Haskap Breeding & Production
Final report, January 2009

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Introduction

Haskap, also known as blue honeysuckles, is a new fruit crop for North America. It has been receiving much interest from consumers, farmers, and the press because this fruit:

+Can have a wonderful blueberry/raspberry flavour (best cultivars)
+It is the earliest fruit to ripen (Mid June)
+Has extreme winter hardiness
+High in antioxidants and vitamins
+Can be mechanically harvested
+Few pests and could be grown organically on the Prairies
+Strong Interest in Japan to buy the crop from Canada
+Has a natural adaptation to northern climates, so it may may be difficult for potential competitors in warmer regions to grow it
+There is much interest in food processors, especially those developing dairy products

There is every reason to believe that the University of Saskatchewan is the world leader in the development of this crop: we have been told this by 5 leading Japanese fruit scientists and president of companies that process Haskap who visited us since 2006. Over the last 10 years we have assembled one of the world's largest and most diverse collection of Haskap derived from Russia, Japan, Kuril Islands and Canada. We have been the only ones to gather the wild Canadian version of this plant. We are pioneers in this area as there are no reports in the literature of anyone intercrossing selections from such diverse areas. However, it is a general principle in breeding of fruit crops that using breeding stock from widely separated locations often leads to hybrid vigour and superior new varieties. Over the last five years, superior selections in the collection have been identified and are beginning to be used in breeding. We have already found superior specimens in our first generation of hybrids.

This project focuses primarily on breeding and selecting new haskap cultivars. It also will perform experiments and make observations with a goal of providing guidelines for commercial production and propagation for this new crop. In particular, information will be gained on the benefits of 'fast tracking' propagation and whether forcing of large plants in the greenhouse is a feasible solution to quickly bring this new crop into the marketplace. The project also involves outreach and engagement activities with growers as well as gathering wild plants and building the University collection.

Note on the term ‘Haskap’: Growers of our new varieties will be marketing their fruit under the name ‘Haskap’ to help set them apart from the many poorer quality cultivars, many of which have commonly been called ‘honeyberries’, ‘sweet berry honeysuckles’ or ‘blue honeysuckles’. For the purposes of reducing confusion for this report I will refer to all cultivars and wild plants as ‘Haskap’.

Breeding

Previous Crosses:

Approximately 6,000 seeds were germinated in the greenhouse during spring of 2007 from seeds generated in previous years from crosses and from Dr. Maxine Thompson's program. These were from previous crosses and open pollination of our better selections. Of these plants, approximately 3,000 were distributed to 9 cooperative growers in Saskatchewan and 3,000 were planted at the U of S research field plots. Open pollinated seeds were also germinated and were sold to the public during our annual plant sale, generating additional funds for haskap and other breeding projects.

2007 crosses:

Based on previous observations, the 7 best Russian and 2 best Kuril accessions were used extensively in crosses. Also used, but only as male parents, were Japanese, wild Canadian, and advanced selections from our breeding program. All crosses were done between parents of different types according to Table 1.

In the field, 113 combinations of parents were intercrossed which resulted in perhaps 25,000 seeds. All female plants were covered with a 'remay' row covers to exclude bees. Most pollen was collected from greenhouse-forced potted plant. The Japanese parents had been evaluated previously by Dr. Bors at the Oregon Haskap breeding program being conducted by Dr. Maxine Thompson.

There were some crosses done in the greenhouse between the plants being used as pollen sources. Perhaps 150 combinations of parents resulted but only averaged 5 to 20 seeds per cross. Greenhouse plants were much smaller and did not set fruit as well as field crosses.

An estimated 18,000 seedlings were grown in our greenhouse from the above crosses. Germination rate was about 80%. However, as part of our selection strategy, we keep only the fastest germinating and most vigourous seedlings. Approximately 50 of the best seedlings of each cross were planted in our fields with the remainder of the better seedlings made available to interested fruit growers. These 24 growers paid $1 or $2 per plant (depending on labour contributions to the program) and signed a contract allowing the University to select from their plants for potential new varieties. (Note 4 of these growers had participated in 2007, thus 29 growers have our breeding seedlings).

2008 Crosses:

Crosses done in the field for 2008 are summarized in Table 2. Fewer seeds per cross were obtained because the "K" parents produce far fewer flowers. Also many of the "J" parents used were rather young plants recently obtained from Dr. Maxine Thompson's breeding program and also did not have many flowers. A notable difference in 2008 was doing the combination of K x J which should result in late flowering offspring.

Greenhouse crosses are summarized in Table 3. Seeds were saved from plants of Japanese origin and some were crossed with wild Canadian germplasm.

Table 1. Summary of field crosses done in 2007. Most crosses yielded between 150 and 250 seeds each.

			Parents					Parents					Parents	
Type	Code		Female	Male	Type	Code		Female	Male	Type	Code		Female	Male
KR*	7	1	98-12	2-06	RJ	J	4	2-07	444-39	RJ	V	14	2-16	45-14
KR	7	2	98-12	2-07	RJ	J	6	2-07	64-72	RJ	V	15	2-16	66-53
KR	7	3	98-12	2-10	RJ	J	7	2-13	41-83	RJ	V	16	2-16	77-74
KR	7	4	98-12	2-11	RJ	J	8	2-13	45-14	RJ	V	19	2-16	43-87
KR	7	5	98-12	2-13	RJ	J	9	2-13	46-55	RK	J	12	2-13	3-06
KR	7	6	98-12	2-14	RJ	J	10	2-13	22-14	RK	L	6	2-10	3-??
KR	7	7	98-12	2-16	RJ	L	1	2-10	77-87	RK	R	6	2-06	3-06
KR	7	8	3-03	2-06	RJ	L	2	2-10	43-87	RK	R	12	2-07	3-07
KR	7	9	3-03	2-07	RJ	L	3	2-10	44-76	RK	T	6	2-14	98-12
KR	7	10	3-03	2-10	RJ	L	4	2-10	46-18	RK	T	12	2-16	3-06
KR	7	11	3-03	2-11	RJ	L	7	2-14	46-55	RK	T	18	2-11	3-05
KR	7	12	3-03	2-13	RJ	L	8	2-14	66-53	RK	V	6	2-06	3-05
KR	7	13	3-03	2-14	RJ	L	9	2-14	22-34	RK	V	12	2-11	HS12
KR	7	14	3-03	2-16	RJ	L	10	2-14	77-87	RK	V	18	2-16	3-07
RC	B	5	2-10	Canada	RJ	L	12	2-14	64-72	RRK	B	0	2-10	Tundra
RC	B	11	2-13	S6	RJ	R	2	2-06	23-23	RRK	B	13	2-13	Borealis
RC	J	5	2-07	S6	RJ	R	3	2-06	66-89	RRK	J	0a	2-07	9-94
RC	J	11	2-13	Canada	RJ	R	4	2-06	45-14	RRK	J	0b	2-07	9-15
RC	L	5	2-10	S6	RJ	R	8	2-07	44-76	RRK	J	13a	2-13	9-94
RC	L	11	2-14	Canada	RJ	R	9	2-07	45-14	RRK	J	13b	2-13	9-84
RC	R	5	2-06	S6	RJ	T	1	2-14	41-83	RRK	L	13	2-14	Tundra
RC	T	5	2-14	S2	RJ	T	2	2-14	42-45	RRK	L	0a	2-10	9-94
RC	T	11	2-16	S6	RJ	T	3	2-14	79-85	RRK	L	0b	2-10	Borealis
RC	T	17	2-11	Canada	RJ	T	4	2-14	66-87	RRK	R	1	2-06	Tundra
RC	V	5	2-06	S2	RJ	T	7	2-16	46-55	RRK	R	13	2-07	Borealis
RC	V	11	2-11	S6	RJ	T	8	2-16	56-18	RRK	R	0a	2-06	9-94
RC	V	17	2-16	Canada	RJ	T	9	2-16	73-39	RRK	R	0b	2-06	9-84
RJ	B	1	2-10	66-53	RJ	T	10	2-16	444-39	RRK	R	13a	2-07	9-84
RJ	B	2	2-10	73-39	RJ	T	14	2-11	73-39	RRK	R	13b	2-07	9-94
RJ	B	3	2-10	22-14	RJ	T	15	2-11	66-53	RRK	T	0	2-14	Borealis
RJ	B	4	2-10	E6sdlg	RJ	T	16	2-11	E6	RRK	T	13	2-16	Borealis
RJ	B	6	2-10	64-72	RJ	T	19	2-11	41-83	RRK	T	20	2-11	Tundra
RJ	B	7	2-13	66-53	RJ	V	1	2-06	66-53	RRK	T	0a	2-14	9-91
RJ	B	8	2-13	43-87	RJ	V	2	2-06	44-76	RRK	T	0b	2-14	9-15
RJ	B	9	2-13	56-18	RJ	V	3	2-06	73-39	RRK	T	13a	2-16	9-91
RJ	B	10	2-13	44-76	RJ	V	4	2-06	444-39	RRK	T	13b	2-16	9-92
RJ	B	12	2-13	64-72	RJ	V	7	2-11	46-55	RRK	V	0	2-06	Borealis
RJ	J	1	2-07	56-18	RJ	V	8	2-11	56-18	RRK	V	13	2-11	9-94
RJ	J	2	2-07	66-53	RJ	V	9	2-11	66-89	RRK	V	20	2-16	Tundra
RJ	J	3	2-07	77-74	RJ	V	10	2-11	77-74	RRK	V	13B	2-11	Borealis

* indicates origin of parents as follows:

K = Kuril

R = Russian Cultivar

J = Japanese Cultivar

C = Wild Canadian Accession

Table 2. Summary of field crosses done in 2008. Approximately 50 seeds were obtained per cross.

Type	Code	Parents Female	Parents Male	Type	Code	Parents Female	Parents Male	Type	Code	Parents Female	Parents Male
KJ	JO 19	3-03	41-75	KR	LK 27	98-12	2-13	RJ	TS 5	2-10	79-95
KJ	JO 20	3-06	43-87	KR	LK 28	3-02	2-11	RJ	TS 7	98-09	41-75
KJ	JO 21	3-03	73-39	KR	LK 29	3-02	2-06	RJ	TS 11	98-09	44-64
KJ	JO 24	3-03	44-76	KR	TS 13	3-02	2-14	RJ	TS	98-09	79-92
KJ	JO 25	3-06	44-34	KR	TS 14	3-01	2-11	RJ?	TK 4	2-11	46-37
KJ	LK 18	3-02	44-63	KR	TS 15	3-02	2-09	RJK	JO 6	2-16	100-32
KJ	LK 23	3-02	66-53	KR	TS 16	3-01	2-10	RK	JO 4	2-16	27-35
KJ	LK 30	3-02	46-55	KR	TS 28	3-02	2-07	RK	JO 10	98-11	51-45
KJ	TK 16	98-12	79-32	KR	TS 29	3-01	2-16	RK	LK 1	2-13	A-19
KJ	TK 23	98-12	66-53	KR	TS 30	3-02	2-13	RK	LK 4	2-13	51-53
KJ	TK 26	98-12	73-34	KV	JO 18	3-05	46-48	RK	TK 1	2-11	51-49
KJ	TK 28	98-12	41-83	KV	TS 22	3-02	40-47	RK	TK 10	2-04	26-78
KJ	TS 18	3-02	79-92	KKJK	LK 20	98-12	74-92	RK	TS 10	98-09	26-72
KJ	TS 19	3-01	79-95	KKJR	LK 19	3-02	71-22	RR	TK 6	2-11	A-32
KJ	TS 20	3-01	44-64	KKJR	LK 24	98-12	77-87	RR	TK 12	2-04	52-33
KJ	TS 23	3-02	41-75	KKRJ	TS 17	3-02	89-46	RR	TS 12	98-09	52-41
KJ	TS 24	3-01	46-55	RJ	JO 1	2-16	52-48	RV	JO 5	2-16	46-48
KJ	TS 25	3-01	66-53	RJ	JO 2	2-16	F38	RV	JO 8	98-11	46-48
KJ	TS 26	3-01	73-39	RJ	JO 3	2-16	41-75	RV	TS 3	2-10	40-47
KJ	TS 27	3-02	56-18	RJ	LK 2	2-13	23-30	RRJ	JO 9	98-11	C-36
KK	JO 17	3-03	27-35	RJ	LK 3	2-13	E3	RRJK	LK 6	2-13	100-34
KK	TK 19	3-03	26-78	RJ	LK 8	2-09	E38	RRJK	LK 7	2-09	100-41
KK	TS 21	3-02	26-72	RJ	LK 9	2-09	52-48	RRJK	LK 12	2-09	74-92
KR	JO 13	3-05	2-07	RJ	LK 10	2-09	23-92	RRJK	TK 2	2-11	100-34
KR	JO 14	3-05	2-04	RJ	LK 11	2-09	44-63	RRJK	TK 7	2-04	100-25
KR	JO 15	3-05	2-13	RJ	TK 3	2-11	E38	RRJK	TS 6	2-10	100-40
KR	JO 30	3-06	2-10	RJ	TK 5	2-11	71-64	RRJK	TS 8	98-09	100-41
KR	LK 13	98-12	2-09	RJ	TK 8	2-04	E3	RRJR	LK 5	2-13	71-22
KR	LK 14	3-02	2-12	RJ	TK 11	2-04	43-87	RRKJ	JO 7	98-11	101-05
KR	LK 15	98-12	98-09	RJ	TS 1	2-10	23-30	RRKR	JO 11	98-11	3-07
KR	LK 26	3-01	2-14	RJ	TS 2	2-10	F38	RRKR	JO 12	98-11	9-92
								RRRJ	TS 4	2-10	89-46

* indicates origin of parents as follows:

K = Kuril

R = Russian Cultivar

J = Japanese Cultivar

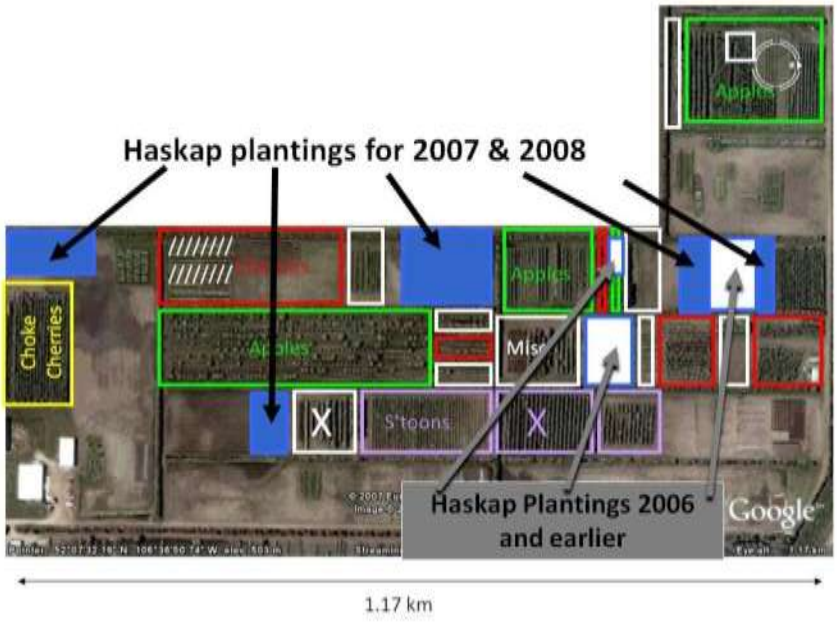
C = Wild Canadian Accession

V = subspecies venulosa

Table 3. Summary of greenhouse crosses done in 2008. These crosses yielded only a few seeds per cross.

