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ALFALFA

The Relation of Type To Hardiness

BY

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ALFALFA

THE RELATION OF TYPE TO HARDINESS.

By Philo K. Blinn.

For forty years alfalfa has been grown with marked success throughout the irrigated areas of Colorado. It has fitted our conditions so well that there has been little cause for failure aside from the lack of moisture. But it is a matter of common observation that there is a gradual loss of plants in the fields of ordinary alfalfa as they become older. In the very old fields, the stand of plants is almost invariably thin. This is usually ascribed to the overcrowding of plants. The thinning out has not usually seemed to decrease the yield of hay. The remaining plants seem to appropriate the extra space to good advantage, the increased size and number of stems making the total yield of hay almost constant. Thus the thinning out has not been regarded as a very serious injury unless it has been unusually severe, in which case it is said to have "run out" or "winter-killed." When it reaches this stage it is usually abandoned for hay production, plowed up and in time reseeded.

In recent years the Colorado Experiment Station has been receiving numerous complaints that alfalfa is not producing what it did in former years. These complaints are made in regard to both hay and seed production. Investigation seems to verify the truth of the claims. There are many local and specific causes for some of the complaints, such as, the injuries caused by grasshoppers, over-pasturing or injudicious irrigation. *There is additional cause for a general complaint in regard to alfalfa production* due to a lack of vigor and vitality in the strains commonly grown. These common types we might class as the southern or Spanish varieties. Originally the alfalfa that was planted in California and the other western states came from South America, and was in turn introduced into that country by the Spaniards during their early conquests. Most of our ordinary alfalfa can be traced to this origin.

The Colorado Experiment Station has conducted alfalfa improvement experiments since 1904. One of the results of these experiments has been to show the lack of hardiness in the southern alfalfa types. Attention was called to the contrast in seed yields and the great difference in types of plants found in the same fields. From certain choice individual plants found at different points in the Arkansas Valley in southeastern Colorado, seed was selected and saved for the beginning of an experiment in systematic seed breeding. The most promising of these selections were sown in a nursery plat April 15, 1905. In this plat was also sown some ordinary commercial seed secured from a dealer in Rocky Ford, Colo., and some imported Turkestan alfalfa from Germany, furnished by Professor W. H. Olin.

Plate No. 1 is a view of this first alfalfa nursery plat, taken just a year from the date of seeding. The six rows of the large stooled crowns in the center were sown with the Turkestan seed. Each of the four rows to the left of the Turkestan rows were sown with the seed of some choice selected plant, while the four rows, to the right of the Turkestan rows, were sown with seed of commercial stock representing ordinary alfalfa. So marked were the contrasts in this test in

Plate No. 1.—The first alfalfa nursery, one year from date of seeding. Four rows on the right sown from commercial seed; six rows in center, Turkestan alfalfa from Germany; four rows on the left seeded with seed from choice native or common alfalfa.

favor of the imported seed, that it was evident that a wider test of varieties should be made, in order to find the best stock to be used as a basis for alfalfa seed breeding.

During the season of 1906, the most promising plants in the six rows of Turkestan alfalfa were selected and saved for seed. Fifteen of these plants gave an average yield of over one and one-half ounces of seed per plant. They also seemed to possess desirable qualities for hay. The seed of each of these choice plants was saved separately. These with about fifty other varieties or strains received from Mr. J. M. Westgate of the U. S. Bureau of Plant Industry, furnished the seed for a second alfalfa nursery test. This nursery was sown April

15, 1907. It consisted of sixty-four plats, each one representing the seed of an individual selection, or a regional variety from some state or foreign country.

