# PRELIMINARY STUDIES OF CERTAIN CREEPING TYPE ALFALFAS AS RELATED TO UTILIZATION IN PASTURE MIXTURES

by

CHARLES WILLIAM ALEXANDER

B. S., Kansas State College
of Agriculture and Applied Science, 1953

---

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agronomy

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1954

TABLE OF CONTENTS

# INTRODUCTION

Throughout the past few years the use of cultivated land for pasture crops has been rapidly gaining favor in Kansas. The possibility of utilizing abandoned land with a profitable pasture crop, labor shortages resulting in less available time for the farmer to devote to cultivated crops, and the soil improving nature of pasture crops are a few of the factors responsible for the growing interest in pasture crops.

Pastures have long been considered to be low in productivity, but this concept is born of the use of the least fertile areas of the average farmstead as pasture. These areas are the "left-overs" after the better land has been used for the production of seemingly more desirable cash crops. This practice has resulted in a serious shortage of grazing land, and the fields turned over to pasture are usually subjected to heavy, intense grazing, further depleting the productivity of a not always too desirable grassland area.

However, there has been a gradual awakening to the realization that a productive, palatable, nutritious stand of a good pasture mixture on good farmland will often times return more dollars per acre than a cash crop on this same land. Not only will cash profits be realized, but long term benefits to the land are also a part of such a grassland program. More often the farmer realizes that the better land on his farm in grass is profitable farming, not only for himself, but due to the soil improving nature of such crops, for those who may farm the same land after him.

Agronomists of the Kansas area are largely responsible for the renewed interest in the use of the tame perennial grasses in the normal cropping routine of the Kansas farmer. They have investigated the use of several such grasses and have recommended several species for varied situations. Due to their efforts

the Kansas farmer has available a good pasture crop for almost any situation on his farm.

The use of mixtures of one or more grasses and a legume has proven to be of even greater value than a single grass alone, and here again the Kansas farmer has available to him much information concerning the use of various mixtures on different sites and in different locales. One such mixture which has emerged as the most outstanding perennial pasture in adapted areas at the present time is that of smooth bromegrass (Bromus inermis) and alfalfa (Medicago sativa). This mixture is more widely recommended in Kansas than any other cool season mixture because of its adaptability and its high palatability. Not only has this mixture gained wide popularity in Kansas but also in many states in the range of adaptation of these two pasture crops.

The two crops are highly compatible. They both require relatively fertile, well drained land. Both have about the same growing season and are highly palatable and nutritious to cattle. The inclusion of alfalfa in the mixture aids in maintaining the nitrogen balance of the soil, thereby forestalling the sod-bound condition which commonly develops in bromegrass. The presence of the grass with the alfalfa reduces the hazard of bloat. The two together will produce more than either one alone, and they are longer lived and productive over a longer part of the growing season than the common pasture plants now grown.

Many farmers have found that the mixture of bromegrass and alfalfa produces a high quality hay which is high yielding and easily put up. Others have found the value of bromegrass-alfalfa as silage, but the greatest value, by and large, lies in its use as a pasture crop. Bromegrass-alfalfa has proven to be of more value than native pasture plants to both the dairy farmer and the stock feeder. Cows on bromegrass-alfalfa produce more milk and remain in better condition than those on bluegrass. Steers being fattened on corn gain faster and finish in

shorter time when supplemented by bromegrass-alfalfa pasture. Alfalfa alone or in mixtures is unexcelled as pasturage for swine and provides excellent range for poultry. Sheep on bromegrass-alfalfa pasture are in better flesh and condition than those which are pastured on bluegrass alone.

However, under the pressure of grazing and environmental influences bromegrass-alfalfa pasture will tend to decline in a period of usually three to four years. This decline is due largely to the loss of the alfalfa from the mixture. Without the alfalfa the bromegrass soon becomes sodbound due to the loss of the soil nitrogen supplied by the alfalfa. The palatability and high protein content of the alfalfa are lost, and the over all yield becomes less.

Alfalfa may fail to persist for various reasons. The root reserves are often times depleted by grazing too late in the fall, or by too frequent removal of the tops for hay, or a combination of both, with subsequent winter survival being low. Often times the use of unadapted varieties results in depletion due to diseases and other environmental causes. However, even if proper grazing methods are followed and recommended varieties used, the common alfalfas (M. sativa) will be maintained in mixture with bromegrass only for a period of three or more years, after which the crop is likely to be largely bromegrass. This loss is due to the ecological relationship between alfalfa and bromegrass.

Since alfalfa is of such importance to the maintenance of a desirable mixture, the problem becomes one of producing an alfalfa which will alter the usual relationship that exists between alfalfa and bromegrass in such a way as to favor the maintenance of the alfalfa. The spreading alfalfas, of which there are two types, rhizomatous and creeping, have excited considerable interest in the past few years. The rhizomatous types, which spread by the unusually long development of crown buds which later take root, have been found to exhibit little spreading in Kansas. However, several strains of the creeping type have been found to be

capable of spreading very well in this area. The possibility of using an alfalfa in a grass mixture that produces lateral roots which will initiate aerial shoots that become independent of the mother plant, thereby being better able to persist in that mixture, presents an intriguing possibility. It is the purpose of this paper and the work presented herein to deal with preliminary studies of various hybrids of the creeping type alfalfas with regard to their use in pasture mixtures.

## REVIEW OF LITERATURE

The use of alfalfa as a feed for horses and cattle dates to earliest history and it is first recorded as being put to such use by the Persians during the time they had overrun Greece about 490 B. C. (Whittet, 1929). As the centuries have progressed alfalfa has assumed a growing importance in the agriculture of the United States as well as that of many others. One of the earliest records indicating the growing importance of the crop to Kansas agriculture was given by Shelton (1888) when he summarized fourteen years of experience at the college experimental farm located at Manhattan, Kansas. In his summary he praises alfalfa highly as a drought resistant, high yielding hay or pasture crop.

