

IMPROVEMENT OF CHOKECHERRY, SILVER BUFFALOBERRY AND HAWTHORN  
FOR CONSERVATION USE IN THE NORTHERN PLAINS 1/

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Abstract.--Chokecherry (Prunus virginiana L.), silver buffaloberry [Shepherdia argentea (Pursh) Nutt.], and hawthorn (Crataegus spp. L.) are important shrub species in the Northern Great Plains for multiple-row windbreaks, erosion control, wildlife habitat, mined-land revegetation, and other conservation purposes. The USDA SCS Plant Materials Center at Bismarck, North Dakota, initiated improvement projects on chokecherry, buffaloberry and hawthorn in 1976-1979 with the objective of assembling, evaluating, and releasing one or more cultivars of each species. These seed source studies began with a search for superior phenotypes and disease free individuals and stands. The collection sites encompassed most of North and South Dakota, and in the case of chokecherry, much of Minnesota. In May of 1983, containerized seedlings of the three species were transplanted into large-scale test plantations in North and South Dakota. Data collection has included plant height and width, vigor, and disease and insect resistance. Differences in size and growth rates based on origin are not readily apparent at this early age. Chokecherry shows the most phenotypic variation in growth form and maturity.

About one percent of the Northern Plains is classified as woodland. In western North Dakota these woodlands are usually referred to as "woody draws", and in eastern North Dakota as "coulees". These sheltered areas are valued as they offer shade to livestock and protection from wind. Chokecherry is a common understory plant while buffaloberry and hawthorn are found on the upper slopes of the wooded draws. These three species are important to the reestablishment of woody draws on surface mined lands.

With the exception of 'Sakakawea' silver buffaloberry and 'Schubert' chokecherry, there are no cultivars of these species available for conservation use in the Northern Great Plains. Clonal ornamental varieties have a narrow gene base and may not perform well in windbreaks or natural plantings that receive less maintenance than urban landscapes. Therefore, single parent selection will not be practiced, given the inherent advantage of genetic diversity for insect and disease resistance in large scale field plantings. Common or inadequately identified seed sources with uncertain performance potential are currently collected and increased by nurseries. The goal of these and other Plant Materials Center projects is to supplement and ultimately replace these sources with seed propagated cultivars of superior, locally adapted, source-identified material.

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Native seed was collected from North Dakota, South Dakota, and Minnesota. The intent of the project was to sample each county at least once in order to acquire a diverse genetic base representing a wide array of ecotypes or geographic races. Over 130 accessions or seed sources were assembled for each species. Over 40 accessions of introduced hawthorn species were obtained from the Canada Agriculture Research Station, Morden, Manitoba. The assemblies were made possible only through the concerted effort of SCS personnel working in cooperation with local Soil Conservation Districts throughout the three states. These individuals located the stands and collected the seed.

Seed source studies of chokecherry, buffaloberry, and hawthorn are underway near Bismarck, North Dakota. Within 10 years, individuals with desirable form, growth rates, fruit production, survival, rate of spread, and disease resistance will be selected. Progeny tests, seed orchards, and outplantings representative of major land resource areas will be established. Further selection and final evaluation in field plantings are planned to document performance and area of adaptation.

#### CHOCHECHERRY

Chokecherry is one the most widely distributed native tall shrubs or small trees in North America (Vilkitis, 1974). It occurs from Newfoundland south to Georgia and west to California and British Columbia. In the North Central Plains its habitat includes moist sites in open areas, along fencerows, roadsides, borders of woods as well as sandy or rocky hillsides and ravines (Stephens, 1973). Three varieties have been described: var. virginiana in the eastern U.S., var. melanocarpa in the west, and var. demissa along the Pacific Coast (Little, 1979). Some forms have yellow rather than dark red or black fruit. The leaves of var. melanocarpa are thicker and cordate rather than oval, oblong or obovate as in var. virginiana. The fruit is less astringent (Sargent, 1965). The leaves and bark are very bitter. The leaves contain prussic acid and when withered, are poisonous to cattle (Gibson, 1913).

Adaptive characteristics of chokecherry include fast growth, dependable fruit crops, tolerance to harsh climatic extremes, and the ability to grow on a wide variety of soil types (Mulligan and Munro, 1981, Vilkitis, 1974). A dominant shrub species in several major woodland habitat types of the Northern Plains (Bjugstad and Girard, 1984), it is browsed by deer (*Odocoileus* sp.) and other big game animals. It spreads by underground stems, forming clumps and thickets that provide wildlife food and cover. Over 70 species of game and songbirds along with several small mammals utilize the fruits or buds (Vilkitis, 1974). Chokecherry has potential for surface mine reclamation (Thornburg, 1982) and the revegetation of depleted game ranges (Dietz et. al., 1980). The stems of chokecherry show an increase in protein from fall to winter, which make it desirable to deer (Dietz, 1972). Studies are underway to select ecotypes with improved seedling vigor, palatability, and productivity in the intermountain region (Monsen and Davis, 1985). It is recommended for the outer row of multi-row windbreaks, single and twin row dense barriers, and wildlife plantings in the Dakotas (Tree Planting Handbook for the Dakotas, 1976). A colorful horticultural variety widely available in the Northern Plains is the red-leaved 'Schubert' chokecherry. When seed propagated, this cultivar has been used for conservation plantings, but common material is generally increased for these purposes.

