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OBSERVATIONS ON ALFALFA.

By E. H. JENKINS.

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# OBSERVATIONS ON ALFALFA.

BY E. H. JENKINS

It is the purpose of this bulletin to describe a single experience with alfalfa during four years, in one of which there was severe drought and in another a winter which was very destructive to alfalfa and clover, and to give accurately determined instead of estimated yields, along with some pertinent chemical data and conclusions.

The rules regarding fitting, fertilizing and seeding land for this crop are so often given in published matter and in farmers' meetings that they need not be rehearsed here.

The value of the crop for hay and for soiling is generally understood. Its value when cut into the silo mixed with corn is somewhat in debate. That cattle will greedily eat such silage and thrive on it is admitted. But as to its odor and effect on the flavor of milk, the olfactory sense of alfalfa enthusiasts seems to give a rather different verdict from that of some dairymen.

How it can be used profitably for pasture is still undetermined.

That it can be grown on many soils in the State is certain; that it and clover furnish the means of reducing grain bills seems clear. Neither of these two crops can be said to be everywhere and always the better suited for this purpose.

It must be determined for each farm separately according to the special conditions whether clover in rotation or alfalfa grown five years or more without reseeded pays best.

The difficulty of curing alfalfa for hay in "catching" weather has been often discussed. Of course great damage may be done to any hay crop if the season is very unfavorable. But we have found no great trouble of this kind in the last four years, curing it mostly in cocks protected by light caps in rainy weather. Water-proof or nearly water-proof caps are worse than none. We find it somewhat easier to cure than clover.

## PREPARATION OF LAND AND PLANTING.

The land, a part of the Mount Carmel field, was a rather sandy loam and a neglected pasture.

The herbage was chiefly poverty grass (*Andropogon scoparius*) and did not pay to cut for hay.

It was plowed in the spring of 1912. To one-half of the plot ground limestone was applied at the rate of four tons to the acre. After thorough disking, the whole field received basic phosphate and muriate of potash at the rate of 500 and 200 pounds per acre respectively.

It was cultivated three times to kill weeds and hold moisture.

In the middle of August it was divided into six plots, each about one-ninth of an acre, and each plot was seeded with one of the varieties of alfalfa named below. Five hundred pounds per acre of soil from an old alfalfa field were broadcast with the seed, which was used at the rate of thirty pounds per acre.

The seed was kindly supplied by the United States Bureau of Plant Industry, through Mr. R. A. Oakley, agronomist.\*

The varieties were:

Grimm, No. 29988, from a forty-year old field, supplied by A. B. Lyman, Excelsior, Minn.

Sand Lucerne, No. 34108, from Nungesser-Dickinson Seed Co., New York City.

Kansas-grown, No. 33710, from Barteldes Seed Co., Lawrence, Kans.

Provence, No. 28094, from Nungesser Seed Co.

Utah-grown, No. 21829, grown in Sevier Valley near Oasis, Utah, from O. S. Bliss.

Turkestan, No. 24353, bought from José D. Husbands, Chile, imported from Switzerland.

All varieties came through the winter of 1912-13 with no trace of winter-killing and made a good start in spring.

When six inches high, the unlimed half of each plot looked uneven, some bunches having a good color and others looking yellow.

Before cutting, daisies were abundant over the whole, but were thicker on the unlimed part.

Early in June, leaf-spot appeared and very badly damaged the crop over the whole field. Sand Lucerne and Turkestan suffered most, particularly on the limed part.

\* Farmers' Bull. 757 issued by the U. S. Dept. of Agriculture contains a discussion and history of these and other alfalfa varieties.

## THE COURSE OF THE EXPERIMENT.

The crop was cut June 16th and was very small, both on account of the leaf-spot and the dry season.

On June 20th, anticipating rain, acid phosphate at the rate of 515 pounds per acre and muriate of potash at the rate of 221 pounds were broadcast over the whole piece.

No rain followed, the drought was severe until the end of August, and the alfalfa made no growth and blossomed when only four inches high. On the day of the field meeting, August 15th, it appeared to be about dead.

After abundant rain late in August vigorous growth began again and the field went into the winter looking very well, except that long-leaved plantain had become abundant.