All the varieties in this nursery could be classed in a general way, as Medicago sativa, or common alfalfa. A few of the plats showed plants with variegated flowers. These might be classed in the variegated strains. There were marked contrasts in the type of plants and

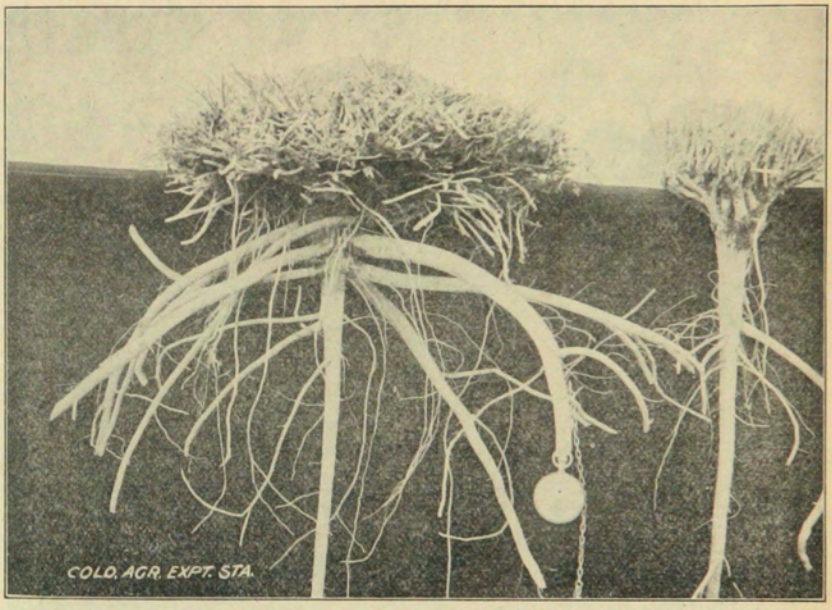


Plate No. 2.—Representative plants of the Hardy and Non-hardy type of crowns of four-year-old alfalfa taken from the same nursery, grown as single plants under the same conditions. The plant on the right, the common or Southern type; the plant on the left, a fair sample of Baltic alfalfa, a variety found growing near the little town of Baltic, South Dakota.

the character of the foliage in different plats. In some plats, there was almost as wide a range of contrasts in the different plants of the plat.

The geographical distribution of the seed that was sown in this nursery was as follows: Four from Arabia; four from Africa; four from South America; four from Spain and Mexico; eight from the Western parts of the United States; eight from the northern states and northern Europe and thirty-two plats of Turkestan alfalfa from different sources.

Each plat was planted with 200 hills; twenty inches apart each way, ten rows of twenty hills each. The plats were separated by a forty inch path between all the plats. The hills were thinned to

single plants when about six weeks old, thus permitting the study of individual plants.

While the nursery was given uniform cultural care, there were marked contrasts in many traits, such as, production of seed; leafiness of the plant; coarseness of the stems; degree of resistance to late spring frosts, and some other points of practical utility.

The factor of overcrowding of the plants in the nursery had been

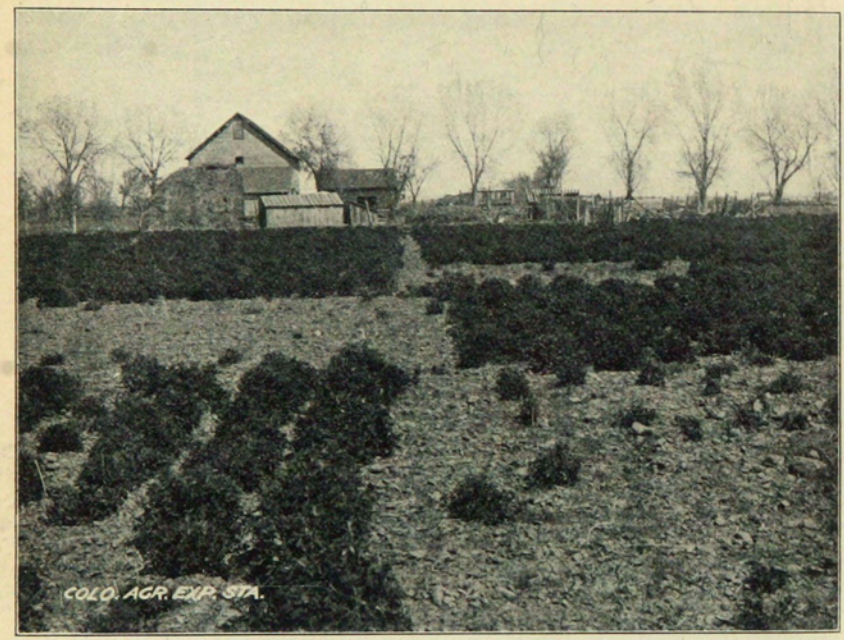


Plate No. 3.—A portion of the 1907 alfalfa nursery, taken April 25, 1911, showing the loss of plants after four winters. In the right foreground, a plat of Ecuador alfalfa; in the forground, a plat from Utah seed; in the left center, two plats of African alfalfa, all dead; in the right center, a plat of Arabian alfalfa, all dead.