Chokecherry is host to a number of insects and diseases. Therefore, selection of less susceptible individuals or sources is a major objective of this project. Common insect pests in the Northern Plains are listed by Stein and Kennedy (1976, 1972). Refer to Table 1. Some, like the tent caterpillars

Table 1.--Common insects found on trees and shrubs in North and South Dakota  
(Stein, 1976)

Tree species	Insect species		
	Leaf feeders	Borers	Sucking insects
<b>COMMON CHOKECHERRY</b>			
<u>Prunus virginiana</u>			
	<u>Alsophila pomataria</u> (fall cankerworm)	<u>Chaetophlocus heterodoxus</u> (a bark beetle)	<u>Asiphonaphis pruni</u> (a plum aphid)
	<u>Archips cerasivoranus</u> (uglynest caterpillar)	<u>Clytophorus verrucosus</u> (a roundheaded wood borer)	<u>Contarinia virginianiae</u> (chokecherry midge)
	<u>Hyphantria cunea</u> (fall webworm)	<u>Ropalopus sanguinicollis</u> (a roundheaded wood borer)	<u>Gyponana flavilineata</u> (a leafhopper)
	<u>Malacosoma californicum</u> <u>lutescens</u> (prairie tent caterpillar)		<u>Rhopalosiphum cerasifoliae</u> (chokecherry aphid)
			<u>Tortistilus inermis</u> (a trechopper)
<b>SILVER BUFFALOBERRY</b>			
<u>Shepherdia argentea</u>			
	<u>Datana sp.</u> (a caterpillar)		<u>Paratrioza arborensis</u> (a psyllid)
	<u>Erannis tiliaria</u> (linden looper)		<u>Psylla magnicauda</u> (a psyllid)
<b>ARNOLD HAWTHORN</b>			
<u>Crataegus arnoldiana</u>			
	<u>Acrobasis indiginella</u> (a leaf crumpler)	<u>Saperda candida</u> (roundheaded apple tree borer)	<u>Chaitophorus populicola</u> (aphid)
	<u>Antheraea polyphemus</u> (polyphemus moth)		<u>Corythucha cydoniae</u> (hawthorn lace bug)
	<u>Caliroa cerasi</u> (pearslug)	<u>Xylotrechus convergens</u> (a roundheaded wood borer)	<u>Eriosoma lanigerum</u> (woolly apple aphid)
	<u>Hyalophora cecropia</u> (cecropia moth)		<u>Rhopalosiphum fitchii</u> (aphid)
			<u>Telomona tristis</u> (treehopper)

(Malacosoma sp.), uglynest caterpillar (Archips cerasivoranus), and fall webworm (Hyphantria cunea) are often more unsightly than destructive. Defoliation caused by fall cankerworm (Alsophila pometaria) can be a problem. A more detailed list of insects is provided by Quist (1980). Leaf spots such as bacterial spot (Xanthomonas pruni) and shothole (Coccomyces lutescens) are prevalent. Also reported are several decay fungi and a stem canker (Valsa leucostoma). Two more troublesome diseases are black knot (Dibotryon morbosum) and the leafhopper transmitted Western-X disease caused by a mycoplasma. Black knot infections, noted for their black, hard, elongate swellings on stems, can girdle and kill infected branches (Lamey and Stack, 1980). Western-X, widely distributed throughout the area, has also been a deterrent to planting chokecherry (Peterson, 1966, Hoag, 1965). Foliage becomes prematurely yellow and red, plants become stunted, and rapid spread can cause severe mortality (Peterson, 1984). To address this problem, the Bismarck Plant Materials Center is cooperating with Dr. Glenn Peterson, Plant Pathologist, USDA Forest Service, Lincoln, Nebraska on a project to screen a large assembly for resistance to Western-X. Plans are to inoculate a plantation in South Dakota for this purpose.

### Assembly and Evaluation

The assembly of chokecherry was initiated and completed in 1979. A total of 179 native sites (accessions) were sampled by SCS personnel stationed in local Soil Conservation District offices throughout the study area of North Dakota, South Dakota, and Minnesota. These individuals were instrumental in locating potentially superior stands and collecting the seed. One or more parents were sampled at each site.