In January, 1914, limestone at the rate of 5,900 pounds per acre was broadcast over the limed portion of the field.

The winter of 1913-14 was particularly severe in its effects on clover and alfalfa, and growers in this State as well as in Massachusetts and Rhode Island suffered very heavy losses. A Connecticut grower reported that he had sixty acres of alfalfa in the fall of 1913; ten acres seeded in that year and the rest from three to five years old. All the new seedings and about half of the older alfalfa were winter-killed. He had one-eighth of an acre of Grimm, which suffered no damage, while another variety seeded at the same time suffered a twenty-five per cent damage.

Neither the Grimm nor the Turkestan variety suffered any damage on the limed part of our field. Sand Lucerne and Provence suffered slightly. The Utah and Kansas varieties suffered most.

Three cuttings were made in each of the following years: 1914, 1915 and 1916. In these years nothing was done to any of the plots except to cut the crops.

## THE EFFECT OF LIMING.

In the first year, 1913, the yield per acre of the limed plots was 2.26 tons, and of the unlimed plots 2.04 tons or 90.3 per cent of the yield from limed plots.

In 1914 the average yield from the limed plots was 4.47 tons per acre; from the unlimed 2.6 tons, or 58.1 per cent of the crop from the limed plots.

It is unnecessary to give the comparison for the other years. Where no lime was applied grass and weeds make up a considerable part of the crop, which is in all cases much smaller than that from the limed part. This is only another demonstration of the well-known necessity of liming land very heavily where alfalfa is to be grown.

#### THE AVERAGE YIELD OF ALFALFA.

The crops here reported will be regarded by alfalfa enthusiasts as very moderate. They show what may be expected for a term of four years on land not in good "condition," and the yield in every case was accurately weighed and not estimated.

The following weights in tons per acre were obtained in the three cuttings (only one cutting in 1913) *from the limed plots.*

*Yield of Alfalfa in Tons of Hay per Acre.*

	1913	1914	1915	1916	Average of 4 years
Grimm .....	2.73	5.93	4.65	4.26	4.39
Sand Lucerne .....	2.06	4.69	3.93	4.35	3.76
Kansas .....	2.56	4.46	4.38	4.29	3.92
Provence .....	2.29	4.47	4.42	4.20	3.84
Utah .....	2.15	3.41	4.26	4.79	3.65
Turkestan .....	1.79	3.88	3.67	4.25	3.40
<b>Average</b> .....	<b>2.26</b>	<b>4.47</b>	<b>4.22</b>	<b>4.36</b>	<b>3.83</b>

The largest yield in any one year was 5.93 tons. The largest average yield for four years was 4.39 tons, and the average yield of all six varieties for four years was 3.83 tons.

Excluding the first year, when there was only one cutting because of severe drought and when that cutting was considerably reduced by leaf-spot, the average yield for three years is 4.35 tons of hay, or about 13 tons of green forage.

As bearing on the yield which may be expected from this crop under more favorable conditions as to preparation of land, the following yields from another field have interest. This field, lying within a few rods of the one above described, had borne three successive crops of wheat and in 1914 was heavily limed, carefully fitted and well inoculated. Its preparation was considered to be nearly perfect.

A comparison of yields is as follows:

	Old Field	1914 Field
20 lbs. seed, average of all varieties, 1915 .....	4.22	5.27
20 lbs. seed, average of all varieties, 1916 .....	4.36	4.16
20 lbs. seed, average of the 2 years .....	4.29	4.72
Highest yield in 1915 .....	4.65	6.3
Highest yield in 1916 .....	4.79	4.5

#### COMPARISON OF YIELDS FROM THE THREE CUTTINGS.

The first cutting of each variety and in every year was much larger than the second or third.

In 1915 the third cutting was considerably larger than the second in five of the six varieties, but in the other years the second was larger than the third.

Averaging all varieties for the three years, 55 per cent of the year's crop was in the first cutting, 27 per cent in the second, and 18 per cent in the third.

A single year's weighings of a crop grown by Mr. C. M. Jarvis yielded 58 per cent in the first cutting, 17 per cent in the second and 25 per cent in the third. The first cutting, however, was much drier than the others and so carried a larger portion of the dry matter than is indicated by the figures given.

