HASKAP EVALUATION AND MANAGEMENT DEVELOPMENTS 2013-2014

NEOSCIA Partner Grant Project – Final Report

Purpose:

To determine the best soils, climate limitation, fertility management, and mulching requirements for this new variety of cool climate berry Haskap (*Lonicera caerulea*) in North-Eastern Ontario.

Background:

Introduced by the University of Saskatchewan (U of S) in 2007, this orchard crop is readily available (by pre-order) through both tissue culture and normal propagation, primarily through greenhouse producers in the western Provinces and the Maritimes. Although more than 500,000 plants of U of S varieties (crosses of Siberian and Japanese strains) have been purchased by both farmers and home gardeners (primarily in the west and Nova Scotia), there was probably less than 30 acres in Ontario prior to 2013, existing mainly on less than half a dozen identified sites. This could be due to the lack of management information available for Ontario, as well as the potential for the plant to do poorly in the warmer climate of southern Ontario (while possibly adapting quite well to northern Ontario conditions). Prior to 2013, little information or promotion of the crop has been done anywhere in Ontario beyond the spring nursery section of the Loblaw "Presidents Choice" grocery chain.

Methods:

In 2013, a total of 2000 plants (originating from tissue-culture) were purchased from Phytocultures Ltd. of PEI. 1680 of these were assigned to 15 growers who would each plant 100 "Companion" plants (25 from each of 4 U of S strains), plus a dozen "Pollinator" plants of a European strain. Each grower would choose what he thought would be the best soil for Haskap on his farm, and manage them by his own decisions. The growers would do survival and growth (height) measurements in the fall of 2013, and identify overwintering losses in the spring of 2014. The RCC for NEOSCIA would visit all sites in 2014, and take final survival and growth measurements, as well as basic soil tests and a cross section of plant leaf tissue for comparative analysis.

One grower (in Temiskaming) had a plastic mulch layer available, as well as a small drip-line irrigation system. This 16th site was chosen for an evaluation of both white and black plastic mulch, at two levels of material thickness. The site would also have amendments of water absorbing "soil polymer" added to specific sections of the rows, to increase the availability of moisture during the growing season. The grower used 160 plants from the original pool, and purchased another 300 plants in order to provide

NEOSCIA with sufficient plants for a meaningful test. The mulch test therefore had 100 plants from each of the 4 U of S varieties being tested, as well as additional “pollinators” in the rows. Measurements similar to those taken at the other 15 sites would be collected.

In 2014, each grower received an additional 46 plants in the spring, consisting of 10 plants of each of the 4 U of S varieties, plus 6 “pollinators” of European origin. These plants would have been potted, and in their second year of growth, in order to match the age and development of the plants that the growers installed in 2013. These plants were used to replace any stock that was found to be dead in the spring of 2014. (Extra plants were planted wherever the grower wanted them, but were not evaluated.)

The sixteen growers were chosen from across the NEOSCIA region, representing climate Zones #1 through #4. All 8 NEOSCIA Districts were represented. In addition, three other interested “Associated” growers allowed NEOSCIA to evaluate their (older) plantations for comparative purposes.

Results:

A: Survival Rates at Planting

Based on the fall, 2013 observations taken by the growers themselves, the overall first season survival rate was just over 90%. Note that some growers had almost 100% survival, while others had lost more than a third of their planting. Similar results occurred in the spring of 2014 with the replacement plants. Discussion with the growers determined that MOST growers received their shipment from PEI within three or four days of mailing. Those that planted immediately had virtually no transplant losses.

However two growers, in isolated locations, did not receive their shipments (via Canada Post) for a week in one case, and 10 days in a second situation. Due to a wet spring in both years, a few other growers had to hold off planting for as much as a week, and they too had more significant losses.

The 2014 potted two year old plants had a more difficult time in transportation. They were more difficult to box at the point of departure, and Canada Post did NOT treat them gently. When the boxes were opened, most growers found that a high proportion of plants had been knocked out of their pots, and much soil had been knocked off of the roots. There were more transportation losses in 2014 than in the previous year.