Fruit was received by the Bismarck Plant Materials Center and macerated to separate seed from the pulp. Each seed lot was cold stratified at 41 F for 150 days, germinated in plastic trays, then transplanted into "styrobloc" containers in the spring of 1980 and 1981. Stock was grown in a lathhouse under sprinkler irrigation and fertilization. In April-May of 1983, 3100 seedlings were hand planted at two field locations.

One plantation is located on U.S. Fish and Wildlife Service land approximately 5 miles east of Bismarck in Burleigh County, North Dakota. Of the original 179 accessions, 160 were established. Figure 1 illustrates the sample site distribution by county for surviving accessions. Experimental design is a randomized block with some blocks incomplete. Accessions are replicated 5 times with 4 trees per replication. An additional outer row is used to offset border effects. A second plantation comprised of similar accessions was established the same year in Sully County, South Dakota. The property is managed by the South Dakota Game, Fish and Parks Department. This plantation will be inoculated with Western-X disease.

Test plantations are maintained under clean cultivation. Weeds are controlled by within-row tree cultivators and hand hoeing. The herbicide simazine was applied to the South Dakota planting in 1985 and 1987. Each year a cover crop is seeded for erosion control at the North Dakota and South Dakota sites. Animal damage has been minimal at the North Dakota site, but more severe in South Dakota. Repellents were applied the year of establishment.

Defoliating insects can be numerous in some years. In order to reduce growth suppression at the North Dakota planting, infestations of fall webworm were sprayed with insecticide in 1984 and 1985. In 1987 the trees were sprayed for control of the uglynest caterpillar. The cecropia moth caterpillar (Hyalophora cecropia) caused significant damage to 7% of the trees in 1985. Leaf spot was prevalent throughout the plantation. A few individuals already express symptoms of black knot.