It is evident that the relative amounts of the second and third cuttings will be greatly influenced by temperature and rainfall during the summer.

#### COMPARISON OF VARIETIES.

Since there is no proof that the soil on which these varieties grew had the same productive capacity—although there is nothing to indicate that this is not the case—any strict comparison of the varieties is inadvisable. Moreover, the hay on none of the plots is pure alfalfa. On all there is more or less grass and weeds, and the proportion of these foreign things cannot readily be accurately determined. It is proposed to analyze the crops next year and from their composition to estimate their *relative* yield of alfalfa.

For three years the Grimm variety gave the highest yield, while in the fourth year two varieties (Sand Lucerne and Utah) surpassed it in total yield.

## WHAT DID IT COST?

Only an approximation of the cost is possible, because most of the operations of fertilizing the plots and of harvesting had to be done with full regard to the twelve separate plots and their yields. It involved the separate handling of twelve small one-ninth acre fields lying close together. Such *extra* costs are not included in the account.

The following are the actual expenses per acre:

*Determined*

Plowing .....	\$ 4.50
Disking and cultivating 3 times .....	10.00
Limestone, 6.95 tons @ \$3.40 .....	23.63
Basic phosphate @ \$15 .....	3.75
Acid phosphate @ \$12 .....	3.09
Muriate of potash @ \$42.50 .....	8.94
	<hr/>
	\$53.91

*Estimated*

*Seeding and inoculating, spreading fertilizers ...	\$10.00
Cutting, curing and hauling crop, 4 tons per year	
for four years, @ \$2.00 per ton† .....	32.00
	<hr/>
	\$95.91

This amounts to \$5.99 per ton as the approximate cost of producing alfalfa, taking no account of use of land and depreciation of plant and equipment.

The prices of fertilizers and labor, except in harvesting the 1915 and 1916 crops, are peace prices.

That the above estimate of cost is not very far from the actual is made quite probable by the following:

The New Jersey Station (Report for 1909, page 51) determined the cost of preparing, fertilizing and seeding a seven-acre alfalfa field and distributed this over a period of five years, the average cutting period of this crop.

The actual cost of harvesting and fertilizing for each year was also proportioned and charged to each crop. The results

\* Team and two men for about 1½ days.

† Above expenses amount to \$3.99 per ton. New Jersey calls the total cost \$5.34. This would leave in our case \$1.35 per ton for harvest. On account of higher cost of labor I add about 50 per cent.

are given below, with those for mixed hay for a three-year period, which furnish an interesting comparison.

	Alfalfa.	Mixed Hay.
Yield, tons per acre .....	4.42	2.63
Cost per ton .....	\$5.34	\$4.82

#### WHAT HAS THE ALFALFA CROP YIELDED IN FEED?

No analyses of these crops have been made, but an analysis made some years ago of a crop carefully weighed and sampled by us gave the following figures (not very different from published average figures) calculated on a yield of four tons per acre in three cuttings. For comparison, average figures are given for clover and meadow hay.

	In 4 tons alfalfa.	In 3 tons of red clover.	In 3 tons of meadow hay.
Mineral matter .....	576	570	318
Protein .....	1097	906	474
Fiber .....	1893	1446	1668
Nitrogen-free extract .....	2605	2076	2568
Fat .....	139	102	132

The significance of these figures lies not chiefly in the larger gross yield of the alfalfa crop but in the one particular of larger yield of protein.

The "grain bill" always, and never so much as now, is a large factor in cutting down, or out, the profit in dairy farming.

The "concentrates," like cottonseed and linseed meals, gluten meal and feed, etc., which contain high percentages of protein, are used chiefly to "balance the ration;" i. e., to put a larger proportion of protein into the ration than it would otherwise contain.

They serve, to be sure, other important uses,—for example, to furnish variety and palatability in the ration and to regulate the action of the digestive tract and a moderate use of some of them will probably always be desirable. But effort should be made to eliminate, as far as can profitably be done, the need of them simply for protein supply.

These high-protein feeds are, in normal times, the most expensive, and no seed can be profitably grown in Connecticut which in its natural state contains nearly as much protein.

It seems necessary to say here that the word "protein," as generally used in discussion of farm feeds, may include nitrogenous matters of various composition which are not true proteins. These non-protein bodies are much more abundant in roughage than in seeds or "concentrates" made from them, and their feeding value has not yet been fully determined.

