

SARE Research Grant

SW06-111 - Fruit and Berry and Berry Crop Trial Program for Native Alaskan Rural Communities in Interior Alaska

Funding Total : \$193,324

Second Year Project Report (2007-2008)

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Alaska Cooperative Extension Service • University of Alaska Fairbanks • October 29, 2008





THE 2007-2008 YEAR IN REVIEW

- FROM PLANTING TO FRUIT IN 14 MONTHS.
- POWERPOINT INCLUDED WITH THIS REPORT

Project Summary: This research project is investigating the potential for the production of domestically grown fruit and berry crops on cold (zone 2) sites in Interior Alaska. This research project utilizes cold, hardy fruit identified in other northern research locations and combines their production with the evaluation of high tunnel plastic structures that can potentially improve survival and yields of these crops. It is our hope that we can identify specific varieties of apple, cherry, plums, and pears that can survive and produce fruit on zone 2 sites and the possible positive impacts of the use of high tunnels to increase survival and fruit yields which could then be acquired and adopted by native communities.

Introduction: Preparations for the 2007 Spring planting of the fruit trees began in Fall of 2006



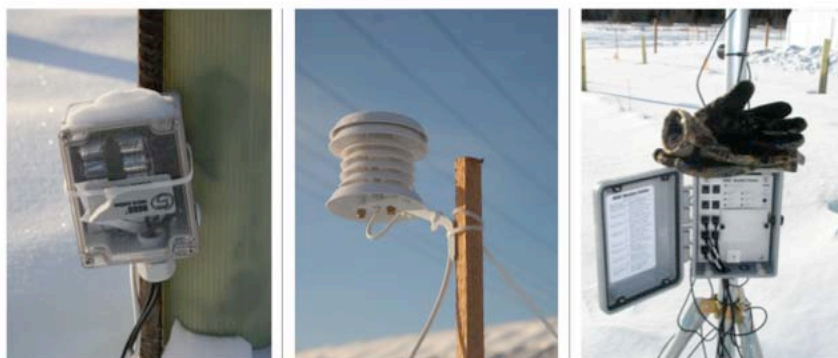
We decided to use the 7 oz. woven mesh plastic as opposed to the 6 mill plastic due to concerns for strength and durability over the winters.

with the location of the research trial on the grounds of the University of Alaska Agriculture and Forest Experiment Station in Fairbanks. Arrangements were made for the purchase of two (42'x96') high tunnels from FarmTek. The structures were erected in late May and early June of 2007. Meanwhile, arrangements were made for the production of the

root-grafted fruit trees including a selected list of 39 apple varieties. The very cold hardy Ranetka Crabapple tree, a cross between Siberian and Dolgo crab trees, was used as the grafted root stock. The trees were picked up at the nursery facilities in Wasilla and delivered to the

planting site at UAF in late May 2007.

Once the high tunnels were erected, we proceeded with the tree planting in mid-June. During October 2007 we established two Hobo weather stations and 4 Hobo micro-stations for recording hourly environmental conditions including air and ground temperatures, relative humidity, PAR,



Data Monitoring - We established 4 Hobo weather micro-stations and one Hobo weather station in an outside plot and in one high tunnel.

Solar Radiation, Wind speed and Gust speed, and soil moisture. These have been very helpful in interpreting the effects of the high tunnels on the trees being grown within them. We were able to monitor conditions of the outside and inside plots throughout the winter and link them to spring survival data. Through this project we were wanting to determine what were the impacts of the high tunnels on survival of the test varieties and any associated impacts on growth and yield for a cold site. Through the use of the weather data stations we were able to determine how closely the test site represents similar cold sites found in rural communities. Any success of the test varieties could then become the basis for recommendations for testing in rural villages.

