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Agricultural Experiment Station • South Dakota State University • Brookings, South Dakota 57007

Cover photo: Niels Ebbesen Hansen once said, "You don't get very far if you keep to the sure safe road all the time." Where he went in his eight trips to Europe and Asia, there were sometimes no roads at all; and he encountered both debilitating drought and blizzards, exposure and bandits in his many months of searching for alfalfas to bring home to South Dakota. The seeds he brought back are in the lines of many of our best alfalfas now growing in this country.

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M.D. Rumbaugh

Few present day alfalfa breeders know the contributions that Niels Ebbesen Hansen (1866-1950) made to alfalfa production in the United States.

N.E. Hansen was born in Denmark, educated at Iowa Agricultural College, and employed as a horticulturist by the South Dakota Agricultural Experiment Station.

He became the U.S. Department of Agriculture's first plant explorer. Plant Introduction Number 1 was a cabbage, *Brassica oleracea*, sent from Moscow, Russia, by Hansen in 1898.[1]

Hansen made eight trips to Europe and Asia. The first was a 4-month journey in 1894 during which he visited eight countries and spent 3 weeks studying the agriculture of European Russia.[2] Undoubtedly, the expedition was suggested by his teacher at Iowa Agricultural College, J.L. Budd, who had collected fruits in Russia in 1882.[3]

Although no alfalfa germplasm was introduced into the United States as a result of Hansen's first trip, he began to consider how introduction and hybridization could meet the need for hardy plants adapted to the Northwest.

In 1896 the relationships between personnel of the Iowa and South Dakota agricultural colleges began to have an important bearing on Hansen's career. James Wilson, who was director of the Experiment Station in Iowa when Hansen traveled to Russia and when he received his M.S. degree at Ames in 1895, served as Secretary of the U.S. Department of Agriculture from 1897 to 1913. His son, James Wilbur Wilson, probably was acquainted with Hansen when both were students in 1895. James Wilbur Wilson was his father's private secretary in Washington, D.C. from 1897 to 1900 and later became director of the South Dakota Agricultural Experiment Station, serving from 1902 to 1938.

It was quite reasonable that the first Agricultural Explorer for the Department of Agriculture should be a scientist experienced in world travel, appreciative of the importance of plant introduction,

and a personal acquaintance of the Secretary and his son.

Hansen's predictions of hardiness were fulfilled

The first expedition was funded by the federal government and lasted from June 1897 to March 1898. The itinerary included eastern European Russia, Turkestan, western China, and Siberia. The overland journey by wagon and sleigh extended 2,000 miles from Tashkent, Turkestan, to Omsk, Siberia, via Kuldja in western China. Five freight carloads of seeds and plants were sent to the plant introduction office.

Among this material were seeds of 18 *Medicago* accessions.[1,4] They included the first Turkestan alfalfa and the first *Medicago falcata* to be deliberately introduced into the United States.

Hansen clearly recognized the potential value of Turkestan alfalfa for the western and northern regions of America. In the description of S.P.I. 469, he states, "endures drought much better than European alfalfa."[1] Two hundred bushels of seed from Tashkent were sent as Accession Number 991. He said of this alfalfa, "Deemed very promising for trial in droughty regions."[1]

His confidence in the merits of these collections was not misplaced. S.P.I. 991 was widely distributed and used. Only 11 years after its introduction, Hansen described it as, "Probably the hardiest form of *M. sativa* is the one introduced from Turkestan in 1898. This proved more resistant to drought and cold than the ordinary alfalfa in cultivation in the United States."[2] Selection within 991 improved its adaptation, and progenies were later distributed as S.P.I 25805 and 25807.[5]

