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Alfalfa Seed Production

(A Progress Report)

By PHILO K. BLINN

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Alfalfa Seed Production.

(A Progress Report)

Philo K. Blinn

Alfalfa is indispensable to the farmers of the western states for hay production and for keeping up soil fertility in their crop rotations. The area in alfalfa is rapidly increasing in many of the eastern states. Consequently, there is a large demand for alfalfa seed for sowing new fields, and each year the supply of desirable seed seems to be more limited.

Considerable imported seed has been used in recent years, but with rather irregular success. Some lots of seed proved to be good, while others seemingly of different strains have not given satisfaction. In the absence of any pure seed regulations there seems to be no way of identifying the best strains of alfalfa seed on the open markets. Consequently, many of the farmers are preferring to sow home grown seed when it is possible to secure it, claiming better and more uniform results.

It has become well established that some strains of alfalfa are superior to others, especially for some localities. It seems important that there should be developed an alfalfa seed growing industry to furnish a more dependable "home grown" supply of the best strains of alfalfa seed.

Fifteen or twenty years ago, certain districts in Colorado were producing considerable alfalfa seed, even exporting some. Recently the same sections are growing barely enough seed for local demands.

During the early years of alfalfa seed growing in these districts, yields of seed varying from five to ten bushels per acre were quite common. Now it is seldom that a grower can secure a yield of more than three to four bushels of seed per acre. This is especially true on some of the best irrigated land. Such yields are not inducement enough for a farmer on high priced land to leave a crop of alfalfa to mature for seed.

The question as to why alfalfa is failing to produce seed as abundantly as it did in former years, has caused the Experiment Station to devote special attention to the problem. The solution has not been fully reached. But some results of value may be reported at this time.

Factors That Influence Seed Production

Influence of Vegetative Growth.—It is a recognized law of plant life that where plants are forced for vegetative growth, there is a tendency to weaken seed production. Many of our cultivated flowering plants are notable examples where the continued forcing for flowers and foliage, without regard to seed production, has resulted in the total loss of the power of such plants to produce seed. This is not only

true of our cultivated flowering plants, but our field crops will act in the same way if handled in the same manner. For instance, the potato, which has been grown for tubers almost indefinitely, produces varieties that fail to set seed balls, which are the true seed of the potato. We have varieties of alfalfa that are non-seed-producing. In fact, many plants have been found in our investigations that even fail to produce flowers, simply forming a modified growth without the functional organs of reproduction where the flowers should develop. Of course such variations disappear sooner or later unless propagated by vegetative cuttings. Since alfalfa is commercially propagated by seed, sterile plants do not originate seedless varieties. Only seed bearing plants are propagated.

Influence of Moisture Supply.—It is the common experience of every farmer who grows alfalfa, that the conditions which make for the best yields of hay, are not conducive to seed production. The heaviest yields of seed have been secured where the plants have seemed to make a rather dwarfed growth, due to the lack of moisture or some other condition adverse to the rapid development of forage. These plants evidently had sufficient moisture at the right time to set and fill the seed, for without any moisture the seed will "blast" and fail to fill. If too much water is applied the seed fails to set apparently due to the luxuriant growth of forage that follows. It seems fair to conclude that the regulation of moisture at the right time and in the right amount is one of the important factors that influences the production of alfalfa seed. It seems almost impossible to formulate a rule to fit all conditions of farms, subsoils and seasons. In one case, three to four irrgations were found necessary to produce seed on a field of heavy adobe that would not absorb moisture easily. While on a lighter loamy soil, one irrigation would induce so rank a growth of hay that the crop was a failure.

