‘Don’, a Diploid Falcata Alfalfa for Western U.S. Rangelands

Michael D. Peel,* Kay H. Asay, Blair L. Waldron, Kevin B. Jensen, Joseph G. Robins, and Ivan W. Mott

ABSTRACT

‘Don’ (Reg. No. CV-205, PI 655519), a diploid falcata alfalfa (Medicago sativa subsp. falcata L.), was developed by the Forage and Range Research Laboratory in Logan, UT, in cooperation with the Utah Agricultural Experiment Station, Utah State University. Recent interest in falcata alfalfa has been high due to its value for increasing the productivity of rangelands. Don was selected for persistence under harsh conditions, uniform yellow flower color, increased seed production, and large-stature plants. Don traces to PI20725, an original collection made by N.E. Hansen in the Don Province of Russia. Don was tested as AU021. Don is significantly more persistent than typical sativa (M. sativa Subsp. sativa L.)–type alfalfas and is meant for use in mixed plantings with grasses either in range or pasture situations typical of the Intermountain region of the western United States. In comparative trials, including irrigated and nonirrigated, where 25 to 50% mortality was observed on sativa alfalfas, Don showed no mortality. When used in mixtures, the production advantage of Don with tall fescue (Schedonorus phoenix Scop.) Holub; syn. Festuca arundinaceae Schreb.; and meadow brome (Bromus riparius Rehm.) ranged from 10 to 32%. When Don is grown with crested wheatgrass on dry rangelands, similar production advantages are expected, which will make rangelands more productive. Furthermore, when grown in mixtures with grasses, Don will not dominate; rather, it has a low growth habit and stays well below the canopy of most cool-season grasses.
of the Lower Volga region of Southeast Russia. Rumbaugh (1979) listed one of Hansen’s collections as S.P.I. 20725 and described the contribution of S.P.I. 20725, which is probably PI 20725.

**Methods**

In the early 1960s, PI 20725 was used by Dr. Melvin D. Rumbaugh in genetic studies at Brookings, SD. The studies included seven other diploid alfalfas, which are minimally described in Tamimi and Rumbaugh (1963). After a number of years, Rumbaugh noted that remnants from PI 20725 were persisting in some subsequent tetraploid alfalfa breeding nurseries. Seed collected from these surviving plants (the exact number was not recorded) was used to establish the original breeding nursery. While the collected material was uniformly expressing the Don phenotype, it is certainly possible that crossing occurred with other diploid alfalfa in the original studies. The original breeding nursery was evaluated at Brookings, SD, where one cycle of selection was completed in 1976 for uniform flower color and increased plant size and seed production. A second evaluation nursery was established in 1978, and a cycle of selection was completed at the Utah State University’s Agriculture Experimental Station Bluecreek Farm. The Bluecreek Farm receives an annual precipitation of 36.5 cm, mostly in the form of snow during the winter months. A third cycle of selection was initiated in 1984 at Utah State University’s Evans Farm (Providence, UT), which receives an average annual precipitation of 44.0 cm. Selection focused on persistence, yellow flower color, and increased plant size and seed production. In 1997, a 1500-plant nursery was established at Evans Farm. The material was evaluated in 1998 and 1999, and 96 plants were selected in fall 1999. Large-stature upright plants of uniform fine-leaf type and yellow flower color were selected. Seed from these plants was produced in isolation and designated Breeder seed. This seed was used to establish a foundation seed field in Logan, UT, in 2002.