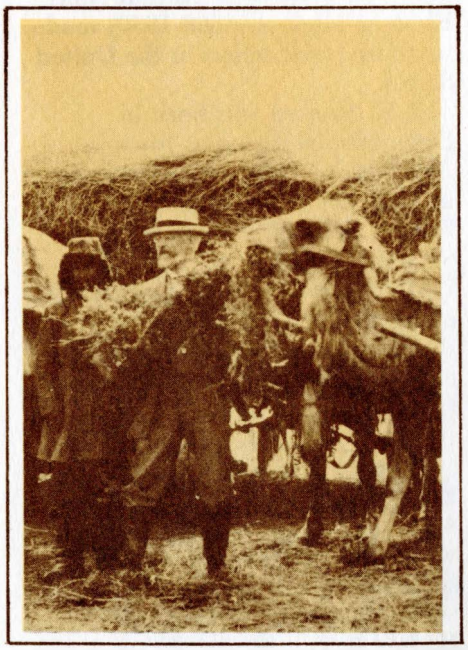
By 1908, alfalfa seed was being exported from Turkestan to North and South America at a rate of 9,600,000 pounds annually.

Not all of this seed was of equal value. Hansen recognized the variation that existed among the sources of Turkestan alfalfa. In his description of S.P.I 1159 from Kopal, Siberia, he commented on the geographic origins of his collections and stated, "These various importations should be kept separate as the plants will probably differ in hardiness."

Turkestan alfalfas are now known to be poor seed producers and susceptible to leaf diseases. However, most modern cultivars that are resistant to spotted alfalfa aphid, pea aphid, stem nematode, bacterial wilt, or phytophthora have Turkestan germplasm as part of their ancestry.[6]

The first deliberate introduction of yellow-flowered alfalfa into the United States was S.P.I. 842, collected near Valujki, Russia.[7] Director Bogdan of the Valujki Experiment Station regarded *M. falcata* as a promising fodder plant for dry steppe environments. The lateness of the season prevented Hansen from acquiring more than one accession.

Hansen also recognized that the two species of alfalfa hydridized in nature. He listed S.P.I. 1034 as *M. sativa* x *falcata* and pointed out that such hybrids had been called *M. media*.[4] After some experience in propagating both species in his Brookings, S.D. nurseries, he correctly concluded that they cross



"Adventurers must not be too cautious." Over trackless steppes, in wagon caravan and troika, Hansen trailed the yellow-flowered alfalfa to Semipalatinsk.

Wooden wheels, no springs, the bed swung from wooden poles—this is the tarantass, the vehicle Hansen traveled in on some tours. Here the other men are probably interpreters. Hansen needed three—Tartar, Russian, and German.

readily and, "that the resulting hybrids combine in large measure the good points of both."[8]

To achieve this crossing for commercial seed production, he proposed a system of machine transplanting plants of the two species in an alternating pattern. One such hybrid was eventually produced and sold by the South Dakota Agricultural Experiment Station as 'Hansen's Hybrid Alfalfa No. 1' and as 'Sibturk' alfalfa. [9,10]

S.P.I. 1159 was an especially significant introduction since it represented a population growing near the northern limit of distribution of *M. sativa*. Hansen postulated, "for the northern regions of the United States we must find the form that had been developed by nature in similar regions in the Old World."[2] His second trip as a plant explorer for the USDA permitted him to extend the search for that form of alfalfa.

Cossack lines have dominated production

The Spanish-American War, the Russian-Japanese War, and the Russian Revolution delayed the journey until July 1906. Over 300 lots of seeds and plants were obtained in a 6-month trip to England, Denmark, Norway, Sweden, Finland, Siberia, Manchuria, and Japan. Among these were seeds of 16 alfalfas including an accession, S.P.I. 20714, that later became of great value to American agriculture.[11]

S.P.I. 20714 was listed in the seed inventory as *M. media* or sand lucerne. The seed obtained for introduction was a fourth-generation progeny raised by Professor Williams at the Moscow Agricultural College. The parentage traced to a single *M. sativa* x *M. falcata* hybrid plant growing wild in the Voronesh Province of the central Volga River region of Russia.