Shelton's reference to the use of the crop for pasture was a forerunner of much literature published on this aspect of its utilization. Throughout the years that followed until the present time many authors have proclaimed the value of alfalfa for pasture purposes. Whittet (1925) recognized the value of legumes in pastures and stated that alfalfa was "one of the most valuable legumes to sow in pastures". He also stressed the use of local adapted strains over imported material. Evvard (1928) mentions the use of alfalfa pasture in a feeding trial while Wildman (1928) described the husbandry of grazing sheep on irrigated alfalfa. Woodie (1928) stated, "....it has been conclu-

sively proven that the growing of lucerne especially for grazing purposes need not be confined to first quality river plat country....", whereas McDougall (1928) accented the possibilities of alfalfa for pasture purposes in districts of low rainfall and high temperatures. Reporting on experimental work conducted at the Nebraska experiment station, Snyder (1930) concluded that steers on full feed of corn made better gains and finished earlier when pastured on alfalfa than when full fed on corn, and given alfalfa hay instead of pasture. McCarty and Grimes (1930) emphasized the use of alfalfa as a pasture crop for swine, while Judd (1931) stressed its importance as a pasture for sheep. Durrance and Rather (1932) concluded that the net returns from both grazing and making hay of alfalfa were distinctly greater than from haying alone. McLennan and Green (1932) proposed the wider adaptation of alfalfa as a pasture crop. Baker (1933) concluded that full feeding heifers on alfalfa pasture was a practical method of beef production. Fraser (1936) stressed the value of using alfalfa for pasture and suggested a nurse crop of oats to help in establishing stands of alfalfa for pasture. Rather and Durrance (1938) studied the time of pasturing alfalfa and Atherton (1939) suggested the use of alfalfa as a summer legume in pastures as well as for hay and silage. Westover and Kosterman (1940) in enumerating the uses of alfalfa pointed out its use as a pasture crop and Cook (1940) described the husbandry of alfalfa as a pasture plant. McAuliffe (1944) outlined a program of livestock feeding which utilized alfalfa pasture.

The use of alfalfa for pasture presented the problem of bloat and with the growing use of the crop for forage, many investigators have reported on this problem. Rather and Durrance (1935) pointed out that most Michigan farmers reporting bloat admitted mismanagement. Proper management of an alfalfa pasture includes the following items as stressed by Rather (1936), Harrison (1937), and Cole (1943),

(1) avoid pasturing young, succulent growth, (2) full feed roughage before turning livestock on the pasture, (3) maintain availability of water and salt at all times, and (4) once started, keep the livestock on the alfalfa constantly.

Alfalfa has long been used as a pasture crop and has proven to be a widely adapted and palatable, nutritious, profitable forage plant under proper management, but only in the last decade has the use of alfalfa in mixture with various grasses begun to be recognized as a valuable and even more profitable way by which to utilize the crop. One of the earliest uses of alfalfa in mixture with bromegrass is mentioned by Ten Eyck (1911) who wrote, "The particular value of the Bromus alfalfa combination is for pasture....". In summarizing the results of an experiment comparing bromegrass alone with a bromegrass-alfalfa combination he pointed out that the mixture yielded the most, whereas brome alone soon became sodbound.

Ten Eyck preceded most investigators by many years with his statements concerning the use of alfalfa in mixtures with bromegrass. Although more recently this combination has come to be regarded as the most desirable, some earlier work investigated the possible use of other grasses. Fraser (1936) suggested the use of alfalfa and bluegrass as supplemental forage crops. Green (1938) stated an "....Ideal pasture mixture...." to be "....60% grass and 40% legume...." and stressed that "....the grazier of the central plains (New South Wales) has no other means of improving his pasture except by the sowing of alfalfa....". An alfalfa-timothy mixture was reported by Harrison (1938) to produce good pasture, fit well into a rotation, and to have presented little bloat problem. Cook (1940), writing under conditions of Australia, suggested the use of the grass Phalaris tuberosa in mixture with alfalfa.

However, it was not long until attention was directed largely at the possible use of bromegrass with alfalfa in mixture for pasture purposes. Rather

(1937) pointed out the need for economical summer pasture and stated that inasmuch as alfalfa and bromegrass are compatible, drought resistant, and palatable, they offered striking possibilities. Harrison, et. al. (1938), reported that an alfalfa-smooth bromegrass mixture, during a two season test, provided least cost per acre pasturage for cows and averaged the greater net return per acre. They stressed the value of alfalfa and bromegrass as a summer pasture of unexcelled quality and quantity. Rather and Harrison (1939) pointed out the value of the mixture as pasture for sheep returning far greater net returns on a season-long basis than any of the native pasture plants indigenous to their region. They also concluded alfalfa and orchardgrass to be a poor mixture since the alfalfa was more palatable and consequently was selected in grazing. Anderson (1941) stated, "Bromegrass is the most important tame perennial grass for use in the seeding of cultivated pastures in eastern Kansas", and "Alfalfa is the best of the legumes for use in a tame pasture mixture in Kansas....". Harrison (1941) emphasized that a bromegrass-alfalfa mixture was equal to pure alfalfa on all counts, even exceeding it in some. Rather and Harrison (1944) found the mixture to be more enduring, somewhat more productive, and as adequate as pure stands of alfalfa in respect to the quality of its nutrients. Ensminger (1944) stated that grass-alfalfa mixtures produced three times as many pounds of beef per acre as pure grass. Summarizing three years of trials Hilton (1944) stated, "Bromegrass-alfalfa provides more pasture and produces more milk than bluegrass pasture, especially during the summer months." Cox and Ahlgren (1946) point out that sods of adapted grasses and legumes are nearly twice as productive as bluegrass under the same conditions. Ahlgren (1948) wrote that one acre of bromegrass-alfalfa in a long rotation is equivalent in production to one and one-fourth to one and one-half acres of timothy and alfalfa and provides as much pasturage as two and one-half acres of fair to good bluegrass. He also points out that therenovation of

bluegrass pastures with alfalfa was highly successful. Alfalfa, when tested alone and in combination with nine different grasses, yielded less alone than in any of the combinations (Comstock and Law, 1948). Wilsie (1949) concluded that alfalfa was the best suited legume for bromegrass. Keith (1950) reported that bromegrass-alfalfa mixtures of 24 per cent and 33 per cent grass were equal in feeding value to pure alfalfa hay. Alfalfa in mixture was more valuable from the standpoint of soil conservation than alfalfa alone (Woods, 1953).