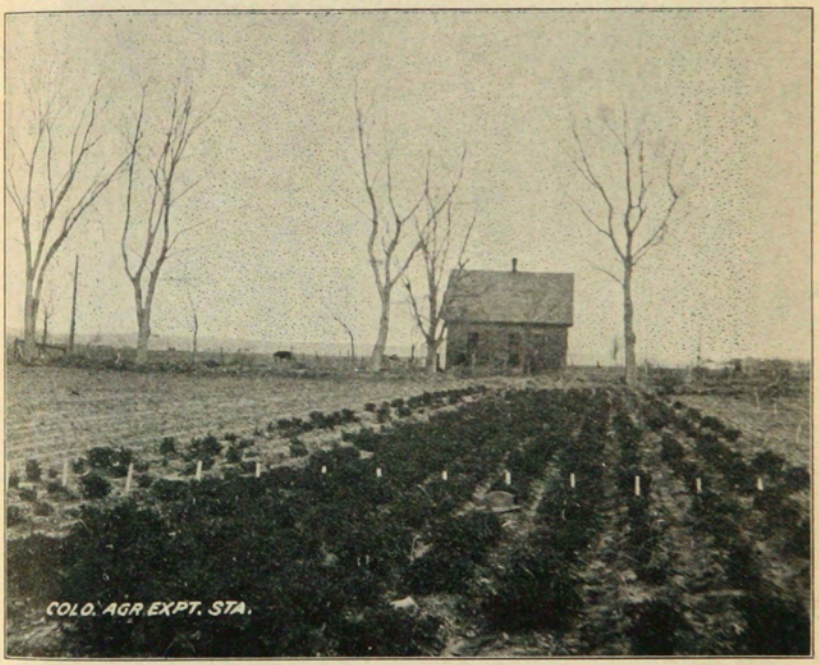
Climatic Conditions and Other Influences.—Aside from the influence of vegetative growth and the moisture supply, there are the effects of climatic conditions and seasonal changes. Injurious insects sects and plant diseases greatly modify the results in alfalfa seed production. But these do not seem to explain why the yields of seed have decreased from former times. There is no perceptible climatic change, nor direct evidence to show that insects or diseases are responsible as a general cause.

CONDITIONS THAT HAVE CHANGED

In canvassing the conditions that may have influenced alfalfa seed production, we find that the question of subsoil moisture is decidedly changed to what it was in the early days of alfalfa seed growing.

Most of the land in Colorado, before being irrigated, had dry subsoil to almost indefinite depths, but after the land had been irrigated for a number of years, an underground water table was established at varying depths from the surface according to the character of the soil formation. When alfalfa was first sown on land that had never been

irrigated it required considerable water to produce a maximum crop of hay. It was principally during this period of time before the subsoil became filled with moisture, that the good yields of alfalfa seed were secured. When the subsoil was dry the growth of alfalfa was retarded and the conditions were more favorable for seed production. Numbers of farmers have related practically the same experience,—where certain fields had produced alfalfa seed very successfully, until a ditch or irrigation on higher ground caused a water table to form under the land, after which the fields no longer produced seed satisfactorily, but they continued to grow forage more luxuriantly than ever. The conclusion seems evident, that too much moisture in the subsoil or con-



No. 1.—The first selections of alfalfa to increase seed production one year from date of seeding; four rows to the left, grown from seed selected from heavy seed producing plants; the six rows in the center sown at the same time, Turkestan alfalfa, commercial seed.

ditions resulting from long continued irrigation are the causes of the decreased yields of alfalfa seed on the well irrigated land. The attempt to regulate moisture supply for seed production on such land has become fruitless because of the lost control in an over supply of subsoil moisture. The uncertain elements of drainage and capillary action in different soils under different conditions make it impossible to depend on results.

TESTS AND EXPERIMENTS

Seed Selection.—One of the first points to attract attention on investigating alfalfa seed production was the fact that there were individual plants that bore seed heavily in fields where most of the plants were failing to form seed. It seemed that if selections of seed from these well filled plants were made, that immediate results would follow by establishing a new strain of seed-producing alfalfa.