				Parents							Parents	
Type			Code	Female	Male	Type		Code		Female	Male	
J	OP	U	1	22-34	OP	J	C	JM	1	bulk Japan		M8
J or K?	OP	U	2	226-61?	OP	J	C	JM	2	bulk Japan		M9
J	OP	U	3	22-72	OP	J	C	JM	3	bulk Japan		M10
J	OP	U	4	43-87	OP	J	C	JM	5	E6 OPOP		M11
J	OP	U	5	444-39	OP	J	C	JM	6	E6 OPOP		M13
J	OP	U	6	45-14	OP	J	C	JM	7	bulk Japan		M16
J	OP	U	7	46-55	OP	J	C	JM	8	bulk Japan		M18
J	OP	U	8	56-18	OP	J	C	JM	9	bulk Japan		M19
J	OP	U	9	66-53	OP	J	C	JM	15	E3		SK4A
J	OP	U	10	71-83	OP	J	C	JM	16	E3		S5
J	OP	U	11	73-39	OP	J	C	JM	18	E6 OPOP		S6
JR	OP	U	12	77-87	OP	KJ	CC	JM	24	KJ bulk		M10
R	OP	U	13	G23	OP	J	C	JM	26	bulk Japan		M13
KR	OP	U	14	9 15	43 87	J	C	JM	50	E6		S6
C	OP	U	15	Yukon	44 76	J	C	JM	51	E6		S7
C	OP	U	16	Yukon	66 89	J	C	JM	56	E6		M18
C	OP	U	17	Yukon	73 39	J	C	JM	58	E40		M28
CC	JR	U	18	Yukon	77 74	J	C	JM	59	bulk Japan		M33
						J	C	JM	61	E6		S3
						J	C	JM	62	E6		SK2A
						J	C	JM	63	E6		S5

Figure 1. Arial view of the Horticulture field plots at the University of Saskatchewan showing previous and recent Haskap plantings.



New Germplasm

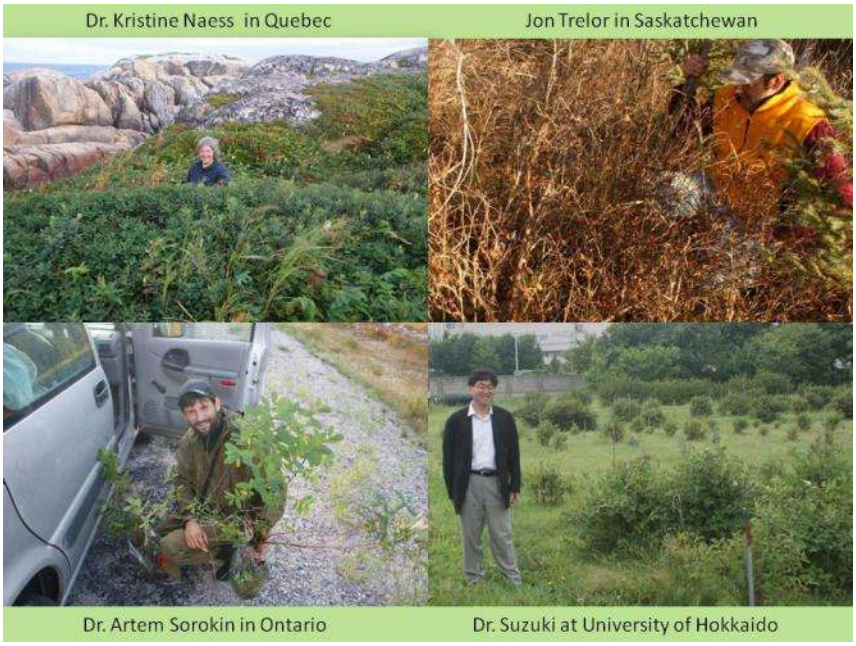
Hundreds of wild haskap were gathered from across Canada and our germplasm from Japan and Russia was substantially increased (Table 4.) Obtaining new germplasm involved many individuals and institutions (Figure 2). Graduate student Tyler Kaban obtained 20 clones from Dr. Maxine Thompson's breeding program at Oregon State University during 2007 while assisting her with harvesting and plant evaluations. Graduate Student, Jon Trelor gathered about 20 plants in 2007 and assisted with gathering wild Haskap in Saskatchewan in 2008. Dr. Bors and Loretta Bors gathered Haskap from Manitoba in 2007. In Japan, gathering Haskap was done by Dr. Bors in cooperation with Dr. Ukai and Dr. Suzuki of the University of Hokkaido and at least a dozen others assisted in the tours that were given. Seeds obtained during the Japan trip were shared with Dr. Suzuki. Dr. Kristine Naess played a key role in finding Haskap in Quebec and Labrador as she had already known several locations where the plants could be found, and she accompanied Dr. Bors on all searches in those areas. Dr. Artem Sorokin of the Vavilov Institute (the world's largest genebank in Russia) accompanied Dr. Bors in his trip through Ontario and sent us additional germplasm from Russia. Dr. Bors began a sabbatical in July of 2008, which made extensive plant collecting possible.

Other grants and plant royalties funded the above mentioned expeditions, but this grant funded the care of the new germplasm once it arrived at the University of Saskatchewan. The accessions from 2007 have been planted in the field but 2008 accessions are currently in pots and plug trays and will be field planted in 2009.

Table 4. Summary of new haskap germplasm obtained in 2007 and 2008. *Clones obtained from the wild were estimated to be 5 plants per location. *Germplasm from China, Russia and Mongolia was sent to us, but all other germplasm was directly gathered by U of SK Fruit Program personnel.*

Year	Location	Sites	Seeds	Clones
2007	MB	23	----	115
	SK	5	----	20
	USA	1	----	20
2008	AB	6	----	30
	SK	35	----	175
	ON	46	15	230
	QC	11	4	55
	NL	5	3	25
	Japan	12	16	----
	China*	1	1	----
	Russia*	----	16	6
	Mongolia*	1	1	----
	Wild		27	650
	Cultivars		29	26
	Total	146	56	676

Figure 2. Some of the people involved in gathering haskap.



Wild *Lonicera caerulea* was found in: seasonal streams, openings in deciduous boreal forest where fallen trees were decomposing, high calcium soils, and disturbance areas near road construction. It was never observed to be a dominant species and was not as common as other *Lonicera.* It seems highly unlikely that this species will ever be invasive. Mainly it grows in areas where trees are doing poorly, in wet areas and partly shaded. It may be an understory plant adapted to low light levels. Figure 3 shows areas in Canada where plants were gathered.

High diversity was noted among wild accessions gathered in Canada. Variation in leaf size, disease resistance, plant height was noted. Some plants were found close to salt water and most berries tasted were good flavoured. Compared to cultivars, wild plants had very small fruit. It is hoped that these plants will be valuable in providing hybrid vigour, disease resistance, and adaptation to Canadian growing conditions. Japanese accessions will undoubtedly contribute large fruit and good fruit shape in future breeding efforts (figure 4). However, Japanese Haskap lacks characteristics needed for mechanized harvesting which can be found in Russian and probably Canadian germplasm.

Figure 3. Google map showing locations where wild Haskap was gathered. The program that generated this map causes pins to fade when too many pins are in close proximity. In fact, there were 126 sites in Canada where wild haskap was obtained. Probably over 300 other sites were searched that did not have haskap. To our knowledge this is the 1st time living plants from this species have been extensively collected in Canada.

Figure 4. Japanese Haskap with exciting large fruit, most of which have the desired round or oval shapes. Some fruit was twice the size of the largest fruit grown at the University of Saskatchewan! Too bad the largest fruit was rather fragile. Seeds were saved from all the fruit shown.

Interesting note:
Hearing that our program had used umbrellas to harvest haskap fruit caused one of the Japanese farmers to laugh profusely, and may have been a factor inspiring the farmer to give Dr. Bors the largest fruit depicted in Figure 4. It was only after that hearty laugh that the farmer led the visitors to his better orchard and later gave Dr. Bors his largest fruit! By 2008, the bushes had grown too large for umbrellas at the University of Saskatchewan; instead children's hard plastic swimming pools were used!

Germplasm expansion summary
This grant allowed a four-fold increase of our field plantings but when the seeds and potted plants in storage are planted next year the result will be a 10-fold increase in germplasm and seedlings from our breeding program.

Germplasm Evaluation

Evaluation of Russian breeding stock:

For 2 years, our team (Tyler Kaban, Jon Treloar, Travis Sander, Jennifer Oulette, and Lee Kalcits) evaluated 17 Russian cultivars for 21 characteristics plus gave them gave them an overall rating (Table 5). Results are compiled in Table 6. The choice of which Russian parents to use for breeding parents in 2007 was based on general notes. But in 2008 it was the 2007 data from this study that played a major role in determining which parents to use.

Noteworthy is that all Russian cultivars fell short of a 'perfect' score, ranging between 64 and 78% using the 'Index Rating'. The 'Field Rating' gave a much wider range of scores, ranging from 50 to 91%, but this method is less scientific and is similar to the selection methods we relied upon prior to this study. Likely, flavour has much to do with choosing a favourite cultivar in the field.

But this study was not an attempt to find what Russian cultivars to plant, but rather to identify superior breeding stock to combine with Japanese haskap. Japanese haskap has noticeably better bush characteristics and larger and better shaped fruit but lacks important characteristics for mechanized harvesting.

Flavour is a concern in both Russian and Japanese haskap. Great flavour seems to be present in 25% of cultivated Haskap, mediocre flavour in 50% and bitterness in 25% (loosely based on travels and evaluations of seedlings in our breeding program). Indices for flavour and mechanized harvesting were compared which resulted in identifying 6 superior Russian cultivars that will be used in breeding in the near future (Table 7).

Table 5: Haskap evaluation sheet

Accession #	_____	**Evaluators**			**Jon & Tyler**		**29-Jun-07**
Bush	**vigour**	low	slight	average	more	very	
	canopy	weeping		spreading		upright	
	productivity	low	slight	average	more	very	
Fruit Retention		holds on tightly	holds on slightly	optimum	detaches easily	falls off	
Scar wetness		Skin tears	oozing without squishing	oozing with squishing	slight oozing with squishing	dry	
Frequency of wetness		0%	25%	50%	75%	100%	
Fruit size		very small	small	average	large	very large	
shape	football	cylinder	bullet	oval	long oval	square	round
side view		flattened		slightly flattened		not flattened	
length		short		medium		long	
texture (in hand)		very soft	soft	average	firm	hard	
Distal end	**shape**	pointed		belly button		rounded	
	opening	small		medium		large	
	hairs	very heavy	heavy	some	slight	none	
Skin texture		smooth		irregular		bumpy	
Bloom		none	some	moderate	above avg	heavy	
Sweetness		none	slight	moderate	above avg	heavy	
Sour		none	slight	moderate	above avg	heavy	
Bitterness		none	slight	moderate	above avg	heavy	
Aroma		none	slight	moderate	above avg	heavy	
Texture (in mouth)		very soft	soft	average	crisp	chewy	
Overall	one of the worst	bad	poor	bland	good	excellent	one of the best

Table 6. Evaluation of 17 Russian cultivars over 2007 & 2008 with 2 reps per year. The 'Field Rating' is the overall impression of the cultivar based on the opinions of the evaluators. The ' Index rating' is based on all characteristics accessed in Table 5, giving them equal weight in a mathematical model. Both Rating systems are expressed as the percent of possible points (ie. 100 would be perfect).

Cultivar	Field Rating	Index Rating
2-04	50	64
2-05	64	72
2-06	83	74
2-07	64	66
2-08	73	70
2-09	63	71
2-10	84	75
2-11	73	74
2-12	64	72
2-13	71	73
2-14	73	74
2-15	66	69
2-16	91	76
2-17	68	76
2-20	57	66
98-09	69	78
98-11	64	71

Table 7. Cultivars ranked in order of decreasing flavour and suitability for mechanized harvesting. The flavour index included evaluation of maximum sweetness and aroma, a moderate level of sour and a lack of bitterness. The index of mechanical harvest ability included data for: fruit retention, scar wetness, frequency of wetness, fruit size, shape, side view, texture (in hand) and distal end shape.

Rank	Flavour	Mech. Harvest
1	2-13	2-17
2	2-17	2-10
3	2-06	98-09
4	2-11	2-16
5	2-16	2-12
6	2-10	2-05
7	2-05	2-14
8	2-08	2-13
9	2-15	2-08
10	98-11	2-09
11	2-14	98-11
12	2-04	2-06
13	98-09	2-20
14	2-20	2-11
15	2-09	2-15
16	2-12	2-07
17	2-07	2-04

	indicates cvs with both flavour & harvestability in the upper 50%
	indicates cvs with either flavour or harvestability in the lower 50%

Relative importance of different Lonicera germplasm for Breeding

Mechanized harvesting

Generalizations regarding different types of *Lonicera caerulea* germplasm are summarized in Table 8. From this table we can conclude that multiple types of germplasm are needed to create superior varieties. This table gives insight into our crossing strategy (Tables 1, 2, 3) which has mostly been intercrossing different types of germplasm. This has been a strategy of Russian breeders, except they have only had access to germplasm from Russia and Kuril. Japanese breeders have only worked within the Japanese germplasm. Only the Oregon State University (Dr. Maxine Thompson) and the U of Saskatchewan Programs have utilized Russian, Japanese, and Kuril germplasm. Considering traits needed for mechanized harvesting, superior new cultivars could be created by crossing Japanese or Kuril stock with either Russian or Canadian stock. However, Russian and Japanese stock has been under cultivation longer and breeders and farmers have already brought together many desirable traits in their cultivars. Thus it is likely that the Russian x Japanese combination will be the fastest way to develop new cultivars. Yet, Kuril and Canadian germplasm have desirable traits that could be useful. Also, hybrid vigour is very desirable phenomena that can occur when interbreeding plants from widely separated geographical locations. Graduate student, Jon Trelor has begun investigating genetic relationships between Saskatchewan and other *Lonicera* germplasm. As with other northern boreal species, it is likely that the Canadian germplasm may be distantly related to the European and Asian species and possibly exhibit hybrid vigour when used in breeding. It will be a few years until the Canadian crosses generated during this grant will be old enough to determine if hybrid vigour occurred.