Through the efforts of many investigators and writers the value of a bromegrass-alfalfa mixture as to compatibility, adaptability, palatability, profitability, nutritive value, and soil conservation, have been adequately proven. Such a mixture is desirable on all counts except for the tendency to decline (Cook, 1940) after a few years of production. This decline can usually be attributed to the loss of the alfalfa from the mixture. Mays (1942) concluded after four years of study that the alfalfa in an alfalfa-johnsongrass mixture was largely replaced by the end of the fourth year. He showed that the percentage of alfalfa remained fairly constant the first two years as did Ensminger (1944), but soon deteriorated. Kalton and Wilsie (1953) also indicated the decline in average precent composition of alfalfa over a four year study. This decline can be attributed to continuous grazing (Fuelleman, 1948), too frequent cutting (Comstock and Law, 1948), or the natural competition effect of the bromegrass which tends to crowd the alfalfa. The alfalfa seldom persists longer than three years (Brown, 1951). Without the alfalfa the bromegrass soon becomes sodbound due to the loss of the soil nitrogen supplied by the alfalfa (Brown, 1951). When the alfalfa does persist it has been known to prevent the sodbound condition for eight years (Cleavinger and Willoughby, 1944). Once the alfalfa is lost, as is usual at the present time, and the bromegrass

becomes sodbound, the original value of the mixture is also reduced.

If an alfalfa could be developed which would persist in such a mixture the value of the mixture could be retained over a much longer period of time. Up to the present time little work has been directed along these lines in alfalfa breeding programs. However, in the past few years considerable interest has evolved in the use of certain spreading alfalfas in pasture renovation programs.

There are three species of alfalfa, Medicago sativa, or purple, blue or lavendar flowered alfalfa, Medicago falcata, or yellowed flowered alfalfa, and Medicago sativa media, variegated alfalfa, a hybrid of the sativa and falcata species, the flower color being intermediate between these two. The creeping types are usually of the falcata or intermediate species and are characterized by drought resistance, cold hardiness, and often by a very branched root system. The sativa species, or common alfalfas, on the other hand, are characterized by relatively high yields of forage and seed, upright growth, some adaptation to warmer climates, less cold hardiness, and a very strong taproot system. Weaver (1932) described common alfalfa as a long lived, very deeply rooted perennial with practically no branches of the tap root in the surface few inches and those that do occur deeper do not spread widely but turn down and follow a parallel course with the tap root. Since the creeping types occur in the falcata and intermediate species, for purposes of this paper the discussion will be devoted to these species with occasional comparison to the common alfalfas or sativa species.

At the outset a distinction should be made between two types of the spreading characteristic, the one occuring more largely in the intermediate species, the other in the falcata species. A type of spreading which is characterized by a low set crown which has the ability of unusually long crown bud development near the surface of the soil may be thought of as the rhizomatous type. Often

times these crown bud shoots will send down new roots thus establishing true rhizomes and a new plant entirely independent of the old crown. This type of spreading is usually found in the intermediate alfalfas and includes such varieties as Rhizoma, Nomad, Sevelra, etc. The "spreading" of these varieties is actually the occurrence of a widely broadening crown which increases its diameter by means of the aforementioned low growing crown buds. These spreaders are capable of initiating much longer and lower growing crown buds than are found in the common alfalfas. Some have been known to spread as much as three or four feet in regions of adaptation. However, under Kansas conditions they have shown little more ability to spread than adapted common types.

In the past few years many popular articles have been written in various farm magazines describing various varieties of the rhizomatous spreaders as highly desirable pasture plants. Little experimental work above that of observation has been done. One variety which has received widespread acclaim on the basis of this type of evidence is Nomad, which was found in Oregon. Jackman and Fowler (1951) thought of it as being a tough, long lived range legume, and Fowler (1954) considered it to show great promise. Other varieties which have evoked considerable interest are Rhizoma, developed by Dr. G. G. Moe of the University of British Columbia, and Sevelra, a locally synthesized strain developed in Idaho. Many other varieties have had some passing interest, but, by and large, little experimental evidence is available upon which to base any recommendations for their use.

Another type of spreading character was early noted in certain strains of Medicago falcata first introduced in 1906 by Prof. E. N. Hansen from Semipalatinsk, Siberia, and Orenburg, Russia (Oakley and Garver, 1917). This type of spreading, unlike that of the rhizomatous type, occurs by true lateral roots usually several inches below the surface of the ground. These roots are capable

of initiating aerial shoots which later develop into entirely independent plants apart from the mother plant. This type of spreading might be likened to that of the bindweeds (Convolvulus spp.), although not nearly so vigorous as these species. Although this character was early noted but not recognized as a spreading character by Thomas LeBlanc in 1783 (Southworth, 1921) he did note that such types were not "choked" by natural grasses and, due to the habit of branching below the surface of the ground, were not injured by grazing sheep. These same types evoked considerable interest when they were first introduced into the United States and were described in detail by such workers as Oliver (1913), Oakley and Garver (1913), and Paczoskij (1917). However, investigations of these types were soon shelved because of their low yield and seed production.