We found that there was a dramatic difference between inside the high tunnel air and ground temperatures and those found outside the high tunnels. The thermal blanketing effect of the 16 inches of snow throughout the winter had a considerable effect on moderating the outside ground temperatures. We were surprised that the unheated but closed-up high tunnels provided very significant improvement in air temperatures. On the coldest day we found that where the outside air temperature was -47°F the inside air temperature was -24°F . The effects of the high tunnels on moderating extreme winter cold conditions resulted in the HT trees have less mortality than the outside plots since the HT temperatures fell well above the anticipated cold temperature limits of tree survival.

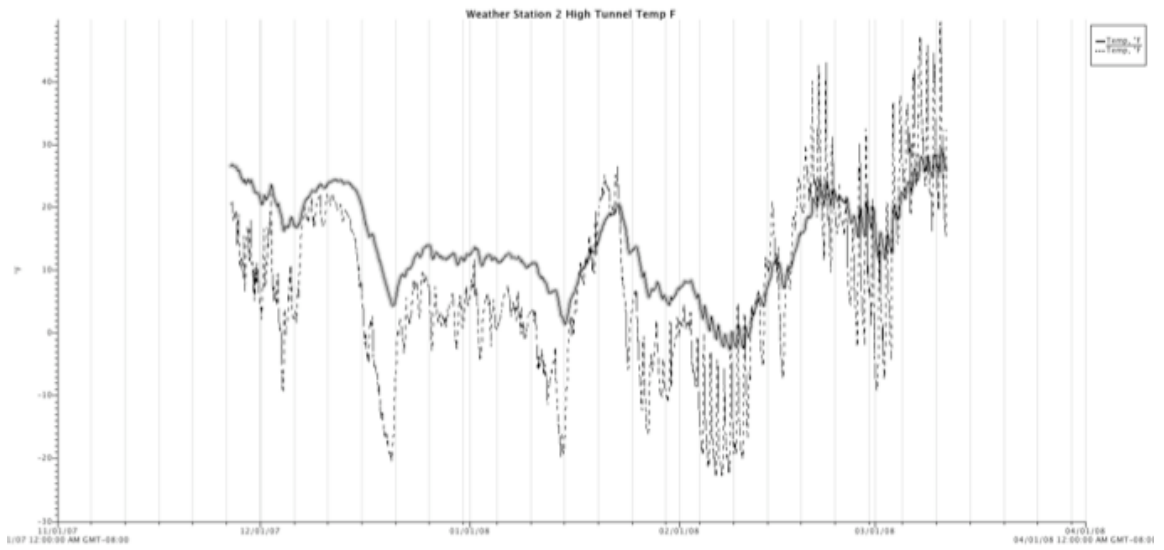
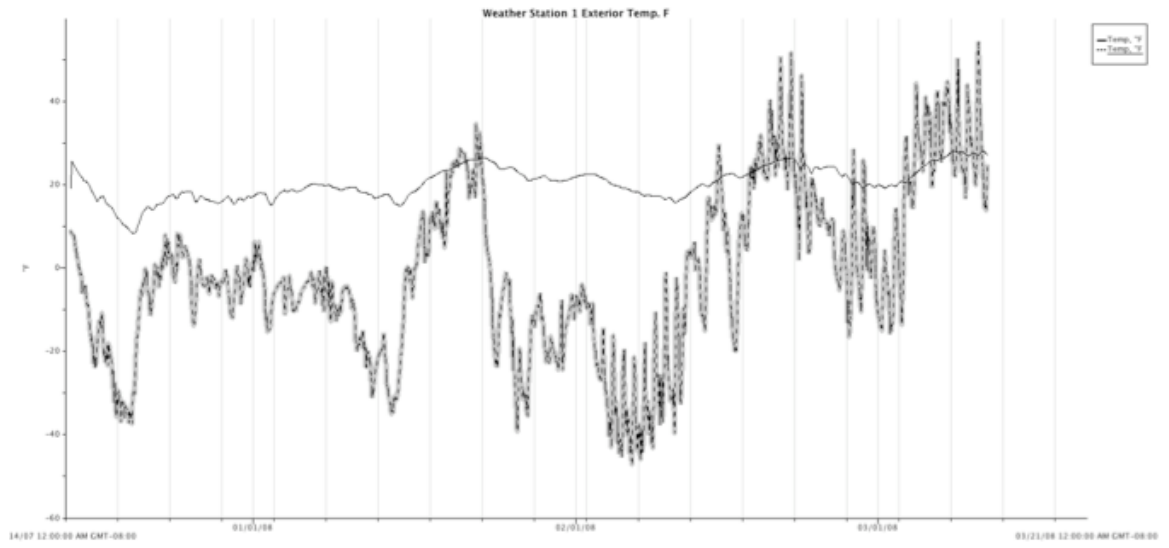
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	Exterior Plot	High Tunnel # 2 Interior
PAR		
Maximum	2553	866
Minimum	1.2	1.2
Average	85.1	16.8
Solar Radiation		
Maximum	1209	390
Minimum	0.6	0.6
Average	58.2	9.8
Air Temperature		
Maximum	54.5	49.6
Minimum	-47.1	-22.9
Average	-1.83	6.7
Soil Temperature 5 in.		
Maximum	28.2	29.4
Minimum	8.4	-2.6