eliminated by thinning the plants to single specimens. Yet after the winter of 1907-1908, over one half of the plants in all the plats seeded with Arabian and North African seed were dead, apparently from winter killing, while the plats seeded with seed from Spain, Mexico and South America had many dead plants and a good many partially killed crowns. The same was true in the native American plats. The plants were often found with just a few stems with life enough to start growth in the spring. But in the Turkestan plats and the plats sown with the northern strains of seed, there seemed to be no loss whatever from winter-killing.

During the season of 1908, the nursery was allowed to produce

seed, the plants being screened. The seed was saved for future work. Irrigation was withheld to induce better seed production. The dry condition seemed to increase the frost injuries the following winter for a still greater loss of plants occurred in the same plats where the winter-killing first began. The northern strains were still free from any injury, while the plats from the Arabian and African seed were practically all dead. The loss of plants by winter-killing has con-

Plate No. 4.—Another portion of the 1907 alfalfa nursery, taken April 25, 1911, showing the portion of the nursery seeded with the Turkestan and other heavy stooling crown types, where no loss from winter-killing has occurred in four winters.

tinued to occur to some extent in the non-hardy plats for the past four winters.

Plate No. 3 is a view of a portion of the nursery, taken April 25, 1911, showing the effects of four winters. The loss of plants in several of the non-hardy plats is noticeable. Plate No. 4 is a view of another portion of the same nursery taken at the same time, showing the hardy northern strains where no loss from winter-killing has occurred.

During the past four years careful examination has been made of many hundred plants, to determine the cause of the loss of plants in one plat and not in another. Several seedings have been made and plowed up, in order to study the relative difference, if any, between the crowns where winter-killing occurred and where it did not.

Plate No. 5.—Seedlings of four months' growth under similar conditions, showing contrast in stooling habits. The crowns on the left, Spanish alfalfa, typical of our common alfalfa, upright crowns without protected buds. The crowns on the right, two Grimm's alfalfa crowns, same age, typical of the hardy type having the underground shoots.

It has been observed that a marked difference exists between the type of the crown, or the stooling habits, of the hardy and non-hardy strains. Plate No. 2 illustrates this contrast in the crowns of two four-year-old plants taken from the nursery, each representing a typical crown of the two types of plants. The distinction between

these types may be better understood with younger plants. Plate No. 5 shows two very representative plants of these two types, only four months' growth from seed, both grown under the same field conditions. The non-hardy type is shown on the left. It has a compacted upright growing crown, with comparatively few buds or shoots below the surface of the soil. The buds are thus exposed to freezing, thawing and drying out which eventually weakens and kills alfalfa in the arid regions.

The hardy type is shown on the right. This is characterized by a more spreading crown, with numerous buds and shoots springing from the crown below the surface of the soil. These underground