It is believed that in both years, failure to survive after planting could be directly attributable to packing problems and associated abuse/delayed delivery by the postal service.

B: Survival Rates Over-Winter (Climate Evaluation)

This was the primary good news story of the entire trial. As predicted by Dr. Bob Bors at U of S, the Haskap is ideally suited to winter survival across all of North Eastern Ontario. In the spring of 2014, most growers reported that they had only lost one or two plants overwinter, and these may have been plants weakened by stress of travel and transplanting in the previous year.

At the most northerly location, Moose Factory, the loss was the highest, at 4%. Still, not bad for a climate Zone #1 location. An "Associated" grower in Temiskaming purchased over 100 pots of two year old Haskap in the fall of 2013, and was unable to plant them due to wet conditions. These pots and plants were covered in leaves and left on the SURFACE of a garden for the winter. There were NO losses. Also keep in mind that the winter of 2013-14 was one of the coldest in the last few decades, complete with the constant winds of the dreaded "Polar Vortex"! Haskap is definitely winter hardy in Zones 1 to 4, and MAY have the POTENTIAL to survive winters along the James Bay coast in Climate Zone "0".

One grower elected to plant the 2013 Haskap in a temporary site, and then transfer the plants to a second, permanent site in the fall (October). This test was done to see if fall planting has any effect on plant survival. In this case, only 2 plants that were healthy at replant, died overwinter.

C. Soil Suitability

There are no current OMAFRA recommendations for either ideal Haskap soils or fertility programs in Ontario. That being said, we must recognize that there are no government recommendations for Haskap anywhere in Canada at this time. Unofficially, research personal suggest that for fertility improvement, a grower MIGHT want to try a raspberry or tomato fertilizer.

What we do know is that the plant grows very well in Saskatchewan, and produces abundantly on the U of S horticultural research lands. Furthermore, the U of S land is described as a Chernozem (orthic dark brown soil) that is moderately calcareous (6-40% range) and of medium to moderately fine texture. This mineral soil is well drained, with low organic carbon, and a pH of 6.1 to 6.7. The U of S does not fertilize the general planting, but does provide irrigation.

In Nova Scotia, a private company (LaHave Natural Farms) is also very successful at growing Haskap, and they make their own fertility recommendations. They have found that old hay fields on well drained Wolfville sandy clay loam is most suitable with an ideal 6.4 pH present. Organic content should be 5 -10%. They highly recommend compost tea, and mulch the soil surface after planting with fishery by-products that are high in calcium (scallop, oyster, and mussel shells). Note that agricultural specialists in NS consider well-drained, medium texture, Wolfville soils to be among the best available, but that they still need both lime and commercial fertilizer or manure to produce the best orchard and potato crops.

The NEOSCIA growers tried the Haskap in a wide variety of northern soil types, including Luvisol, Gleisol, Podzol, and high organic matter soils (see Chart #1). Based on the greatest stem lengths achieved by the variety Borealis, the soil analysis of the best 4 sites showed a history of high cow manure application and generally significant calcium content. These were Gleisol and Luvisol soils, but had been adjusted to a medium texture over years of manure addition (most were long term garden locations). The next 4 best sites also had substantial calcium content, but had no manure added. The remaining test sites generally had low calcium soils (Podzol), with no fertilizer or manure added, and these represented that half of the group with the least stem growth.

Moisture availability played only a minimal part in the outcome of the trial. All of the sites (except the free draining Podzols) were moist to wet through all of 2014, as well as the fall of 2013. In fact, excess rain in the spring of 2013 caused exceptionally high transplanting losses of Haskap (and strawberries) at one site, and the grower pulled out of the program. Other (low lying) fields had occasional flooding throughout 2014, but once established, this does not appear to be a concern for Haskap survival, although growth rates are believed to be reduced. An “Associated” Grower planted his Haskap on two- foot wide raised beds, and had better than average results in a high water table area.

D: Fertility Issues (from Leaf Tissue and Soil Analysis)

For the most part, this study only considered the response of the primary Haskap varieties to the natural fertility of the soil, given that the reports from U of S indicated that neither commercial fertilizer nor manure was added in most of their trials. Four of the NEOSCIA trials did involve soil with either a history of heavy manure application, or had manure added to the soil prior to planting. These four sites produced the greatest growth rates for ALL varieties, not just the Borealis that was the focus of Chart #1.