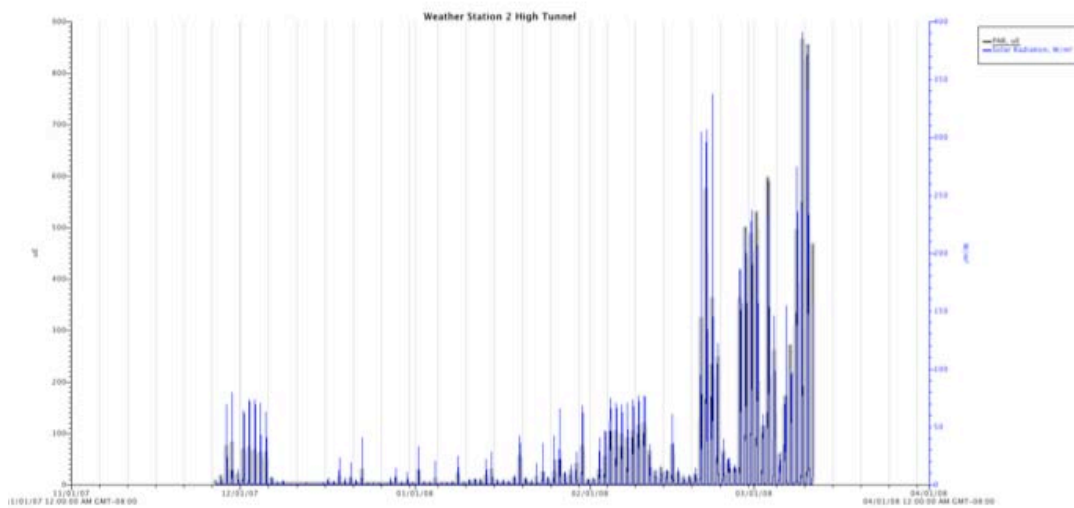
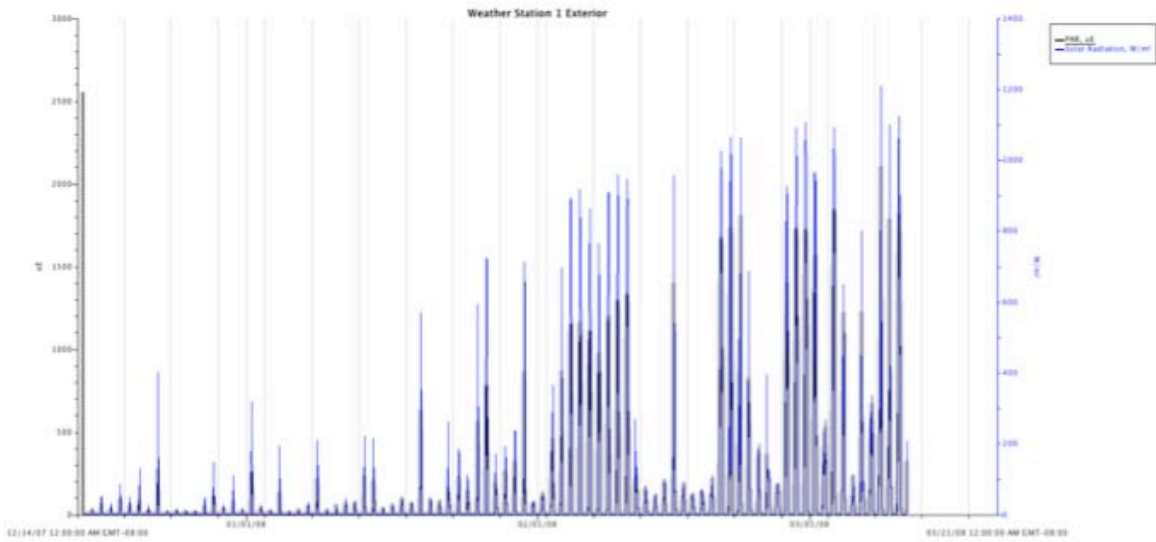
The table above is a summary of the weather conditions found on the research site from December 14, 2007- April 21, 2008.