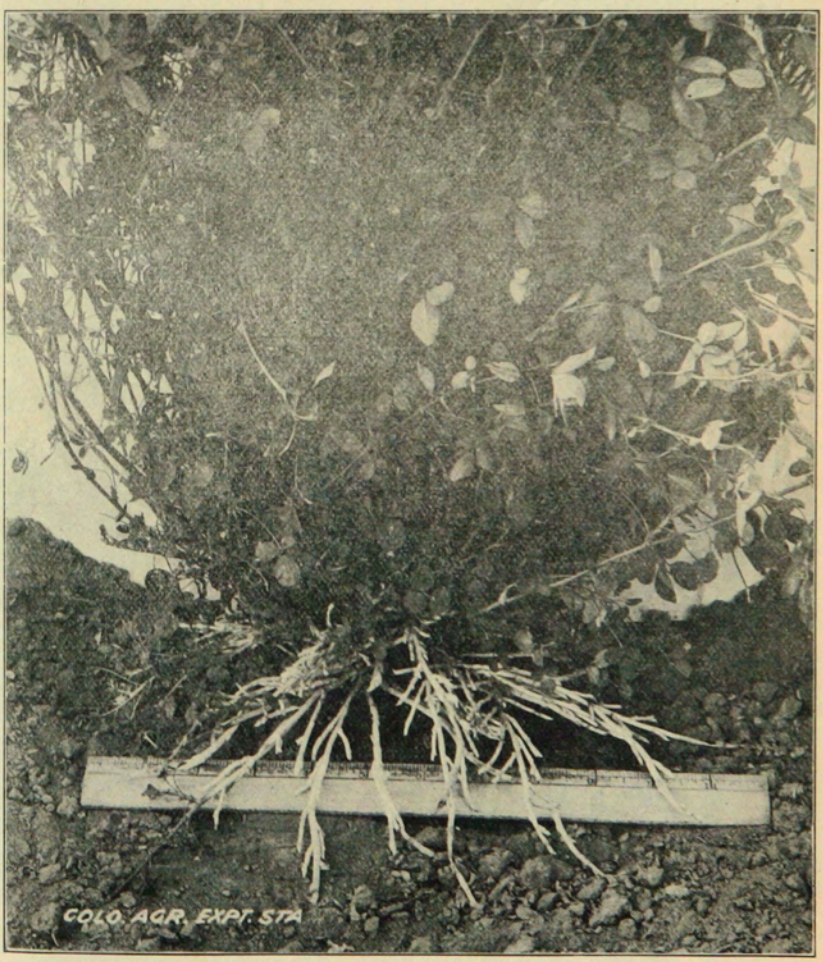


Plate No. 6.—A fine specimen of the hardy type, Grimm's alfalfa. Soil removed three inches in depth to expose all the underground shoots.

shoots in some of the best plants of this type, have been found several inches below the surface of the soil. The bud area in this type of plant is thus protected by the soil from drying or freezing. A fine specimen of this type of plant is shown in Plate No. 6. The soil in

Plate No. 7.—A portion of the 1910 alfalfa nursery, showing the great contrasts in stooling habits under uniform conditions. The small row just to the left of the center, Elche alfalfa from Spain. The heavy crowns to the right are selections of Baltic and Turkestan alfalfa.

Plate No. 8.—A portion of a field test of the hardy and non-hardy types. On the right, Peruvian alfalfa from Colorado grown seed. On the left, Baltic alfalfa from Colorado grown seed. Field seeded March 17, 1909; view taken March 25, 1911.

Plates Nos. 9 and 10.—Two adjacent Turkestan plants, May 3, 1909, two days after freeze of 18°. No. 1, dark green foliage, practically uninjured. No. 2, light green foliage, leaves and stems entirely frozen back. (Plate from Colorado bulletin, No. 154.)

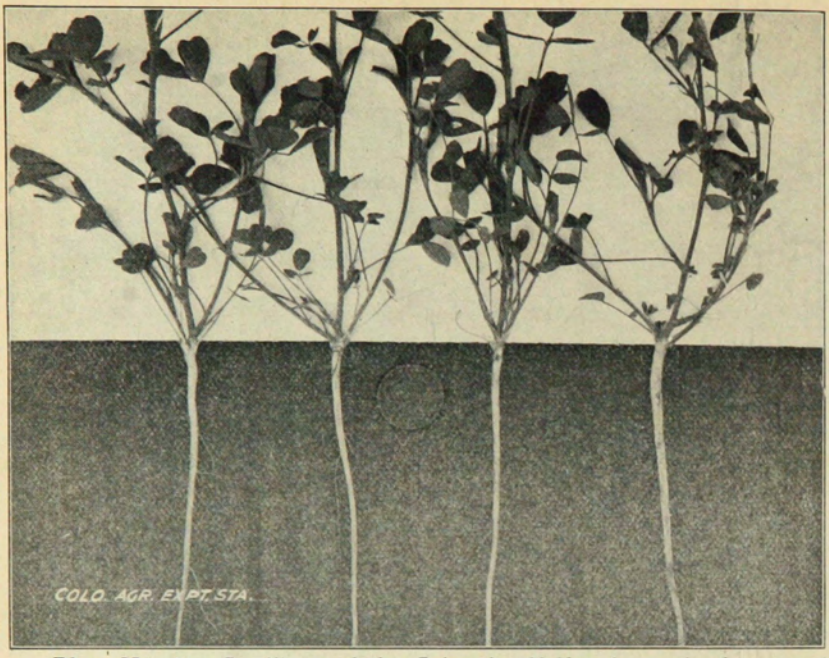


Plate No. 11.—Seedlings of the Grimm's alfalfa, six weeks from seed, showing the early stooling traits.