**Data Collection**

Don was tested as AU021 in six separate trials to measure establishment, persistence, forage yield, and production when grown in mixtures with tall fescue [Schedonorus phoenix (Scop.) Holub; syn. Festuca arundinacea Schreb.] and meadow brome (Bromus riparius Rehms.). Trials were on Utah State University experimental farms at Nephi, UT (annual precipitation 30 cm), Evans Farm, and Bluecreek. In 2002, a trial was established at Evans Farm to test Don in monocultures with other alfalfas and in mixtures with ‘Martin’ tall fescue and ‘Cache’ meadow brome. The trial was established as a randomized complete block design (RCBD) with a strip plot arrangement using the line-source irrigation system described by Hanks et al. (1976). Reported data are only from the highest irrigation level meeting evapotranspiration and the lowest not receiving any supplemental irrigation. Mortality was estimated from the mixed seeding with grasses following Vogel and Masters (2001). This consisted of the number of squares (15 cm²) out of 32 containing a live plant and reported as a percentage. In 2003, dryland trials were established in an RCBD at Nephi and Bluecreek with the primary purpose to compare the relative persistence of Don with other commonly available cultivars and secondarily to compare relative forage production under harsh conditions. A relative dormancy was determined following a modified version of the method of Teuber et al. (1998) at Nephi, the difference being that irrigation was not possible. However, in 2005 sufficient fall rainfall occurred at the Nephi location to initiate growth. Mortality in these trials was the difference between actual plant counts from the original and final plant populations. A second dryland uniform trial was established in an RCBD at Evans Farm and Bluecreek in 2004 to measure establishment and forage yield. In 2005, a trial was established in an RCBD at Evans Farm with other falcata and sativa alfalfas. All forage harvests were with a Swift Current Sickle bar harvester (Swift Current, SK).

A Partec PA II flow cytometer (Münster, Germany) was used to verify Don’s ploidy level using Partec’s CyStain UV Precise P kit and protocol. A plant of ‘Vernal’ alfalfa (Brink et al., 1955) known to be a tetraploid was used as a standard, and 120 seedlings of Don were tested. The seedlings were then grown out to characterize the morphology of Don.

**Characteristics**

Long-term persistence is difficult to demonstrate without trials that extend for the duration of expected persistence. Even so, we were able to demonstrate Don’s potential for persistence. Don showed no decrease in plant stand over a 3-yr period when grown in a monoculture or mixtures with tall fescue or meadow brome (Table 1). In the same trial, no differences in mortality among alfalfa cultivars were observed when grown in monocultures with irrigation; however, without irrigation, Amerigraze and P3SV08 showed significantly more mortality than Don. Furthermore, when grown in mixtures with grasses, ‘Ladak’, ‘Spreader3’, ‘Amerigraze’, and ‘P3SV08’ showed significant mortality, ranging from 25 to nearly 50%. In contrast, Don showed no measurable mortality when grown in mixtures with either meadow brome or tall fescue (Table 1). Variable results for mortality were observed under dryland conditions.

### Table 1. Percentage of alfalfa remaining in monocultures, mixtures with tall fescue and meadow brome, under irrigation and nonirrigation following four harvests per year during 2003, 2004, and 2005, Evans Farm, Providence, UT.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Alfalfa monoculture</th>
<th>Tall fescue mix</th>
<th>Meadow brome mix</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Irrigated</td>
<td>Nonirrigated</td>
<td>Irrigated</td>
</tr>
<tr>
<td>Don</td>
<td>103a</td>
<td>99a</td>
<td>102a</td>
</tr>
<tr>
<td>Ladak</td>
<td>94a</td>
<td>91ab</td>
<td>75bc</td>
</tr>
<tr>
<td>Spreader3</td>
<td>95a</td>
<td>84ab</td>
<td>80b</td>
</tr>
<tr>
<td>Amerigraze</td>
<td>91a</td>
<td>81b</td>
<td>77bc</td>
</tr>
<tr>
<td>P3SV08</td>
<td>97a</td>
<td>62c</td>
<td>64c</td>
</tr>
</tbody>
</table>

*Means within a column followed by the same letter are not significantly different (P = 0.05).*
Alberta’ and ‘AC Yellowhead’, a tetraploid, was developed by Agriculture and Agri-Food Canada, Swift Current, Saskatchewan. In a comparison of the relative forage production of Don and AC Yellowhead (data not shown), yield of Don was 13% higher ($P = 0.09$) than AC Yellowhead. The trial was not in place for sufficient time to compare persistence of Don with AC Yellowhead. Don has not been compared in field trials with Anik.

It was apparent from all trials that Don is highly dormant. In fall 2005 conditions at Nephi were favorable to collect dormancy data. Average ratings were 1.0, 4.8, 2.6, 3.5, and 2.2 for Don, ‘Dona Ana’, Ladak, Saranac, and Vernal, respectively.