Three sites did have commercial fertilizer trials that were run in conjunction with other trials such as plastic mulch, manure presence, and fall transplanting. All three produced the same result in regard to commercial fertilizer. The growth rate of MOST Haskap varieties was significantly LOWER at the end of the second season, when commercial fertilizer was applied in the first year. One site indicated that a moderate level of commercial fertilizer application was superior to a high rate of application. There is no indication of which nutrient may be causing the negative reaction. More fertilization trials are essential.

A 9 sample leaf tissue analysis was undertaken in the fall of 2014. The trial was originally intended to take samples from all sites, but the shortage of leaves on most sites (of 112 plants) prohibited the project from being undertaken, for fear of damaging the viability of the plants going into winter. As a result, the test was conducted on the

Table 1. Comparative “Borealis” Growth Rates in Different Soils and Nutrient Regimes

Rank	Height (cm)	Moisture	Location	Soil	Comment
1	62.3	wet	Earlton	Dark Grey Luvisol - Calcareous clay	historic manure, no fertilizer added
2	54.1	wet	Earlton	Dark Grey Luvisol - Calcareous clay	historic manure+ fertilizer
3	42.4	wet	Lorraine Valley	Grey Wooded Luvisol - Calcareous silty-clay-loam	Composted manure, plastic mulch
4	40.1	wet	Bracebridge	Gleisol?-low Calcareous clay	composted manure
5	39.1	wet	Chelmsford	Rego-Humic Gleisol-Calc.silt-loam	historic manure, no fertilizer
6	33.7	wet	Verner	Gleyed Grey Luvisol-Calc.silt-loam	annual river flood plain
7	31.3	moist	Bracebridge	Luvisol? - low Calcareous loam	historic well fertilized soil
8	30.5	wet	Iroquois Falls	Orthic Humic Gleisol-Calc.clay-loam	very heavy plastic mulch
9	30.0	moist	Moose Factory	Luvisol? -Calcareous silt-loam	Soil + vegetable compost
10	29.0	dry	South River	Podzol - low Calc. gravelly loam-sand	Soil + incorp. Sawdust
11	28.5	very wet	Haileybury	Grey Wooded Luvisol-28% OM Incorporated In Calcareous subsoil	Fall transplant trial
12	26.9	moist	Timmins	Orthic Grey Luvisol-Calcareous loam	Carbonatite trial
13	24.8	dry	Wawa	Podzol- Low Calacareous sand	typical wild blueberry soil
14	22.1	wet	St.Joseph Is.	Orthic Gleisol-Low Calc. sandy loam	hay competition
15	NA	moist	Massey	Gleyed Grey Luvisol - low Calcareous silty-loam	lost in hay
16	NA	moist	Sault Ste. Marie	Podzol - low Calcareous sandy loam	lost in hay
17	NA	NA	Englehart	NA	withdrew
18	NA	NA	Manitoulin	NA	withdrew
19	Ref	wet	Haileybury	Grey Wooded Luvisol – 13% OM Incorporated in Calcareous subsoil	third year plants
20	Ref	moist	IGA Store	32% OM “potting” soil	designed soil
21	Ref	moist	Sturgeon Falls	Orthic Gleisol - low Calcareous sandy loam	fourth year Borealis (1 M) prod 4# per plant
22	Ref	moist	Blezzard Valley	Gleyed Humo-Ferric Podzol - low Calcareous sand, high water table	former sod farm, 2nd year: Tundra = 32.7 cm

500+ plants of the plastic mulch trial, and on the older plants of the "Associated Growers". On eight sites, the green leaves were pulled from the twigs in early September, and yellow/brown leaves were collected from the ground at the final site in October.