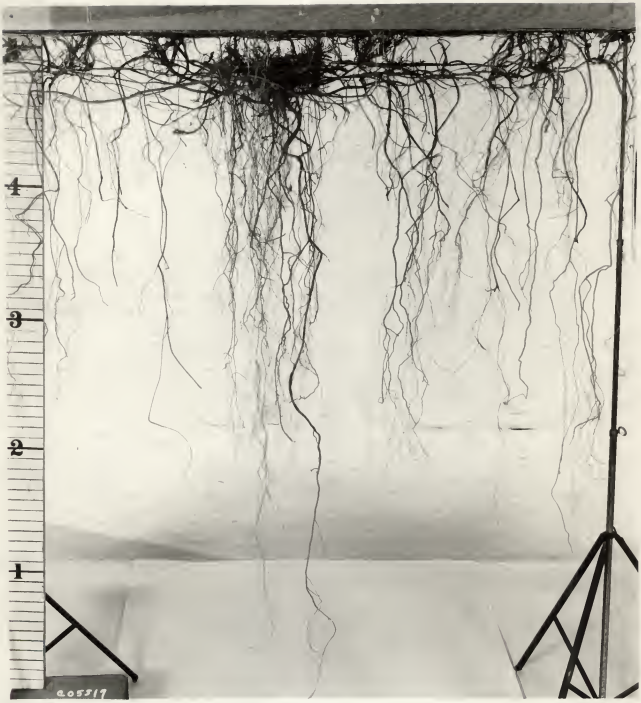
Since the recent interest in pasture type alfalfas has turned attention once again to these creeping types, the ability of an alfalfa plant to spread by lateral roots would seem to indicate that here may lie a useful tool. Aamodt (1952) stated, "It now seems likely the most promising plants for the dryland West will be in the form of creeping, drought resistant alfalfa, especially suited for grazing use." Smith (1950) described adventitious shoots from lateral roots as being a rare occurrence, and of the types studied, only certain yellow-flowered varieties and a variegated variety, Ladak, produced such shoots. Oakley and Garver (1913) early stated that perhaps the greatest use of these types would be their value in a selection and hybridization program. They also gave detailed descriptions of the prostrate, fine stemmed, fine leaved nature of the falcata types.

It would appear that if this character of root spreading could be retained in a hybrid of higher yield, prostrate nature, and a higher seed production the answer to the need of a persistent pasture legume in mixture might be found. However, such a premise would most certainly have to

## EXPLANATION OF PLATE I

Excavated root system of a creeping alfalfa plant. Note the strong lateral root system. This plant established 48 crowns in an area of approximately 10 square feet. The plant was 3 years old when excavated.

PLATE I



## EXPLANATION OF PLATE II

Kansas Common Alfalfa excavated to a depth of approximately 4½ feet. Note the strong tap root as compared to the creeping type in Plate I, and the short crown shoots which have developed a broadened crown. The plant was 3 years old when excavated.

be investigated before it could be said that the need had been adequately fulfilled. Certain hybrids have been produced which retain the root creeping character, although it is not as yet thought to be dominant in its expression. Information dealing with the ability of these hybrids to express their spreading character in mixture with grass, especially bromegrass, and their ability to persist in such a mixture under grazing pressure, has not been obtained at the present time. The work presented in this paper is a preliminary study of such problems.

## MATERIALS AND METHODS

Two studies were undertaken, one to study the time at which lateral root development was initiated, the second to investigate the competitive ability of three root creeping type hybrids in competition with bromegrass. (Each study will be discussed in turn as each topic is taken up.)

### Experimental Area

Root Study. This study was conducted in a greenhouse maintained by the Agronomy Department of Kansas State College. The experimental material was seeded December 17, 1953, in a bed of uniform silt loam soil. The bed itself was approximately two feet above ground level and excavated to a depth of approximately three feet and then refilled with desirable soil. A steam radiator stood parallel to the bed along one side. The plants occupied an area in this bed of approximately five by ten feet.

Competition Study. This trial was conducted on the sandy loam bottom land soils of the Soil Conservation Service nursery located near Manhattan, Kansas, and operated under lease by Kansas State College. Alfalfa plants were transplanted to this area July 9, 1953, after being started in the greenhouse from

cuttings made earlier in the spring. The site covers an area of approximately 1/5 acre and is apparently uniform, occurring on level ground and within the same soil type.

## Plant Materials

Root Study. Registered Buffalo alfalfa and a four-way synthetic creeping type bearing the Canadian accession number Sc3484F were used in this study. The Canadian number was received as seed from Dr. D. H. Heinrichs of the Forage Plants Division of the Canadian Department of Agriculture, Swift Current, Saskatchewan, where considerable work with creeping type alfalfas is being conducted.

Competition Study. Registered Buffalo alfalfa was again used with three creeping type hybrids bearing the Canadian accession numbers of Sc24760, Sc24776, and Sc24729. This Canadian material was also received from Dr. Heinrichs as clonal selections from the crosses Ladak (Ladak x Siberian), Siberian (Siberian x Ladak), and (Ladak x Siberian) x (Ladak x Siberian) and described as being of high percentage creeping ability, good yield, and capable of high seed production.

## Design of the Experiment

Root Study. Buffalo alfalfa and the creeping type were planted side by side in two blocks of eight rows each, four inches between rows. The rows ran from the east to the west for ten feet (the width of the bed) and the Buffalo occupied the northernmost of the two blocks.

Competition Study. The Buffalo alfalfa and the three creeping types were planted in four blocks with three foot spacing between plants. There were eight, fifteen, eleven, and eleven rows respectively of each type alfalfa with three foot spacing between rows and sixteen plants within the rows.

On September 23, 1953, Achenbach bromegrass was sown on one-half of the

experimental area. This placed each block of alfalfa one-half in competition with bromegrass and one-half without competition. A few weeds volunteered the second year although they did not reappear after the first cutting. The blocks were maintained free of weeds the first season.

## Sampling Techinque

Root Study. At intervals of two weeks for eight periods plants in one foot of each row were removed from the end of the row and fifty plants were selected at random. The plants were removed from the bed using a sharpshooter spade and the soil washed from the roots in a large container of water. After the seedlings were more mature, it was found that more accurate data could be taken by merely crumbling the soil away from the roots. This was easily done without injury to the roots inasmuch as the soil was friable and in good condition. After removal the plants were taken to a work table nearby and the plant height and the length of root measured in centimeters. The crown diameter was measured by placing each seedling under a thickness gauge. The number of secondary roots was counted by use of a hand lens when young but unaided as the plants matured, then the top was severed at the crown, placed in a packet and the root in another. After the tops and roots had had sufficient time to reach a constant air dry weight their weights were taken on a torsion balance and recorded.