# Sample Sites For Chokecherry (By County)

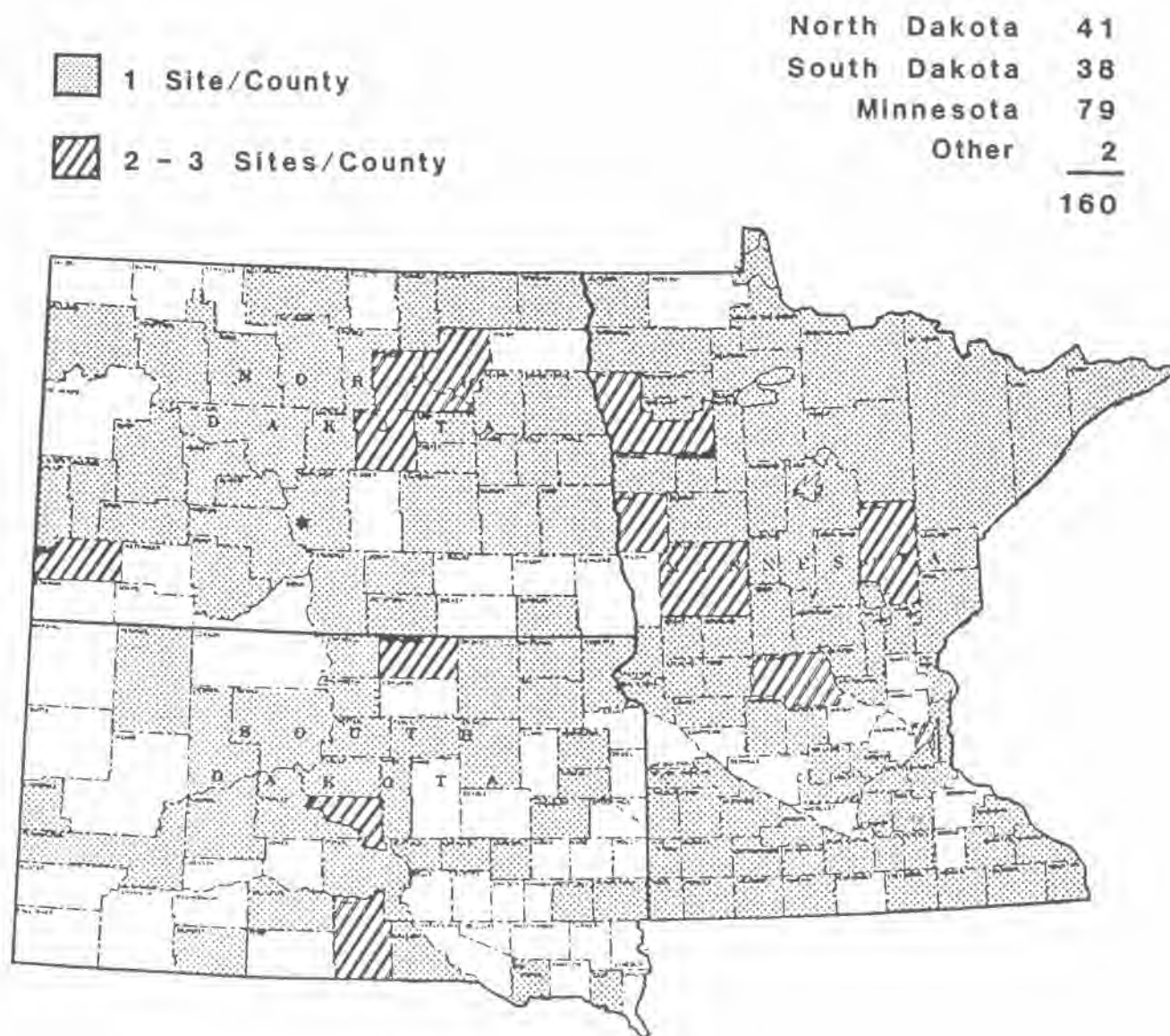


Figure 1.

For the first four growing seasons, performance data has included survival, height, and canopy width. In 1985 (North Dakota only), visual comparison ratings were recorded for plant vigor and rate of spread. Both multiple and single stem types are apparent. About 8% of the plants showed very little suckering, while 2% showed a very high rate of spread. The remaining 90% were what is typical for chokecherry. Early growth rates are highly variable, ranging from 33 to 71 cm/yr (Figure 2). Heights up to 277 cm (9.2 feet) were recorded in 1986. Survival in 1985 totaled 95%. Differences in size and growth rates based on north-south latitudinal origin are not apparent at this early age. Survival at the South Dakota plantation is 56%, partly a result of poor establishment and droughty conditions the past two growing seasons. Maximum recorded height was 86 cm (2.8 feet).

#### SILVER BUFFALOBERRY

Silver buffaloberry [Shepherdia argentea (Pursh) Nutt.], is a native, thorny, thicket forming large shrub or small tree well adapted to the cold temperatures and semi-arid climate of the Northern Plains. While its geographical distribution is centered in the Dakotas, Montana and southern regions of the Canadian Prairie Provinces, it can be found scattered from the Central Plains west to Oregon and California (Elias, 1980). Habitat includes moderate textured soils in prairie valleys, along streambanks or steep, eroded hillsides (Stephens, 1973). An excellent account of the species and its ecology is provided by Looman (1984).

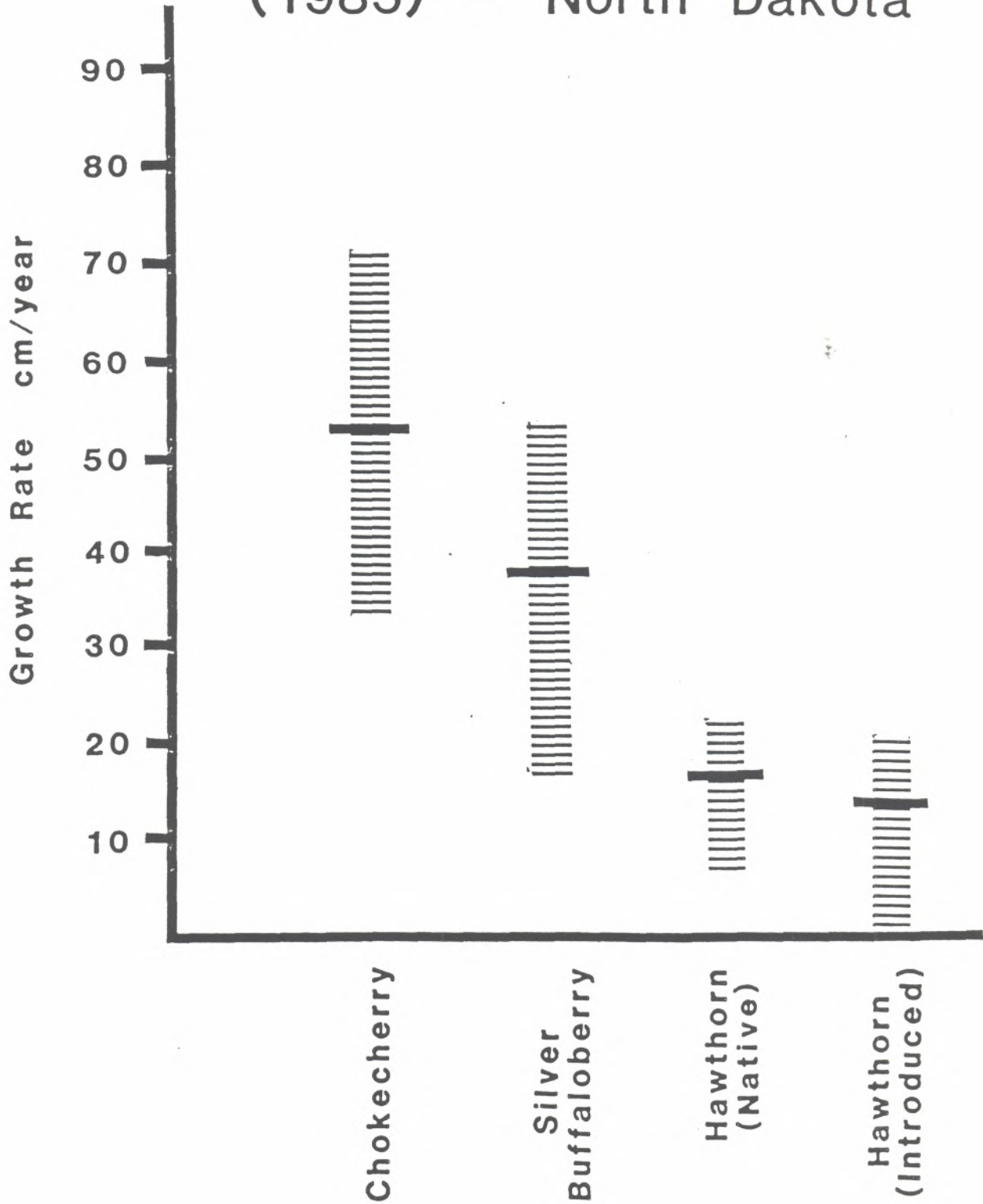
Often forming single clone patches and nearly impenetrable clumps, silver buffaloberry is an important source of cover and food for small and large game animals (Hladek, 1971). Despite the sharp thorns, domestic cattle and mule deer (Odocoileus hemionus) browse young shoots and eat the red berries. Cottontails (Sylvilagus nuttallii) and jack rabbits (Lepus townsendii) browse new shoots and eat the stems and bark in winter. The abundant fruit is food for cedar waxwings (Bombycilla cedrorum) in the fall (Looman, 1984). Evans and Dietz (1974) reported that among seven woody species tested, its fruit provided the best nutrition for sharp-tailed grouse (Pediacetes phasianellus) in winter. The fruit makes excellent jelly.