As we evaluate the new germplasm obtained in the last few years, table 8 can be used to identify superior accessions within each group to use in breeding. For example, if we can find Japanese accessions that have uniform ripening and don't hold too tightly onto their fruit, they would be used extensively in breeding.

F*ruit quality*

Flavour is quite variable in Japanese and Russian berries. Within each group there are individuals with exceptional flavours, but fruit being somewhat tart is most common. It was rather surprising to discover that some varieties bred in Siberia were intentionally bred to have some bitterness. Our visitor from Russia, Dr. Sorokin, explained that the bitter berries are used in preparation of flavoured vodka, having a similar utility to tonic water. During the visit to Japan, most of the farms visited had seedlings gathered from the wild which varied quite differently from bush to bush. Undesirable bitter and bland fruit seemed to be almost as common as tart and sweet fruit. While in Japan, some blue honeysuckles purchased from China was found to be horribly bitter. It was explained that such fruit might be suitable for medicine but was not good for food products.

In contrast to Japanese and Russian cultivars, the few Kuril selections in our collection are all rather sweet and mild. If anything, the Kuril accessions seem to need additional tartness. Indeed many of our Russian x Kuril hybrids have a good blend of sweet and tart that gives a superior flavour to either parent. Similarly, fruit from the 12 or so wild Canadian accessions so far tasted were good flavoured, but seem to be more like Kuril.

But only a small sampling of wild Canadian berries was eaten as the seeds were too valuable.

Thus far, wild Canadian berries appear to be the smallest of all but the fruit has only been observed in the wild. It is likely that fruit size will increase when grown under cultivation without weedy competition. It will also be interesting to see if the Canadian accessions continue to display the bright blue colour that the berries occasionally displayed in the wild. A brighter blue colour may indicate a thicker wax layer on the fruit and could be protecting the fruit from rots and from drying out. Some of the fruit found in late August in northern Ontario was still found plumb and good tasting yet the fruit had been ripe at the end of June according to a local passerby.

Table 8. Comparison of traits for different types of Lonicera caerulea germplasm. These are general observations, there can be exceptions.

Types	Advantages	Disadvantages	Other
Russian	+Uniform ripening +Most can be harvested by shaking +Upright plants +Productive +Early ripening +Tart flavour common	-Tubular, smaller fruit -Plants quit growing by end of June -some can be bitter	*Variable for flavour and disease resistance
Japanese	+Larger more rounded fruit +Longer period of active growth +Productive +Late ripening +Tends to be resistant to leaf diseases	-Uneven ripening -Most plants hold onto fruit too tightly	*Variable for flavour
Kuril	+Uniform ripening +Late ripening +Sweet pleasant flavour +Larger, round fruit +Highly resistant to leaf diseases +Leaves stay green and healthy through summer	-Low productivity -Short plants - Most plants hold onto fruit too tightly	*most of the good traits seem to be dominant when used in crosses
Canadian	+Early ripening +Brighter blue than other types +Most are sweet pleasant flavoured +Well adapted to Canada +Mostly round fruit	-Small fruit size -Most plants have drooping branches	*Only recently acquired, there is much we don't know about these. * variable resistance to leaf diseases

Fruit Shape

Examples of different fruit from various regions can be seen in Figure 5. Round or oval fruit are more desirable for rolling on a sorting line, but might be more desirable for marketing purposes. Although the berry depicted in Figure 6 is certainly 'shocking' and liked by many, an informal survey done by students an few years ago showed that only 20% of students liked that shape; 80% liked oval or round. Also, in Japan drawings of Haskap fruit on products always show roundish fruit (Figure 7). If processed, fruit shape would not matter, but it could matter if fresh or frozen fruit is sold to the public.

Figure 5. Fruit from different germplasm pools. In the Russian and Japanese photos, each berry is from a different cultivar and the stem is facing up. In the 'Japanese photo' the long berry is actually a Russian berry included for contrast. An attempt has been made to keep the photos at a similar level of magnification to illustrate size differences. Except for the wild Canadian berries, all other berries are from plants about 4 years of age. We have observed that berries can get much larger as the bushes get older.

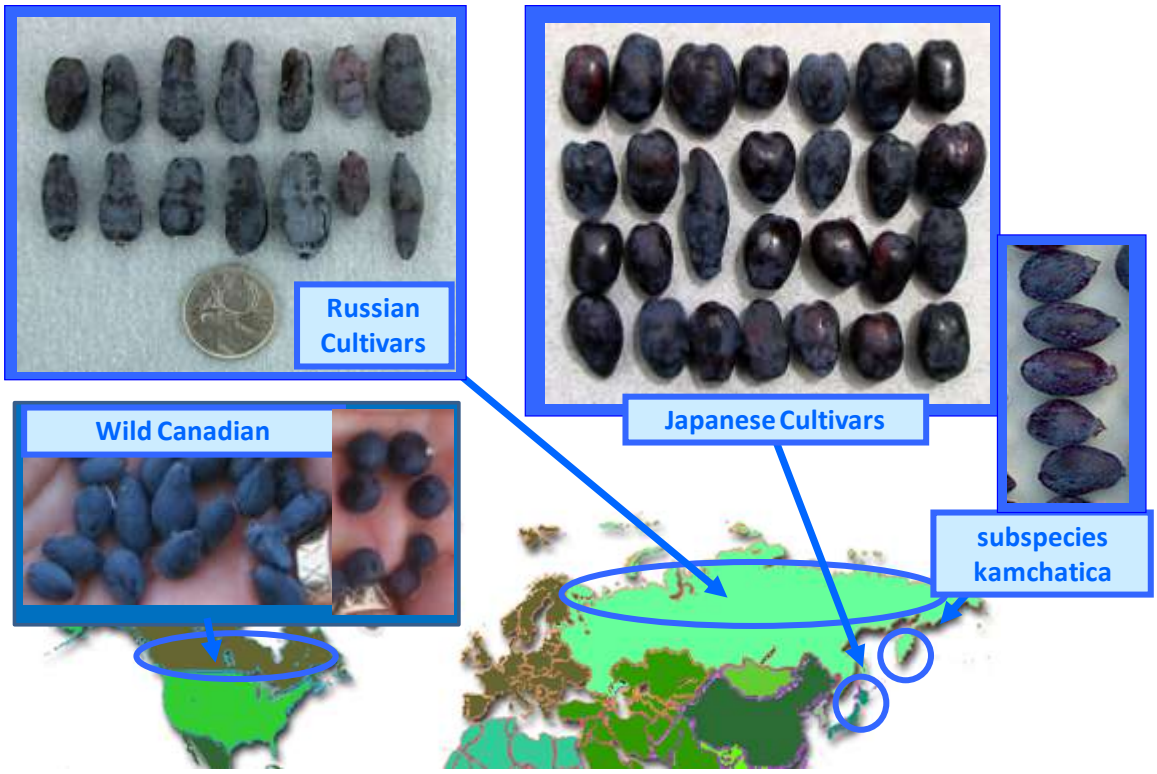


Figure 6. A Russian accession with unusually long fruit. Most accessions have fruit half as long. Unfortunately, this long fruit was quite delicate and did not roll properly on a sorting line, making it undesirable for mechanical harvesting and sorting. If such fruit were less delicate and available in grocery stores, would people buy it because it is so different? These large fruit appeared during the 6th season.

Figure 7. Some Japanese products with illustrations showing round Haskap fruit. Products shown include candy, tea, jam, and wine. Other Haskap products sold in Japan are baked goods, juice, ice cream, noodles, fresh and frozen fruit. In the centre is the Haskap Producers new mascot 'Prince Haskap' born in 2008! Interestingly, 3 of the illustrations show uneven ripening.

Selecting our best seedlings

In 2007, a field of approximately 1200 seedlings was evaluated for possible release. These were from crosses done 4 years previously when we had only a few varieties in our collection. Within each row, the best plants were chosen based on observations of productivity, fruit size and flavour. They were then evaluated for mechanized harvesting as illustrated in Figure 8.

Figure 8. Mimicking mechanical harvesting and sorting to evaluate our seedlings. This figure is taken from a presentation given on Haskap Day 2007. The program can't afford a mechanical harvester, so that operation was mimicked, but we do have a cleaning and sorting machine.

- Step 1: Tag best plants in each row for:
  - Productivity
  - Healthy Plants
  - Large Fruit Size
  - Flavour

- Step 2: Harvest Best Plants
  - Shake into umbrellas
  - Did berries stay on the plants and shake off easily?
  - Bleeders?
  - Total Yield

Figure 8 continued.

- Step 3: Initial Processing
  - Run through sorting line
  - Firm or Mush?
  - If too small or not round enough there were problems

- Step 4:
- Fruit size & shape
- Taste Test on frozen fruit
  - Panel of 9: growers, professors, students, technicians
  - Compare best 8 from 'Row 9' with 'Blue Belle' and frozen blueberries

Note: The top fruit's shape was undesirable plus it had ugly hairs on the end. The boxy fruit below was deemed more desirable.

Result:

- **All Row 9 were easily better than Blue Belle or Blueberries**
- **Slight taste differences between row 9 plants**
- **9-94 (Borealis)**
  - **best flavour, largest berries**
- **9-84 (Tundra)**
  - **almost best flavour, 2nd largest berries**
  - **Looked good after sorting line**

Variety trials

The original grant proposal called for the establishment of variety trials. However, none of the cultivars evaluated (in Tables 6 and 7) were fully acceptable for mechanical harvesting. As a group the Russian cultivars lacked large fruit size and were not round shaped (Table 8) and we were under obligation not to distribute any of the Japanese clones from Dr. Maxine Thompson's breeding program. It seemed counterproductive to establish trials for unacceptable cultivars. Instead, we distributed 7500 seedlings to 23 growers (in 2008) with at least 75% of these growers being from Saskatchewan. Most growers received 300 seedlings which included representatives from 10 different families. Growers received hybrids resulting from intercrossing Japanese and Russian cultivars, which as mentioned earlier, is the combination most likely to be successful in the near future. All growers signed agreements allowing the University to retain all rights for future varieties.

Additionally we had planned to do a greenhouse trial to discover a range of pH for Haskap. We consulted with soil scientist who said this would be impractical, as the only way to attempt such a test might be to use sand a substrate, which would not be very meaningful to growers. Also if we wanted to use a peat based potting mixture, it would be unworkable because it is difficult to change the pH of such a naturally acidic substrate. In the wild however, Dr. Bors encountered wild Haskap in swampy areas known for lower pH while also knowing that the University plots are pH 7.9. In tissue culture the plants get pH 5.7! In the wild I have seen wild Haskap growing side by side with blueberries, and blueberries are known to have an optimum pH of 5.4. Also in the wild I have seen Haskap growing in the high calcium soils of northern Manitoba.

It seems unlikely that pH will be of concern to haskap growers. However, pH is a major concern for blueberries, which cannot be grown in many area including the Prairie, because our soils are too alkaline. In the last two years we have 29 farmers growing our breeding seedlings (26 being in Saskatchewan) and likely hundreds of gardeners and farmers buying our new cultivars. It will be rather easy in the years to come to have soil tests done on some of these locations to determine a range of optimal soil conditions for this crop. But it also seems likely that the plants collected across Canada this last year may have differences in adaptation to different soils.

New Haskap Varieties released

During 'Haskap Day' in 2006, the growers and nurserymen were quite impressed with our 'row 9' seedlings and they insisted that the best from that row be selected and released as new varieties. The convincing argument given at the time was that inferior cultivars were finding their way into the marketplace which could discourage growers and consumers from this crop. Row 9 plants were in fact hybrids between Russian and Kuril cultivars. They possessed the tartness of the Russian and the sweetness of the Kuril parents and fruits were noticeably larger than other Russian cultivars we were testing (see Figure 9). Growers were aware that even better cultivars would be produced by the program in perhaps 5 years, but most felt they would rather learn to grow with these new plants than with inferior ones. In 2008, after extensive tasting of more Japanese and Russian Cultivars, the 'row 9' seedlings are still at the top of the list for flavour.

Figure 9. Berry of a 'Row 9' plant, which resulted from a Russian x Kuril cross (9-91). Similar in length but twice as wide as the Russian parent, many 'Row 9' plants had berries heavier than any Russian cultivars in our collection. Such results were completely unexpected. The 'Row 9' cross was originally done out of intellectual curiosity since Kuril plants are the least productive plants in the collection and the shortest!

In 2007, the best plants in Row 9 were evaluated, selected, propagated and released to nurseries. The two varieties were named. 'Tundra' was recommended for commercial growers while 'Borealis' was recommended for gardeners. Both were in the best flavour category. The main difference between them is that 'Tundra' fruit was the most durable and looked well after shaking off the bush and being run through a sorting line and 'Borealis' had the largest fruit in row 9 but was rather delicate. Three other selections were released for testing but were not named: 9-15, 9-91, 9-92.

The following section is a document given to propagators to use in promotional information:

New Haskap Varieties from the University of Saskatchewan

Note: we are calling these varieties 'Haskap' because our Japanese co-operators considered them to be of high enough quality to be used in the Japanese market. Also, these varieties have ancestors from the Kuril Islands which were once part of Japan.

'Tundra' may be the variety best suited for commercial production at this time (2007). Tundra's fruits were firm enough to withstand commercial harvesting and sorting at the University of Saskatchewan, yet tender enough to melt in the mouth. Firmness is a rather rare trait especially for large fruited blue honeysuckles. Ranking at almost the top for flavour and fruit size the shape of its fruit was deemed acceptable for the Japanese market. Its fruit is at least 50% larger than blue honeysuckles currently available in Canada. Its firmness and the fact that this variety does not 'bleed' from the stem end when picked could make this variety especially suited for Individually Quick Frozen (IQF) processing.

'Borealis' has the distinction of having the best testing and largest fruit size in our breeding program as of 2007. (However, there were many good tasting haskap varieties and it was hard to decide) Its fruits were usually twice the size of any of the 35 Russian varieties in our collection of similar age. (Most varieties of haskap/blue honeysuckles seem to have larger fruit as the bushes get older). Unfortunately, this variety does not have the firmness of 'Tundra' and it is not suitable for IQF. It tends to get a bit mushy when handled with equipment. It may be best for home gardeners or U-pick operations who can hand pick the delicate fruit. Or if shake harvesting the fruit, the berries will be damaged and will need to be quickly processed. Not only did the breeder and a University panel choose it as having the best flavour, but its top rating for flavour was also verified by a Japanese Company that chose it as the best tasting of 43 samples!

Three Experimental Selections

Propagators and growers interested in commercial production prevailed upon us to release additional varieties for trial. The following two selections are from the same family as 'Tundra' and 'Borealis' and are similar in flavour. If additional tests in the coming years are favourable, then we may give these selections names.