Competition Study. On May 30, 1954, three-foot square sampling areas were selected at random in each block, the original plants marking the corners of each area. Five of the sampling areas were chosen in the grassed area and five in the no-grass area of each block of alfalfa. The prostrate stems of the original plants were laid back from the area to be examined for new, independent plants initiated from the lateral roots of the original plants. The area was

then closely examined and all new plants counted and the figure recorded. A total of forty samples were taken.

## EXPERIMENTAL RESULTS

### Seedling Root Study Data

The average plant height, top and root weight, crown diameter, and number of secondary roots per centimeter root length for fifty individual plants taken at eight different age levels are presented in Table 1. These averages are also graphed and presented in Plate III.

An examination of the data indicates that generally Buffalo alfalfa was more vigorous and made more growth over the period of study than did the creeping type. Buffalo out-performed the creeping type in every character studied except the production of secondary roots.

Inasmuch as the experiment was not replicated, nor was pure randomization employed in the sampling technique, the data were not submitted to statistical analysis. The differences that are shown in the data, therefore, can only be inferred to be reflecting true differences between the two types of alfalfa with respect to the characters studied. However, inasmuch as it is generally known by workers familiar with alfalfa that actual differences do occur between the two species used in this study, the data obtained serve to indicate the general nature of the early growth curves, recognizing that true differences will later develop if they have not already done so.

### Competition Study Data

The numbers of independent plants initiated in representative areas by each of the four alfalfas under study are presented in Table 2. Here again, although

Table 1. Seedling root study data as an average of fifty individual plants taken at eight different age levels.

| Age (days) | Plant Height (Centimeters) | | Crown Diameter (1/1000 in.) | | Top Weight (Milligrams) | | Root Weight (Milligrams) | | Number of Secondary Roots per Centimeter Root Length | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Buffalo | Creeping | Buffalo | Creeping | Buffalo | Creeping | Buffalo | Creeping | Buffalo | Creeping |
| 13 | 4.4 | 3.5 | . - | - | 4.1 | 1.3 | 1.4 | 1.3 | .45 | .67 |
| 28 | 12.0 | 10.1 | .0031 | .0027 | 24.5 | 23.3 | 4.0 | 7.5 | 1.28 | 1.35 |
| 40 | 20.2 | 18.9 | .0047 | .0037 | 125.8 | 53.2 | 21.6 | 12.4 | 1.50 | 1.69 |
| 56 | 32.1 | 37.2 | .0097 | .0067 | 435.0 | 100.0 | 82.0 | 39.5 | 1.47 | 1.83 |
| 70 | 41.2 | 28.9 | .0125 | .0109 | 366.5 | 321.5 | 117.5 | 70.5 | 1.32 | 1.59 |
| 83 | 48.5 | 33.0 | .0134 | .0127 | 545.0 | 364.0 | 240.0 | 83.0 | 1.11 | 1.67 |
| 97 | 46.5 | 36.2 | .0141 | .0136 | 496.0 | 451.0 | 234.1 | 126.0 | 1.67 | 1.90 |
| 111 | 42.1 | 32.5 | .0136 | .0122 | 473.0 | 473.0 | 248.3 | 132.6 | 1.27 | 1.56 |

## EXPLANATION OF PLATE III

Fig. 1. Average plant height of fifty individual plants of Buffalo and creeping type alfalfa graphed at eight stages of growth.

Fig. 2. Average diameter of crown of fifty individual plants of Buffalo and creeping type alfalfa graphed at eight stages of growth.

Fig. 3. Average weight of the tops of fifty individual plants of Buffalo and creeping type alfalfa graphed at eight stages of growth.

Fig. 4. Average weight of the roots of fifty individual plants of Buffalo and creeping type alfalfa graphed at eight stages of growth.

Fig. 5. Average number of secondary roots per centimeter root length of fifty individual plants of Buffalo and creeping type alfalfa graphed at eight different stages of growth.

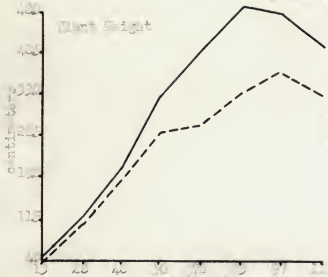


Fig. 1.

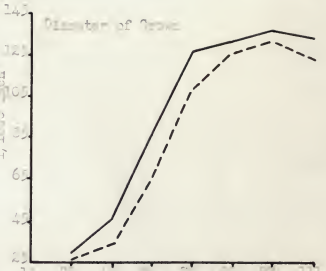


Fig. 2.

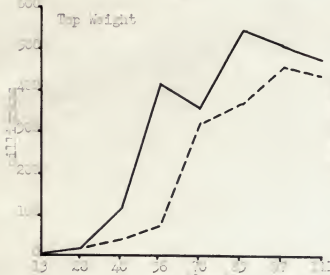


Fig. 3.

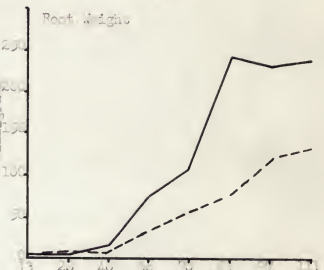


Fig. 4.