Leaf tissue was collected from all 5 varieties (Borealis, Tundra, Indigo Gem, Indigo Treat, and the Czech 17 Pollinator) at the plastic mulch trial. Soil quality, other additives, and manure application was similar across the site. What is most striking is the uniformity of the analysis for all varieties tested. As Haskap currently does not have a standard for analysis, the results were compared to "established raspberries", which have a comparable fibrous root structure. Under this pretext, the plants had deficient to low % levels of N,P,K, and Mg in the vast majority of tests. Similarly, the % Ca, Zn and B was high to excessive, while %Cu was always below the deficient standard. % Mn and Fe bounced between the low and medium range. The level of sulphur was low, (by LaHave Forest standards for Haskap, but not determined for Ontario raspberries) of between .28 and .42%. These results indicate that growers who have a large number of varieties need not be variety specific in their leaf collection for analytical testing. In lieu of any other Provincial results to date, simply take whatever leaves that you have, and apply the results uniformly to all varieties.

Three leaf tissue tests for plants grown in highly organic soils by an "Associated Grower" provided similar results, except that Magnesium was in the medium range, while Mg, Mn and Fe presence was medium to excessive. N,P,K and Cu were in the deficient to low range (same as the preceding 5 tests).

The final test was taken after leaf drop on a third site in order to evaluate if there were any substantial differences that could be attributed to either soil or timing of leaf collection. A slightly lower level of %N,P,K in the leaves may be associated with timing. Considerable differences in Zn, Cu, Fe, and B (when compared to the original 5 tests) could indicate a difference in the soil quality.

Note that the Ca% in the leaf tissue of all 9 analysis was Excessive (IF Haskap responds the same as Raspberries). The corresponding soil test in 8 of the 9 situations indicated a high presence of soil calcium. The 9th site had a low level of soil calcium, but the tissue analysis showed excessive concentrations. Recognizing that the Saskatchewan soils have an abundance of Calcium, this may be an indicator that Haskap have a specific need for Calcium that could be met by making the element more available to the plant.

A battery of 40 soil tests were taken, with evaluations completed for pH, OM, Texture, Cation Exchange, P,K,Mg,Ca,Zn,Mn,Cu,Fe,B, and Base Saturation, as well as Zn and Mn index, plus K/Mg ratio. This data will provide a baseline for future Haskap fertility research across the whole of north-eastern Ontario. A copy of the data has been sent to the OMAFRA Haskap specialist.

Again, with recognition that these results are for Raspberries as opposed to Haskap, attention to soil and leaf tissue concentrations of Boron and Copper should be reviewed. Despite high soil Copper levels, all leaf tissue tests were seen to be deficient. Conversely, despite uniformly low soil Boron analysis, all leaf tissue tests were analyzed as being high to excessive in Boron concentration.

Soil pH was identified as running from the mid-5 range in the case of Podzols, to the mid-7 range in the case of Luvisols and Gleisols with a high Calcium content. This is within the Haskap growing range.

Soil Organic Matter content may be a much more important indicator of soil health than any other factor except Calcium. First, we must recognize that the “designed” potting soil that is used by commercial nurseries was tested to be above 30% OM. The nutrition applied is unknown, but the high OM content allows fibrous roots to maximize their growth. Similarly, moisture deficiency is less of a concern in high OM soils. Haskap grown in Calcium deficient Podzols are also dealing with OM levels at less than 3%, and growth has been shown to be less than in high OM soils. Most Luvisols and Gleisols range between 4.5 and 6.5% OM. The exceptions are soils with heavy manure application (6 to 16%), and muck soil (over clay Gleisols) at 13 to 28% OM. Note that Haskap in well manured soil perform better than Haskap in muck soil (flooding issues in 2014?)

The issue of soil moisture was also addressed. The plants placed in the Haileybury Community Garden were assigned to the wettest corner. They experienced flooding in the fall of 2013, the spring of 2014, and from August to freeze up in 2014. Although the full response will not be known until the spring of 2015, the plants were definitely healthy, but visibly shorter than average, in this past fall. In 2014, the roots were NOT in saturated conditions for only 2 to 3 months. Some other low-lying fields also experienced flooding conditions in parts of 2014, but the plants are still alive. Note, however, that Dr. Bob Bors did find wild Canadian varieties of “Lonicera caerulea” flourishing on the edge of wetlands across northern Ontario, and especially near Thunder Bay. They were growing on hummocks, at the edge of fens and marshes, where it was too wet for Tamarack and Black Spruce, but too dry for typical aquatic plants. For comparison, at the U of S, a bulrush marsh that dried out a few years ago was planted to Haskap. When the water returned a couple of years later, the Haskap in the flooded center area of the marsh died out and the bulrush came back. However, the Haskap survived on the margins, wherever the bulrushes did not grow.

