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# Alfalfa

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—BY—

WM. P. HEADDEN

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# ALFALFA

(A SYNOPSIS OF BULLETIN NO. 35.)

BY WM. P. HEADDEN

Bulletin No. 35, issued in 1896, is still in constant demand. This bulletin consists of nearly 100 pages, and covers a large part of the matters relating to this valuable plant. Because of its size, however, and its not being indexed, it is difficult to find a fact or statement to which one may wish to refer. Further, because of the unusually large edition issued, and the cutting down of the mailing list made at the same time, there a large excess, of which a number still remains. A synopsis, such as is here given, will take the place of an index and will be useful both to those who already possess a copy of No. 35 and to those who may in the future receive one. This synopsis is therefore prepared as a supplement to bulletin No. 35. Owing to its size it is not likely that No. 35 will be re-issued, as bulletin 110, and this synopsis, will fill its place, so far as the demands of the general public are concerned.

Copies of the original bulletin may still be obtained on application.

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OBJECT AND SCOPE OF BULLETIN . . . . . 2

HISTORY OF ALFALFA . . . . . 2-4

Description of the plant; native place, probably Media, whence the name Medick; introduced into England 1650; cultivated by Greeks and Romans; culture has not been continuous in Italy; brought to South America by the Spanish; brought from Chili to California in early fifties; 1854; brought to Colorado in the early sixties, 1862-3(?).

CULTURE . . . . . 4-8

Methods in vogue essentially the same as have been in use for centuries. Methods differ slightly for different soils and climates. Cold, wet winters and poor drainage constitute bad conditions for cultivation of this plant. It is customary to sow with a protective crop.

*Seed.*—Screenings produce good stand of healthy plants, sufficient to produce maximum crop. Seed bed should be deeply prepared and plants receive abundant water during first season. Tap roots not always present. Transplanting has been practiced with good results. Three cuttings made in England and seven in Catalonia. Alfalfa yields better hay when sown broadcast than when sown in drills. Life of the plant is given as from two to fifty years. Alfalfa needs water to produce a crop. Its long roots may enable it to live without much water, but not to produce a good growth. Alfalfa does well in a wide range of soils; also of altitude.

VARIETIES . . . . . 8-9

Two varieties, at least, in alfalfa as grown in Colorado; one has red stem, small, dark green leaves and dark purple blossoms; the other has green stems, large and lighter green leaves, and lighter blossoms. The red stemmed plants are earlier and leafier than the green stemmed.

Three French varieties experimented with did not retain their distinctive features.

Turkestan alfalfa experimented with did not change its character.

There are but slight differences in the composition of e varieties.

COMPOSITION OF ALFALFA, HAY, LEAVES, STEMS, ETC. . . 9-32

Preparation of samples.

Samples dried in the air and at 100° show no difference in composition. It is not well to dry above 100°, page 9.

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Samples taken before bloom, beginning bloom, half bloom, full bloom, with seed formed and with mature seed.
Samples of flowers, leaves, stems, roots, etc.

*Proteids in Alfalfa at Different Periods of Growth and in Alfalfa Hays at Different Cuttings* . . . . . 10-11

The average percentage of proteids found in our laboratory samples, were: in first cutting alfalfa, about 14.0 per cent.; in the second cutting, 14.43 per cent.; in the third cutting, 13.05 per cent. In the farm samples, first cutting, 14.92 per cent.; second cutting, 13.99 per cent.; third cutting, 13.47 per cent.

*Analysis of Alfalfa Hay as Cut and of the Same Damaged by Rain* . . . . . 12

As cut, ash, 12.18; crude fat, 3.94; crude protein, 18.71; crude fibre, 26.46; nitrogen free extract, 38.71. Damaged by rain: Ash, 12.71; crude fat, 3.81; crude protein, 11.01; crude fibre, 38.83; nitrogen free extract, 33.64.
First cutting hay contains more proteids than second or third cutting.
Amount of proteids is nearly stationary from beginning to half bloom, and decreases after full bloom.

*Crude Fibre* . . . . . 13-16

Percentage of crude fibre varies a little, due to varieties; also to conditions of soil and moisture.
Percentage of crude fibre increases with age of plant, but is fairly constant from the period of early to full bloom.
Percentage of crude fibre in supposedly distinct varieties grown in drills was the same as in ordinary hays.
Percentage of crude fibre in second cutting hay is essentially the same as in the first cutting.
The percentage in third cutting varies more than in the others, but averages about the same.

*Fat or Ether Extract* . . . . . 16-17

The average percentage extracted is 1.539 per cent.

*Nitrogen Free Extract* . . . . . 17-19

Average percentages obtained from labratory samples were:
For first cutting hay ..... 31.69
For second cutting hay ..... 34.27
For third cutting hay ..... 32.72
Average percentages obtained from field samples were:
For first cutting hay ..... 34.35
For second cutting hay ..... 34.04
For third cutting hay ..... 34.74

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*Moisture in Air Dried Hay* . . . . . 18

The moisture in the laboratory samples averaged 6.03 per cent. the field sample, 7.09 per cent.; under ordinary Colorado conditions the average will not be far from 6.5 per cent. Air dry alfalfa hay under our usual conditions absorbs moisture rapidly. One ton of ordinary air dry hay will readily absorb 114 pounds of moisture during a damp spell.