As an actinorhizal pioneer species, buffaloberry is an important and widely propagated plant for land reclamation and amenity plantings in the USA and Canada (Fessenden, 1979). This hardy species has long been recognized for its successful use as a shrub row in shelterbelts of the Northern Plains (Johnson, 1928, Olson and Stoeckeler, 1935).

Insect problems are generally not severe. However, Psyllids (Psyllidae) are frequently reported. Common leaf feeding and sucking insects in the Dakotas are listed by Stein (1976) (Table 1). Looman (1984) found the larvae of June beetle (Phyllophaga sp.) and Click beetle (Elateridae) feeding on the roots. The disease white heart rot (Fomes ellisianus) is species specific and widespread. The decay organism infects maturing stands, rendering them weak and susceptible to wind damage. A fungal canker (Cucurbitaria sp.) infects younger plants. Also present in the plains is a leaf spot (Cylindrosporium sp.) (Peterson, 1967).

'Sakakawea' is the only variety available for conservation use in the Northern Plains. It is a selection from the Canadian cultivar 'Goldeye', and was released in 1983 by the Soil Conservation Service in cooperation with the state Agricultural Experiment Stations of Minnesota, North Dakota and South Dakota (USDA SCS, 1985). This seed propagated cultivar is recognized for its good to excellent survival, seed production, and uniformity. Twelve to 20% of the offspring express a trait for yellow fruit. The selection serves as an interim release. Further improvement of growth rate, form, branch angle, disease resistance or other traits should be possible because of the species broad range and ecotypic variation.