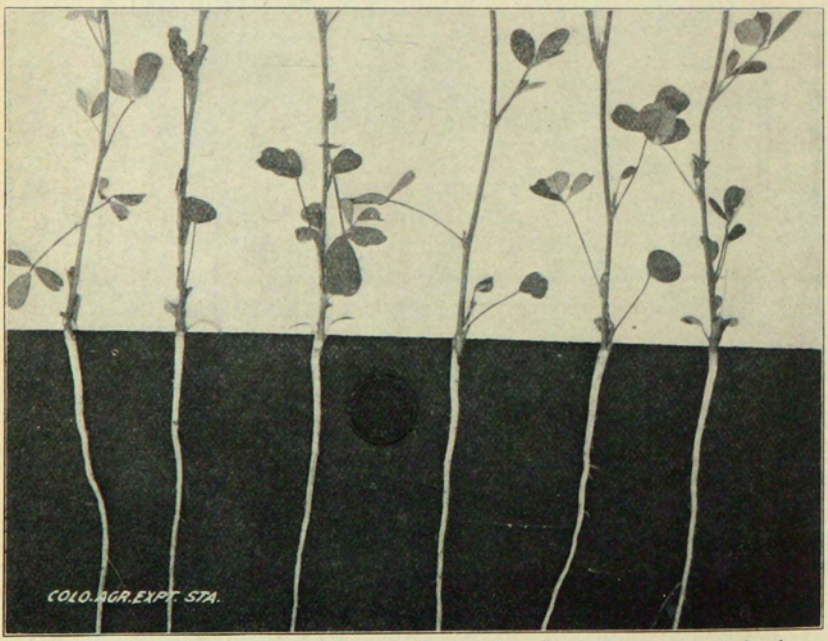


Plate No. 12.—Seedlings of the ordinary Spanish alfalfa, six weeks from seed, showing the upright growth and less tendency to stool or form a crown.

this case was removed three inches deep to expose all the underground shoots, some of which were over eight inches in length. This plant was from a nursery row of the Grimm's alfalfa, only six months growth from seed. The seed that produced this plant came from a field in northern Minnesota, over forty years of age. The budding area of such a plant is enormous. It will stand the loss of many buds without apparent injury and the soil protection will insure it against the usual winter cold.

There is also a tendency for the underground shoots to take root at some distance from the old center crown. This may be seen by observing the numerous small roots that are extending beneath the large crown in Plate No. 2. In old stools of alfalfa of this type, the original plant has been found in some cases to be dead. But it was surrounded by a ring of healthy secondary crowns formed by the underground shoots that have taken root and formed independent plants. Thus the hardy type will maintain a permanent stand of plants, while the non-hardy type which has the upright compacted crown with the buds exposed, has scarcely any tendency to take root from the crown. This will result in serious injury, in time weakening and eventually destroying the plant. Thus the stand of plants in the non-hardy type is bound to become thin.