'9-15' This selection had almost twice as much fruit, by weight, than other selections in its family. However, yield of the original mother plants is not always a reliable predictor of yield if grown elsewhere and requires additional plantings to verify. This selection also has a trait rare in Haskap; its berries are a bit chewy when eaten fresh. Perhaps this trait is desirable for some processed products. We are hoping that chewy fruits hold their shape better when cooked. We plan to test this selection further to see if there is some advantage of 'chewy' in processing.

'9-92' This selection is like a slightly smaller version of 'Tundra'. It could be mixed in the same rows with 'Tundra' plants and harvested at the same time. Its flavour is similar

but more tangy than 'Tundra' which may be more desirable for some products. Only a few propagators have this selection as it was harder to propagate.

'9-91' Similar in fruit size to tundra but easier to propagate than '9-92'. Berries a bit more stretched than others being released for testing. Flavour is excellent.

Characteristics of the 2007 Haskap varieties from the U of Saskatchewan

Name	Scar	Yield (g)	Average Fruit Weight (g)	Fruit End	Fruit Shape	Flavour	Stems	Integrity
Borealis	Wet	average	1.62	small + bb	short flat boxy	sweet tart	a	c+
Tundra	Dry	average	1.49	small	long flat bullet oval	sweet tangy	a	a
9.15	Dry	above average	1.30	small	robust short oval	sweet, chewy	a-	b
9.91	Dry	average	1.41	small	Flat cylinder	Nice tangy sweet	a	b-c
9.92	Dry	average	1.29	small	long flat oval	tangy sweet	a	a

Explanation of characteristics measured

Scar

The scar is where the fruit is attached to the stem.
Some fruits 'bleed' at the scar when picked (wet) or are dry. Dry is preferable.
A wet scar can mean that the fruit was picked too early.
However, some varieties may always have a wet scar.
We harvested our fruit the last week in June.
Borealis, is either is a late variety or it may always have a wet scar.

Yield

Yield is based on the mother plants that were approximately 2 feet high and 3 years old.
This data is very preliminary and inconclusive.
To be measure yield properly, it is best to have many plants on several soil types.
The U of S site is notorious for its heavy clay soil and slow growth of young plants.
That 9.15 had twice the yield was an important reason for its being selected for further trials.

Avg. Fruit Weight (g)

We measured 10 berries of each selection, but did not include any unusually small fruit.
Very small fruit can occur when a certain flower was not well pollinated.
The average Russian blue honeysuckles at that age were 0.7 grams and the largest were 0.9 grams.

End

The ends of the fruit where the flower was attached can vary.
Small is desirable. bb is short for belly button.
Some people like the bb, some don't
Pointed hairy ends are most undesirable, none of these selections had that

Flavour

Descriptors are listed in order of importance.
Thus sweet tangy is sweeter than tangy sweet.
A panel of 8 compared 8 U of Sk selections, Blue Belle and frozen cultivated blueberries
All U of S selections were unanimously judged superiour to Blue Belle and blueberries
The U of Sk selections were considered highly acceptable and similar
but there was a preference for 'Borealis' as the best tasting of the above group.
Chewiness of 9.15 is not desirable for fresh fruit. More research is needed to
determine if 9-15 could be good for certain products that require a firmer berry.

Stems	Selections were harvested by shaking fruit off the bushes. Notes were made regarding how many stems were still attached to the fruit. An 'A' rating meant that stems were not found on the fruit. An 'A' rating meant that a few stems were found on the fruit after shaking.
Integrity	After shaking, fruit was run through a sorting line which drops fruit a few inches while a fan blows off debris. This caused damage to many selections. An 'A' rating meant that fruit was mostly dry and undamaged A 'B' rating meant that Fruit was slightly damp from juice released from damaged fruit A 'C' rating was average damage which would not be optimum for commercial production, most of the fruit tested in the program got a C rating. D' and 'E' ratings were for selections with extensive damage

For more info on Haskap or other prairie fruits visit:
http://www.usask.ca/agriculture/plantsci/dom_fruit/index.html

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To further assist our propagators, photos were taken and given to them for use in their catalogs, websites and other promotional material (Figure 10).

Figure 10. Photos like these were taken for each of the new varieties for our propagators. These are all of 'Tundra'.

Propagation and Cultural Practices

Tissue culture methodology and cultural practices were improved during the last two years. As we developed or observed worthwhile practices, the new ideas were written into handouts and put on the web and often would be talked about in presentations to growers. Propagation technology however was not shared with the general public, but has only been given to licensed propagators of our new varieties.

Tissue Culture Handouts

Two handouts based on our research were given to propagators of our new cultivars. The first summarized TC experiments. As tissue culture companies often experiment, it was important to include what did not work as well as the best new treatments. The second handout incorporated the results with previous research we had done years ago, into a new recipe.

Pollination testing

Our new haskap varieties were cross pollinated with each other and covered with cloth bags to exclude bees. We did not get satisfactory results so we recommend using unrelated Russian varieties for pollination. Below is the text that describes what was done that became a handout for growers. Propagators have also distributed this handout to growers:

. *Haskap Pollination Strategy*

By Dr. Bob Bors

Haskap/blue honeysuckles need cross pollination

Haskaps require cross pollination of a compatible variety to produce fruit. It is often said that "two varieties are needed for cross pollination" but that rule is an incomplete truth. The whole truth is that "two varieties with different compatibility genes are needed for cross pollination"; they also need to bloom at the same time.

Which Varieties to choose as pollinators?

Plant varieties that are not directly related as pollinators. The new U of S varieties are related to Blue Belle, Blue Velvet, Kiev #8 and 'Tomichka', so these may not work as well. It is more likely that other Russian varieties could be acceptable pollinators such as 'Berry Blue' 'Berel', 'Gerde', 'Ognennyi Opal' or 'Dew Drop'. Why Russian varieties and not Japanese or Kuril Island types? The Russian varieties bloom the same time as our new varieties. Japanese and Kuril types bloom 2 to 3 weeks later. Of the above possible pollinators, I'd recommend 'Berry Blue' (also called Czech #17) because it is a fast growing tall plant that makes many flowers. The flavour and yield is acceptable although

the fruit size is very small. I don't know enough about the other varieties mentioned to make a judgment.

Can the recent U of S varieties pollinate each other?

Since our first generation of Haskap varieties are closely related they likely share some incompatibility genes. We intercrossed our new Haskap varieties and test selections (Borealis, Tundra, 9-15, 9-91 and 9-92) with each other in Spring 2007. Results so far indicate that 9-15 was the best pollinator in the group but that it wasn't as good as using most Russian varieties. 9-15 pollen did result in fruit set of Borealis and Tundra, but the berries did not seem to be as big, indicating partial seed set in the berries. For most fruit, the number of seeds that set inside a fruit is proportional to fruit size. We will attempt the experiment again in 2008 to verify the results.

Unfortunately, we are obligated to not release varieties in our collection that were given to us for the purposes of breeding. However, we could release seedlings from the breeding program. I will be writing an article on this topic.

How many pollinators do I need?

The below chart illustrates 3 planting plans for pollination. On the left is a strategy for using 2 varieties that are equally desirable that can pollinate each other. In the centre is a plan where variety X is more desired than its pollinator (p). On the right is a plan for using a pollinator that is not very desirable. Although the ratio in the 3 plans is 1:1, 1:2 and 1:8, each plant has variety x next to a pollinator.

X	P	X	P
X	P	X	P
X	P	X	P
X	P	X	P
X	P	X	P
X	P	X	P

X	P	X	X	P	X
X	P	X	X	P	X
X	P	X	X	P	X
X	P	X	X	P	X
X	P	X	X	P	X
X	P	X	X	P	X

X	X	X	X	X	X	X	X	X
X	P	X	X	P	X	X	P	X
X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X
X	P	X	X	P	X	X	P	X
X	X	X	X	X	X	X	X	X

This next chart shows a plan where each pollinator is either 1 or 2 plants away from the main varieties in a 1:24 ratio. Research with several tree fruits has shown this to be acceptable for pollination. However, if a pollinator plant dies it could leave many plants without pollination.

X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	P	X	X	X	X	P	X	X	X	X	X	P	X	X	X	X	P	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

The following are various strategies that can be applied to Haskap or any other fruit crop that has not been adequately studied for compatibility.

1. Plant the orchard with the variety you like but leave spaces or rows for pollinators for planting at a later date. If the pollinators are planted a year later it probably won't make too much difference. Fruit production in the first year or two may actually hold back plant growth, so the effect may be to get larger plants sooner.

X	X	X	X	X	X
X		X	X		X
X	X	X	X	X	X
X	X	X	X	X	X
X		X	X		X
X	X	X	X	X	X
X	X	X	X	X	X
X		X	X		X
X	X	X	X	X	X

2. Plant several varieties in the orchard with each row being different. Shuffle the rows so the same types aren't always next to each other.

X	Y	Z	W	Y	X
X	Y	Z	W	Y	X
X	Y	Z	W	Y	X
X	Y	Z	W	Y	X
X	Y	Z	W	Y	X
X	Y	Z	W	Y	X
X	Y	Z	W	Y	X
X	Y	Z	W	Y	X
X	Y	Z	W	Y	X

3. Plant rows of seedlings, perhaps as part of the cooperative fruit breeding program at the University of Saskatchewan. Because seedlings will have variable fruit characteristics it would be best to have separate rows of seedlings. The below suggested strategy has each plant 1 or 2 plants away from a pollinators. S = seedling.

X	X	S	X	X	X	X	S	X	X	X	X	S	X	X
X	X	S	X	X	X	X	S	X	X	X	X	S	X	X
X	X	S	X	X	X	X	S	X	X	X	X	S	X	X
X	X	S	X	X	X	X	S	X	X	X	X	S	X	X
X	X	S	X	X	X	X	S	X	X	X	X	S	X	X
X	X	S	X	X	X	X	S	X	X	X	X	S	X	X

Future Pollinators

With our recent grant from the Saskatchewan Government, we are breeding dozens of different haskap parents together and expect to produce over 20,000 seedlings by 2010. When these seedlings grow up we will be able to select new varieties that will be proven to be good pollinators. Eventually we will want to release pairs of new varieties that easily pollinate each other but look so much alike that it will be hard to tell them apart.

For more info on Haskap or other prairie fruits visit:
http://www.usask.ca/agriculture/plantsci/dom_fruit/index.html

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Fast Track Nursery Production

For breeding purposes:
Seedlings that resulted from the greenhouse crosses (done early in 2007) were replanted 4 seedlings into each 1 gallon pot. Approximately 200 pots were planted in this way. Typically, these plants grew to be 0.6 to 1.0 meters tall before going dormant. Some of these were field planted and others left in a protected area unplanted. Other plants were left in their original small plug trays or field planted as small plugs. In 2008 we noted that about half of the plants were blooming. We determined that this method is too time consuming and expensive to use on all our seedlings but may be worthwhile for special crosses.

For clonal production:
Our new variety 'Borealis' was extensively used with 4 sizes of styroblock containers. 'Borealis' was chosen because it propagated the fastest in tissue culture. Height data has not been taken yet on the plants grown in different containers. However, it seems certain that the cuttings in the largest containers were not much taller than cuttings in the smallest containers. It seems that our new selections will grow a certain height and then shut down. But when field planted there may be some advantage of a larger root system. These were field planted in 2008.

Of special note is that the Japanese selections do keep growing in the greenhouse and can produce considerably larger plants. It may be that a study of container growth will be needed in the future when we have a few more generations of breeding with Japanese selections.

Disease Resistance Experiments

In August leaf condition was measured (Table 9 & 10) by Dr. Jill Thomson. We had 3 main fields that were observed: 2 fields had 6 plants of each variety grown in the same area and the 3rd field had the original stock plants. In most cases each 'n' was based on 6 plants grown in a block.

A type of mildew was observed on many accessions (Figure 11) and mycelia was seen under the microscope. As the fungus was not in reproductive mode, fruiting bodies were not present, making identification of precise species impossible.

A phenomenon of darkened leaves that showed no signs of pathogens was observed on many plants. It was hypothesized that this could be due to a hypersensitive reaction or possibly sunburn. Data was taken on this as it appeared to have dead leaf tissue involved and could be having a detrimental effect on plant growth and yield.

An overall rating was done which took into account the combined effects of leaf darkening and mildew. This scale may be particularly important for nurseries interested in having healthy looking plants for landscaping purposes.

Figure 11. Lonicera caerulea showing leaf disorders. Leaves on the left have a scorched look where entire leaf sections have died. The leaves on the right have a more spotted appearance. Plants like these were found in the wild and in cultivation.

Table 9. Leaf condition of Lonicera accessions measured in August. The 'overall rating' takes into account both disorders with 1 being unacceptable and 3 being highly desirable. The mysterious 'dark' disorder seems to be physiological as no pathogens have been found; one theory is that it may be sunburn. Perhaps leaves unfolding during cloudy days get sunburn if then exposed to bright sunny days. In the wild many plants were found living as understory plants, perhaps these are more prone to sunburn?

Accession	n	% dark	% mildew	Overall Rating
Highly desirable				
3-03	2	1.0	1.5	3.0
3-05	2	1.0	1.5	3.0
ger	2	1.0	6.5	3.0
3-02	2	1.5	8.0	3.0
Desirable				
3-10	2	9.0	5.5	2.5
ber	2	1.5	11.5	2.5
2-07	2	3.0	14.5	2.5
2-10	2	4.0	19.5	2.5
98-11	2	8.5	24.5	2.5
98-12	2	4.5	31.0	2.5
Acceptable				
2-09	3	20.0	13.3	2.0
3-09	2	12.5	14.5	2.0
2-11	4	11.3	17.0	2.0
2-05	2	3.5	20.0	2.0
2-12	2	4.5	20.5	2.0
2-04	2	10.5	20.5	2.0
2-13	2	4.0	21.0	2.0
2-16	3	3.3	27.7	2.0
Undesirable				
2-17	2	28.5	13.0	1.5
2-15	2	7.5	18.5	1.5
2-08	2	12.5	20.0	1.5
2-20	3	32.0	12.0	1.3
2-06	2	20.5	20.5	1.0
98-09	1	21.0	24.0	1.0
2-14	2	33.0	29.5	1.0
ogn	1	56.0	68.0	1.0

The two new U of Sk varieties and most of the advanced selections currently being propagated for growers showed the highest levels of resistance to mildew and the mysterious leaf darkening. Only 9-15 showed problems in this area. The evaluations are based on the original plants. See Table 10.

Table 10. Leaf condition of U of Sask new cultivars and advanced selections, measured in August 2007. The 'overall rating' takes into account both disorders with 1 being unacceptable and 3 being highly desirable.