*Ash or Mineral Constituents* . . . . . 19-21

The amount of ash present in alfalfa hay varies but slightly. The average for the first cutting is 9.08 per cent.; for second cutting 10.24, and for the third cutting 9.83 per cent. for our laboratory samples. The results for the field samples were a little higher, 11.19, 10.48, and 10.07 per cent. for the respective cuttings. These figures are for the pure ash. A five-ton crop of alfalfa removes about 1,025 pounds of ash or mineral matter.

*Water in Alfalfa* . . . . . 21-22

The average percentages of water in the first and second cuttings are 73.14 and 71.08. The water in the third cutting was not determined. Other determinations for the first and second cutting gave 74.76 per cent. for the former, and 72.80 per cent. for the latter. One hundred pounds of green alfalfa, first cutting, makes about 27 pounds of hay; and 100 pounds of second cutting makes about 29 pounds of hay.

*Amids, Amid Nitrogen* . . . . . 22-25

The amid nitrogen in the first cutting of alfalfa hay corresponds to 10.85 per cent. of the total crude proteids or albuminoids, and 19.93 per cent. of the total in the second cutting, while we found but 5.03 per cent for the third cutting.

Colorado samples differ greatly from Texas samples given in Texas Bulletin No. 20, 1892.

The amids probably reach their maximum at about the period of half bloom, as they begin to disappear as the plants go out of bloom.

The bloom itself is rich in amids (see p. 28 for analysis). About 20.28 per cent. of the total albuminoids being amids.

*Nitrogen as Nitric Acid* . . . . . 25

Nitrogen is not present in this form—the result of 18 tests.

PARTS OF THE PLANT . . . . . 25-32

***Stems p. 25.***—Average diameter, 0.17 of an inch; height five and one-half feet under favorable conditions. Proportion from 40 to 60 per cent. of the plant; the rest of the plant is represented

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essentially by the leaves. The fresh stems contain about 60 per cent. of their weight of water. The mechanical loss in making alfalfa hay is from 15 to 20 and even 66 per cent. Composition of alfalfa stems is that of a fairly good hay, p. 26. The amid nitrogen in the stems is very low.

*Leaves, p. 27.*—Alfalfa leaves affected by a fungus, p. 27. Fresh leaves contain 68.72 per cent. of water. The leaves are very rich in proteids up to half bloom, but are not so rich when past full bloom.

The amids in the leaves are high, about 15.65 per cent. of the total albuminoids.

The percentage of ash in the leaves is high, about 14.00 per cent.

A large percentage of the leaves is lost in hay making, (p. 26).

*Flowers, p. 28.*—The flowers are important as they indicate the turning point in the development of the plant. The fresh flowers contain 72.69 per cent. of water. The composition of the flowers is similar to that of the leaves.

*Analyses p. 28.*—The amids are more abundant in the flowers than in any other portion of the plant. The flowers are not sufficiently abundant to account for the large amount of proteids in the hay cut when the plants are in half bloom. The ether extract of the flowers is not very high and does not foreshadow the large amount of oil in the seed.

REVIEW OF QUESTIONS RELATING TO ALFALFA HAY MAKING . . . . . 29-32

The time of cutting; the influence of irrigation; the influence of growing on high and low lands; comparison of results obtained in Texas, New Jersey, and Colorado. The composition of the various cuttings shows but little variation.

Composition is not the only factor in making a good hay.

Analyses of alfalfa hays, laboratory samples, made from plants at different periods of development, grown without irrigation, on low land and on high land, p. 31.

Analyses of parts of the plant grown under same variety of conditions, p. 31.

Analyses of alfalfa hays, farm samples, p. 32.

ALFALFA AND CLOVER HAY COMPARED . . . . . 32-33

Analyses of clover and alfalfa hays, p. 32. Green alfalfa yields 2.5 per cent. more hay and contains about 7.00 per cent. more digestible food than clover.

ALFALFA, RED CLOVER AND PEA VINE ENSILAGE COMPARED . . . . . 33-34

The dry matter in alfalfa ensilage is 30.19 per cent. Analyses

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of alfalfa, pea vine and clover ensilages, p. 33. The pea vine ensilage was made from pea vines after the peas had been threshed out for canning purposes. The ash in alfalfa ensilage is much higher than in the hay, indicating a considerable loss of dry matter.

Alfalfa ensilage is eaten freely by cattle. The so-called "brown hay" is alfalfa hay which has passed through a fermentation in the stack and is considered an excellent fodder for cattle. Alfalfa ensilage is easily damaged by putrefactive fermentation.

Analysis of damaged alfalfa ensilage, p. 34.

PLANT FOOD TAKEN FROM THE SOIL BY ALFALFA . . . . 35-37

Leguminous plants such as alfalfa are considered as nitrogen gatherers, and when they are incorporated with the soil in which they have grown add nitrogen to it, but when they are removed it is questionable whether this is so or not.