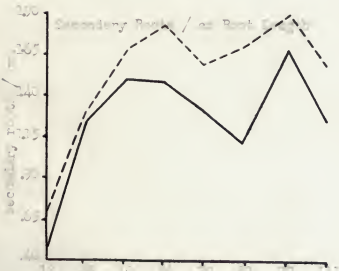
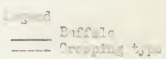


Fig. 5.



statistical analysis was not used because of the meager data and the nature of the design, true differences are at least implied by the data. One creeping strain has successfully established new plants, independent of the mother plant, through its ability to send out lateral roots which produce aerial shoots. However, inasmuch as these plants have had only a short time in which to exhibit

Table 2. Competition study data - total number of independent new plants initiated per total sampling area of ninety square feet.

| | With Bromegrass | Without Bromegrass |
|---|---|---|
| Sc24776 | 17 | 18 |
| Sc24760 | 1 | 1 |
| Sc24729 | 1 | 0 |
| Buffalo | 0 | 0 |

their creeping ability it is too early to say whether the other two strains will also spread in competition with grass. At the present time only the one strain, Sc24776, can definitely be said to be able to spread in competition with bromegrass in the early stages covered by this trial.

## DISCUSSION AND CONCLUSIONS

The problem of finding desirable, pasture type alfalfas to be used in mixtures with grass, alfalfas which are capable of maintaining an adequate percentage of the composition of the mixture, has undergone preliminary study in the experimental work presented herein. Although the greenhouse study could not be carried on long enough to determine at what stage of growth the lateral root development begins it did show that consistent differences exist between the creeping type and common alfalfas and that these differences are initiated in the early stages of development. Although it is not known at the present time, such knowledge may become of practical signifigance in the husbandry of any pas-

ture alfalfa that may be developed within the falcata or intermediate species. The possibility of slower regrowth, as indicated by the root study, and the need for a longer period in which to establish stands may merit further, more detailed study. It is conclusively indicated by this study that the intermediate types are not so vigorous in the seedling stage, not so productive as are the common alfalfas. However, they do have a more branched root system, hence they may be better equipped to deal with droughty conditions sometimes encountered in Kansas.

Although the data collected from the competition study are based on a relatively young trial one can recognize certain trends which may point the way to further progress on the problem of pasture alfalfas for Kansas. Although competition has been in real effect for less than three months, it is apparent that at least one strain is capable of making early headway in utilizing its spreading potentiality to persist in competition with bromegrass. Whether the other creeping type hybrids will also spread vigorously is yet to be observed. Thus it appears that the possibility of finding an adapted, readily spreading strain is not too remote. However, to state that such a strain will improve the persistency of alfalfa in bromegrass-alfalfa pasture mixtures cannot as yet be justified. This can only be tested by using such alfalfas in grazing experiments.

## SUMMARY

Two studies were conducted, one to determine the time at which certain strains of Medicago falcata initiate the lateral roots which later produce aerial shoots that develop into entirely independent plants apart from the original mother plant. The other study conducted was one to determine the relative ability of three creeping type hybrids to compete with bromegrass

in a bromegrass-alfalfa mixture.

The root study was carried out in the greenhouse using a block of registered Buffalo alfalfa and a block of a creeping type alfalfa bearing the Canadian accession number Sc3484F. Each block was seeded in a uniform silt loam soil bed with eight ten-foot rows spaced four inches apart. At intervals of two weeks the plants in one foot of row were removed from the end of each row. The soil was removed from the roots of the plants, and fifty plants from each block randomly selected for study. In addition to inspection for development of lateral roots, data were taken on plant height, root length, weight of roots and tops, crown diameter, and the number of secondary roots.

The competition study was conducted on a sandy loam bottom land soil near Manhattan, Kansas. Three strains of creeping type alfalfa and registered Buffalo were planted in four blocks. The creeping types bear the Canadian accession numbers Sc24776, Sc24760, and Sc24729, and are clonal selections from the crosses Ladak (Ladak x Siberian), Siberian (Siberian x Ladak), and (Ladak x Siberian) x (Ladak x Siberian). After the plants were well established Achenbach bromegrass was seeded across one-half of each block, thus one-half of each block grew in competition with grass and one-half without competition. Data on the number of new plants initiated by each strain with grass and without grass were taken.

Although the greenhouse study did not reveal the time of lateral root development it did show that obvious differences in the intermediate and common alfalfas are initiated early in the development of the plants. The information gained may become of practical importance in the management of a pasture type alfalfa developed within M. falcata. The study further indicated the need for more detailed study of the problems of slower regrowth as related to grazing dates and intensities, and in the establishment of stands of the alfalfa in pasture mixtures.

Indications from the competition study are that it is possible to obtain an adaptable, readily spreading strain of pasture type alfalfa for Kansas, but its ability to persist in mixture with bromegrass must be tested under grazing pressure.

ACKNOWLEDGMENTS

The author is indebted to Mr. C. O. Grandfield, U.S.D.A., Division of Forage Crops and Plant Diseases, Alfalfa Investigations, for his cooperation and aid in making the writing of this thesis possible. Special acknowledgment is due Dr. K. L. Anderson, his faculty advisor, for valuable suggestions and assistance in all phases of the experimental work and writing of this thesis, to Dr. H. C. Fryer for his suggestions in the interpretation of the experimental data, and to his wife without whose consideration and aid the work could not have been done.

## LITERATURE CITED


Aamodt, O. S.
Rambling alfalfas - new hope for dryland pastures. Crops and Soils. 5:7-10. October, 1952.

Ahlgren, H. L.
The brome-alfalfa partnership. Hoards D. 93:193. March 10, 1948.

Anderson, K. L.
Tame pastures in Kansas. Kans. Agric. Expt. Sta. Cir. 206. 1941.

Atherton, D. O.
White grubs and pasture deterioration on the Atherton tableland. Queensland Agric. Jour. 52:484-522. 1939.

Baker, M. L.
Fattening yearling heifers on alfalfa pasture. Nebr. Agric. Expt. Sta. Bul. 281. 1933.

Brown, E. M.
Good pastures pay. Mo. Agric. Expt. Sta. Bul. 547. 1951.

Cleavinger, E. A., and L. E. Willoughby.
Bromegrass in Kansas. Kans. Sta. Coll. Ext. Cir. M-52. 1944.

Cole, H. H.
Production and prevention of bloat in cattle on alfalfa pasture. Jour. Animal Sci. 2:285-294. 1943.

