A yield and day length requirement evaluation of single- and multi-cut sainfoin (Onobrychis viciaefolia Scop.)
by Ronald Howard Delaney

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Agronomy
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Abstract:
Seventeen sainfoin lines (Onobrychis viciaefolia Scop.), 'Eski' sainfoin (0. viciaefolia Soop.), 'Ladak' and 'Haymor' alfalfa (Medicago sativa L) were evaluated for their regrowth and forage yielding ability for two years at two locations. Two weeks follpwing the first harvest, the seventeen sainfoin lines were 9-12 inches high compared to the 4-6' inch height of Eski. Eski produced 78% of its total season yield the first harvest compared to a range of 57-70% for the regrowth lines at Bozeman, Montana. Under three-cut conditions at Huntley, Montana, Eski yielded 6l% the first harvest and the regrowth lines ranged from 43-57%= At Huntley, the second harvest year all regrowth lines produced a greater total season yield than the single-cut type Eski. The two alfalfa varieties also, yielded more than Eski at Huntleyc The regrowth sainfoin lines were similar to Eski in seasonal yield at Bozeman the second harvest year0 With one exception, all sainfoin entries yielded more than Ladak and Haymor alfalfa= The day length requirement for flowering of five sainfoin clones was studied= Artificial day lengths of 13 1/2 and 16 1/2 hrs under 65-45 F day-night temperatures were used. The effect of the growth chamber day length pretreatment was also evaluated when plants were transplanted to the field= The studies did not allow separation of the growth types depending on day lengths. The day length requirements for optimum flowering were not the same for all five clones.

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ABSTRACT

Seventeen sainfoin lines (*Onobrychis viciaefolia* Scop.), 'Eski' sainfoin (*O. viciaefolia* Scop.), 'Ladak' and 'Haymor' alfalfa (*Medicago sativa* L.) were evaluated for their regrowth and forage yielding ability for two years at two locations. Two weeks following the first harvest, the seventeen sainfoin lines were 9-12 inches high compared to the 4-6 inch height of Eski. Eski produced 78% of its total season yield the first harvest compared to a range of 57-70% for the regrowth lines at Bozeman, Montana. Under three-cut conditions at Huntley, Montana, Eski yielded 61% the first harvest and the regrowth lines ranged from 43-57%. At Huntley the second harvest year all regrowth lines produced a greater total season yield than the single-cut type Eski. The two alfalfa varieties also yielded more than Eski at Huntley. The regrowth sainfoin lines were similar to Eski in seasonal yield at Bozeman the second harvest year. With one exception, all sainfoin entries yielded more than Ladak and Haymor alfalfa.

The day length requirement for flowering of five sainfoin clones was studied. Artificial day lengths of $13\frac{1}{2}$ and $16\frac{1}{2}$-hrs under 65-45 F day-night temperatures were used. The effect of the growth chamber day length pretreatment was also evaluated when plants were transplanted to the field. The studies did not allow separation of the growth types depending on day lengths. The day length requirements for optimum flowering were not the same for all five clones.

INTRODUCTION

The interest in sainfoin (Onobrychis spp.) is rapidly expanding in the United States and Canada. The increased use of this legume is creating a demand for development of growth types which are adapted to various climates, soils and agronomic uses. The Montana developed 'Eski' sainfoin has shown alfalfa weevil resistance and fails to cause bloat. Eski yielded well on dryland and in areas where a large first cutting of hay is desired. It has not performed well under irrigation in areas where two and three cuttings of hay are normally harvested. The performance of Eski in irrigated pastures has also been impaired by inadequate distribution of forage yield throughout the season. Weed invasion has also been a serious problem in pure Eski stands.

Based on the current problems with sainfoin the need for differing growth types became apparent. A type which would produce upright growth following harvest and distribute its forage yield throughout the season would be desirable. A regrowth type of sainfoin would possibly have a yield advantage over the present single-cut type when grown in the longer growing season areas of Montana. The purpose of this study was to select and evaluate the yield potential of a multi-cut sainfoin type in Montana.

A logical source for sainfoin with a genetical potential to regrow following harvest was the vast number of Onobrychis spp. introductions growing at Bozeman, Montana. Of 144 introductions planted in 1965 the remaining 98 were evaluated for their ability to elongate following harvest in 1966.