In addition to these observed temperatures we were interested in the effect of the plastic 7oz. mesh plastic covers on the high tunnels for filtering both photosynthetically active radiation (PAR) and total Solar Radiation.

The following two charts (page 5) compare the daily soil and air temperatures for the outside (exterior) and inside the high tunnel conditions. The snow cover on the outside plots provided substantial protection for the outside trees. The inside plot had colder soil fluctuations than the outside plots but was still very tolerable for the trees to survive.



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The two charts shown on the following page compare the solar radiation and PAR for both the exterior and interior plots during the 07-08 winter period. These results indicate that the filtering of the high tunnel covers is especially pronounced during the winter and improves as summer progresses. However, even at the peak of summer we found that the 70z woven mesh transparent

plastic cover material effectively filters about 30% of PAR to the trees. Based upon the survival, growth, and yield of the inside HT trees, we concluded that the shading had not caused a substantial loss to the trees. Given the long day length that we have at our northern latitude, it may even provide some protection from sun scald.

It was noticeable that the shading effect was much more pronounced during winter than when you got to summer. After consulting with experts on this issue it was concluded that this effect was most likely due to the reduced sun angle on the horizon and the effects of snow on the outside and ice and frost built up on the inside surface of the plastic cover that served to disperse the available



light as well.

We found the covers to be relatively strong and durable under a snow load and cold temperatures.

Throughout the duration of the winter we found

that most of the trees did not lose their leaves until early spring. This however did not seem to



effect their survival. Although the outside trees did loose their leaves, they were subjected to much more wind events and colder temperatures which probably contributed to the differences in leaf retention. We were careful to try and harden off the trees both inside and outside by reduced watering in late summer.



Throughout the winter we were challenged to be able to get the snow off of the roof of the high tunnels due to the distance to the peak of the roof and difficulty with the accumulated snow on the sides of the tunnels that you had to stand in in order to use the snow rake on the roof. We eventually were able to find a

snow rake that was long enough and sturdy enough to do the job.

The following table summarizes the first year survival (June 2007-08) and flowering results.



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 Fairbanks SARE 06-111 Research Trial Results for 2007-2008.