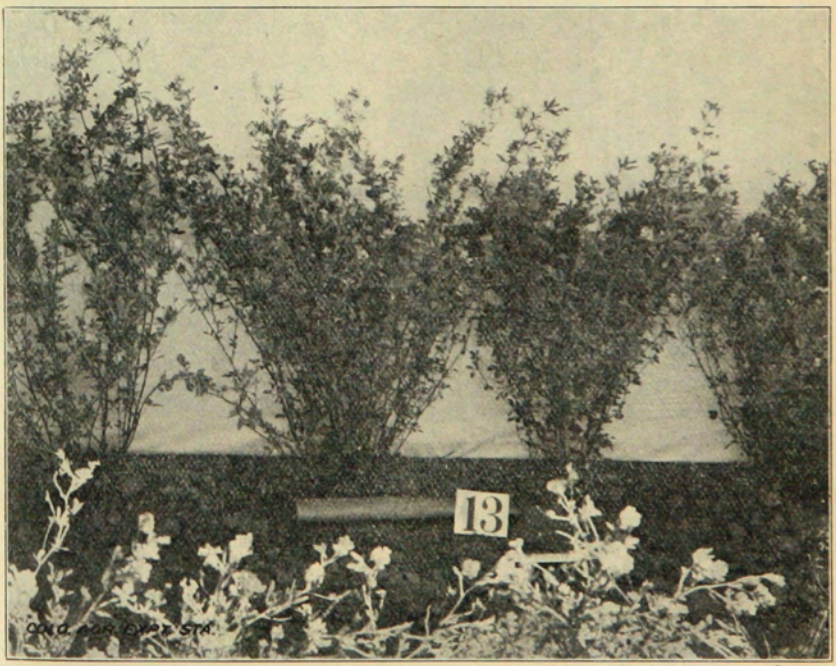


Plate No. 13.—A portion of a select nursery row, from pedigreed seed, showing the uniformity and desirable type. Plants four months' growth from seed.

The relation of the stooling habits in alfalfa to the vigor and vitality has been repeatedly shown in the nursery and field tests of the past seven years. Plates Nos. 7 and 8 are two other views showing the contrast in the stooling habits of the different types.

There seems to be a grading of the types to different degrees of hardiness. This can be seen in the irregular size and types shown in the plates in this bulletin, and in almost any field of alfalfa. This is evidently one of the reasons for the gradual loss of plants. The least hardy types are the first to be killed, the others following gradually as the conditions become more severe. There are evidently other factors that go to make up resistance to cold besides the stooling habit.

Plate No. 14.—A portion of another row in the same nursery, from commercial seed, showing the irregular types, many of which are undesirable.

There is a difference in the effects of frost on the green leaves and stems of the plants above ground. The dark colored foliage is apparently more resistant than the light green color. Plates Nos. 9 and 10 show the effects of frost on two adjacent Turkestan plants. The light green one is frozen down; the dark green one has hardly a leaf hurt.

Turkestan alfalfa, because of its stooling habits, has been mentioned in this bulletin as one of the hardy types. So far, it seems to be a desirable variety altho there is a wide variation in the different strains. There are also several objectionable features to the Turkestan

alfalfa, namely, a tendency to produce a poor yield of seed and a habit of very early starting in the spring, with a correspondingly early check in growth in the fall. Thus the first crop is made light or injured by late spring frosts and the last crop is cut short by the plants beginning to become dormant. Hence, for Colorado conditions, Turkestan alfalfa has not proven to be the most desirable.

The results of the nursery tests seem to emphasize the fact that there is more significance in the TYPE OF THE PLANT from which the seed comes than in the variety name or the locality from which the seed may be derived.

The alfalfa seed commonly sold on the markets has had no special breeding outside the natural selection from winter elimination.

In Minnesota and in North and South Dakota, where the winter conditions are far more severe than in Colorado, the tests of alfalfa varieties for cold resistance have been very interesting. In several large variety tests, the same results have been secured, namely, the Grimm, Baltic and Turkestan varieties of alfalfa have proven to be the most hardy of a large list of alfalfas from different parts of the world. These results tally almost exactly with the results of similar tests in Colorado. All of these three strains have a distinct type of crown as compared to the type of crown found in the non-hardy varieties. The fact is *the hardy strains of alfalfa have spreading crowns with underground root stocks and shoots with buds which are protected by soil, from winter freezing.*