Diverse degrees of regrowth ability were found in these introductions. It was observed that cutting dates only two weeks apart may determine if a particular type will regrow. This led to an investigation of the day length requirements for elongation of sainfoin.

LITERATURE REVIEW

Sainfoin, genus Onobrychis, is creating considerable interest in the United States and Canada. Sainfoin shows great potential in alfalfa weevil infested areas. Its non-bloating quality increases its desirability for hay and pasture. Most reports indicate sainfoin is best adapted to calcareous soils under dryland conditons. Jensen and Sharp (19) in Nevada reported that sainfoin will persist in highly saline soils. The annual precipitation minimum for sainfoin is approximately thirteen inches (12). Tests at Nevada indicate sainfoin is more tolerant to frost than alfalfa (19). At Creston, Montana 'Eski' (Onobrychis viciaefolia Scop.) produced unsatisfactory dryland hay yields on acid soils of forest origin (26). Eski exhibits good drought and winter-hardiness in Montana (14).

The yield potential of sainfoin indicates that under one-cut conditions Eski will equal or out-yield alfalfa; however, where two or three cuttings are harvested alfalfa (Medicago sativa L.) is generally higher yielding if the alfalfa weevil is controlled. Hanna and Smoliak (17) reported that sainfoin will yield equal to alfalfa at the first cutting in Canada.

The nutritive value of sainfoin is similar to alfalfa. Holden (18) reported that sainfoin has a higher leaf to stem ratio than alfalfa and is lower in protein and crude fiber. He also found that sainfoin had a greater percentage of nitrogen free extract in comparison to other forage legumes. The protein quality of sainfoin seed is similar to soybean oil meal.

Sainfoin consists of many species with widely differing adaptation

and growth characteristics. Recent studies by Badoux (2) indicate that Onobrychis viciaefolia Scop. is a general term for several species of sainfoin. Chapman and Yuan (11) in a cytological evaluation of twelve species were unable to distinguish between these species.

Andreev (1) has described the types of sainfoin grown in Russia as common, sandy and transcaucasian. Common or vetched-leaved Onobrychis viciaefolia Scop. has medium drought and winterhardiness. Characteristically, during the year of establishment, the common type develops slowly; however, in the second year early spring growth occurs. Shain (27) reports that common has slow recovery and is used as a one-cut forage in Russia. Sandy sainfoin, Onobrychis arenaria Kit., excells the other two types in winterhardiness (1). It also has good drought tolerance. The one-cut growth habit of sandy sainfoin resembles the common type. Transcaucasian sainfoin, Onobrychis transcaucasica Grosh., exceeds the common type in winter hardiness, drought tolerance, and yield. The yield of the transcaucasian type results from its two and often three cuts per year under irrigation. It is considered to be less long-lived than the common or sandy sainfoin.

Giant and common sainfoin are grown in England. Common is reported by Fyfe (15) to be a single-cut type as it lacks the ability to flower twice in one year. Thomson (30) found that the large first harvest of common sainfoin allowed it to yield more under hay and pasture conditions than giant. It was also able to withstand the pasture treatment better than the giant type. Baker (3) reported that giant

sainfoin, Onobrychis sativa L., is a multi-cut type. The highest season yield was obtained when it was cut twice at full bloom.

A Persian type of sainfoin, Onobrychis viciaefolia, forma persiia, Shiryaev, is classed as a "many-cut sainfoin" by Kellner (20). Another source of potential regrowth material has been described by Bawolski (6) in Polish populations of sainfoin. Varga (32) in Romania has developed variety ICA_6 which is a high yielding multi-cut sainfoin type. This variety also provides a high seed yield the second cutting if the first cutting is harvested at the bud stage. Eski, the only registered variety in Montana, has been reported by Cooper and Roath (13) to be primarily a one-cut type.

Onobrychis viciaefolia Scop. or the single-cut type sainfoin generally fails to bloom the year of seeding. Bawolski (4) suspected that the inability to bloom the first year and to produce a second cutting in subsequent years may be correlated to a day length requirement. He subjected plants at four stages of growth (after sprouting, 10 days, 20 days, and 30 days after germination) to a twelve hour photoperiod representing a short day. All the plants which characteristically develop only a rosette the year of seeding elongated and bloomed after the application of short days. The increases in height resulting from these short day treatments for O. viciaefolia Scop. and the multi-cut O. transcaucasica Kit. are shown in Figures 1 and 2.