Apple Variety	High Tun. 1 (Live/Dead)	High Tun. 2 WS (Live/Dead)	Outside 1 WS (Live/Dead)	Outside 2 (Live/Dead)	Total Tunnel (Live/Dead)	Total Outside (Live/Dead)	Flowering	Total Comb. (Live/Dead)
Advance	1/1	0/1	2/0	1/0	1/2	3/0		4/2
Altaiski Sweet	2/0	0/0	3/0	1/1	2/0	4/1		6/1
Arbordale	0/1	0/0	0/0	0/0	0/1	0/0		0/1
Arctic Red	2/0	3/0	1/0	2/0	5/0	3/0	F	8/0
Brookland	2/0	0/1	1/0	1/0	2/1	2/0	F	4/1
Carroll	1/0	0/0	0/0	1/0	1/0	1/0		2/0
Chinese Early Golden	0/1	1/0	1/0	1/0	1/1	2/0		3/1
Collet	1/0	1/0	1/0	1/0	2/0	2/0		4/0
Garland	1/0	1/1	1/1	2/1	2/1	3/2	F	5/3
Golden Uralian	2/0	2/0	1/1	1/0	4/0	2/1		6/1
Goodland	2/0	1/0	2/0	1/2	3/0	3/2		6/2
Heyer 12	1/	2/0	3/0	2/0	3/0	5/0	F	8/0
Heyer 20	1/1	2/0	2/0	0/1	3/1	2/1		5/2
Lee 11	0/0	0/0	0/0	0/1	0/0	0/1		0/1
Lee 17	2/0	1/1	1/1	1/0	3/1	2/1		5/2
Lee 21	2/0	1/1	1/1	0/2	3/1	1/3		4/4
Norcue	1/0	0/1	1/1	2/0	1/1	3/1		4/2
Norda	1/0	1/0	1/1	0/2	2/0	1/3		3/3
Nordale	0/0	0/0	1/0	0/0	0/0	1/0		1/0
Norhey	0/0	2/0	2/1	1/1	2/0	3/2	F	5/2
Norkent	0/1	0/0	0/0	0/1	0/1	0/1		0/2
Norland	4/0	1/0	1/0	1/0	5/0	2/0	F	7/0
Norson	0/0	0/1	1/0	1/1	0/1	2/1		2/2
Northland	1/0	0/1	1/1	0/0	1/1	1/1		2/2
Nova Sibirski	2/0	1/1	1/0	2/0	3/1	3/0		6/1
Parkland	2/0	2/0	1/1	2/0	4/0	3/1		7/1
PF-12	2/0	2/0	1/1	2/0	4/0	3/1		7/1
Prairie Magic	1/1	2/0	1/2	1/0	3/1	2/2		5/3
Prairie Sun	2/0	1/1	1/0	1/1	3/1	2/1	F	5/2
Red Heart	1/1	3/0	1/0	1/1	4/1	2/1		6/2
Rescue	1/1	0/1	0/2	2/0	1/2	2/2	F	3/4
September Ruby	0/1	0/0	0/0	1/0	0/1	1/0		1/1
Shafer	0/1	0/0	0/0	0/0	0/1	0/0		0/1
Summer Red	2/0	2/0	0/2	0/2	4/0	0/4	F	4/4
Trailman	0/1	0/1	0/2	0/2	0/2	0/4		0/6
Ukalskoje	2/0	2/0	2/0	1/1	4/0	3/1	F	7/1
18-8-9	2/0	2/0	2/0	1/1	4/0	3/1		7/1
18-18-11	1/0	1/0	2/0	0/1	2/0	2/1		4/1
18-10-32	2/0	1/0	2/0	2/0	3/0	4/0		7/0
8919	2/0	2/0	2/0	2/0	4/0	4/0	F	8/0

Review of Conditions of the Trial.

High Tunnels

The tunnels were checked regularly throughout the winter for snow build up and damage. Both tunnels made it through the winter without any major damage. The straw used for winter insulation inside the tunnels caused some pest issues early in the spring and was removed promptly. Vole traps and poison were set in the tunnels in early May. Both tunnels were thawed and extremely wet in early May. All plant covers were removed from inside tunnels and in exterior plots Mid May. The end walls were also removed in early June. Tunnels were tightened and anchors were secured as needed. Repairs were made as needed.