# RANGE OF GROWTH RATES (1985) - North Dakota



# Sample Sites For Silver Buffaloberry (By County)

-  1 Site/County
-  2+ Sites/County

North Dakota	67
South Dakota	33
Other	1
	<hr/>
	101

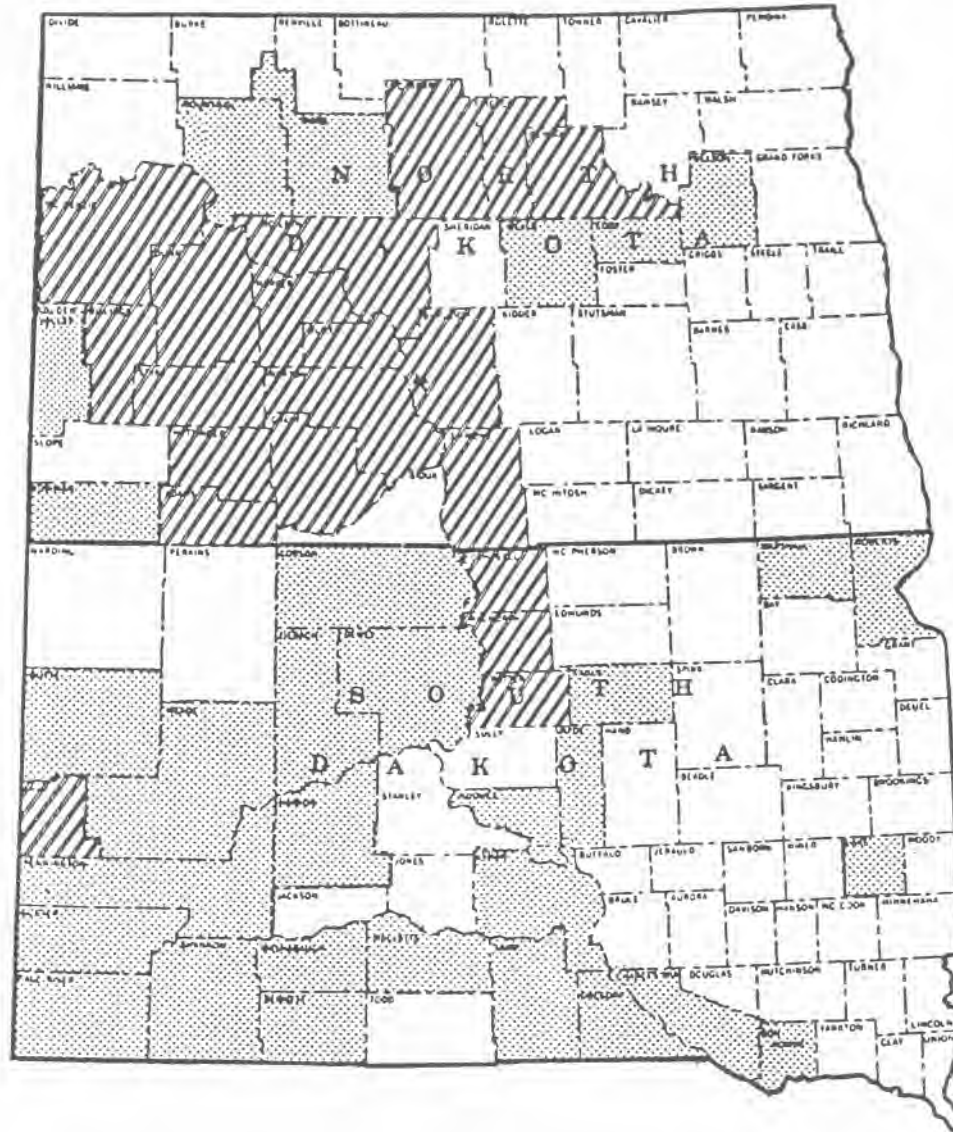


Figure 3.



### Assembly and Evaluation

The silver buffaloberry assembly was initiated in 1977 and completed in 1979 with the assistance of SCS field personnel. One hundred thirty four sites were sampled in North and South Dakota. Seed was collected from 1 or more parents at each location. An additional 4 seed lots were obtained from the Canadian Department of Agriculture's research station at Morden, Manitoba. From the original collection, 101 accessions are represented in the test plantation near Bismarck. Figure 3 illustrates the geographic distribution of sources by county. Production methods, establishment, experimental design, and plot maintenance are similar to the chokecherry project. A total of 1700 containerized seedlings were transplanted to the field in May of 1983.

Survival, plant height, and canopy width have been recorded since 1983. Vigor, insect damage, and disease symptoms were visually scored in 1985. Eight percent of the shrubs were partially defoliated by the cecropia moth caterpillar. While other phytophagous insects were detected, they did not appear to cause significant damage. Survival totaled 85% in 1985 and plant vigor was rated good to excellent. Average growth rates ranged from 17 to 54 cm/yr (figure 2). Several accessions have exceeded heights of 228cm (7.6 feet). Geographic trends in size and growth rates are not yet apparent.

After 5 to 7 years, promising ecotypes or individuals will be selected and increased for further testing. Eventually, one or more seed propagated cultivars will be released to supplement 'Sakakawea' as the recommended variety for conservation use in the Northern Plains.