Accession	n	% dark	% mildew	Overall Rating
New U of Sk Cultivars				
Borealis	1	1.0	5.0	3.0
Tundra	1	5.0	1.0	3.0
Being tested by growers				
9-91	1	1.0	1.0	3.0
9-92	1	5.0	1.0	3.0
9-15	1	50.0	30.0	1.0

In fall, diseased leaves were gathered and stockpiled for use in inoculating seedlings in the greenhouse. These will be in March 2008 to attempt to create a screening technique to find resistant selections.
It has been noted that mildew often occurs in the greenhouse but it is uncertain if this is the same type that occurs in the field.

Experiment 1. Evaluation of fungicides for control of mildew on haskap seedlings in the greenhouse.

Introduction:
Significant levels of mildew have been observed on Haskap seedlings being grown in the greenhouse. This is of concern for two reasons:

1) The mildew infection may reduce plant vigour and have a negative impact on the seedlings when they are transplanted outside
2) Transplanting infected seedlings means that an inoculum source for the disease is present immediately the seedlings are planted out.

A fungicide treatment at the seedling stage may reduce disease levels, and possibly eliminate the pathogen before transplanting. A number of fungicide treatments were evaluated in the spring of 2008, including products available to the home grower and commercial growers.

Materials and Methods:
In early May 2008, 24 seedlings of two lines, all with obvious mildew infection on the leaves, were planted into 5" pots. The two lines chosen were RCT17 and RJJ1; both these

lines have been used in the haskap breeding program, and are susceptible to mildew at the seedling stage in the greenhouse. Five fungicide treatments were applied to four plants of each line, and there was an unsprayed check treatment for each line. The fungicide treatments were:

1) No chemical check, sprayed with water only
2) Bordo copper spray (copper from Tribasic Copper Sulphate, 53%) at a rate of 4.5ml/ L water
3) Safers sulphur at 35ml/L water
4) Lance (70% boscalid, BASF Canada) at 1.2g/L water
5) Proline (prothioconazole, 480g/L, Bayer Crop Science Inc.) at 0.8ml/L water
6) Pristine (25.2% boscalid, 12.8% pyraclostrobin, BASF Canada) at 2.0g/ L water.

The copper and sulphur sprays were purchased from a local garden store and would be available to the home gardener. The three other fungicides would only be available to commercial growers

Before spraying the plants were evaluated for disease. All plants had from 75-100% of their leaves infected with mildew, and cleistothecia (the perfect, overwintering stage of the fungus) were present on all except one plant. The plants were sprayed to run-off and were placed on benches in the greenhouse. The RJJ1 plants all had new growth present on the seedlings, but no new growth was present on the RCT17 plants.

The seedlings were evaluated for mildew infection three weeks after the fungicides were applied.

Results and Discussion:

There were no effects of fungicide treatments on leaves that were already infected with mildew before treatment. This is not unexpected as a fungicide treatment is unlikely to remove existing infection. The viability of the infection in terms of transmission of disease to new leaves was not examined directly. However there was very little infection of new leaves for both treated and untreated seedlings. In the RCT17 line there was only infection of new growth on one of the untreated seedlings. In this line, new growth usually occurred not as new leaves but as new side shoots. In the RJJ1 line new leaves were produced on the main shoot, and there was slight infection of the new leaves in all but the sulphur treated plants. However the differences were not great and further testing is necessary before sulphur could be recommended as a control treatment.

Experiment 2: Evaluation of fungicides for control of mildew on haskap under field conditions.

Introduction:

Mildew has often been observed on haskap bushes in the field by the beginning of August. Necrotic damage is also observed on the leaves of some lines, and it is possible that this blackening of the leaves is due to mildew infection (death of the cells due to parasitism), or a reaction of the plant to infection (death of cells to prevent infection). Fungicide application may prevent mildew infection, and also have an impact on the necrotic response of the plants. Three fungicide treatments were evaluated in August 2008 at the University of Saskatchewan orchard.

Materials and Methods:
Six plants of nine lines already established in the cultivar collection orchard at the University of Saskatchewan orchard were selected for the trial, and the plants were identified with coloured flag markers within a row. This trial contains plants that were four years old, and were already fruiting. The lines selected for the trial were: SX2-14 (2 sets), SX2-15, SX2-05, SX98-09, SX2-06, SX2-08, SX2-11, 3-09. Sprays were applied in early August, after harvest, when there was very little mildew present on the bushes. A trace of infection was observed on the lower leaves of some bushes, but the majority of bushes showed no signs of infection prior to fungicide application. There were six bushes of one line within in a row, and the three bushes on the east side were sprayed with fungicide, the other three bushes were not sprayed. The fungicides applied were:

1) Bordo copper spray at a rate of 4.5ml/ L water
2) Safers sulphur at 35ml/L water
3) Pristine at 2.0g/ L water.

These fungicides were previously evaluated in a greenhouse trial and were applied at the same rate. Two L of each fungicide were prepared and the bushes were sprayed to run off. Copper was applied to SX2-15, SX2-11, SZ98-09, Sulphur was applied to SX2-10, SX2-08, SX2-15 and Pristine was applied to SX2-14, SX2-06, SX2-14.

Results and Discussion:
Very little disease had developed by mid August and no differences were observed between treated and untreated bushes. A second spray application was made on August 15. The bushes were rated for presence of mildew and leaf necrosis on September 12. The average values for the treated and untreated bushes are given in Table 11. The data is collected from eight different genetic lines, and is not replicated therefore statistical analysis was not conducted. However, when results are compared within the treatments it can be seen that no mildew developed on the bushes sprayed with copper or Pristine, but low levels did develop on comparable bushes that were not sprayed. Levels of mildew on the sulphur treated bushes were very similar to those on untreated bushes. Thus it would seem that copper and Pristine applications are worth investigating further for control of mildew on haskap bushes. Overall mildew levels were very low, and greater differences might well be observed when infection pressure is higher.

Table 11. The effect of fungicide application on the development of mildew and leaf necrosis of haskap bushes at the University of Saskatchewan orchard, 2008.

Fungicides applied:											
Copper				Sulphur				Pristine			
Sprayed		Unsprayed		Sprayed		Unsprayed		Sprayed		Unsprayed	
%M*	%N**	%M	%N	%M	%N	%M	%N	%M	%N	%M	%N
0	8.3	0.3	13.3	0.7	5	0.3	6.7	0	10	1.7	10
0	20	0.3	25	0.3	5	0.7	5	0	15	0	8.3
0	25	5.3	25	0.3	8.3	0.3	5	0	5	2.3	8.3

*Average % of bush leaf area affected by mildew

**Average % of bush leaf area affected by necrosis.

The percentage of leaf necrosis did not appear to be affected by the spray treatments suggesting this effect is not connected to disease development. It has been suggested that necrosis is a response to the presence of insects, and further investigation is recommended.

Greenhouse Growth Study

This study was funded by the Alberta Hort Congress and ADF.
Vera Oster did the experiment which was designed by Linda Matthews.

Botanical literature indicated that Haskap was adapted to wet conditions. In the wild it is usually found in or nearby wetlands. There was also a mention in a Russian paper that Haskap may have some drought tolerance and that there are in fact many wetland plants that have drought tolerance, as sometimes ponds and wet areas will dry up. In Saskatchewan, high saline soils can be occasionally be found near seasonal ponds. But in the case of Lonicera, tolerance levels to saline conditions has not been mentioned in scientific literature.

The experiment was done on our new variety 'Borealis' using plants recently taken out from tissue culture , placed in a mistbed and followed by a few weeks acclimation period in the greenhouse. Plants of similar size were used and were randomly sorted among treatments and reps. Then, depending on the experiment, plants were cut back to 2 or 3 nodes. All experiments had 3 reps.

Plants were grown in 3 inch pots, using #4 Promix soilless media, which is a very common potting mix used for fruit plug production. Presented below are the total shoot grow measured at the end of the experiment. The experiment ran from April 29, 2008 through July 31, 2008.

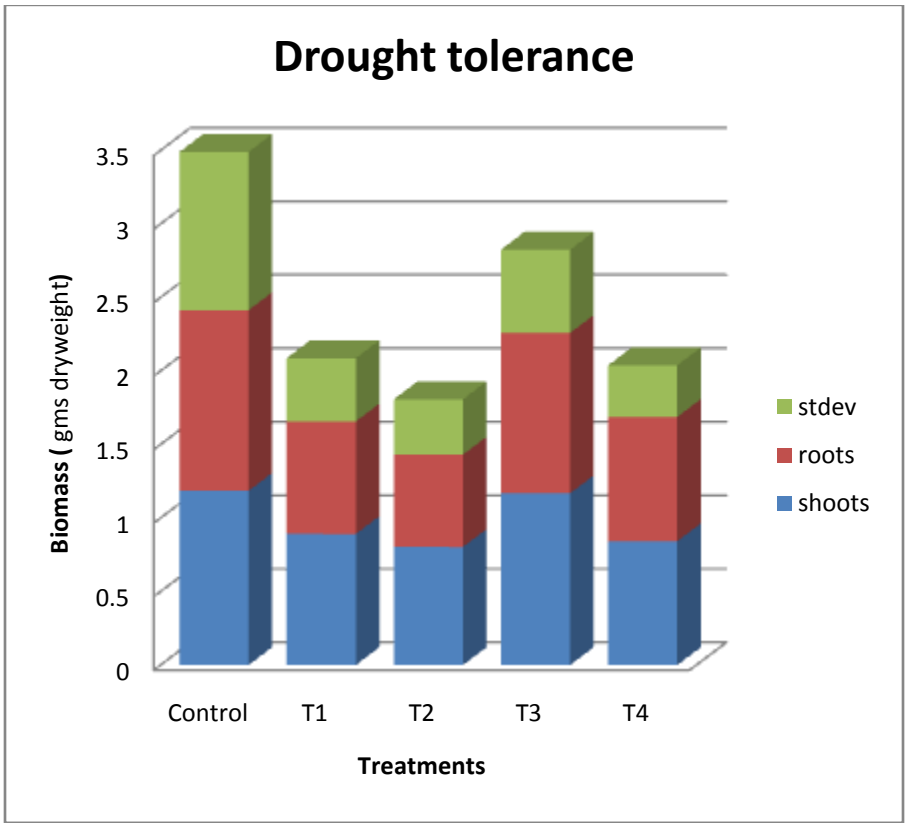
Drought Testing Methods

- Plants selected were cut back to 3 nodes.
- All plants placed in trays and watered from the bottom
- Control plants were watered as required.
- T1 test was watered every 2nd day (1 day between watering).
- T2 test was watered every 3rd day.
- T3 test was watered every 4th day.
- T4 test was watered every 5th day.
- 250 ml of water was used at each watering.
- Plants were fertilized May 13 – 15, June 3-4 and 9th, June 23-25

Drought Testing Results

Haskap plants did best when watered as required followed by being watered every 4th day. The greenhouse plants appeared a good degree of drought tolerance. It should be noted that this experiment occurred in part during the hottest month of the year (July).

Figure 12. Greenhouse test for drought tolerance of Borealis Haskap.



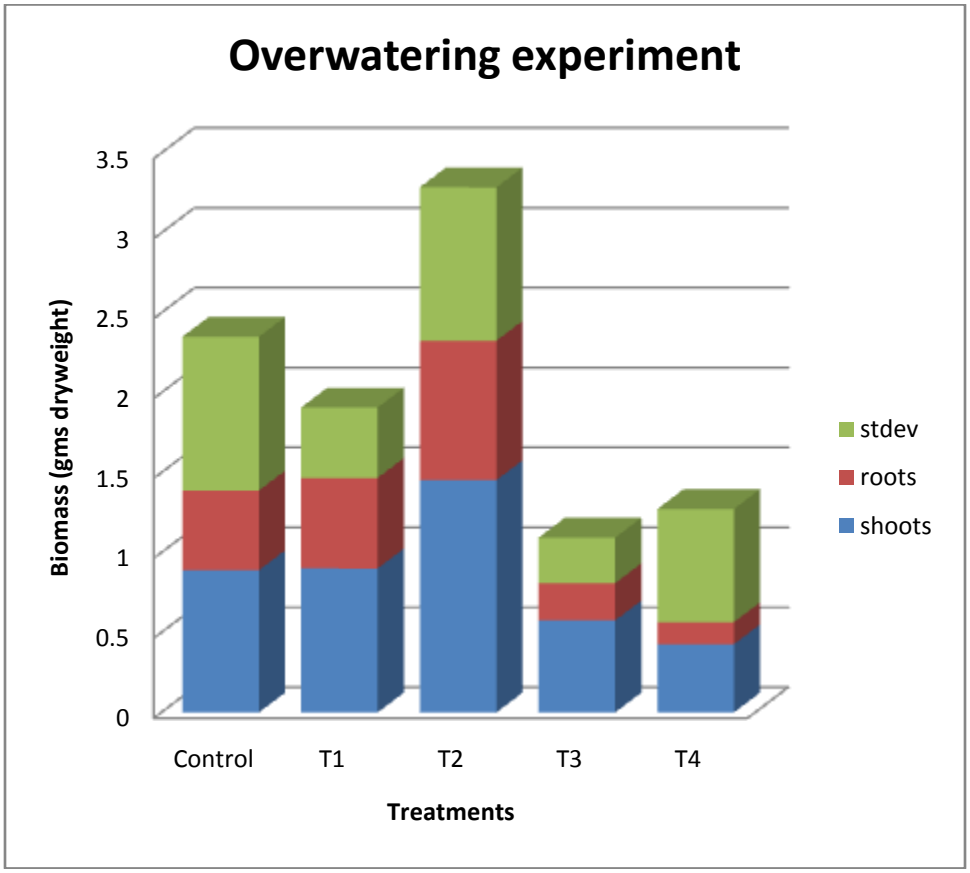
Overwatering Test Methods

- Plants selected were cut back to 3 nodes.
- All plants placed in saucers of various sizes, 4, 6, 8, 10 but the control plants were watered as needed and had no saucers.
- The trays were all filled when the size 10 tray was empty of water. Thus, the treatment with Saucer size 10 was in effect continually in water.
- Plants were fertilized May 17, June 4, and June 25, 2008.

Overwatering Test Results

Plants sitting in water continually (T4) had 40% less growth than the best treatment of T2 (Figure 13). Surprisingly, the T4 plants did not die despite roots being in continuously saturated soil for 3 months. This indicates a high degree of tolerance to overwatering especially since these were very young plants. But it is clear that overwatering was not beneficial for optimal growth. The control plants which were watered as required had similar growth to plants in #4 saucers but the best were in #6 saucers. Marked decrease in shots and roots occurred in the most wet treatments.

Figure 13. Greenhouse test for overwatering tolerance of 'Borealis' Haskap. The control plants received water as required and were not sitting in water at any time. Other treatments had plants sitting in saucers of different sizes which resulted in various times for sitting in water. T1 had the least amount while T4 was continually sitting in water.