Irrigation

Drip irrigation was installed to both tunnels and one exterior plot. 1" poly pipe was used for the main and 3/4 " for the sub main. Each tree received a foot and a half of micro tubing which contained two inline 1/2gal per hour emitters. Trees were watered twice weekly for one hour until September when watering was tapered and eventually stopped mid month. Exterior plots received additional rainfall throughout the summer.

General Maintenance

Tunnels and plots were weeded and tilled daily and weekly as needed. The entire site was tilled once a month with a tractor. Cover crops were planted in neighboring fields in order to reduce weeds inside the trial area.

Trees and other plants

Apple trees that did not survive the winter were removed and replaced.

Buds broke on a few trees inside the tunnel in Late May. Some hornets and small flies were seen inside the tunnels throughout the summer.

All trees were fertilized in Late May. Trees received 113g of a 10-10-10 organic fertilizer from Peace of Mind. Pear, plum and cherry trees were also planted inside the tunnels (see map).

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The following berries were planted both inside and outside tunnels (see maps):

Scientific Name	Variety
<i>Ribes rubrum</i> (Red Currant) (Black Currant)	Cherry Red Black September
<i>Lonicera caerulea var. edulis</i> (Honey Berry)	Blue Bird, Blue Sky, Blue Belle, Berry Blue
<i>Rubus arcticus L. subsp. X stellarcticus</i> Arctic Raspberry	Anna, Sophia, Beta, Valentine
<i>Hippophae rhamnoides</i> Sea Berry	Baikal, Male Sea Berry, Orange Delight, Siberian Splendor, Sunny

The following additional fruit trees were planted in the high tunnels only:

Name	Variety
<i>Pyrus pyrifolia</i> (Asian Pear)	Raja P. Bet. , Seuri OHXF 513
<i>Prunus x domestica</i> (Plum)	Bavay's Gage, Shropshire Damson
<i>Prunus avium</i> (Cherry)	Crown Jewel, Crimson Passion

Plant materials were obtained from Dan Elliott (Wasilla, AK) and One Green World (Molalla, OR).

(Refer to the trial planting maps)

Data Collection: (Refer to data summaries and graphs)

Climate Data

We collected climate data from inside one high tunnel and one of the exterior plots starting in October of 2007. We are measuring the following:

- Air temperature
- Soil temperature (between 5-10 inches deep)
- Relative humidity
- Solar radiation
- Photosynthetic Active Radiation
- Soil moisture
- Wind speeds and gusts

Loggers collect data every hour. Batteries were replaced in the fall and repairs were made as needed.

Survival Data

Survival data was collected in mid May. Our highest survivors overall included the following varieties. We anticipate these varieties to become leading candidates for testing in rural sites.

Variety	Live/Dead
Altaiaski Sweet	6/1
Arctic Red	8/0
Brookland	4/1
Carroll	3/0
Golden Uralian	6/1
Goodland	6/2
Heyer 12	8/0
Heyer 20	5/2
Lee 17	5/2
Nova Skibirski	6/1
Parkland	7/1
PF-12	7/1
Prairie Magic	5/3
Prairie Sun	5/2
Red Heart	6/2
Trailmen	7/1
Ukalskoje	7/1
18-10-32	7/0
8919	8/0

Apple Harvest

Apples were harvested in early to mid September. They were weighed and sugar content was measured with a refractometer (see chart below).

Apple Harvest 2008

<i>Tunnel 1</i>	Date of Harvest	No. of apples	Weight (g) AVE	Sugar Content (Brix) AVE
Prairie Sun	9/2/08	3	69.57	8.33
<i>Tunnel 2</i>				
Prairie Sun	9/2/08	12	72.52	13.45
Lee 21	9/2/08	1	168.34	12.00
Norhey	9/17/08	3	86.33	7.00
Arctic red	9/17/08	22	17.78	6.70
Heyer 12	9/17/08	8	56.89	10.75
Norcue	9/17/08	1	56.66	13.00
Red Heart	9/17/08	2	12.84	8.00
Arctic Red	9/17/08	3	24.43	11.33
Ukalskoje	9/17/08	7	38.48	12.29
<i>Exterior 1</i>				
Heyer 12	9/17/08	1	155.13	7.50

Winter Preparations (2008-09)

Winter preparations will be similar to last year's preparations. Ends will be put on and tunnels will be sealed with plastic sheeting as done the previous winter. Trees inside the tunnels will be insulated with reflective insulation material and all replacement trees will be covered with treepees (tree covers) and tree guards (vole protection). Newly planted replacement trees in the exterior plots will be covered as well. Winter temperatures and snowfall will be monitored throughout the winter.