In 1910, Hansen assigned the name 'Cossack' to this population.[12] A related accession, S.P.I 20716, was named 'Cherno' and both received emphasis in Hansen's propagation and distribution program.[13]

These two introductions were later merged to become the cultivar 'Cossack', which achieved a greater degree of success than any other of Hansen's alfalfas.[14] The name Cossack was retained after compositing the two populations.[9] As recently as 1958, it was planted on 258,000 acres in the United States.[15]

More importantly, Cossack was used in the breeding of nine other cultivars of great value, including 'Ranger' and 'Vernal'. For a number of years, these last two cultivars dominated alfalfa production in the

Back in South Dakota, Hansen used 1-year roots to stretch his small supply of seeds. This modified Bemis tobacco planter transplanted 100 roots per minute at Ipswich in 1912. He could get 500 shoots per crown and over 1000 pounds of seed per acre in the third year.

United States. They have likewise been used in the breeding of at least 45 of the 160 cultivars now used in this country.[6]

The most noteworthy *M. sativa* obtained during the 1906 trip was S.P.I. 20711. Although it was collected at Moscow, the original source was seed from a single plant from Tashkent. Hansen named it 'Select Turkestan', and it was later used as one parent of the 'Sibturk' hybrid.[10]

Nine *M. falcata* collections were obtained. Two of these, S.P.I. 20718 and 20719 from Omsk, were widely publicized and distributed. It was S.P.I. 20725, however, that had the greatest impact on North American alfalfa culture. Hansen selected the name 'Don' for this accession because of its origin in Don Province. Although a diploid with 16 somatic chromosomes, Don proved to be an excellent pistillate parent in natural crosses with Grimm and/or Ontario variegated alfalfa in Dr. G.G. Moe's Nursery at Vancouver, British Columbia, in 1920. These hybrids led to the cultivars 'Rhizoma' and 'Narragansett'. [16,17] Both of these were of some importance themselves and were later used in breeding Algonquin, ATRA-55, Citation, Iroquois, Polar I, Roamer, Scout, Team, Valor, WL202, WL210, 520, and possibly other cultivars.[6]

Hansen acquired more *M. falcata* accessions during his third expedition of 1908-1909. The primary purpose of that trip was to obtain seeds of new forage plants in Siberia. While successful in the attempt, he was greatly hampered by unfavorable weather, which delayed seed ripening, and by a major cholera epidemic.[2]

It was during this journey that he collected alfalfa at its most northerly point of distribution near the Aldan River between Yakutsk at 62° north latitude and Verkhoyansk at 68° north latitude. This accession was S.P.I. 24454.[18]

Experiment station personnel in the territory of Alaska were aware of N.E. Hansen's explorations and of his evaluation of the merits of *M. falcata* for severe climates. Four alfalfas were planted in 1909 at Fairbanks and Sitka and five at Rampart.[19] Among them was S.P.I 24452 collected by Hansen near Obb, Siberia. Additional accessions were acquired, and in his annual report for 1911, Director Georgeson wrote, "All the varieties of Siberian alfalfas introduced by Prof. Hansen and offered for sale by the South Dakota Experiment Station have been procured and are growing."[20]

He related that live plants were shipped from South Dakota to Sitka where they were rooted, propagated by cuttings, and mailed out to other sites in Alaska the following spring.

Seed of the yellow-flowered Siberian alfalfa was first produced in quantity at the Rampart Station in 1913.[21] This was planted and replanted as seed and increased until, by 1919, a 40-acre field was established.[22] Other alfalfas were tested at the Alaska stations but failed to survive or to produce sufficient seed.[23] Higgins discussed the potential of the *M. falcata* S.P.I. 24452, and concluded that it could not be recommended for the interior of Alaska because of its slow growth, low yield, and failure to ripen seed regularly.[24] In spite of these shortcomings, it has been maintained in the Alaskan breeding program and included in two recent germplasm pools.[25,26] The Alaskan *M. falcata* population has also proved valuable for study of winterhardiness and adaptive processes.[27,28,29]

It is somewhat puzzling that the researchers in Alaska distinguished between S.P.I. 24452, which they identified as *M. falcata*, and the 'Obb' population in their reports.[30,31,32]

Hansen assigned the name 'Obb' to the accession S.P.I 24452, and a population by that name was transplanted at Fairbanks in 1913 along with 'Omsk' and 'Irkutsk'.[21] The plants were received from Sitka and none survived the following winter.[33] Siberian cultivars also were seeded at Fairbanks in 1914, but only a few scattered plants survived.[34]