### HAWTHORN

Hawthorns (Crataegus spp.) comprise a very large and diverse genus of medium to tall thorny shrubs and small trees in North America, Europe, and Asia. They are commonly known as "red haw" or thornapple, with very little distinction made between them by the ordinary observer. According to Little (1979), this unstable genus evolved rapidly and produced numerous hybrids following colonization of vast new open areas and forest clearings. At one time, as many as 700 to 1100 species were described, mostly in the eastern United States. Little's checklist accepts 35 native and 1 naturalized hawthorn species. Some are true breeding and apomictic (Muniyamma and Phipps, 1979, 1984). The only common species indigenous to the Northern Plains are fleshy (C. succulents) and round-leaved hawthorn (C. chrysocarpa). The two species are difficult to distinguish. Round-leaved hawthorn is smaller, more shrub-like with stout thorns. The leaves and petioles have red glands. Fleshy hawthorn lacks these glands, is more tree-like and has slender thorns. Intermediate types, possibly hybrids, can be found. Another less common species is downy hawthorn (C. mollis), found in eastern South Dakota and extreme southeastern North Dakota. The dense pubescence on the underside of the leaves, inflorescence, and petioles separate it from the other species. Its broad leaves and large fruit are important traits. All three species occur on rich lowlands and along the margins of woods, streambanks, or rocky hillsides (Stephens, 1973). Another species, Arnold hawthorn (C. arnoldiana), is hardy in the Dakotas and recommended for dense barriers, multi-row windbreaks as well as recreational area and wildlife plantings (Tree Planting Handbook for the Dakotas, 1976).

Hawthorns are extremely valuable wildlife food and cover. Succulent shoots and young leaves are a palatable browse for deer, cattle and rabbits. Dense, thorny stands deter predators and provide excellent nesting sites or brood-rearing areas for grouse, turkey (Meleagris gallopavo), robins (Turdus migratorius), doves (Zenaid macroura), catbirds (Dumettella carolinensis), and

blue jays (*Cyanocitta cristata*). The fruit is eaten by many game and songbird species (Sharp, 1974). It is not generally used for human consumption, though the Indians used it during periods of famine (Gilmore, 1977).

Common insect pests of *C. arnoldiana* are noted by Stein (1976) (Table 1). Severe problems are not apparent. Hawthorns are susceptible to a number of diseases typical of Rosaceous species including fireblight (*Erwinea amylovora*) (Hepting, 1971). Fungal leaf spots or leaf blights (*Fabraea* spp.) are frequently described (Schroeder, 1975, Davidson and Davison, 1972, Pirone, 1978). Cedar-apple and cedar-hawthorn rusts (*Gymnosporangium* spp.) are a major component of hawthorn pathology in the United States because of the damage caused to junipers (*Juniperus* spp.) as the alternate host (Hepting, 1971). Cockspur (*C. crus-galli*) and Washington hawthorn (*C. phaenopyrum*) are considered rust resistant (Wade and Worf, 1974). Our objective is to select species or seed sources exhibiting lower levels of natural disease infection in addition to superior growth rate, form and survival characteristics.

### Assembly and Evaluation

Both native and introduced hawthorns were assembled for the study in 1976 and 1977. The native collection included seed sampled by SCS personnel from 139 sites in North and South Dakota. An additional 45 seed lots of introduced hawthorn species were obtained from the Canada Agriculture Research Station at Morden, Manitoba. A list of these species can be found in table 2. Stratification trials indicated that a 90 day warm period (70-80 °F) followed by 90-140 days of cold treatment (34-38 °F) in moist sand promoted the highest germination for most seed lots (USDA, SCS, 1978). Approximately 1400 containerized seedlings were outplanted in May 1983. Seventy five of the native and 31 of the introduced accessions were established. The geographic distribution of native sources is illustrated in figure 4. Experimental design and location are the same as the silver buffaloberry project. Plots have been maintained under clean cultivation. Flexible netting was placed over each seedling at planting time to provide protection from deer and rabbit browse. The netting, combined with annual fall applications of animal repellent, have been effective in reducing damage and insuring survival of the plantation.

Data collection from the 1983 through 1986 field seasons included tree height, canopy width, and survival. Plants were visually rated for vigor and amount of animal browse in 1985. In 1986 plants were rated for vigor and insect damage. Survival rate is 98%. Despite growth reduction from moderate deer browse, growth rates (1985) averaged 15 cm/year with a range of 0 to 23 (figure 2). Maximum recorded height (1986) was 140 cm (4.7 feet). Introduced species rank higher in vigor than native sources at this early age. No significant insect or disease problems were noted. Geographic trends in size or growth rate are not yet obvious.

### SUMMARY

Seed propagated cultivars of three important woody species: chokecherry, silver buffaloberry, and hawthorn are needed for conservation use in the Northern Plains. The USDA SCS Plant Materials Center initiated projects in 1976-1979 with the objective of assembling a diverse genetic base of material in order to identify a portion of the ecotypic variability within each species. This variability should provide the basis for selection of superior seed sources based on disease resistance, growth rate, survival, fruit production or other characteristics. After field testing and further selection, one or more cultivars of each species will be released for commercial nursery production. These large assemblies of genetically diverse germplasm can be utilized by research agencies willing to cooperate further in more intensive tree and shrub improvement work.