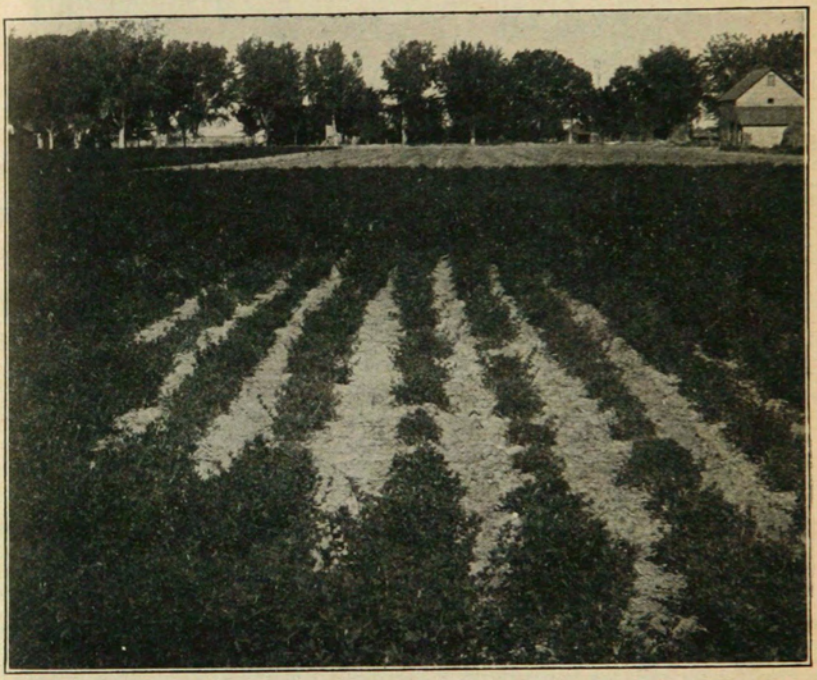
Selections of this kind were made in 1904. The results, however, were disappointing, owing to the fact that the selections were made from some ordinary alfalfa which afterwards proved to be much inferior in point of forage production as compared to other strains which were tested with these selections. Plate No. 1, is a view of this first test. The four rows to the left in the picture are the progenies of these first selections; the six rows in the center were Choice Turkestan plants. Owing to this unfavorable comparison the selections were abandoned for more promising ones that were subsequently made from a larger comparative test of sixty-four different strains of alfalfa from the different sections of the world secured from the U. S. Department of Agriculture. These varieties were sown in adjacent plats and all received the same care and were under the same conditions as nearly as possible. Each plat was thinned to single plants in order to observe the characteristic traits of the different individual plants and types.

The results of this comparative test have been interesting and valuable. It was shown that there are other contrasts of qualities in alfalfa that are more valuable than mere seed production. For instance, the important questions of hardiness, disease-resistance, and the quality and quantity of forage produced, are points that are fundamentally important in seed selection. Hence our efforts have since been directed towards developing and establishing a type of alfalfa that will combine all the desirable traits as far as possible. The results have been encouraging. Plants have been found among the best hay types that produced as high as two ounces of seed per plant.

Systematic seed selection has proved to be efficient in establishing greater uniformity in the types and qualities desired in alfalfa. The leaf characters, the stooling habits, and the flower colors have been reproduced true to type in the progenies of many of our selections. The seed producing traits of different plants in almost every strain tested, have shown inherent tendencies, which clearly indicate that seed selection will be one of the important factors in improving the production of alfalfa seed. It has been found possible to produce seed from good hay types if the proper cultural conditions are supplied. The results of a great number of selections that have been made during the past eight years have demonstrated that under favorable conditions of growth, the best types of alfalfa for forage are not inclined to produce much seed, and that the best seed yielding plants are not as a rule the best types for hay production. In other words, a strong

inherent forage producing tendency in alfalfa has much the same relation to seed yields as an exceptionally favorable growing condition. Thus it is thought that the best types of alfalfa should be developed by systematic selection and breeding. Then, the seed for commercial seeding should be produced where the conditions of growth can be regulated to some extent, either by natural conditions favoring the production of seed, or by artificial methods of controlling the growth of the forage.

Moisture Requirements for Seed Production.—The amount of moisture in the soil best suited to seed yields has not been determined in unit terms of any kind. In fact the results of observations on this point are rather conflicting.