At Rampart Station, G.W. Gasser reported in 1916 that 20 strains and cultivars of alfalfa had been tested, with only four proving to be hardy. "These are *M. falcata*, Omsk, Obb, and Gobi Desert, all yellow-flowered."[35] Gasser continued to distinguish between the Alaskan *M. falcata* and Obb in his reports for 1916 and 1917.[36,37]

It is known that S.P.I. 24452 was used erroneously to identify a population of *M. falcata* from Irkutsk (S.D. No. 44) in three publications of the South Dakota Agricultural Experiment Station.[12,38,39] A comparison of the descriptions of Hansen's collections in the Bureau of Plant Industry inventories with the descriptions in the South Dakota bulletins led to the conclusion that S.D. No. 44 (Irkutsk) and S.D. No. 61 (Siberian) were both derived from S.P.I. 24454 and that S.D. No. 42 (Obb) was S.P.I. 24452.

I believe that the plants or seeds labeled as S.P.I. 24452 and sent to Alaska were, in fact, S.D. No. 44, which was derived from S.P.I. 24454. It seems probable that the accession which Hansen obtained at the most northerly point of distribution of *M. falcata* (S.P.I. 24454) would be the population to excel in the Alaskan tests.

Hansen suggests using alfalfa in rangeland

In his inventory listing of S.P.I. 24452, Hansen clearly expressed his opinion of the value of *M. falcata* as a pasture species. He cited its use in Siberia and then suggested, "it will be well to remember that this plant, while primarily intended for the severest regions, endures more pasturing than common alfalfa, and may be found valuable to introduce

One year after transplanting, this Semipalatinsk alfalfa bore out Hansen's faith in the Russian stock. He sold or gave away seed and roots.

into native pastures as a wild plant farther south."[18]

In a later publication he stated, "These alfalfas and clovers may be used in two ways: 1) as a cultivated crop for hay and pasture, and 2) to introduce as wild plants into the native ranges of the Prairie Northwest, where they will probably be able to hold their own with any plants now found there."[13]

This may have been the first suggestion for using alfalfa in rangelands of the United States. Sod seeding of alfalfa into existing grass stands was done in experiments at Highmore, S.D., in 1909 and in 1912 by Garver and at Cottonwood, S.D., by Hume in 1916.[7,40,41] Results of feeding trials with *M. falcata* hay were available in 1913.[42]

The vigor and growth habit of the introductions from Semipalatinsk convinced Hansen that his next trip should be devoted to collecting seeds in that region. This was accomplished in 1913. The trip was funded by the state of South Dakota on the authority of the state legislature rather than by the federal Department of Agriculture. The major accomplishment was the obtaining of 3,250 pounds of seed of Semipalatinsk *M. falcata*, much of which was immediately distributed for planting.[43] This also was the *M. falcata* used as the female parent in the 'Sibturk' hybrid.[10]

Root proliferation is discovered

It was during this period that an unusual form of plant growth was discovered at the Highmore, S.D., station by Samuel Garver. Plants of *M. falcata* from Orenburg (P.I. 28071) were described by him as follows:

> Laterals from the main roots of plants often extend for a distance of from 30 to 36 inches, then send stems to the surface. These laterals, parallel to the surface, are from 6 to 10 inches below the surface.
>
> As a rule, these lateral roots show enlargements. At an enlargement, where a shoot is sent to the surface, sometimes roots are sent down and sometimes not. The laterals also vary considerably in thickness. The roots may continue small for quite a distance, then grow larger.
>
> Occasionally a small root shows signs of having been originally connecting roots with the main roots. The small roots have been broken off or rotted and then will be left and independent root systems. Numerous sprouts and shoots appear along many roots.[44]

Plants were sent to the Office of Forage Crops Investigation in Washington, D.C., and a more detailed description was published.[45] This was the first report of root proliferation in alfalfa. The trait was also discovered in another accession from Orenburg (S.P.I 23625) and in two from Semipalatinsk (S.P.I. 28070 and 24455).[7]

Farmers who received roots wrote back their astonishment at the alfalfa's drought response. This, at Sansarc, SD, got less than 5 inches of rain in the 14 months after transplanting.