A water absorbing “soil polymere” was applied to specific sections of the rows under Plastic Mulch in Temiskaming. However, with the excessive moisture throughout 2014, there was no point in the growing season when the Haskap were stressed for moisture in any portion of the field. The trial will be evaluated in future, hopefully drier years, as the polymer could last in the soil for 5 years.

E: Soil Mulch Application

The test of various applications of plastic mulch gave very good results. Drip-line was placed under this Temiskaming trial, but it was only used to wet the soil directly after planting in 2013. Even in the hot, dry periods of the 2013 summer, soil moisture that percolated up from the subsoil was trapped under the plastic and kept the soil uniformly moist, without the need for using the drip-line. Only where plastic mulch was used (Temiskaming and Iroquois Falls) were weeds not a problem. Note that a number of growers lost control of the weed growth in the late summer of 2014, as they were unable to either rototill or mow in the continual wet soil conditions. Hand hoeing close to the plant damaged roots. (Weeds growing close to the plant had to be hand-pulled.)

As the summer of 2014 was cool and cloudy, there were no observations to be made on the potential value of choosing either black or white plastic mulch. However, it was clear that light duty mulch deteriorated too quickly to be of multi season value. Holes developed where animals (deer, ‘coons, and cows), trampled the cover. These holes had to be patched with red “Tuck Tape” that works very well. The ideal choice was heavy duty black plastic mulch that is normally used for tree plantations, and is expected to last 5 years. It withstood everything but the cattle stampede. A much heavier fabric was used at Iroquois Falls, and it had no perforations, but cost will likely prove prohibitive. Growth and weed control was good wherever plastic mulch was used.

No NEOSCIA grower used sawdust, chips, or bark as a mulch, but an “Associated Grower” used a primarily cedar sawdust as a mulch with very good weed control results and good Haskap growth. Note that there is a concern that extra nitrogen might need to be added when laying down a high carbon mulch, as soil organisms will rob the soil of nitrogen in order to improve the efficiency of carbon decay.

However, we must recognize that all plastic mulch will break down over time and a replacement mulch will be required in order to control weeds. Rototilling is not a long term option as the fibrous Haskap roots were found to spread out laterally, especially where there is a high water table. It is speculated that wood chips/sawdust could be placed over the decaying heavy duty plastic about year 6. The remaining plastic would keep the wood from direct contact with the soil, thereby slowing carbon decay. It may also be possible to place a thick layer of Podzolic sand over the plastic mulch at some point. These sands are readily available in the north, cost very little, and usually remain weed free due to their pH and ability to shed water. They can eventually be incorporated with the soil below. However, trials will have to be done to determine the correct depth of the sand.

Note that a long term, higher than average quality of drip-line must also be added under the mulch, in order to provide nutrients in a liquid form to the Haskap, a crop that could be productive for 30 years. Liquid fertilizer applications might also include organic sources of nutrients.

Summary:

Haskap is ideally suited to production in North-Eastern Ontario, from Muskoka to Moose Factory, and from the Quebec border to Wawa. It has been successfully tested and found to be winter hardy in Climate Zones 1 through 4, specifically in the winter of 2013-14, which was the most severe winter in decades in this region.

Haskap has been grown in many soil types from the mid-5 to mid-7 pH range. Growth appears to be best in Luvisol and Gleisol soils with significant calcium content. It will grow at a slower rate in Podzols with a low Calcium content, but these soils can be amended with CALCITIC lime to possibly improve growth rates. It is possible that other minor nutrients should be applied, but the grower must have ALL elements evaluated by means of a soil test, with a follow up leaf tissue analysis done as early as the end of the second year. It may be possible to get a “feel” for the needs of Haskap by evaluating the leaf tissue of other species that are already growing on the site (such as Raspberries or other fruit crops, or potatoes and tomatoes) that are “believed” by SOME plant specialists to need similar nutrition. This tact must be taken as there are currently NO government recommendations for Haskap fertilization requirements, anywhere in Canada.