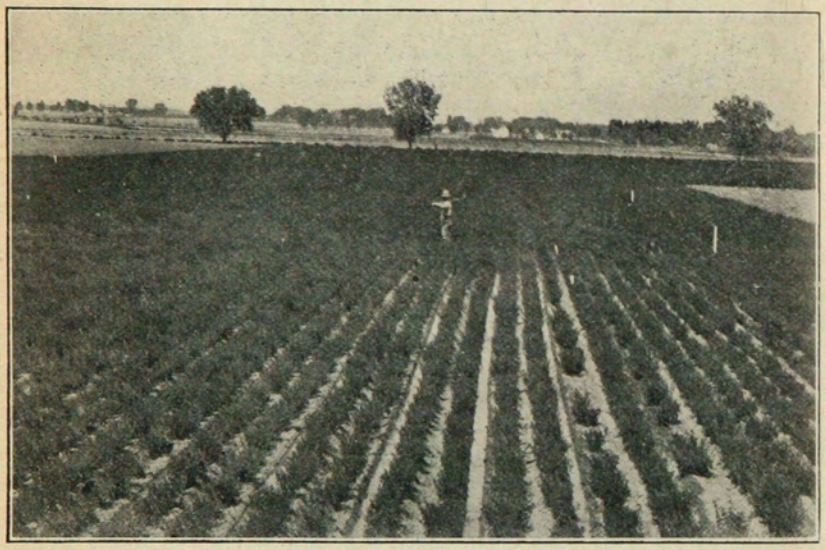


No. 2.—A dry spot in an alfalfa field where irrigation was witheheld two seasons, to test seed production. The dry spot was caused by a gravel layer eight feet below the surface; balance of field growing rank with the subsoil moisture.

It is usually conceded that a heavy, dashing rain when the alfalfa is in full bloom is injurious to the seed prospects, as the flowers that are out at the time usually fail to form seed. Yet there are numerous experiences which seem to indicate that a light irrigation when the field is just passing out of full bloom is often beneficial to the seed crop. Again it has been noted that alfalfa on ditch banks, where there is a continual supply of moisture, has some times set well with seed; while in fields that have plenty of subsoil moisture, growing

good crops without irrigation, will not form seed satisfactorily. Hence it is difficult to draw conclusions. But there is ample evidence to show that *how, when,* and *where* moisture is supplied has something to do with the question as well as the *amount* of water.

Plate No. 2, is a view of a dry spot in a field of alfalfa planted in rows where irrigation has been withheld for two years to test seed production. The soil is a deep sandy loam, sixteen feet to the water table, and the alfalfa in this field grew rank with no apparent need of irrigation except in some dry spots. Here it seemed possible for one to find the proper amount of moisture required to form seed, for somewhere between the dried up center of this spot and the rank growing portion of the field there should have been a point that had the proper moisture to set seed. Such was not the case as there was practically no difference in the seed yield. The whole field failed to set seed satisfactorily.



No. 3.—An alfalfa nursery, each row a different strain, irrigation withheld for over a year; in the forground, plants showing need of moisture, distant ends of the rows not needing moisture owing to the capillary moisture in the subsoil; water being applied to the dry portion in every other row to test results of light surface irrigations.

A test hole with a soil auger proved that the cause of the dry spots was due to a gravel stratum eight feet below the surface which cut off capillary moisture. The rest of the field had twelve feet of moist soil.

Plate No. 3, is a view of one of the nursery plats at Rocky Ford which has been held without irrigation for over a year. The lower

half of the rows are suffering for the need of moisture, while in the upper half the rows can hardly be distinguished, due to the rank growth resulting from the subsoil moisture.

The dry portion of this nursery has been divided into three different parts, each portion to be irrigated with a different amount of moisture.

Before irrigating, moisture determinations were made for each foot in depth in the moist, and dry portions of the plat, with the following results of moisture percentages based on the dried soil samples:

AMOUNTS OF MOISTURE IN MOIST AND DRY PARTS OF ALFALFA PLAT.

	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Moist part....	7.9	7.5	6.1	5.1	5.3	6.0	7.0	7.6	10.3	11.8
Dry part.....	5.3	4.5	3.9	3.8	4.1	5.0	5.5	5.6	5.1	7.7

Gravel was encountered at ten feet under the dry portion, and was not encountered under the moist part of the plat.