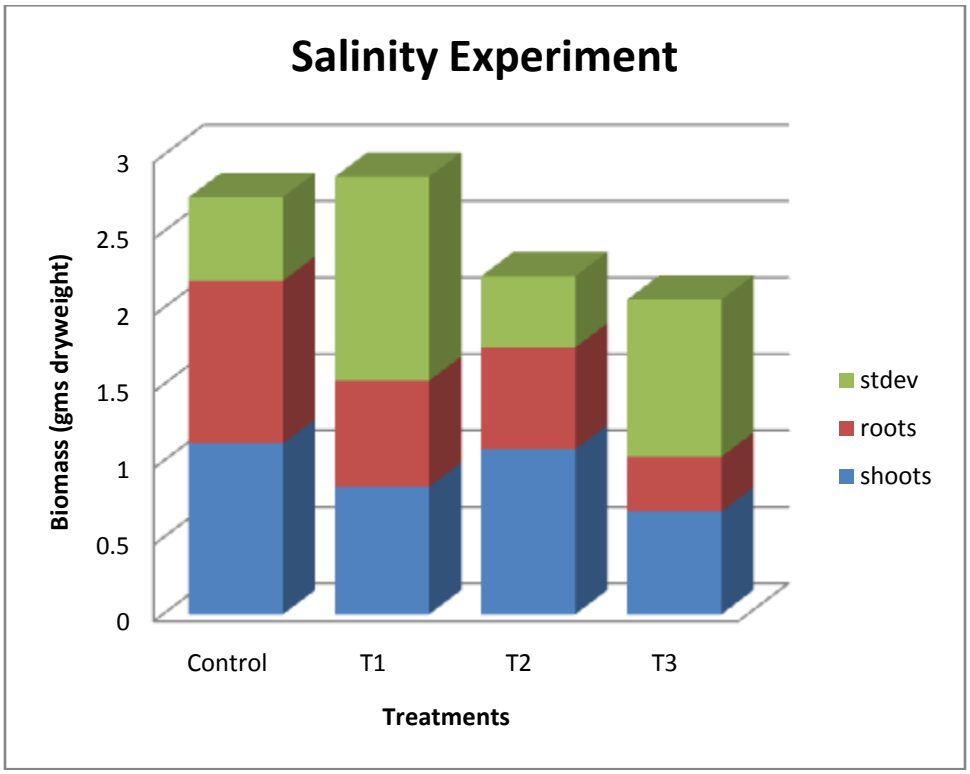
Salinity Testing Methods

- Plants selected were cut back to 2 nodes.
- Four tests with 3 repetitions in each test were made.
- All plants placed in Saucers and watered from the bottom
- 250 ml of water used at each watering.
- Watering was done as needed.
- Plants were fertilized May 13, June 2, June 23, 2008

Salinity Testing Results

Control plants were slightly taller than any salinity treatment (Figure 14). Although the highest salinity level was expected to damage or kill the plant, this did not occur, indicating some degree of salinity tolerance.

Figure 14. Greenhouse test for salinity tolerance of 'Borealis' Haskap.



General conclusions for the greenhouse experiments
In the greenhouse, haskap had considerable tolerance to drought, overwatering and saline conditions which could indicate potential for tolerance in the field. But keep in mind that this study was looking at plant growth, not fruit production. Research on other crops indicates low levels of salt can reduce fruit production. Although Haskap can be found in the wild in wet areas, this does not mean that wet areas are preferred for optimal growth. It may be that Haskap is just better at tolerating wet conditions. Areas that occasionally get wet, say short times in spring or every few years, might cause fruit crops such as cherries or apples to be destroyed. But perhaps Haskap could survive in sporadically wet areas, thus allowing fruit production in areas that would not be fit for other fruit crops.

Interesting observations

The following observations were made during 2007 and 2008 regarding Haskap. Some of these observations have been incorporated into our grower guide handout and others have

been mentioned at grower meeting. Other observations indicate areas to consider for future research.

- Two rows of haskap plants were left unpicked to observe how long the fruit would be marketable after ripening.
    - No fruit rotted, of any variety, indicating possibilities for a long shelf life!
    - Small or long thin berries (almost all Russian types) dried up by Mid July or early August.
    - Fat round large berries such as 'Tundra' and 'Borealis' looked good all summer! They tasted good until early August in 2007 and Early September in 2008. (2008 had one of the coolest Augusts on record.) Later they developed an undesirable off flavour. Even so it seems hard to imagine that any berry could taste good two months after ripe when left on the bushes!
    - The fruit of some varieties fell off in July and August while others held on even if dehydrated.

- Haskap Berries dry quickly in the small food driers. If you leave them overnight it is likely they will be too crispy by morning. Drying does change the flavour, but this is the case with most fruits. I personally prefer the fresh or frozen flavour over dried Haskap. More research is needed in this area.

- Much of the wild haskap in Canada has branches that fall over when too long. (But there are also upright types that don't do this). These branches get covered with leaves and eventually root. Perhaps, they could be deliberately 'layered' it the field to produce new plants.
- In the greenhouse, the first shoots typically flop over. When the plant gets bigger either in the greenhouse or when planted in the field, the plant sends out sturdier upright shoots. A grower might become concerned and feel a need to stake young plants but really there is no need to do so.
- Haskap makes a very nice wine. Described by amateur winemakers as similar to grape or cherry wine. Colour of the wine is a deep burgundy.
- Mixing thawed Haskap berries in a fruit salad with apples will turn the apples 'beet red'.
- While it is true that wild Haskap is adapted to wetlands and surrounding areas, this does not mean that any wetland will do. In fact, haskap is found in wetlands with high organic matter and good levels of nutrients in the soil. These types of wetlands have a high diversity of plant species and tend to have a higher pH than wetland with low levels of nutrients.

Grower Guide Information

The below grower guide factsheet was created in 2008 based on our experiences, observations, experiments and discussions with growers. This handout answers most questions that new growers have about establishing Haskap orchards. This Handout is available on the web and was given to Haskap Propagators and Haskap Canada to use on their websites or to print out for promotional purposes.

Growing Haskap in Canada

Dr. Bob Bors, Assistant Professor, Department of Plant Sciences, University of Saskatchewan

Why grow Haskap?
Good varieties of Haskap have a fresh raspberry/blueberry flavour with a special zing common only to Haskap. The plant has few pests and is the first fruit crop to ripen each season, being earlier than strawberries by a few weeks.
The plant is well behaved: it doesn't sucker, no thorns, need little pruning in early years and likes to fruit when very young.

Too many names for such a new crop!
Common names for *Lonicera caerulea* include:
Haskap: a ancient Japanese name of the Anui people (also spelled phonetically as Haskappu, Hascap, Hascup),
Blue Honeysuckle: descriptive translation from Russian
Honeyberry: coined by Jim Gilbert of 'One Green Earth Nursery', Oregon
Sweet Berry Honeysuckle; an old common name from the 1940s
Swamp fly honeysuckle: a common name coined by botanists who found it growing in swampy areas. Not a recommended name for marketing purposes!
The species itself is commonly listed in old records of Canadian herbariums as:
Lonicera edulis
Lonicera villosa
Lonicera villosa var *edulis*
Lonicera villosa var *caerulea*
'Haskap' is being promoted as the name to use by the 'Haskap Canada' grower group to signify superior varieties descended from Japanese germplasm (see haskap.ca). It may become a brand for fruit that meets quality standards suitable for the Japanese market.

History
Lonicera caerulea is a circumpolar species native to northern boreal forests in Asia, Europe, and North America. It is mainly found in low lying, wet areas or high in mountains.

Hokkaido Island in Japan has a history of using this berry that goes back hundreds of years.

Siberian horticulturists became interested in this plant in the 1950's which spawned collecting of wild plants and resulted in breeding programs throughout the former Soviet Union. The Vavilov Institute has a tremendous collection in St. Petersburg.

'Borealis' a new U of SK variety recommended for home gardeners

A Russian variety beginning to ripen. When fully ripe, berries should be purple inside

Horrible tasting, ornamental versions of this plant were bred in the 1950's at a research station in Beaverlodge, AB which probably caused fruit breeders in North America to be completely disinterested in this plant.

In the late 1990's Dr. Maxine Thompson and Mr. Jim Gilbert (both of Oregon) began spreading the word at scientific and grower's conferences that there were flavourful versions of this plant in Japan and Russia. Dr. Thompson began her breeding program at Oregon State University, basing much of her breeding program on Japanese selections. Her selections are being tested in several states and at the U of SK. Mr. Gilbert's nursery, 'One Green Earth' has been selling Russian cultivars with anglicized names that have the word 'Blue' in them. Notable are the varieties 'Blue Belle and Berry Blue which were our favourites in 2003.

The University of Saskatchewan planted 4 varieties that Mr. Gilbert was selling in 1998. In 2008, we have one of the most diverse collections in the world. We have 35 named Russian cultivars, 70+ 'Japanese-type' selections and hundreds of seedlings from Dr. Maxine Thompson breeding program in Oregon, 6 Kuril Island types and about 600 accessions gathered from the Boreal Forest in Canada. We have perhaps 8000 seedlings planted from controlled crosses as of 2008.

So far Japanese types have been hardy here. But we are anxious to see what hybrids will be like that resulted from crosses between Japanese, Russian or Canadian parents. Often hybrid vigour results when plants from distant lands are intercrossed. Hybrid vigour can mean faster growing, larger plants with bigger fruit! We are attempting to bring together the best attributes from the different regions represented in our collection. Already we have combined worthwhile attributes from Russia and Kuril Island types.

In 2007 we released two named varieties **'Borealis'** and **'Tundra'** and 3 test selections; **9-91**, **9-92** and **9-15**. These 5 are Russian / Kuril-Island hybrids. They have fruit are much larger than Russian cultivars currently on the market in North America, taste better and have a nice round shape. The leaves have less powdery mildew than other varieties we have tested.

The recommendations below are based on my experience with Russian and the hybrids in the U of S breeding program. .

Hardiness: They are extremely hardy. We have never seen winter damage on them. One winter we forgot to cover some plants in 3inch pots with woodchips (our usual procedure for nursery stock). All the plants survived. Our worse winter had a low -47C; no problem.

Hardiness is not just the ability to survive extremely cold winters. It may also involve the ability to stay dormant when warm weather occurs in the middle of winter. **If you live in a more southern location or on the west coast there is a good chance Russian or Russian/Kuril hybrids may attempt to grow during a warm spell.** This is the case in Oregon and the reason Dr. Thompson is working with Japanese types; they are much slower to come out of dormancy. Our breeding plan includes developing cultivars with a deeper dormancy for warmer areas and for a later season crop.

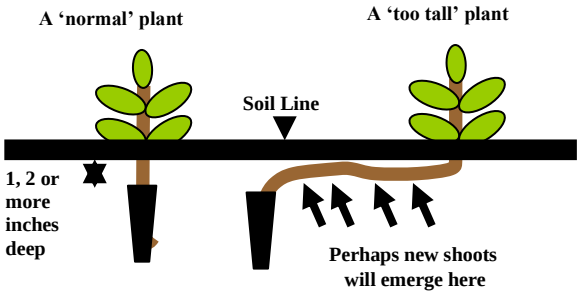
Spacing: Within-row spacing is recommended at 1 meter if you want them to grow into a hedge. At 1.3 meter they would probably remain as individual bushes.

Haskap bushes are well behaved: they don't make suckers and have a nice rounded shape

Planting Depth

Plants can be planted one, two or more inches deeper than original depth to compensate for possible heaving or to establish a deeper root system. In the wild, shoots sometimes fall over, get covered with leaves, and

then root. I think it would be possible to plant overly long shoots sideway under the ground and it may make for a wider bush if shoots sprout from the underground buds along the stem.



Pollination & planting several varieties
In Saskatchewan they bloom from late April to early May and can take -7C to an open flower without damage.
Haskap need two unrelated varieties in close proximity for good pollination. Almost any Russian Variety will pollinate any of the new University of Saskatchewan varieties. There is an in-depth article on this subject on our website.

Fertilizer: Many Prairie and Great Plains soils have adequate soil fertility to sustain haskap.
If you get soil testing done, it is highly unlikely that any testing company will know what to recommend specifically for haskap due to lack of experience. However, Haskap is actually more closely related to potatoes and tomatoes than it is to other fruit crops. Perhaps ask for a tomato recommendation and let me know if it works out well for you. Soil testing and fertilizer incorporation prior to planting is recommended. Subsequent fertilizing should take place only during spring as rapid succulent growth later in the growing season is prone to winter injury. In Japan growers are using composted manure as the chief fertilizer.

Watering: During the first three years watering is extremely important for tree establishment. Irrigation is less critical for established trees. The established haskap orchard at the U of SK is seldom irrigated but we have heavy clay soil that holds moisture. If we were on sand, we would probably be irrigating much more. Farmers often water once a week during the hottest part of the summer. As a general practice it is best to water a few times thoroughly to promote deep root growth. Watering frequently with small amounts of water results in a shallow root system, which can make a plant more prone to drought conditions especially when you go on vacation and stop watering it!
Keep in mind that it is very hard on a plant to use wilting as a sign to water. If your plants wilt every 6 days then you should water every 5 days.
Where irrigation is provided, it should be discontinued in fall to encourage dormancy development.
In the wild, Canadian blue honeysuckles are often found in boggy areas and near or in seasonal streams. Plants seem to do ok in the low spots of our university field. But a couple farmers that have planted in wet and well drained areas have reported that they do better with well drained soil.

Grass Cover and weeding: Grass between rows serves to reduce mud, and to compete with trees for moisture at the end of the growing season. In dry areas it is best to maintain grass-free alleys between rows. Similarly, establishing trees should be kept grass and weed free. In areas with adequate moisture, grass can be permitted to fill in below established trees. Some growers keep orchards weed/grass free through July, but permit weeds and grass to grow in August to reduce the available moisture supply promoting dormancy, and also facilitates snow trap. Long grass in winter may however also provide winter cover for rodents that gnaw bark and girdle trees.
Glyphosate herbicides are not recommended. Most fruit species are highly susceptible to damage. It is possible to use herbicide but beware that a drifting mist can cause extensive damage.
.
Windbreaks: Protection to the west and north of any prairie orchard is highly recommended. Winter damage is often a function of desiccation caused by direct exposure to prevailing winds.

Pests: There are reports in our Herbarium that deer browse bushes in the wild, but we have not seen that at the University field. When deer get into our research plots they usually eat cherries and apples and have not been seen on haskap.

Help me!

Birds, particularly Cedar Waxwings, love Haskap. For 3 years they ignored our berries but then they wiped out 2 years of crops before we bought bird netting. I recommend using a ½ inch netting. If you buy the cheaper 1 inch you will have birds stuck with their heads in the net. It's pretty gross especially when they are dead. Waxwings will 'freeze' when trapped and it is fairly easy to remove them. They don't try to attack you.