Table 2.--HAWTHORN SPECIES (*Crataegus* spp.) received from the Canada Agriculture Research Station, Morden, Manitoba which were established in the test plantation.\*

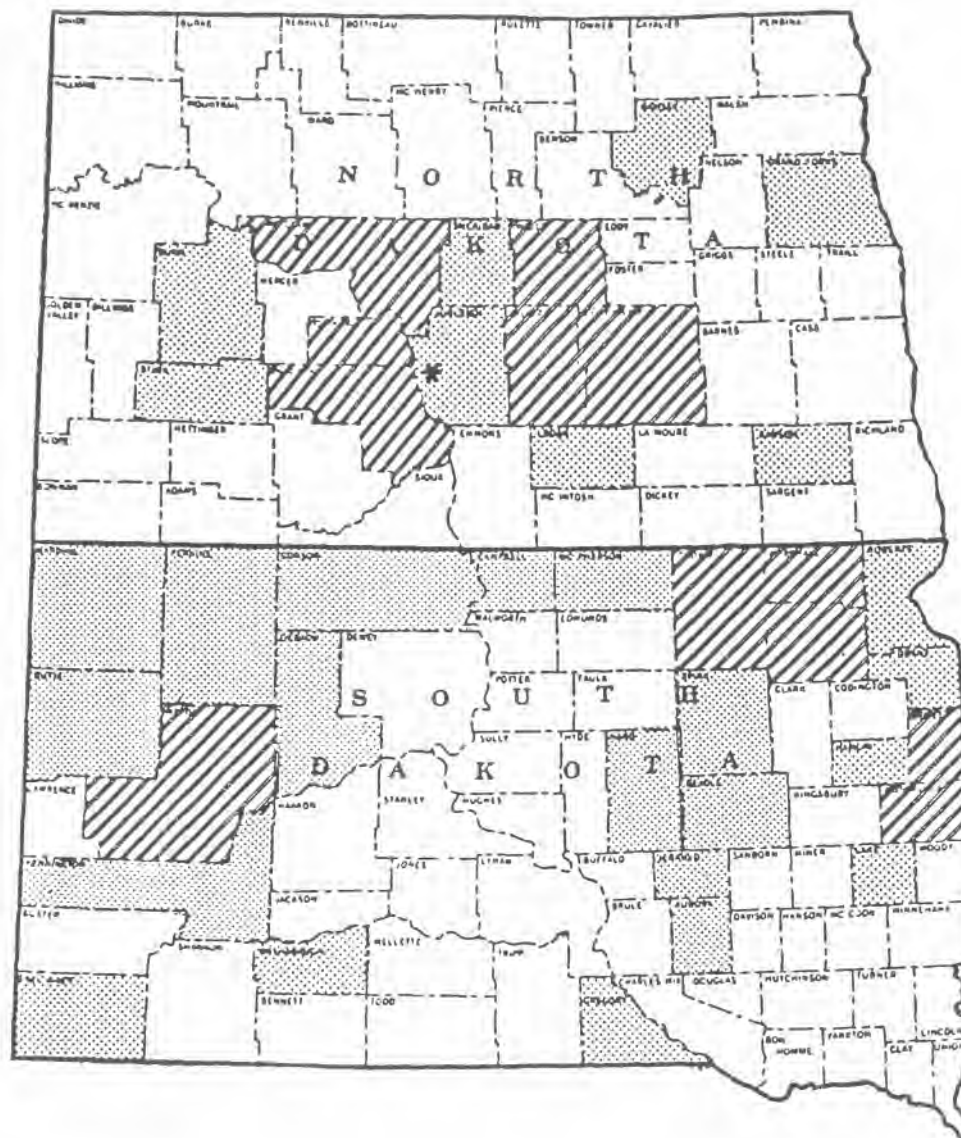
<u>Species</u>	<u>Common Name</u>
arnoldiana	Arnold
canadensis	Canada
chlorosarca	blackfruit
champlainensis	Champlain
pedicellata	Ontario
rivularis	river
punctata	dotted
caesia	--
edulis	--
ambigua	Russian
coccinea	scarlet
florentaria	--
floribunda	--
franmea	--
mordenensis	Morden
nudiflora	--
scabrida	Brainard
-- skinnners dwarf	skinnners dwarf
submollis	Quebec
dunbarii	--
coccinoides	Kansas
dahurica	--
submollis/arnoldiana	--
erythropoda	Cerro
strigosa	--
prunifolia	--
rivularis/skinnners dwarf	--
intricata	Biltmore
macroserma	--
Total: 29 species/varieties	

\* 14 additional species (individual seed lots) did not germinate or survive transplanting.

# Sample Sites For Native Hawthorn (By County)

-  1 Site/County
-  2+ Sites/County

North Dakota	28
South Dakota	42
Other	5
	<hr/>
	75



174  
Figure 4.

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