Haskap roots are very fibrous, and they need mineral soils of moderate texture and significant moisture bearing capability. Acidic organic soils in the north (black muck or peat) will not carry all of the essential elements, especially Calcium. However, a shallow organic soil that can be worked into Calcium rich mineral subsoil could approach an ideal situation. When amending mineral soils to achieve a better texture and water holding capacity, our field research tells us that the first choice should always be manure. (There were test results that indicated that some element…in an unknown quantity…in commercial fertilizer may actually reduce plant growth.) The best alternative in the north is incorporation of organic soil. Apply all soil additives only to the row where the Haskap will be grown. Applications to the whole field will only increase competitive weeds and hay.

The use of plastic mulch that will survive for 5 or more years is critical to eliminate weed competition. Haskap roots tend to be shallow and spreading, therefore rototilling and hoeing will disturb them and thereby reduce plant growth. Similarly, a full lawn cover that can be mowed will compete for moisture and nutrients, reducing plant growth. The plastic also holds moisture under the layer, and cycles it in the soil below by way of percolation. If a wood based mulch is chosen, it should be primarily cedar as it does not decompose quickly, thereby reducing demands on soil Nitrogen availability.

If you choose to grow Haskap on Podzol soils, remember that at a minimum, lime should be tilled into the rows prior to planting. Because these more acidic soils have drought issues, organic material should ideally be added. To reduce risk even more, lay drip-line along the rows, then cover the rows with plastic in order to hold moisture in. (There was no result on the soil polymer trial, so at this point we cannot say if this soil additive will work as well as organic matter for moisture containment.)

Haskap will not die out on soils prone to flooding, as long as the site is relatively dry from mid-May through August, to allow for fruit production and annual growth. A trial by an Associated Grower, and tests done at the Haileybury Community Garden indicate that the development of a raised bed prior to planting will provide the “freeboard” that is necessary for good production.

Next Steps:

2014 is the last year for the HASKAP project. The RCC for NEOSCIA will continue to monitor as many sites as possible, and report developments (such as fruit production) in future editions of the NEOSCIA “Breaking Ground” farm newsletter. It is also important that a HASKAP DEMONSTRATION SITE be developed in northern Ontario, either on public or private land. In addition, it was noted that the individual plants of ALL varieties (produced by tissue culture) had a significant variation in height from plant to plant within each variety. If this trait exists through the 2015 season, reasons for it must be evaluated.

Acknowledgements:

NEOSCIA thanks OSCIA for providing the basic “Partner” grant of $10,000 over two years to carry out this project. Phytocultures Ltd. (WWW.phytocultures.com) of Cornwall, PEI, provided the plant material at 50% of the plant value, while SGS Agrifood Laboratories similarly provided analytical services at 50% of the true value. South Temiskaming Sud (Community Futures Development Corporation), funded through FEDNOR, is to be thanked for their contribution of $2560 that was applied to the soil and plant tissue testing program. A big thank you also goes out to the many farm co-operators, as well as the “Associated” growers who gave great support to the vision of a new horticultural product for the North.

Communication Plan:

This report will be redeveloped as shorter, more specialized articles, and will be printed in upcoming issues of the NEOSCIA “Breaking Ground” farm newsletter over 2015. They will be accessible on line, and by way of the OSCIA publication archives.

Project Contacts:

Evan Elford, the OMAFRA specialist for Haskap, based at Simcoe Research Station, is the Provincial contact for this project, and has a copy of all of the analytical data. Graham Gambles, (RCC for NEOSCIA) undertook the data collection for this project, and has copies of the analytical data, plus the original records of the plant growth for all varieties studied, and all other accumulated field data. If you would like to review specific data, contact him at 705-672-3105 or email to gamblesgraham@yahoo.ca