Forage Production

From a forage production standpoint, Don has a demonstrated value for use when grown with grasses. When irrigated and nonirrigated treatments of meadow brome and tall fescue grown in monocultures and in mixtures with Don were compared, total seasonal production of the grass–Don mixtures was significantly higher than the grass monocultures (Table 3). The seasonal production of meadow brome–Don mixture was 13% and 10% higher that the meadow brome monoculture under irrigation and nonirrigation, respectively. A similar trend but larger response was observed in the tall fescue–Don mixture, with a seasonal production of 32 and 17% higher production than the tall fescue monoculture under irrigation and nonirrigation, respectively. Under a four-harvest scenario, meant to simulate grazing, the difference between grass monocultures compared with grass–Don mixtures was evident in the early harvests, with no differences later in the season, particularly without irrigation.

In all trials where monocultures of Don were compared with sativa-type alfalfas, Don’s forage yield was less (Tables 2 and 3). On average, across the tests where Don was compared with other cultivars in monoculture, the sativa types averaged 30 to 40% more forage production. This result highlights the reason Don is only recommended for use in mixtures. Two falcata alfalfa cultivars are known. ‘Anik’, a diploid like Don, was developed by Agriculture and Agri-Food Canada, Beaverlodge, Alberta and ‘AC Yellowhead’, a tetraploid, was developed by Agriculture and Agri-Food Canada, Swift Current, Saskatchewan. In a comparison of the relative forage production of Don and AC Yellowhead (data not shown), yield of Don was 13% higher ($P = 0.09$) than AC Yellowhead. The trial was not in place for sufficient time to compare persistence of Don with AC Yellowhead. Don has not been compared in field trials with Anik.

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respectively. Initiation of vigorous spring growth can be as much as a week behind Vernal, and after the initial spring growth Don will go completely dormant without moisture. When dry conditions persist during autumn, plants of Don may appear to have died when they are actually only dormant and will regrow the following spring.

Histograms from the flow cytometry showed Don with peaks at one-half the gain of Vernal, a teraploid (2n = 4x = 32), demonstrating that Don is a diploid. Based on the number of plants tested, if teraploid plants were present in the cultivar, they would represent less than 1% of individuals.

**Morphological Characteristics**

Don has a semidecumbent bowl-shaped growth habit like that describe by Sinskaya (1950) as a 2 to 3. The low growth habit will not be a detriment to grazing but does make it difficult to harvest with a mechanical harvester. This is a probable reason that its yield is lower in trials where much of the forage is not picked up by a mechanical harvester. When used as intended for grazing in mixtures with grasses, the low growth habit of Don could be an advantage. Its growth does not extend above the canopy of most grasses, whereas growth of typical sativa-type alfalfa can extend above the canopies of many grasses.

Don has yellow flowers. During Foundation seed production, plants with light purple and variegated flowers were observed. These accounted for less than 1% of the plants and were rogued out. During the late bud stage, 1 to 2% of the flower buds were observed to have a purple hue, but after these flowers were fully opened they were indistinguishable from any other yellow flower. The bright yellow flowers of Don are attractive and as such should make it desirable for use as a low-maintenance ornamental along roadways in the Intermountain western United States. After maturity, the mature seeds would provide a source of protein to wildlife throughout winter months. Under favorable conditions, Don flowers later than Vernal and tends to be somewhat later maturing. Pod shape ranges from sickle to one complete coil. Don has small fine leaves and fine stems. Seeds of Don are small, with 880,000 seeds kg\(^{-1}\), compared to typical commercial alfalfa around 500,000 seeds kg\(^{-1}\). Those unfamiliar with the seed of Don could easily con-

and the roots are more fibrous. The crown of Don is typically 3 to 4 cm below the soil surface, with some buds much lower. While not quantified, it has been observed that the top main part of the crown can be removed, and the plants will still initiate growth from well below the soil surface.

**Availability**

Breeder and Foundation seed will be maintained by the USDA–ARS Forage and Range Research Laboratory, Logan, UT. Seed will be made available to commercial growers by the Utah Crop Improvement Association, Logan, UT 84322-4820 for production of Registered and Certified seed. Breeder and Foundation seed have been produced by the Forage and Range Research Laboratory. Small seed samples for research purposes can be obtained from the National Plant Germplasm System. Appropriate recognition should be given when this cultivar contributes to the development of new germplasm or cultivars.

**References**