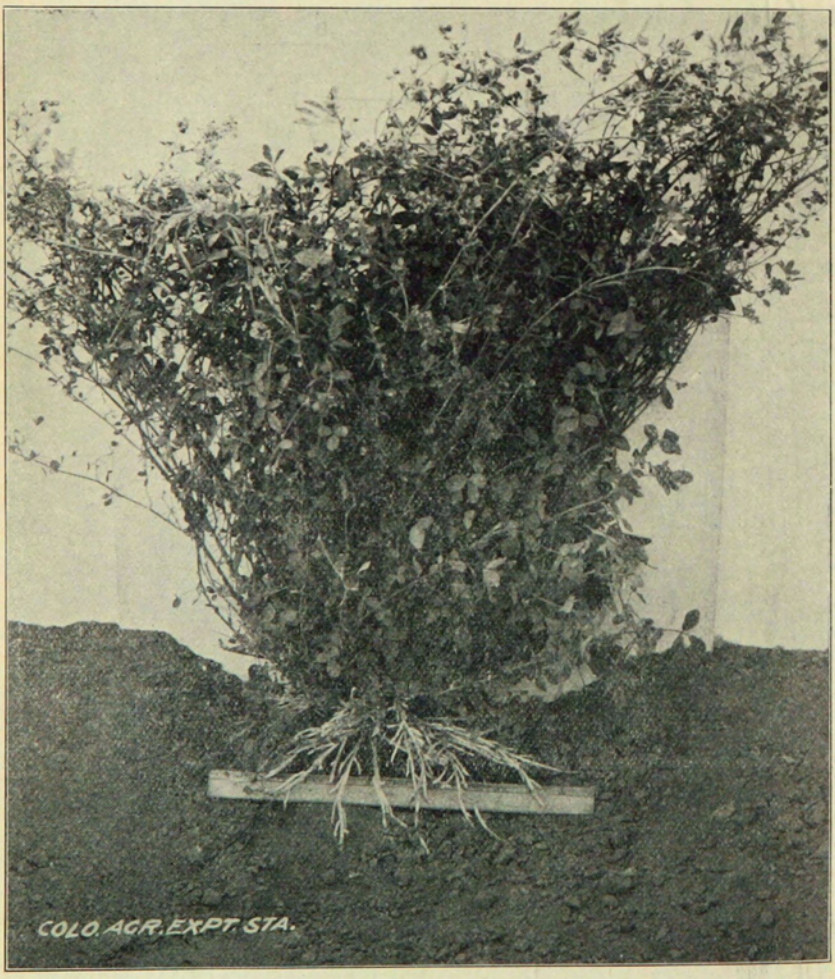
The non-hardy strains of alfalfa have more upright stooling crowns with the bud areas very near the surface, exposed to winter freezing, thawing and drying out. Hence, there is a decided relation between the TYPE OF THE CROWN and its tendency to winter-kill.

The stooling traits of the hardy strains are shown in the early seedling stage. This is illustrated in Plates 11 and 12. Plate No. 11 shows some seedlings of Grimm's alfalfa only six weeks from seed. Plate No. 12 shows some ordinary Spanish alfalfa the same age. Both lots were taken at the same time and under the same conditions in the field. The heavy stooling habit of the Grimm's alfalfa is very evident. The significant value of this trait can hardly be overestimated. It not only affords immunity from winter losses, but the protected underground buds are less liable to injuries from over-pasturing or attacks from grasshoppers. The spreading crown seems to be associated with a very much branched surface root system, in addition to the deep tap root. This growth habit makes surface moisture easily available. Hence, it is not surprising that the Grimm's and Baltic alfalfa should have proven to be the best type for dry conditions. This is confirmed by the dry land tests.

The Grimm's and Baltic strains of alfalfa have revealed the most promising traits in the Colorado tests, but the Baltic seems to be in the lead in seed production and slightly in the lead in hay yields. Apparently there is little difference except in seed yield, yet there are contrasts in the relative merits of different selections which are

evidently transmitted. Hence, the strains of alfalfa can be made more uniform through seed selection. This is illustrated in Plates Nos. 13 and 14, which are sections from the same nursery. Plate No. 13 is a row sown with seed from selections for three generations. The plants are all desirable and relatively uniform. Plate No. 14 is another row seeded with commercial seed. It shows four markedly irregular types of plants, none of which are especially desirable. Thus the results of systematic seed selection have been very encouraging.

The conclusion is: That a hardy, desirable hay producing alfalfa, with good seed yielding tendencies, is within easy reach by means of systematic seed breeding.



A six months' old Grimm's alfalfa plant. The underground shoots three inches below the surface.