In a later experiment Bawolski (5) reported that under Polish growing conditions (latitude 51° 26' N) the two year developmental

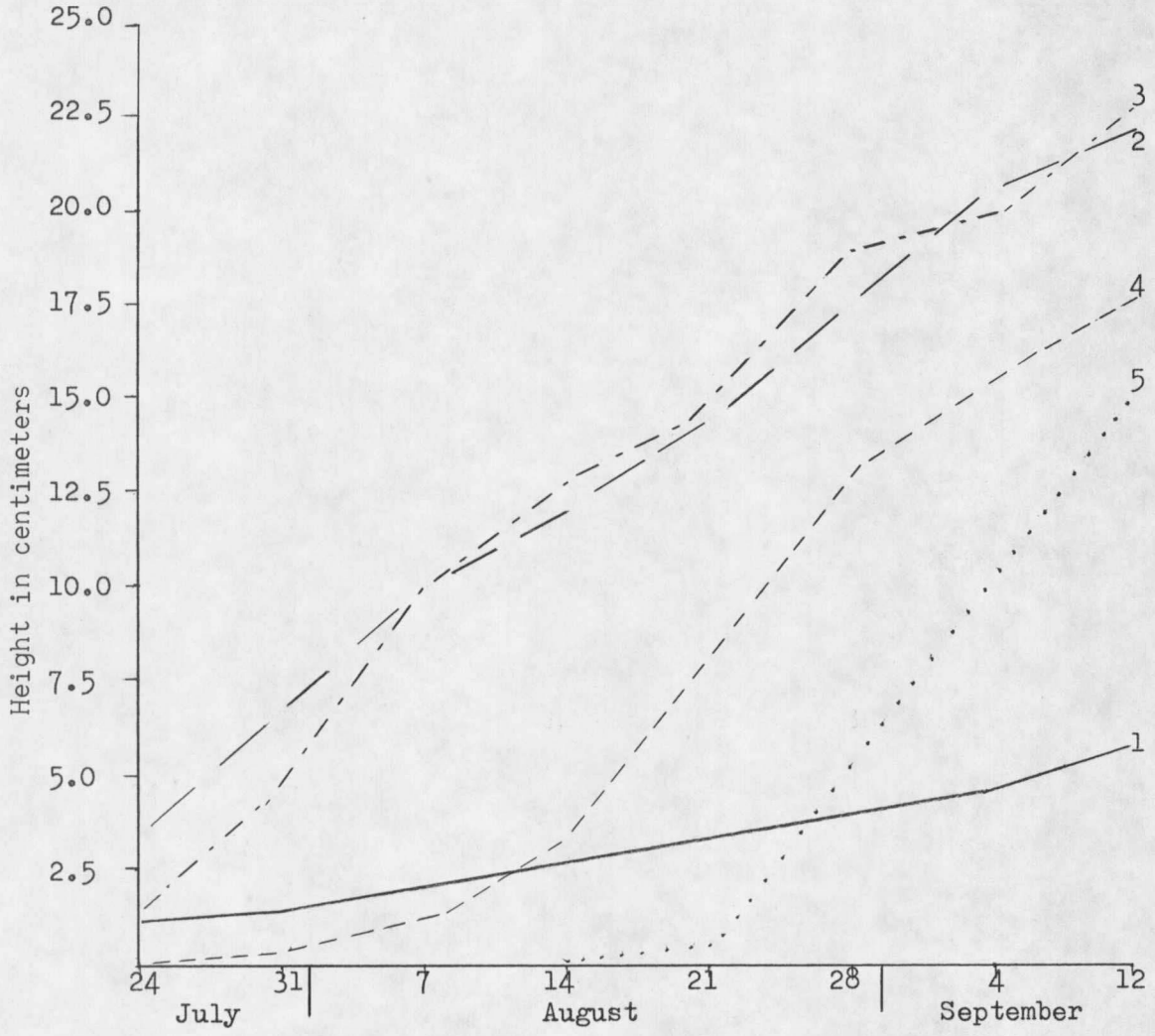

Fig. 1. The growth of plants of Onobrychis viciaefolia Scop., Bawolski (4).
1. Control combination [subjected to long days only]
2. The day shortened immediately after sprouting
3. The day shortened 10 days after sprouting
4. The day shortened 20 days after sprouting
5. The day shortened 30 days after sprouting