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8919	Norkent / dead	18-8-9	berries Red Currant / cherry red	18-10-32 / dead
18-8-9/dead	Norcue	Heyer 12	Honey berry / blue bird Arctic Rasperry / Sophia Sea Berry / sunny	Red Heart / dead
18-10-32	Norda / dead	Carroll / dead	dead Arctic Rasperry / Valentina	Summer Red / dead
*Rescue	Lee 11 / dead	Lee 21 / dead	dead Arctic Rasperry / beta	Goodland / dead
Norson	Chinese Golden Early	Norland	dead Marion Berry	Arctic Red
Garland	*Advance	Goodland **	Black Currant / Black Sept. dead	18-18-11 / dead
Novaskibirski	*Golden Uralian	Prairie Sun	Sea Berry / Siberian Splendor Sea Berry / Orange Delight	Lee 17
Norcue	*Golden Uralian	Trailman / dead	Sea Berry / Baikal Honey Berry/ Blue Sky	Golden Uralian
Rescue	*Heyer 12	Brookland	dead dead	Sept. Ruby
Collet	Novaskibirski	Advance	dead	Prairie Sun
Lee 21	Parkland	Trailman / dead		Prairie Magic
*Advance	Altaiski Sweet	PF-12		Arctic Red
Norson	Heyer 12	Rescue		Parkland
PF 12	Garland **	Heyer 20		Altaiski Sweet / dead
*Trailmen	Ukalskoje	8919		Norhey / dead
	Exterior 2			
	60 Trees			
	Planted July 11, 2007			
	**replaced			
	Heyer 20 and Brookland			
	planted on August 23			
	7ft apart and 12 feet between rows			

High Tunnel Plot 1 planting map - inclusive of berries planted in 2008.

Novaskibirski		*Lee 21	18-8-9		*21-61-69
Advance		Summer Red	Arctic Red	Evans Cherry Shropshire Damson Seuri	Heyer 20
8919		Heyer 12	Ukalskoje	Raja (planted June 2008)	Artic Red
Norhey	Red Currant / Cherry red H.B./ blue bird	18-10-32	Garland		18-18-11
Heyer 12	H.B./ blue sky Arctic Rasp./ Anna	Parkland	Summer Red		Prairie Magic
Goodland	X Black currant/black sept. marion berry	*21-61-69	Red Heart		Chinese Golden Early
Heyer 20		*Rescue	Lee 17		Norland
18-18-9	Altaiski	*Norson	Lee 21	*Norhey NovaSkibirsi	*Nova Sibirski
Arctic Red	Norda	8919	PF-12	Norland (planted Aug 23)	*Golden Uralian
*21-61-69	Golden Uralian (planted Aug 23)	Ukalskoje	Collet		Parkland
Norda		Red Heart	*Trailmen	*Rescue	Prairie Sun
Prairie Magic	Sea Berry/ siberian Sea Berry/ orange Sea Berry/ baikal	Red Heart	Golden Uralian	Cherry Crown Jewel Crimson Passion (Planted June 2008)	*Northland
Prairie Sun	X H.B. / blue bird X H.B. / blue belle	Norhey	PF-12		*Lee 17
		TUNNEL 2 Silas			
		58 Trees			
		Planted July 10, 2007			
		7 ft between trees and 12 feet between rows			
		* replacements planted July 2008			

High Tunnel Plot 2 planting map - inclusive of berries planted in 2008.