Comstock, V. E., and A. G. Law.
Effect of clipping on the yield, botanical composition, and protein content of alfalfa-grass mixtures. Amer. Soc. Agron. Jour. 40:1074-1083. 1948.

Cook, L. J.
Lucerne and its use as a pasture plant. Jour. Dept. Agric. S. Australia 44:205-207. 1940.

Cox, H. R., and C. H. Ahlgren.
Improved pastures from better grasses and legumes. New Jersey Agric. Expt. Sta. Cir. 492. 1946.

Durrance, A. B., and H. C. Rather.
Experiments with alfalfa as pasture for dairy cows. Mich. Agric. Expt. Sta. Quar. Bul. v15:30-35. 1932.

Ensminger, M. E.
Grass and grass-alfalfa mixtures for beef production in eastern Washington. Wash. Agric. Expt. Sta. Bul. 444. 1944.

Evvard, J. M.
Feeding hogs on alfalfa. Successful Farming 26:26. June, 1928.

Fowler, B.
Are creeping alfalfas panning out. Farm Jour. 18:42-43. April 2, 1954.

Fraser, W. J.
Champion of alfalfa pasture. Hoards D. 81:88. February 25, 1936.

_____.
Championship pasture team. Hoards D 81:22. April 25, 1936.

Fuelleman, R. F.
Methods of management of a bromegrass-alfalfa mixture. Jour. Animal Sci. 7:99-109. 1948.

Green, J. L.
Lucerne on the central plains will withstand severe conditions. Chief means of improving pastures. Agric. Gaz. of New S. Wales 49:2-6, 61-65. 1938.

Harrison, G. R.
Alfalfa for pasture. Hoards D. 82:484. September 10, 1937.

_____.
Alfalfa pasture stands the racket. Hoards D. 83:574. November 25, 1938.

Harrison, C. M.
Alfalfa and smooth bromegrass as a pasture. Hoards D. 83:147. March 10, 1941.

Harrison, C. M., and K. T. Wright, and G. E. Taylor.
Comparative study of the value of alfalfa and a mixture of alfalfa and smooth bromegrass as a pasture for dairy cattle. Mich. Agric. Expt. Sta. Qual. Bul. V20:225-228. 1938.

Hilton, J. H.
Alfalfa-bromegrass makes good pasture. Ind. Agric. Expt. Sta. Cir. 290:1-6. 1944.

Jackman, E. R., and R. G. Fowler.
New alfalfa you can pasture...and keep too. Farm Jour. 75:54-56. December, 1951.

Judd, K.
Lucerne for pasture in wheat districts. Agric. Gaz. of New S. Wales 42:901-907. 1931.

Kalton, R. D., and C. P. Wilsie.
Effect of bromegrass varieties on yield and composition of a brome-alfalfa mixture. Amer. Soc. Agron. Jour. 45:308-311. 1953.

Keith, T. B.
Alfalfa and alfalfa-bromegrass hays for growing and fattening lambs. Jour. Animal Sci. 9:491-494. 1950.

Mays. D. W. Jr.
Changes in the proportion and yield of alfalfa and Korean lespedeza in mixtures with grasses. Amer. Soc. Agron. Jour. 34:856-859. 1942.

McAuliffe, W. S.
Grazing lucerne for raising pigs. Jour. Dept. Agric. S. Australia 47:416-419. 1944.

McCarty, M. A., and M. F. Grimes.
Pasture Crops for Swine. Penn. Agric. Expt. Sta. Bul. 254. 1930.

McDougall, A. H.
Lucerne and pasture improvement at Trangie experimental farm. Agric. Gaz. of New S. Wales 39:775-776. 1928.

McLennan, L. W. and J. L. Green.
Lucerne on grazing properties at Michelago and Quianbeyan. Agric. Gaz. of New S. Wales 43:409-410. 1932.

Moodie, A. W. S.
Lucerne as a pasture plant on hilly country. Agric. Gaz. of New S. Wales 39:327-330. 1928.

Oakley, R. A., and S. Garver.
Two types of root proliferation in alfalfa. U.S.D.A. BPI Cir. 115. 1913.

_____, _____.
M. falcata, a yellow flowered alfalfa. U.S.D.A. Bul. 428:1-70. 1917.

Oliver, G. W.
Some new alfalfa varieties for pastures. U.S.D.A. BPI Bul. 258. 1913.

Paczoskij, J.
Development of the root system of Cirsium arvense and Medicago sativa with reference to their vegetative reproduction. Observations carried out in Russia. Int. Rev. of Sci. and Prac. of Agric. 8: No. 4:563-565. 1917.

Rather, H. C.
When they go onto alfalfa. Successful Farming 34:10. May, 1936.

_____.
Mixture of alfalfa and smooth bromegrass for pasture. Mich. Agric. Expt. Sta. Cir. Bul. 159:1-7. 1937.

Rather, H. C., and A. B. Durrance.
Pasturing alfalfa in Michigan. Amer. Soc. Agron. Jour. 27:57-65. 1935.

Rather, H. C., and A. B. Durrance.
Study of the time of pasturing alfalfa. Amer. Soc. Agron. Jour. 30:130-134. 1938.

Rather, H. C., and C. M. Harrison.
Starch reserves in the roots of pastured alfalfa when grown alone and in mixtures. Mich. Agric. Expt. Sta. Quar. Bul. v21:281-291. 1939.

_____, _____.
Alfalfa and smooth bromegrass for pasture and hay. Mich. State Coll. Agric. Expt. Sta. Cir. 189. 1944.

Shelton, B. M.
Cultivated grasses and clovers in Kansas: fourteen years experience at the college farm. Kans. Agric. Expt. Sta. Bul. 2. 1888.

Smith, D.
The occurrence of adventitious shoots on several alfalfa roots. Amer. Soc. Agron. Jour. 42:398-401. 1950.

Snyder, W. P.
The use of alfalfa pasture for fattening cattle. Nebr. Agric. Expt. Sta. Bul. 239:1-12. 1930.