A grower suggested buying a type of bailing netting for round straw bales. I was told this may be 1/4th the price of regular netting but is likely to have a 1 inch holes so you could have a bird problem. It might only last a year.

In Japan, they don't have a bird problems in commercial orchards, but I did not see many birds when I visited. Perhaps they have lost habitat in southern nesting areas of Japan or nearby mainland where the human population is so dense. Many growers have reported bird problem. But I have noticed birds tend to ignore Haskap when other berry crops, like Saskatoons, begin to ripen. Perhaps in the future we can grow early varieties of Haskap for the birds and later varieties for us. But bird netting may be the way to go.

Diseases: The only diseases we have seen is powdery mildew which starts in the heat of July which is well after harvest. Susceptibility varies tremendously between varieties. Some varieties are severely affected while others seem immune Our new selections are very resistant except 9-15 which was susceptible. (9-15 had twice the yield and may have been particularly stressed that year from the heavy fruit load).

Mildew

The mildew is white for a few days but then the leaves became partly brown in some Russian varieties.

Sunburn?

On some varieties we see a mysterious bronzing on leaves that may be sunburn. Our plant pathologist, Dr. Jill Thomson, found no evidence of any pathogen causing this. Perhaps this occurs when leaves unfold under many days of cloudy weather and then subjected to long bright days?

Pruning: I think it best to train it as a renewable shrub like saskatoons, dwarf sour cherries or high bush blueberries. Pruning should be undertaken in late winter or early spring. Mainly you should thin out older branches when the bush gets too dense. But never remove more that 25% of a bush in any year. They don't sucker so you won't have to worry about that.

If disaster strikes
If some unfortunate event occurs that kills the top of the bushes, say a major ice storm, unusual winter, fire, or someone runs it over with a lawnmower, it is quite possible the plant will come back from the crown. They are on their own roots so the regrowth will be the same variety.

Harvest: Bushes often bear a few fruit the year after planting but it will be 3 or 4 years before the bushes are big enough to get a few kilos per bush.

We usually see our first fruit changing colour around the 1st of June in Saskatoon. However it is the 2nd or 3rd week in June when all the berries are purple and have begun to be purple inside. Don't be too anxious: bite some berries in half, if its green inside they aren't ready.

In 2006 & 2007 we left a row of plants unharvested to see how long the fruit would still be good. In 2006, which was a hot year, the berries tasted good until the second week in August. In 2007, which had the coolest August in 30 years, the fruit tasted good until early September. Selections that had big fat berries (like Borealis and Tundra) were the best, but thin tubular Russian types dehydrated by late July. Some varieties dropped their fruit easily and others (including our new varieties) held onto their fruit.

Uniform Harvest Russian and Russian / Kuril hybrids have uniform harvesting; all the fruit is ready all at once. This attribute may make them particularly adapted for mechanical harvesting. We have shaken fruit from young plants into umbrellas and when larger into kid's swimming pools. Japanese types are known to have uneven harvesting but these type of varieties are not currently available on the market.

Yield: Our oldest plants were bearing about 7 kilos / bush after 5 years. IN Japan they expect their better plants to produce 3 kilos.We haven't had our new varieties around long enough to know but I would think it would be similar level. Generally speaking we find farmers often get higher yield than we do at the University.

Because Haskap produces its crop so early, I don't think it will ever be as productive per acre as later crops such as cherries or apples.

I would venture to guess that Haskap will be a very consistent crop from year to year because the plant will have most of the summer to prepare for winter. The crop will be harvested before hail starts in July and August and before insects have time to build up.

How long can my plants live?
We have some ornamental blue honeysuckles at the University that are over 30 years old. They are quite healthy despite being partly shaded by a large poplar tree. Many productive 30 year olds were seen in Japanese farms.

The trunk of this 30+ year old Blue Honeysuckle looks similar to an old grape vine with a 'shredded bark' look. Although rather ornamental, it would be rather hard to shake the fruit off this bush because the trunk is 3 inches across. Hopefully, growers will prune out branches when they begin to get too thick. Gardeners may opt to turn the plant into a bonsai-like plant with character, and hand pick each fruit!

Uses and Fruit Quality:
Haskap can be used in processed products: pastries, jams, juice, wine, ice cream, yogurt, sauces, and candies.

When frozen fruit is placed in the mouth it melts away. Seeds aren't noticeable when eating but if you look for them you will see they are practically the same size and shape as kiwi fruit. The skins simply disintegrate which has caused some excitement amongst ice cream and smoothie makers. Also the fruit turns dairy products into a bright purple-red.

Haskap makes excellent wine, some say similar to grape or cherry wine. The wine will be a rich burgundy colour. Its juice has perhaps 10 to 15x more concentrated color than cranberry juice.

Haskap wine and juice has a deep burgundy colour.

Acknowledgements:
Breeding of Haskap is currently funded by Saskatchewan Agriculture agriculture.gov.sk.ca

The Alberta Farm Fresh Producers Association albertafarmfresh.com and The Alberta Horticultural Growers Congress and Foundational Society albertahortcongress.com have given us grants related to Haskap production practices and health benefits.

For more information on haskap visit the University website USASK.CA and do an advance search on the word 'fruit' or visit the grower group website: HASKAP.CA.

Outreach and Engagement Activities

The various handouts incorporated into the report above represent an important part of our outreach activities. But this section describes our dealings with growers and grower groups.

Haskap Canada

Haskap Canada is a national group that started when group of about 50 growers decided to 'start a group' during Haskap Day of 2006. In 2007 it was named and incorporated as a non-profit organization. Open to all Haskap growers this group has as its goals to help publicize haskap, assist in getting research done and to help educate growers about best practices. Perhaps 70% of the members are growers in Saskatchewan.

Dr. Bors was asked by members to be one of the founding directors of the board of directors of Haskap Canada. This group maintains a website 'Haskap.ca' and has annual meetings, chief among them 'Haskap Days' at the University of Saskatchewan. Being a director involved several planning meetings, contributions to a website, and filing documents for non-profit status.

Haskap Days

This annual grower event was organized and hosted by our program both in 2007 and 2008. Previously this had been a one day event, but interest and the need for more information led to expand it to be a 2 day event these last 2 years. Most of the talks given were our staff and students. One of the most successful activities of this event is that growers get to see and taste the fruit on the research plots. The combination of good flavor and the early ripening date serve to generate much excitement.

- 90 growers attended each year, perhaps 80% from Saskatchewan
- activities included presentations by Dr. Bob Bors and other Plant Sciences personnel (see agendas below)
- presentation topics included An Introduction to Haskap, Haskap Research and Breeding, Haskap Breeding in Oregon, Wild Canadian Haskap, Growing and Training Haskap, Haskap Product Testing and Development
- Haskap Canada Directors spoke about Haskap Canada
- Panel discussion about the Japanese Marketing Strategy
- licensed propagators were in attendance
- plant sale to raise funds for the Fruit Breeding and Research Program

Presentations

During 2007 and 2008's Haskap Days 17 talks were done by fruit program staff. Also 16 other presentations were given to 9 groups. Because of the strong interest in Haskap, most of the generic sounding titles below (such as Fruit Breeding for Northern Canada) had about 20 minutes spent on Haskap.

2009. **Gathering Haskap across the Canadian Boreal forest and in Japan**
Saskatchewan Fruit growers Association Annual Conference

2008. **Fruit Breeding for Northern Canada**
Meeting for visiting scientists from Norway

Haskap research and industry Update
Saskatchewan Fruit growers Association annual conference
Alberta Berry School Conference
Hokkaido Haskap conference

Introduction to Haskap
Hokkaido Haskap Conference, Japan

Grower Assisted Fruit Breeding
Alberta Berry School Conference

Berry Basics
Gardenscape show in Saskatoon.

Industry Update
Haskap Canada meeting

2007. **Fruit Program at the U of Sk.**
Natural Products Network Meeting, at U of Sk

Fruit Breeding at the U of Sk.
Plants Canada Conference
Gardenscape, Saskatoon

International Haskap.
Saskatchewan Fruit Growers Association Annual Conference.

Overview of the U of Sk Fruit Program
Saskatchewan Fruit Growers Association Annual Conference.

R.H. Bors, and C. Peters. **Prairie Fruit Production (A Field Demonstration)**
Seager Wheeler Farm, Seeding Trends.

R.H. Bors and C. Peters. **Planning, Planting and Pruning an Orchard**
Seager Wheeler Spring Orchard Event.

Haskap Days Agenda 2007

Cost is $35 for Thursday June 21.
There is no charge for those who attend the discussions on June 22.
Please let us know if you are coming by contacting Haskap.ca with an email or leaving a message in the evening (after 6pm) at 306-978-8316.
If you don't contact us ahead of time, please bring a chair or sit on the ground.

Thursday, June 21		
Time	**Speaker(s)**	**Title / Activity**
8:30		**Registration**
9am	**Bob Bors**	**Introduction to Haskap** *Bob will talk about what makes Haskap so unique and why it is worth trying.*
9:30	**U of S Staff** **Linda Matthew**	**Haskap Research** **Antioxidants** *Linda does health and value-added research in the fruit program. Recently she has been involved in anti-oxidant research of several fruit species including Haskap.*
	Bob Bors	**How we selected the new varieties** *Methods designed to mimic mechanical harvesting and processing, taste panels, and breeder observations were used to select the best varieties*
	Tyler Kaban	**Haskap breeding in Oregon** *Tyler in an undergraduate student who spent 2 weeks helping Dr. Maxine Thompson with haskap breeding in Oregon.*
	Jon Treloar	**Wild Canadian Haskap** *Jon has been gathering wild Canadian haskap as part of his Master Degree research.*
10:45	**Bob Bors**	**Tour of haskap plots** *See our Haskap breeding plots in person.*
Noon		**Lunch on your own or buy a barbeque lunch from Parkland Agroforestry (profit goes for Haskap research)**
1:00	**Rick Sawatzky** **Bob Bors &** **Growers**	**Growing and training haskap bushes** *We will discuss our own growing methods as well as various theories on what could be done differently.*
2:00	**Linda Matthews** **&** **Parkland Agroforestry**	**Haskap product testing and development** *While Haskap may seem similar to Saskatoons and blueberries it has clear advantages over those two crops for certain products*
2:45	**Break**	
3:00	**Bob Bors & Jill Thompson**	**Sask Ag and Food research grant for Haskap** *What we plan to do over the next two years*
3:30	**Various**	**Advice and information from those who are**

	companies	**propagating Haskap**
4:00	**Haskap Canada Directors**	**What will happen tomorrow**
4:15	**End of talks, Socialize until 5pm**	
Note: Prairie Plant Systems will be providing doughnuts and coffee for the event.		
Friday		
All Day	**Plant Sale starting at 10 am, ending at 5pm (unless a big line-up)**	
9am	**Panel of those who had dealings with Japan**	**Summary of Haskap Services visit to Saskatoon and other developments with Japan**
9:30		**Open discussion about Japanese marketing Strategy**
10:15	**Coffee break**	
10:30	**Haskap Canada Directors**	**What is Haskap Canada and what could it be?**
10:45		**Open discussion on Haskap Canada**
Noon		**Lunch on your own or buy a barbeque lunch from Parkland Agroforestry (profit goes for Haskap research)**
The afternoon agenda will be posted on the www.haskap.ca website		

Haskap Days Agenda 2008

This event is geared towards commercial fruit production.

Cost is $25 for each day or $35 for both days combined.

Dr. Maxine Thompson was unable to attend. Instead, Dr. Mitsuko Ukai has agreed to give a talk on 'Haskap in Japan and China' in addition to her talk on 'Haskap Health Benefits.

Thursday, June 19		
Time	**Speaker(s)**	**Title / Activity**
8:30		**Registration**
9am	**Dr. Bob Bors**	**Introduction to Haskap** *Bob will talk about what makes Haskap so unique and why it is worth trying.*
9:20	**Bob Bors & Rick Sawatzky**	**Growing Haskap bushes** *We will discuss our own growing methods as well as various theories on what could be done differently.*
10:00		**Tour of haskap plots** *See our Haskap breeding plots in person.*
Noon		**Lunch on your own**
Haskap Breeding		
1:30	**Dr. Mitsuko Ukai**	**Haskap health benefits** Dr. Ukai is a food chemist at Hokkaido University. She is a professor who works closely with Japanese businesses to develop new healthy food products with Haskap (and other foods).
2:30	**Dr. Bob Bors**	**Haskap/blue honeysuckle breeding in Saskatchewan** *Bob will discuss the different types of Blue Honeysuckle/haskap from Russia, Japan and Canada and how they are being used in our breeding program.*
3:30	**Break**	Coffee and snacks provided by Prairie Plant Systems
3:45	**Jon Treloar**	**Saskatchewan blue honeysuckle** *Jon will discuss the research he is doing as part of his Master Degree Thesis and how he uses Haskap in his job to promote agriculture to elementary and high school students.*
4:15 to 5:00	**Mitsuko, Bob , Rick & Jon**	**Open discussion with the researchers** The day's speakers will answer questions.

Friday, June 20.		
All Day	**Plant Sale starting at 10 am, ending at 5pm (unless a big lineup)**	
9:00	**U of S Staff**	**Tour of Fruit Program** We will look at the entire fruit program, not just Haskap. We will have several staggered tours leaving every 15 mins or so. The tour will take approximately 1.5 hours.
Coffee and snacks provided by Prairie Plant Systems		
9:00	**Propagators & Processors**	**When not on the tour, please peruse pamphlets and speak to people propagating or processing Haskap. Also, please purchase plenty at the plant sale.** (Say that 5 times fast!)
Noon		**Lunch on your own**
1 pm	**Dr. Mitsuko Ukai**	**Haskap in Hokkaido and China** *Dr. Ukai will discuss past and present Haskap production in Hokkaido and her recent visit to a Chinese factory that makes Haskap and other fruit juices.*
2 pm	**Linda Matthews**	**In a Haskap Jam** *Linda led the Fruit Program crew to the U of Sk Food Centre to manufacture 3000 jars of haskap jam. We learned much in the process!*
3pm Break		
3:15 pm	**Haskap Canada** Board of directors	**The most common questions about Haskap** The Haskap.ca website gets visitors from around the world. Hear the most common questions, answers, and good guesses.
4pm to 5pm	**Haskap Canada**	**Open discussion about Haskap promotion and marketing.**
Saturday, June 21		
The Saskatchewan fruit Growers will visit two fruit growers on their annual tour the next day. The tour starts in the Saskatoon area. Please visit http://www.saskfruit.com for more details. **It will be possible to register at Haskap Days for the SFGA tour.**		
Saturday, June 21 and Sunday 22		
If you are really up for a fruit extravaganza tour, consider taking the 'Parkland Artisan Tour' which is a self guided tour that is in the vicinity of Shellbrook, Saskatchewan. (perhaps an hour from Saskatoon). On that tour you can visit Honeywood Nursery, a historical site that specialized in fruit varieties (and still has some for sale). For more info see: http://lavalamp.dyndns.org/~grayston/tour/		

Volunteers

Master Gardeners, the Parkland Agroforestry group, Haskap Central Sales, and individual farmers continue to donate time to assist us with the Haskap project. An estimated 40 individuals helped us these last two years with planting seedlings, transplanting, and harvesting fruit.