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			*Rescue	Golden Uralian
Heyer 12	*Trailmen		*Trailmen	*18-10-32
altaiski sweet	*Trailmen		Advance	Norda
*advance	Northland		Lee 17	Prairie Sun
*rescue	Altaiski Sweet		Heyer 20	*Norhey
*Shafer	Norcue		*Altasaski Sweet	Norhey
Lee 21	Goodland		18-8-9	Ukalskoje
*Altasaski Sweet	Altaiski Sweet		Heyer 12	*18-10-23
*Norcue	Arctic Red		Brookland	Norda
Goodland	8919		18-10-32	Advance
18-8-9	PF-12		Garland	Summer Red
Heyer 12	Norda		Red Heart	Prairie Magic
8919	Norhey		Norland	*21-61-69
18-18-11	Novaskirski		Chinese Early Golden	*Golden Uralian
Lee 21	*Golden Uralian		Prairie Magic	Collet
*Lee 21	Parkland		*Red Heart	Prairie Magic **
	Exterior Plot 1			
	56 Trees			
	Planted July 11, 2007			
	6ft between trees and 6 ft between rows			
	**planted August 23 replaced Prairie Sun			
	* replacement plants planted July 2008			

Exterior Plot 1 planting map - inclusive of berries planted in 2008.

8919	Norkent / dead	18-8-9	berries	18-10-32 / dead
18-8-9/dead	Norcue	Heyer 12	Red Currant / cherry red	Red Heart / dead
18-10-32	Norda / dead	Carroll / dead	Honey berry / blue bird	
*Rescue	Lee 11 / dead	Lee 21 / dead	Arctic Raspberry / Sophia	Summer Red /dead
Norson	Chinese Golden Early	Norland	Sea Berry / sunny	
Garland	*Advance	Goodland **	Arctic Raspberry / Valentina	Goodland / dead
Novaskibirski	*Golden Uralian	Prairie Sun	Arctic Raspberry / beta	Arctic Red
Norcue	*Golden Uralian	Trailman / dead	Marion Berry	
Rescue	*Heyer 12	Brookland	Black Currant / Black Sept.	18-18-11 / dead
Collet	Novaskibirski	Advance	dead	
Lee 21	Parkland	Trailman / dead	Sea Berry / Siberian Splendor	Lee 17
*Advance	Altaiski Sweet	PF-12	Sea Berry / Orange Delight	
Norson	Heyer 12	Rescue	Sea Berry / Baikal	Golden Uralian
PF 12	Garland **	Heyer 20	Honey Berry/ Blue Sky	Sept. Ruby
*Trailmen	Ukalskoje	8919	dead	Prairie Sun
	Exterior 2		dead	
	60 Trees		dead	
	Planted July 11, 2007			
	**replaced			
	Heyer 20 and Brookland			
	planted on August 23			
	7ft apart and 12 feet between rows			

Exterior Plot 2 planting map - inclusive of berries planted in 2008.



Apple Crop Images from the Summer of 2007.

Outcomes and Expectations - 2009:

Results from the SW06-III Trial this past year proved to be very encouraging both for the number of varieties that survived and those that then produced fruit. It was a good winter for testing with a coldest temperature of -47F and about 16 inches of snow on the ground. We found that the growth of the trees in the high tunnels was dramatically greater than that found in the exterior plots. The trees in general appeared to be very healthy heading into the second winter and we anticipate excellent survival again. We are especially excited about the potential for this coming years fruit crop and hope to substantially increase fruit yields. Through use of careful monitoring of site conditions, we have confidence in being able to recommend varieties that likely would be capable of surviving similar conditions in rural communities. In addition to the monitoring the trial through next summer we are intending to develop an educational document that will summarize the management procedures we used with both the exterior plots and those within the high tunnels. We believe that this trial has great potential to showcase cold tolerant varieties and culturing treatments that can open new doors for successful fruit tree production with rural cold sites in Interior Alaska.