Plant breeders in Canada were the first to make serious attempts to utilize the root-proliferation trait in an improved cultivar.[46] Their plant selections were widely distributed. At least eight cultivars now in use have parentage tracing to the Canadian nurseries. These cultivars are 'Cancreep', 'Drylander', 'Kane', 'Rambler', 'Roamer', 'Spredor', 'Travois', and 'Victoria'.

'Teton' was bred in part from S.P.I. 24455 but does not have proliferating roots. Another rhizomatous cultivar, 'Sevelra', was developed from a 1908 seeding of Grimm, Orenburg, and Semipalatinsk on a 7-inch annual precipitation site in southern Idaho.[47] All of these populations were bred with the intent that they would be able to survive and be productive when grazed.

Farmers respond to Hansen's offer

During this period of collection of plant materials, N.E. Hansen was vitally concerned that they be distributed and used properly. In 1910, he offered to send 10 alfalfa plants free to the first 10 applicants from each county in South Dakota. He received 800 requests.[48]

The cultivars most frequently sent to the farmers were Omsk 1908 Siberian (S.P.I. 24453), Semipalatinsk Siberian (S.P.I. 24455), Cherno (S.P.I. 20716), and Cossack (S.P.I. 20714).

The South Dakota legislature initially appropriated $1,000 annually for 2 years to finance this program. However, it continued with additional funding until June 30, 1919.[49] Hansen reported, "It has been a big extra load to carry but one that has been a great pleasure to me as I felt it was a worthy cause."

His commitment was such that he personally supervised the transplanting of alfalfa at more than 16 locations in South Dakota during April and May 1912. That year over 80,000 alfalfa plants were distributed from his propagating beds.[50]

The magnitude of the program is shown by records of over 50,000 started plants being shipped to one recipient. This practice of shipping plants continued at least as late as March 20, 1920. On that date, an order for plants of both Cossack and Orenburg was filled.

When first offered for sale to the public on January 10, 1910, plants of seven accessions were priced at 25 for $2.50 or 100 for $8.00.[51] A packet of inoculated soil was included with each shipment. In 1913, 350,000 Cossack and Cherno plants were grown for transplanting; part of them were offered for sale in 1914 at $1.00 per hundred or $4.00 per thousand.[52]

Seeds of eight populations were listed in 1912, priced at $1.00 per packet of 100 seeds. A ninth population, Cossack, was being distributed by offering 100 seeds as a premium for membership in the South Dakota Horticultural Society.[53]

One year after the 1913 expedition, seed of Semipalatinsk was offered for $5.00 per pound; this dropped to $2.00 per pound by 1918.[52,54] The distribution program contined until Hansen's retirement on June 30, 1937.

Hansen's contributions will outlast his name

N.E. Hansen was accompanied by his son Carl on a last trip to the Soviet Union in 1934. He was invited by the Lenin Academy of Agricultural Sciences to represent America at a 4-day celebration and national holiday in Michurinsk during which his friend Ivan Michurin was presented the Order of Lenin. This was to honor Michurin for 60 years of research and breeding of horticultural crops. Hansen delivered an address in the English language with N.I. Vavilov as interpreter.[55]

After his return to South Dakota, Hansen wrote that, "Much new plant material was found."

None of it is known to be in use in alfalfa breeding today. His impact on alfalfa improvement seems to have been largely ignored by many breeders during the 1930 to 1948 period. An extensive report on alfalfa breeding in the U.S.

Department of Agriculture Yearbook for 1937 does not cite his work or mention his name except for a listing in a table as the originator of the Cossack cultivar.[56] Yet by 1978, the germplasm that he collected had been used in the breeding of at least 75 alfalfa cultivars.

Perhaps the best description of N.E. Hansen and his work was that of Secretary of Agriculture James Wilson when he said of Hansen, "He is an intelligent, intrepid fellow, full of resources, and nothing stops him. When he sees anything of value he knows it, and when he goes after a thing, he gets it."[57]

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