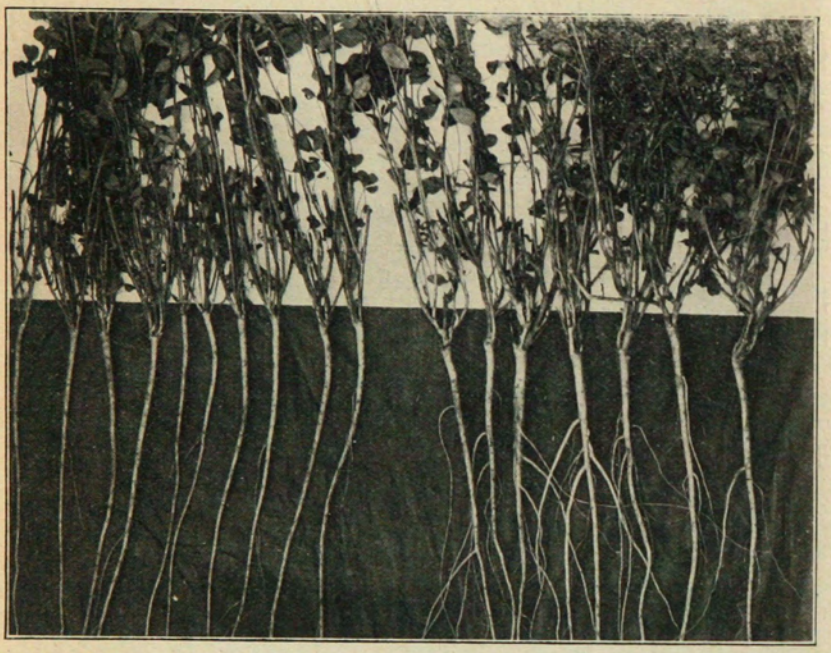
It will be observed that in both portions of this plat the soil is driest from three to six feet in depth. It is evident that the plants have made their growth from the precipitation at the surface, and from the deep subsoil moisture through their long roots that were developed when irrigation kept the whole subsoil moist, as rootlets were encountered to the depth of ten feet. More extended investigations will be necessary before drawing definite conclusions. But these tests suggest two reasons why alfalfa growing on deep subsoil moisture might fail to set seed well. First, when the plants are in full bloom and forming seed there is an extra demand for moisture that may not be supplied fast enough through the long roots passing through the dry surface soil, consequently the flowers "blast". Second, owing to the fact that the plants are deriving most of their nourishment from the deep soil areas, it may be that the failure to set seed is due to the availability of food constituents in the subsoil or to the absence of some constituent.

CONTROLLING MOISTURE FOR SEED PRODUCTION.

The usual attempts to regulate moisture for seed production are fruitless of results because the ordinary methods of growing alfalfa for hay are inadequate for the purpose of seed production.

Thick Seeding.—The method of seeding alfalfa thickly, either by drilling or broadcasting, is admirably suited to the production of fine hay, but is not suitable for the production of seed. The stems growing thickly, fine and succulent are more likely to "lodge" with wind or rain, and the flowers are borne principally on the tips of the plants due to the overcrowding. In a very thin stand of alfalfa the stems grow more branched and stocky, the flowers are produced in greater profusion over the whole plant and are more inclined to set seed.

Irrigation by Flooding.—The general practice of irrigating alfalfa by surface flooding, has succeeded well in growing hay, but the tendency is generally towards getting the soil too wet for good results for seed production. Where land has been flooded for a number of years the soil becomes compacted, and will crack, and dry very rapidly. If irrigated it easily becomes too wet, making it next to impossible to regulate the moisture conditions suitably for seed production where land is flooded.



No. 4.—A contrast between the root development of alfalfa in a thick stand irrigated by surface flooding shown in the left; and plants of the same variety sown the same time in rows twenty inches apart, cultivated and irrigated in furrows, as shown in the plants on the right.

Combining Hay and Seed Production.—Experience has shown that it is not practical to combine the production of hay and seed from the same field, because of the different moisture requirements for each. The success of the hay crop almost precludes the chance of the success of the other. Yet, there is usually a light growth of hay in connection with alfalfa seed growing, as the season in Colorado is not long enough to mature two crops of seed in one year.

ALFALFA IN ROWS FOR SEED PRODUCTION

Growing alfalfa in rows with intertillage, for seed production, is not a new idea, but it is practically new in Colorado. Until the Ex-

periment Station advocated the method as a means of regulating the moisture supply for seed production, there was little sown in rows outside of the experimental plats. The advantages of this method for conserving moisture, and controlling the application of light irrigations are obvious. Many farmers who are interested in alfalfa seed growing have seeded large fields in rows during the past two years, with a view of producing seed.