Southworth, W.
A study of the influence of the root system in promoting hardiness in alfalfa. Scientific Amer. 1:5-9. 1921.

Ten Eyck, A. M.
Grasses. Kans. Agric. Expt. Sta. Bul. 175. 1911.

Weaver, J. E.
Root system of farm crops in relation to practical crop production. Nebr. State Bd. of Agric. Report 220-532. 1932.

Westover, H. L., and W. H. Kosterman.
Uses of alfalfa. Farmers Bul. 1839:1-35. 1940.

Whittet, J. N.
Clovers and lucerne in pastures. Agric. Gaz. of New S. Wales 36:641-647. 1925.

_____.
Lucerne as pasture in western districts. Agric. Gaz. of New S. Wales 40:1-16. 1929.

Wildman, H. N.
Grazing sheep on irrigated lucerne. Agric. Gaz. of New S. Wales 39:463-464. 1928.

Wilsie, C. P.
Evaluation of grass-legume associations with emphasis on the yields of bromegrass varieties. Amer. Soc. Agron. Jour. 41:412-420. 1949.

Woods, J. E.
Effect of grasses on yield of forage and production of roots by alfalfa-grass mixtures, with special reference to soil conservation. Amer. Soc. Agron. Jour. 45:590-595. 1953.

# PRELIMINARY STUDIES OF CERTAIN CREEPING TYPE ALFALFAS AS RELATED TO UTILIZATION IN PASTURE MIXTURES

by

CHARLES WILLIAM ALEXANDER

B. S., Kansas State College
of Agriculture and Applied Science, 1953

---

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agronomy

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

The use of cultivated land for tame pasture crops has been rapidly gaining favor in Kansas. Farmers have found that fertile land can be just as profitably utilized when seeded to an adapted pasture mixture as when this same land is farmed with cash crops.

Coming to the forefront only in the past decade the mixture of smooth bromegrass (Bromus inermis) and alfalfa (Medicago sativa) has proven itself to be a highly profitable, adaptable, compatible, palatable, and nutritious pasture crop. This mixture provides more total forage over a longer part of the growing season than the now commonly used pasture plants.

However, due to the ecological relationship between alfalfa and bromegrass, the alfalfa fails to maintain itself in the mixture for a period not much longer than three or four years. With the loss of the soil nitrogen provided by the alfalfa a sodbound condition of the bromegrass is likely to develop which results in a subsequent decline in the total value of the pasture crop.

Certain spreading alfalfas have gained considerable interest as a possible tool in solving the problem of a persistent alfalfa in pasture mixtures. Many of these spreading alfalfas have gained widespread repute for their ability to thicken their stands and spread as much as three or four feet from the original plant.

There are two types of spreading in alfalfa which have been noted at the present time. The first occurs by the unusually long development of the crown buds. These crown shoots may initiate new roots, thus becoming true rhizomes which have established new plants independent of the original crown. This type of spreading is termed rhizomatous and is characteristic of such varieties as Rhizoma, Nomad, and Sevelra. To date none of these

varieties have been known to spread in Kansas anymore than adapted common alfalfas.

The second type of spreading occurs by the development of true lateral roots usually several inches below the surface of the ground. These lateral roots are then capable of initiating aerial shoots which become independent plants apart from the mother plant. This type of spreading is termed creeping and is similar to the bindweeds (Convolvulus spp.), although lacking their vigor. Certain strains of the creeping type have been observed to have the ability to spread very well in the Kansas area. Their use in pasture mixtures, therefore, presents the intriguing possibility of a persistent adapted alfalfa in grass mixtures in Kansas. The studies presented herein begin the preliminary work of evaluating this possibility.

Two trials were conducted, one to determine the stage of growth at which lateral root development begins, the second to determine the relative ability of three creeping type alfalfas to persist in competition with bromegrass. The method of study and the experimental results will be discussed in turn for each trial.

## Root Study

This study was conducted in the Agronomy Department greenhouses of Kansas State College in a bed of uniform silt loam soil. Eight rows four inches apart of registered Buffalo alfalfa were seeded December 17, 1953, and the same amount of creeping type seeded the same date in an adjacent block. At intervals of two weeks for eight periods plants were removed from one foot of row and fifty plants of each alfalfa randomly selected for study. In addition to noting if the initiation of lateral root development had begun, data were taken on plant height, top and root weight, crown diameter, and the number of secondary roots

per centimeter root length.

Although the stage of growth at which lateral root development was initiated could not be determined, an impression of the general nature of the early growth curves for the characters studied was obtained from the data taken. Generally the Buffalo alfalfa was more vigorous and made more growth over the period of study than did the creeping type. In every character studied Buffalo alfalfa was consistently greater except in the production of secondary roots. Such information serves to indicate that the creeping types are less vigorous in the seedling stage, hence more detailed studies of problems of establishing stands, rates of grazing and time of pasturing are inferred. The greater production of secondary roots by the creeping type may be a means by which these alfalfas will be better able to withstand the drought conditions often times encountered in Kansas.

## Competition Study

This trial was conducted on the sandy loam bottom land soil of the Soil Conservation Service nursery, near Manhattan, Kansas, now under lease to Kansas State College. Registered Buffalo alfalfa and three creeping type hybrids were transplanted July 9, 1953, to an area of approximately 1/5 acre. Four blocks with three foot spacing between plants were established. On September 23, 1953, Achenbach bromegrass was seeded over one-half of the area, hence each alfalfa block occurred one-half with grass and one-half without grass.

On May 30, 1954, ten sample areas of nine square feet were randomly selected in each block, five of the areas selected in the grasses one-half and five in the no-grass one-half. The number of new plants initiated in these areas were then counted and recorded. The data obtained conclusively indicate that at least one

creeping strain was capable of utilizing its spreading ability early in its growth. Whether the other creeping types will be able to do so must yet be observed. The possibility, therefore, of a creeping type which will spread in competition with bromegrass is definitely shown, although to state that such an alfalfa will persist in that mixture, with or without grazing pressure, has not been determined by this study to date.