Hart and Humphrey, however (Jour. Biolog. Chem., XIX, p. 140), have found in several experiments that the nitrogen of alfalfa hay is as effective for the production of protein in milk as is that of corn meal.

The very elaborate and painstaking work done for many years past by Dr. Osborne at this Station has shown that the true proteins, of which there are many, differ in proximate composition, in reactions and—because of these differences—in feeding value. This difference in feeding value he has directly and abundantly proved by tests with animals.

If two feeds therefore contain equal amounts of digestible "protein," it does not follow by any means that they are of equal value either for growth or maintenance. Therefore in all comparisons of the protein content of feeds these things must be borne in mind.

Applying the average result of all tests of digestibility given by Henry (Feeds and Feeding) to the figures given above, it appears that a ton of meadow hay of the best quality may contain about 90 pounds of digestible protein, and a ton of alfalfa hay 194 pounds.

In the present state of our knowledge it is not too much to assume that the feeding of a ton of alfalfa hay supplies about 100 pounds of digestible protein more than a ton of meadow hay supplies, and thereby reduces the need for digestible protein in boughten feeds by approximately that amount.

Let us see what that would mean.

Cottonseed meal contains about 34.0 per cent of digestible protein. It would follow, then, that increasing the protein in "roughage" by substituting alfalfa hay entirely for meadow hay should decrease the need for protein in concentrates by about the equivalent of 294 pounds of cottonseed meal for every ton of alfalfa fed. These 294 pounds of cottonseed meal at present prices cost more than seven dollars.

In feeding, many other things than the chemical composition and digestibility of feeds must be considered. Hart and Humphrey found in two tests that when alfalfa was fed with nothing else except a small amount of starch it had a noticeable diuretic effect and reduced the milk yield—but not the milk pro-

tein. In ordinary practice, fed in conjunction with other feeds, we find no record of such an effect.

#### WHAT PLANT FOOD HAS THE ALFALFA CROP TAKEN FROM THE LAND?

The following figures give the facts from the sources just mentioned and are in pounds per acre:

	In 4 tons alfalfa hay.	In 3 tons clover hay.	In 3 tons meadow hay.
Nitrogen .....	181	133	80
Phosphoric acid .....	42	28	19
Potash .....	136	145	97

The nitrogen of the alfalfa and clover grown on other than land, rich in nitrogen comes largely—how largely one can do little more than guess—from the air, and does not deplete the soil. In meadow hay it has been almost entirely drawn from constituents of the soil and fertilizers.

#### CONCLUSION

Probably alfalfa cannot be used as the exclusive form of roughage for dairy cows; yet if fed with silage at the rate of ten pounds per day and head, taking the place of that amount of meadow hay, it will reduce the amount of digestible protein necessary to be added in the grain ration by about one-half pound per day and head.

Alfalfa, red clover and soy beans can all be grown successfully in any part of Connecticut. No one of them is adapted to all requirements.

Soy beans are an annual, can be planted as late as June first, either alone or with corn, and cut for soiling by the latter part of August or earlier:—a catch crop where winter grain or fall or spring seeding has failed.

Alfalfa, good for five years or more after seeding, is to be used on land not needed for rotations and lying perhaps at some distance from the manure pile and the center of farm work. It is a heavy yielder and a soil improver.

Red clover, practically a two-year crop, is suited for short rotations and is also a soil improver.

All three are rich in protein and make this protein in large measure from the air.

The Station has for some years demonstrated the value and uses of soy beans on its field at Mount Carmel, and in 1915 by the field tests of farmers in different parts of the State. Reference to this work is made in Bulletins 185 and 191. Both Stations are now continuing this work in coöperation with the Extension Service.

The value of red clover is more generally understood.

No dairy farmer in the State should neglect to study the uses which he can make, under his special farm conditions, of one or more of these crops. Directions regarding laying down land to alfalfa will be found in Joint Circular No. 3 of the Storrs Station and the Extension Service, and directions for planting soy beans will be found in the bulletins of this Station to which reference is made above.

We believe that the growing of one or more of these nitrogen-gathering, soil-improving, protein-producing crops is an essential in dairy farming.