It is too early yet, to make reports of results, for it is very evident that there will be much to be learned, in regard to the cultural care, the amount of irrigation, how, and when to apply the water for the best results. The application of this information to the different soils on different farms in different seasons, will need to be worked out more fully.

No. 5.—A view of alfalfa nursery, each row a different strain; the large row in the center with large crowns, is Grimm's alfalfa; note small crowns of South American strains on either side of the Grimm; all the same age, and had the same cultural care.

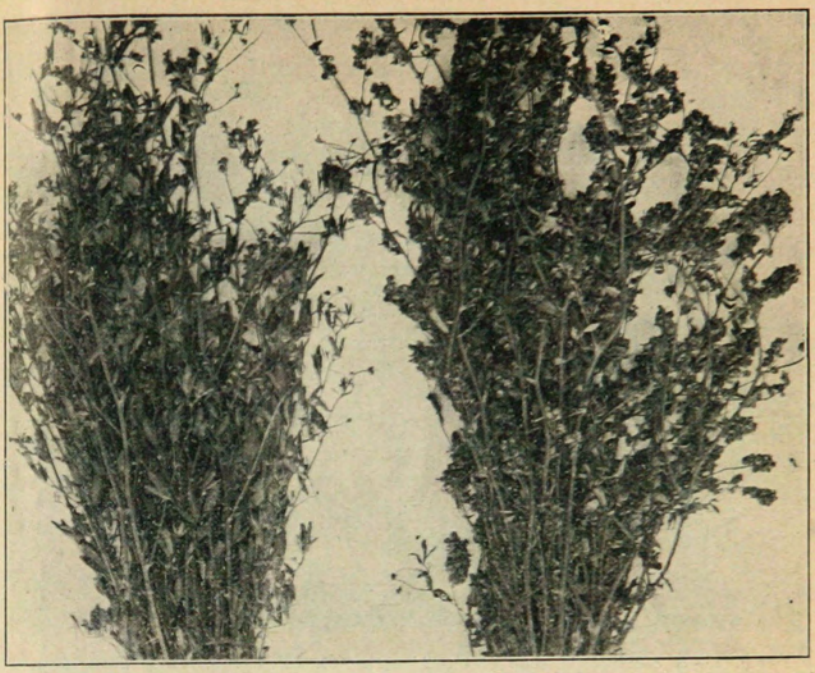
The Advantages of Alfalfa in Rows.—Having alfalfa in rows, permits thoro cultivation to kill weeds, destroy grasshoppers' eggs, and conserves monsture. It makes it possible to control light applications of water by irrigating in furrows. These can be made in every row, or every other row as is found necessary. By having these furrows "logged out" smoothly, a very light irrigation can be applied with little flooding or over soaking of the soil. By varying the distance between the rows, and the rate of seeding in the rows, it is possible

to establish a uniform, thin stand, which is essential to securing the stocky growth that is neccessary for good seed production. Growing alfalfa in rows with intertillage, induces more surface branching of the roots, which is desirable in dry land conditions, or where it is desirable to regulate the growth with surface moisture. Plate No. 4, shows the relative growth of side roots in alfalfa flooded, and that grown in cultivated rows.

No. 6.—A contrast in leaf color and size of two choice forage types from the Grimm row shown in Plate No. 5.

Objections to Alfalfa in Rows.—The difficulties in handling hay machinery on the rough furrows is the principle objection urged against alfalfa in rows, but by running the mower with the rows, or diagonally across the rows, this objection can be overcome. There is also a tendency for the loose soil in rowed alfalfa to wash out with heavy rains, but by selecting the proper field and running the rows on a slower grade, this difficulty can be obviated. If alfalfa in wide rows is left neglected it will become a veritable weed patch.

Distance Between Rows.—The proper distance to seed alfalfa in rows for seed production has not been fully established. In fact there will probably be no set rule, as the distance will vary according to the location, the supply of moisture, and the nature of the soil.

