lesion nematodes. Both crops are warm season forage

crops that should be established after June 15th, but can also be established later in the summer depending on your rotation. Ideally, these crops (alone or in mixture) should be cut at least once to allow the root mass to expand and to maximize the amount of biomass being returned to the field. These crops can also be harvested for livestock feed if trading land with dairy or beef producers.

Improving Soil Health and Organic Matter through Cover Cropping

Perhaps your greatest concern is improving soil health and soil organic matter. We know from recent reports by the PEI Department of Agriculture that soil organic matter has been trending downward in the province over the past twenty years, and some areas of PEI show very low organic matter percentages. While additions of manure and compost have shown to be the fastest way to improve soil organic matter, the use of cover crops and maximizing the amount of time that a field is home to a growing crop can also help conserve and build organic matter, along with reducing tillage.

Presentations by Blake Vince (a cash crop farmer from Southern Ontario) and Guy Forand (with Belisle Dairy Nutrition in Quebec) at the PEI Soil & Crop Improvement Association Conference in March 2018 highlighted the many benefits of forage-based cover crops for improving soil health, water holding capacity, soil structure, nitrogen fixation, and more. Mr. Vince advocated for the use of diverse cover crop mixtures with ten or more species in the mixture, citing research indicating that crop diversity leads to not only higher biomass accumulation

but also improved microbial activity and diversity in the soil. Blake uses mixtures that combine grasses (ie. oats, sudangrass, ryegrass), legumes (ie. alfalfa, faba bean, peas, crimson clover, balansa clover, chickling vetch), brassica species (ie. oilseed radish, tillage radish) and other crops (ie. buckwheat, phacelia). These crops can be planted as a full season cover crop or can be planted following a summer harvested crop. If you desire a mixture that will serve as a two year cover crop, you should ensure sufficient species in the mixture will overwinter to grow in the second year.

One area where I see increased potential for cover crop adoption is following tillage in the late summer or early fall in preparation for potatoes the next year. Many producers are using residue tillage equipment such as Lemken or Synkro machines in the late summer or fall instead of using a moldboard plough. Once again, this provides ample opportunity for using a cover crop to keep topsoil on the field, holding nutrients like nitrogen and potassium in the soil, as well as having a growing crop to help build organic matter. Simply broadcasting barley or oats on that tilled fields would cost-effectively accomplish this. This is also an option following ploughing as well, provided ploughing does not occur too late in the season. According to presentations made by Dr. Judith Nyiraneza and Dr. David Burton at the AIM Nutrient Management Workshop in January 2018, fall tillage that is not followed by a cover crop significantly increases the risk of nitrate leaching from the field, particularly following a legume crop like clover or alfalfa. This negates much of the benefit of growing these crops if much of that

nitrogen is lost from the soil before the next year.

As you can see, there are many factors to consider when deciding how to integrate cover crops into your rotation. Nonetheless, there is substantial evidence, both scientific and anecdotal, that supports utilizing cover crops as much as possible on your farm. Not only does it have benefits for the environment, it builds trust with our non-farming neighbours and has both short-term and long-term economic benefits for your operation.

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Field of tillage radish in mid-October, following buckwheat incorporated mid-summer.