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Nutrient Management, Variety Trials, and Pest Control in Potatoes - Bridging the Gap Between "Conventional" and "Organic" Agriculture.

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Cavendish Farms conducts collaborative trials to evaluate new potato varieties, response to fertilizer rates and manure applications. A wide range of pesticides and other techniques of pest control are evaluated. Although these trials are considered "conventional", some of the information gleaned from the trials has application for "organic" production. The presentation will give an overview of the trials.

It is recognized that Colorado Potato Beetles (CPBs) can develop resistance to commonly used insecticides. In the mid 1990s, populations of Beetles on PEI were confirmed to have resistance to insecticides in several chemical families (synthetic pyrethroids and carbamates).In response to frustration expressed by commercial growers, a "trencher" machine was constructed to lay plastic trenches as a barrier to the movement of adult Beetles in the spring, prior to egg laying. Although several published reports gave positive reviews of the procedure, growers encountered several difficulties in obtaining the desired level of control. In theory, the Colorado Potato Beetle adults over winter in the soil and emerge in the spring over a 2-3 week period. The beetles travel to nearby fields, planted to potatoes. While many of the beetles can walk considerable distances, some can fly up to a mile. Beetles generally must climb up on a plant or object and jump off to initiate flight. The plastic lined trenches, if constructed correctly, will allow beetles to enter the trench. Most cannot exit the trench due to the steep incline and slippery plastic, especially if covered with a fine film of soil. Several farmers encountered problems in laying the plastic without any folds on the side-walls. If a fold or crease occurred, beetles could "walk out". In several instances, growers had placed the trenches along hedge rows of spruce and Balsam fir trees. The trees exuded gum that fell on the trenches and became mixed with fine soil. This rough surface provided excellent traction for the beetles and the traps did not work satisfactorily. While progress was being made in fine-tuning plastic lined trenches and flamers, Imidacloprid (Admire) was introduced to the market and was rapidly accepted as a very efficacious insecticide to control Colorado Potato Beetles, Flea Beetles and aphids. While the product has provided excellent control of Colorado beetles in Canada and USA for the past 5-6 years, some reports of Beetle resistance to Admire have recently been documented in USA. Future control measures for these formidable and versatile pests will require a range of techniques to achieve acceptable results.

In Europe, there are many private potato breeders. If they develop promising seedlings, the small private breeders usually collaborate with larger companies to market and distribute their new varieties. Plant Breeder's Rights legislation recognizes that the new varieties are the intellectual property of the breeder and permits the collection of royalties for up to 25 years. Potato breeding in Canada and USA is largely done by government and universities. Several private breeders, in Canada, have developed new potato varieties. The breeder produces tens of thousands of seedlings and places them in evaluation trials. Only a small percentage of the seedlings survive the initial two years of evaluations. The selection of the seedlings for possible commercialization depends upon the fertility regime, disease and insect pressures in the trial sites. Undoubtedly, some seedlings would show high performance under a traditional system (wide range of pesticides for weed, insect and Late Blight control, high applications of fertilizer) compared to a reduced input or strict organic regime. Conversely, some seedlings that showed limited potential in the traditional system might perform well under the "reduced input" regime. Theoretically, the following traits would be valuable for potatoes suited to reduced inputs or "Organic" regimes:

- Rapid early growth of foliage to compete with weeds
- Efficient use of soil nutrients and efficient removal of nutrients from soil
- Moderate to high resistance to different strains of Late Blight
- Relatively early maturity to minimize exposure to Late Blight that often occurs late in the fall
- Unappealing to Colorado Potato Beetles and other insect pests without having high concentrations of natural toxins i.e. glycoalkaloids. Current federal regulations do not permit the registration of potato varieties that consistently have TGA concentrations above 20 mg per 100g of fresh weight.

The current marketing of organic potatoes in stores is often done in combination with specialty varieties with unique skin and flesh colors and smaller tuber sizes. A variety with high quality flesh is a benefit as consumers are willing to pay a premium price for high quality produce. The buying habits of consumers are changing. In addition to purchasing organic produce, there is increasing interest in purchasing potatoes by variety name. Most of the potato varieties in Canada and USA have very limited resistance to late Blight. Some organic potato producers have been relying on copper sulfate (Bluestone) for Blight prevention. While the product will provide some preventative protection for Late Blight, repeated applications of the product will lead to death of the potato foliage (phytotoxic). Because the product kills other soil organisms and is persistent in the soil, it may be banned in some European countries.

Cavendish Farms personnel conducted extensive evaluations, over a 6 year period with genetically modified potatoes. In the transformed clones of Shepody and Russet Burbank, we witnessed excellent controls of the Colorado Potato Beetles and excellent resistance to Potato virus Y (mosaic) and Potato Leaf Roll virus (PLRV). We achieved excellent control of weeds in transformed potatoes containing a tolerance clone for glyphosate herbicide. The table and processing quality of the transformed potatoes was equal to the "non–transformed clones. Transformed clones had been developed with a reasonably

high degree of resistance to Late Blight. The genetically modified clones were commercialized and later shelved due to public pressure. The use of genetically modified clones would greatly reduce the need for pesticides.

Cavendish Farms has been evaluating “wild” species of potatoes as a source of resistance to aphids. Some wild species of potatoes had a high degree of resistance and may be used by breeders to transfer naturally occurring resistance. The transfer of the aphid resistance into new varieties may take many years.

The concept of “nutrient management” is rapidly becoming integrated into crop and animal production in Canada and the USA. Because of intensive agricultural activity in Europe and the accumulation of high concentrations of nutrients in soils, restrictions are being enforced to limit the applications of fertilizer and manure in some areas. The restrictions are based on concerns over leaching of nitrates into ground water and runoff of nutrients into rivers and lakes. Some growers in PEI have embarked on projects with extension personnel to become more proficient in the calculating the removal of nutrients by some crops and the specific value of manure and other fertilizer sources to replace the nutrients. The removal of crops from a field without replacement leads to depletion of nutrients and lower yields in future crops.

Sixteen essential nutrients are required for plant growth. Crops remove nutrients from the soil and the nutrients removed can be replaced by applications of manure, rock bearing minerals or concentrated fertilizers. Because of the increased interest in nutrient management resulting from increasing nitrates in well water, Cavendish Farms conducted replicated trials with beef manure as a fertilizer to assess nutrient credits. When partially composted beef manure was added to the soil at the rate of 25-28 tons per acre prior to planting, yields of Shepody and Russet Burbank increased from to a pay weight of 140-150 cwt/acre compared to non-fertilized check plots with 50-70 cwt/acre in 2002. Commercial fertilization of trials with 800-1000 pounds per acre of concentrated fertilizer resulted in pay yields of 200-250 cwt/acre pay weights. Even when the full chemical fertilization program was practiced with Nitrogen (N), phosphorous (P) and potassium (K), potato yields continued to increase in the manure treated plots. The yield increases from manure may be a function of several factors -supplies of nutrients, increased microbial activity in the soil and increased water holding capacity due to the increased organic matter. Applications of pellitized chicken manure in 2003 (banded at 1000 pounds per acre) led to 30 % total yield increase over non–fertilized plots for the Russet Burbank variety but yields in the manured plots were still only 50% of the plots receiving concentrated fertilizer (13-20-20 at 1000 pounds per acre). Application of manure did not increase the severity of scab disease in the research plots.