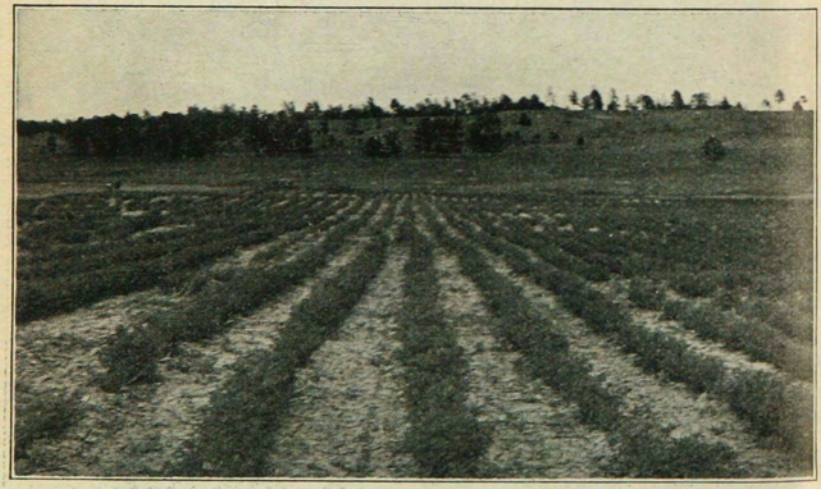


No. 7.—A contrast of inherent seed setting traits of two adjacent plants.

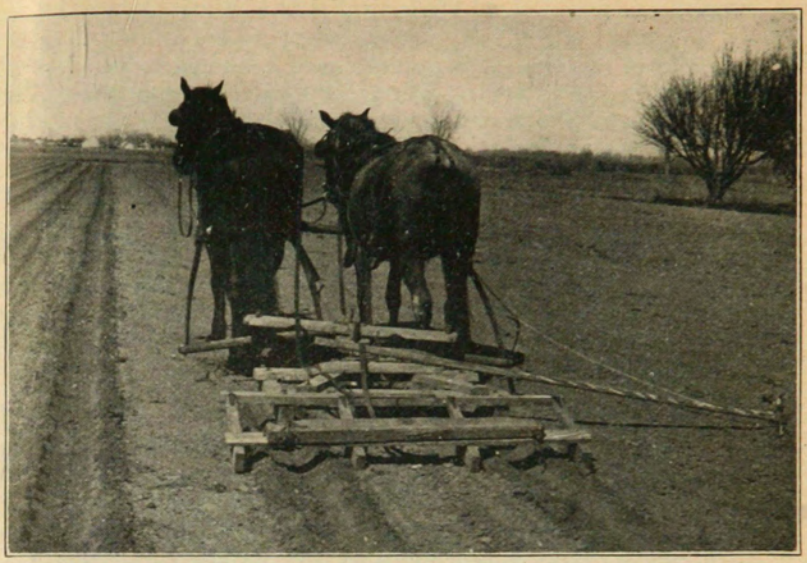
No. 10.—A field of Grimm alfalfa sown in twenty-inch rows, under irrigated conditions, seeded at rate of four pounds per acre. Photo taken May 8, 1912.

No. 8.—A contrast, in time of blooming, a trait valuable for early honey flow, and possibly in seed production.

Under Irrigation.—The twenty inch rows have been used because the same tools used in sugar beet culture, were convenient to use in alfalfa. It has become evident that even at twenty inches apart in rows,

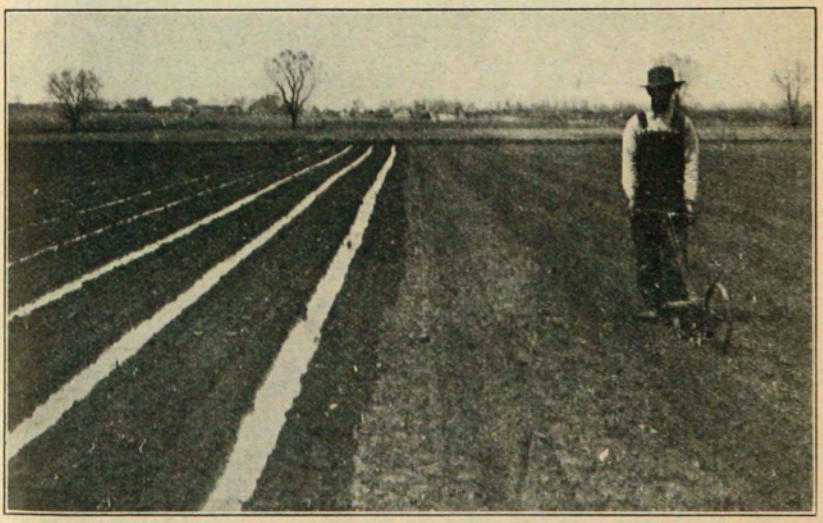


No. 9.—A view of the poorest portion of twelve acres of Grimm alfalfa sown in forty-two inch rows at Eastonville, Colo., under dry-land conditions, altitude 7200 feet, taken June 13, 1912, one year after seeding, rate of seeding two pounds per acre.