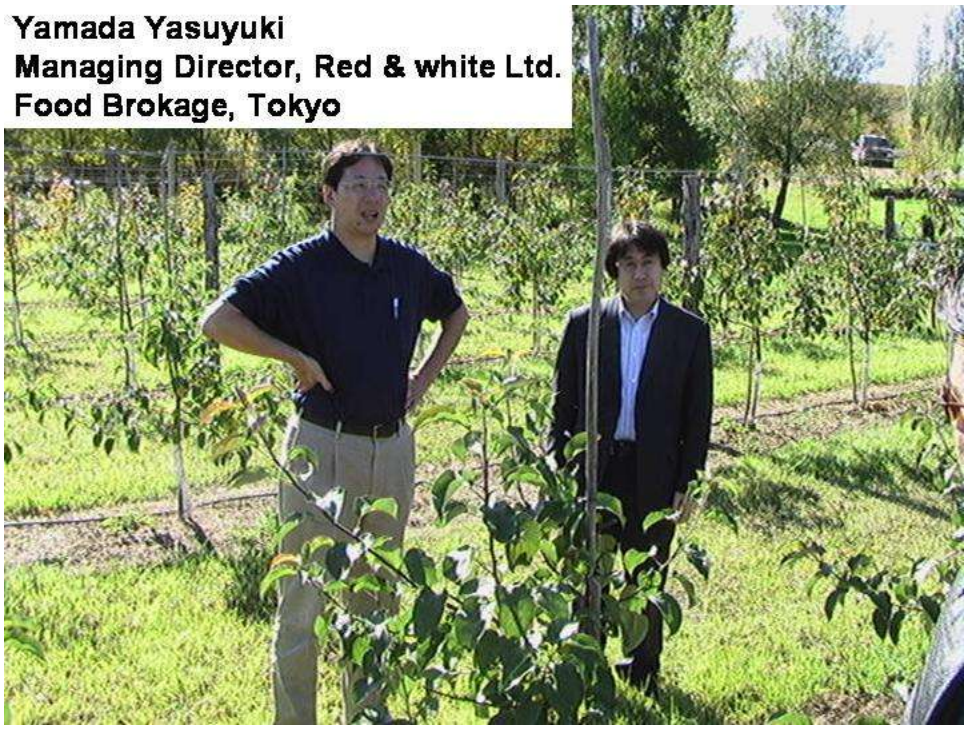
Japanese Companies

A trade mission from Japan enabled the heads of 2 companies to visit us in the fall of 2007. We arranged extensive tours for both CEO's including meeting with growers, the food centre and our research facilities. Both were also interested in other fruits being grown in Saskatchewan.

Dr. Bors met owners and key personnel of perhaps 12 companies in Japan, most of which were interested in buying Haskap from Canada

Figure 15. Mr. Ichimachi displays his line of beverages. Second from the right is his Haskap soft drink.

Figure 16. Mr. Yasuyuki and Mr. Ichimachi visit an apple orchard outside of Saskatoon.



Food Centre Jam

Since Value-added manufacture is being considered by many of our growers, it was decided that the fruit program should get involved in the manufacture of our own product. This way we would be quite experienced in working with the food centre and could more easily relate to our growers as well as use the information to advise growers about the food centre. The experience has been used by Linda Matthews in talks to growers.

Linda Matthews developed recipes and worked closely with Food Centre Personnel co-ordinated all activities related to this project. And the fruit program crew along with some volunteers worked at the food centre to manufacture Blue Honeysuckle Jam in 70ml containers that is being used for promotional purposes (Figure 17). (Note: we also did cherries) A small grant was obtained from Sask Fruit Growers Association and Haskap Canada to send Haskap berries for nutrient analysis, required for nutritional labelling.

This jam has been given to dozens of visitors to our program. This jam has been used in trade shows and events by Haskap Canada, growers, and propagators. In particular it was sold at Gardenscape to about 800 public.

General reaction to the jam has been that people really like it. However, the fruit in the jam is made from our combined seedlings and varieties in our collection. Thus it is very much equivalent to the

‘average’ seedling. We anticipate that quality will further improve once if jam is made with our best new varieties, which taste much better than average.

Figure 17. Fruit Program personnel and volunteers making Jam at the U of Sask Food Centre. The Food centre is a joint University-Provincial Gov’t-Federal Government program designed to incubate new businesses desiring to manufacture food products and to assist companies developing new food products.

Table 12. Fruit Distribution for product research and development

Fruit harvested from the research field plots was been given or sold to organizations for research and promotional activities. In many cases, it was Dr. Bors or the university staff who encouraged people at meetings to contact us if interested in using fruit for product development.

Group	Purpose
Dean of Agriculture & Bioresources	Bean Feed & College Chocolates & Visitor tours & Pancake Breakfast
Saskatchewan Fruit Growers	Conference
Carlton trail Ag Society	Cherry Festival & meeting
Riverbend Plantation	Product development research
Saskatchewan Agriculture and Food	Meetings
Haskap services (Japan)	Product Development
Jerry's Food emporium	Product Development
Farm Pure	Product Development
Prairie Sun Orchard	Product Development
Parkland Agroforestry Products	Product Development
Homestead Ice Cream	Product Development
Prairie Plant Systems	Promotion
Haskap Central Sales	Promotion
NRC, PEI	Antioxidant testing
Ryo Minoue, Food Broker	Product development/testing for Japanese Pharmaceutical company (25 samples)

A highlight of the activities listed above was when Jerry's food emporium made Haskap desert part of the "Taste of Saskatchewan" event in Saskatoon in 2007. Photos of this desert and a story about them made it to the 3rd page of the Star Pheonix. Hundreds of people got to taste it and Jerry's Food Emporium owner was very interested in getting a regular supply of this fruit.

On a continual basis, Haskap fruit products or frozen fruit is used by the fruit program and by the Dean of Agriculture & Bioresources Office to give to visitor and for tours. Various products made from the University Haskap can be seen in Figure 18.

Figure 18. Haskap products made from University supplies of Haskap: clockwise starting from upper left: Gellato, Jam, Ice Cream and whole frozen fruit. While many growers have planted Haskap, it will be a few years before commercial quantities become available. Some growers and propagators are using these products to advertise the fruit they anticipate in a few years.

Cooperative Research

University of Oregon Haskap Breeding Program

Two students (Jon Trelor & Tyler Kaban) visited Dr. Maxine Thompson in 2007 and brought back 20 clones from her breeding program. They gained practical experience that will be useful in their research and future careers in plant breeding. This grant did not fund the trips of the students but it did fund the propagation and care of the new germplasm once it arrived.

University of Hokkaido

Dr. Mitsko Ukai, a food scientist and professor, visited us for 3 month in the summer of 2007. And she spoke at the 2008 Haskap Days. She has been analyzing our fruit for health benefits and antioxidant strength. She is also comparing them the fruit of this species grown in Japan. Her results are confidential until she publishes papers, but it is safe to say she is very pleased with the health value of haskap grown by our program.

Dr. T. Suzuki, a fruit scientist and professor, also visited us for a few days. He was very impressed with our breeding program and wants to forge a stronger working relationship with us.

Both Dr. Ukai and Dr. Suzuki have invited and hosted Dr. Bors during his visit Japan to speak at a conference in 2008 and to assist them in evaluating their collection of Haskap. They also assisted in visiting haskap farm, processing plants and collecting wild Haskap in Japan.

Vavilov Institute

The Vavilov Institute is the world's largest genebank and is the largest institute in Russia doing fruit breeding and research. It is one of the few institutions breeding fruit in a climate similar to ours. The head of their fruit division, Dr. Artem Sorokin, visited us for one month this summer. We had long discussion about potential cooperation in the future and have already exchange several seedling lines for a few fruit crops, especially Haskap. Dr. Bors has been asked to co-chair the '1st Virtual International Scientific conference on *Lonicera caerulea* L.' which will take place in 2009.

International implications

Leading Haskap scientists from Russia and Japan and industry leaders for this crop in Japan have expressed the opinion that the U of Sk is a major leader in this field. Neither Japan nor Russia has collections of North American stock and most breeders in those countries do not have much stock from outside their own country. But the U of Sk has sizeable collections of Japanese and Russian germplasm and is actively using both for breeding. Just as important as genetic diversity are the unique goals for our breeding program: we want haskap to be mechanically harvested and sorted, and we want multiple harvest dates of uniformly ripened berries. These have not been the goals of other breeding programs in the past. So although we are a relatively new program, we may a bit ahead in selecting for those traits mentioned.

Haskap breeding/development in Japan has some similarities to Saskatoon development in Canada. In neither case was breeding carried out on a large scale possibly because of the plentiful existence of rather good wild plants. The breeding program I saw while visiting there had seedlings numbering around two hundred or so each, while most Canadian berry programs (including the U of Sk) have thousands of seedlings. Much of the effort for Haskap development in Japan has been to identify superior seedlings in the wild and in farmers' fields (who got their plants from the wild), grow them in test plots and either select the best or interbreed the best. Uneven ripening and tendency for Japanese haskap to hold onto its fruit too tightly has led Japanese researchers in the past to conclude that Japanese Haskap can't be mechanically harvested. (Likely, they believe it is possible now.) Without mechanization, there really wasn't much of an incentive to develop this crop. Had earlier breeders in Hokkaido been aware of Russian varieties that ripen uniformly and are easier to detach, they might have developed varieties suitable for mechanization. The climate of Japan would likely cause Russian accession growing there to bloom too early (mid winter during warm spells), as has been the case in Oregon. Thus it would be difficult for Hokkaido breeders to find anything exciting in Russian germplasm if most years they don't get a crop.

It should be noted that Dr. Suzuki and Dr. Hoshito at the University of Hokkaido have seeds from all plants I collected in Japan and they are investigating increasing the ploidy level of Haskap. This group has also been involved in selecting superior plants from the wild. Such research could someday result in much larger fruit. Although the Provincial Research Station of Hokkaido had stopped breeding Haskap a few years ago, just last year the National Fruit Research Station started its own program to breed Haskap. It will be interesting to see how these Hokkaido programs proceed in the next few years. There has been a considerable push in recent

years by the Federal Government in Japan to increase domestic food production. Whether this will include increased funding for developing new crops, such as haskap, is yet to be seen.

While Japan may at present be behind in breeding mechanically-harvested Haskap, they certainly are ahead in product development R & D and research into health value of Haskap. Many companies and several University researchers are involved. This type of research can only help drive the demand for Haskap produced in Canada. While In Hokkaido, I met with perhaps a dozen reps of companies who were enthusiastically interested in buying Haskap from Canada.

The other major area for haskap/blue honeysuckle breeding and research is Russia. Dr. Sorokin of the Vavilov Institute heads the fruit section of that genebank and he specialized in evaluating Blue Honeysuckles during his PhD research. The following summary of Russian breeding and research is based largely of conversations with Dr. Sorokin and from the dozen or so scientific papers from Russian authors that were translated from Russian:

There are probably around 10 institutions throughout Russia which have released Blue honeysuckle varieties in the last 30 years. For some of these institutions, the breeding has been a sideline of individual researchers and not a major goal of these institutions. Germplasm gathered throughout the former Soviet Union has been the parents for these new varieties. Several programs adopted a strategy of intercrossing various subspecies of *Lonicera caerulea*. Initially this intercrossing may have been done out of curiosity to see if different *Lonicera* species were compatible, but later it was recognized that accession once thought to be different species were instead subspecies and fully capable of interbreeding. This led to much improvement in new varieties because using different 'subspecies' could bring together characteristic from diverse genotypes. Neither Japanese nor North American germplasm has been used to develop Russian varieties, although at least one breeding program in Eastern Russia has acquired some Japanese germplasm.

In Russia, the breeding of Blue Honeysuckles has mainly been done with home gardeners in mind. Although there may be some organization of fruit growers in Siberia, most of Russia does not have fruit farms, and Russian-grown fruit is not offered in grocery stores in the cities of western Russia. But gardeners may have several Blue Honeysuckle bushes in their home gardens. Scientific papers and books on the subject indicate scientists have evaluated many characteristics but not for mechanized harvesting. Newer varieties seem to have larger fruit size by becoming longer (example: figure 6) rather than rounder and wider. In a book co-authored by Dr. Sorokin, 42 varieties were evaluated, but only one of these 'Kamchadalka' was listed as ripening in the late season. We have this variety in the U of Sk collection and can confirm that it ripens around the same time as Japanese selections. While Russia clearly possesses late ripening germplasm, it seems likely that late ripening has not been a major goal in breeding programs. This is easy to understand since the early ripening habit of Blue Honeysuckles is one of the reasons this fruit is very popular both in Russian and now in Canada. Gardeners do not often brag about being the last one on the block to have their crop come in! But having a late season crop to harvest could be very important for large fruit farms using mechanical harvesting. Interestingly enough, Dr. Sorokin suggested that Russia might be a place to market our Haskap since grocery stores are only stocking foreign produce!

The other major breeding program in North America is the one started and run by Dr. Maxine Thompson. We have been actively cooperating with each other these last 5 years, Being located in Oregon, developing Haskap with deeper dormancy has been a major concern solved by using mainly Japanese stock as parents. As a retired breeder / professor from Oregon State University, Dr. Thompson extensively evaluates her seedlings for many traits and has done much to develop large fruited, tasty, upright, productive advanced selections. There are at least 5 locations in the US testing her advanced selections. It is very likely that the US will have Haskap production for more southern locations based on Dr. Thompson's breeding efforts. But it may also be true that her cultivars may be important for late fruiting in Canada.

Conclusions

This grant allowed us to establish a great number of seedlings from controlled crosses and helped to greatly expand our germplasm collection. We also were able to evaluate existing germplasm for worthwhile traits and in particular for adaptation to mechanized harvesting and processing. Although a few new cultivars were released, it is easy to see that improvements will likely continue over the next few years and generations of breeding.

There has been a tremendous level of interest from growers. A few months after their release, we received reports from our Saskatchewan propagators that over 120,000 had been ordered. It seems every day that we have phone calls and emails about this new crop. Many articles have been written, talks have been given to growers, as well as many emails and phone calls answered. Haskap is in its early stages of commercialization with many new growers experimenting with the crop. Our close involvement with farmers, especially those growing our seedlings, will allow us to fine tune the breeding process and bring about new varieties and develop innovative production practices for this exciting new crop!