No. 11.—A marking and logging out device for seeding and irrigating alfalfa in rows, to prevent surface flooding of the soil.

alfalfa should be seeded very thinly, for the best results in seed production. It is difficult to seed uniformly in rows with much less than two pounds of seed per acre for rows 20 inches apart.



No. 12.—Drilling alfalfa nursery in twenty inch rows, and irrigating in logged out furrows, between every other row; note moisture "subbing" entirely across the space between the forty inch furrows without any flooding.

Alfalfa on Dry Land.—Under dry land conditions experience has shown that thirty-six to forty-two inches apart is required for alfalfa in rows, for in this case, it is a question of a limited moisture supply, where the success of the crop will depend on conserving the moisture by cultivation and limitating the number of plants to draw upon it.

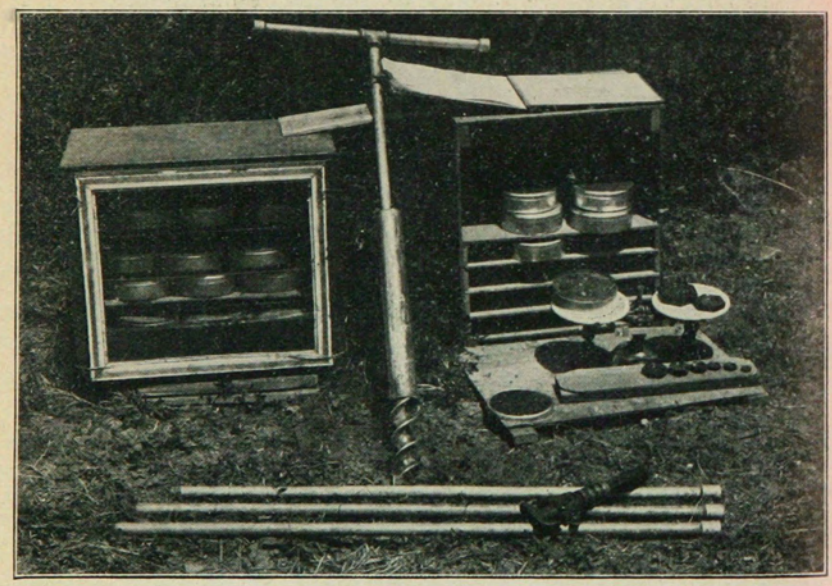
A thoro preparation of the soil by deep tillage for one or two years previous to starting alfalfa on dry land is necessary to establish moisture in the subsoil. Then it is essential to start with a thin stand of plants, keep these clean of weeds, and hold all moisture possible by cultivation to insure the alfalfa living over the dry seasons.

Alfalfa seed growing on dry land is partly in the experimental stage. Results have been secured that will warrant the prediction that some of the dry land sections will be devoted to alfalfa seed growing, when the different soil conditions are understood, and the cultural requirements are carried out.

CONCLUSIONS.

The results of the investigation in alfalfa seed production indicate that alfalfa seed yields can be improved by systematic seed selection to develop the inherent traits of seed production in the desirable types; by selecting fields that are adapted to growing alfalfa seed which are not over soaked with subsoil moisture; by seeding thinly in rows to secure a stocky growth and permit intertillage; and by regulating the moisture supply with cultivation and light furrow irrigation to control vegetative growth.

May 29, 1913.



No. 14.—Apparatus for determining soil moisture; a 12 foot jointed soil auger with sleeve to follow the auger bit to remove soil easily; a set of trip scales with tin boxes for samples; a sheet-iron stove-oven for drying samples; a glass door for the oven when set in strong sunshine will heat soil samples 110 to 125 degrees; sufficient to dry samples in three days to air dry samples.