The ash content obtained from our samples probably represents the normal amount which a healthy alfalfa plant will take up.

Table showing the pounds of the various plant foods removed by 1,000 pounds of alfalfa hay. One ton first cutting alfalfa hay removes 143 pounds of ash constituents; one of second cutting, 165 pounds, and one of third cutting, 127 pounds. Carbon, carbonic acid, and sand not reckoned. One ton clover hay removes 128 pounds of ash constituents.

ALFALFA SEEDS . . . . . 37-44

Analysis of seeds, p. 31; analysis of ash, p. 92. Description and size of alfalfa seed, prime seed, 1st, 2d and 3d quality of screenings, p. 38. Amount of seed sown to the acre, p. 39.

WHAT CONSTITUTES A GOOD STAND OF ALFALFA . . . . 39-40

Hay produced by single plants in thick and light stands. Number of stems thrown up by individual plants, p. 41. Stems produced by plants having much space are not larger than those produced by plants which are crowded; the size of the stems is influenced by other conditions. The amount of seed necessary to produce a good stand depends upon the vitality of the seed and the vigor of the plants produced.

VITALITY OF ALFALFA SEED . . . . . 41-44

Alfalfa seed said to be low in vitality. Experiments made to refute this statement. Description of samples of seeds used. How the experiment were made. Results of experiments p. 43. "Hard Seed" explained and germinating power given, p. 43. Duration of experiment, three days, sufficient to form

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a judgment of the value of the seed. Six-year-old alfalfa seed had lost but little or none of its germinating power. Screenings give good results even when two or three years old. Failures to obtain a stand are due to causes other than the lack of germinating power of the seed.

ROOTS AND STUBBLE OF ALFALFA . . . . . 44-64

The popular description of the roots exaggerated and erroneous. Very large roots exceptional and not normal. The root system is very simple, Plates II to X. Fibrous roots are almost wanting. Spongioles found at the depth attained by the tap roots. Spongioles described.

*Depth Attained by the Roots.*

The depth attained by alfalfa roots varies with the soil; it may also be determined by the height of the water plane. Alfalfa roots are more tolerant of water than popularly supposed. Illustrated in Plate XIII.
Locality in Weld County chosen for digging out samples of alfalfa roots, p. 48. Section of soil given, p. 48. Plants were five or six years old and vigorous. Roots had penetrated the hard layer and did not divide. Depth reached was eleven feet nine inches, ending in a soft sandy clay. At the next place chosen the soil was nearly uniform to depth attained by roots. This soil was a clay and was formerly used for making brick. Age of these plants five or six years; length of roots twelve feet three inches. Effect of raising the water plane, p. 49.

*Effect of Age on Size of Roots* . . . . . 50

Observations show great variation; some nine months old roots are larger than others six years old.

*Death Rate of Roots* . . . . . 50

In five years from seeding two-thirds of the plants had died. The yield of hay not affected. Dying out of the plants or thinning of the stand not objectionable provided it is uniform. The plants die in two ways, p. 51. The second mode of dying illustrated by plates XV, XVI and XVII. Alfalfa roots when cut off below the crown do not bud and reestablish the plant, and their power of throwing out adventitious roots is small.

*Alfalfa Roots Cut by Gophers* . . . . . 52

Alfalfa plants endure this root pruning to a remarkable extent.

*Nodules on Alfalfa Roots* . . . . . 52-53

These occur in three forms; as warty excrescences on the roots, in large colonies, and as single nodules. The first

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form occurs near the surface; the second is most abundant at depths of from three to five feet; and the third at all depths up to eleven and a half feet. Illustrated in Plates XI. and XIV.; also shown in Plate XIII. Partial analysis of nodules page 53.

*Ratio of Roots to the Tops* . . . . . 53-54

This ratio varies greatly with individual plants. In field culture it is more than an average alfalfa plant on which the top equals or exceeds the weight of the root.

*Alfalfa Stubble* . . . . . 55

The stubble, taken to a depth of six inches, five days after cutting, is equal to about two thirds of the weight of the green alfalfa as cut by the mower. The dried stubble found per acre ranging from 2.5 to 3.34 tons.

*Composition of the Stubble* . . . . . 56

Analysis of ash of stubble, page 92.
Mineral constituents per 1,000 pounds of stubble, page 56.

*Composition of the Roots* . . . . . 56-58

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Methods of preparing roots—could not wash them, page 56. Fresh roots contain 60.41 per cent. water. Fodder analyses of root, page 57. Ash constituents are easily washed out of the roots. Properties of aqueous extract of roots, page 57. The presence of starch doubtful. Mineral plant food contained in each 1,000 pounds of air dried roots, page 58. Ash constituents dissolved out of roots by water equal 11.99 pounds per thousand. Phosphoric and sulphuric acids, but particularly potash, went into solution.

*Manurial Value of Stubble* . . . . . 59

Each ton of stubble contains 8.31 pounds of phosphoric acid, 15.52 pounds of potash. 36.37 pounds of nitrogen; giving the value of the stubble at $6.75 per ton, or $19.28 per acre.

*Manurial Value of the Roots* . . . . . 60

The weight of roots per acre is nearly twice as great as that of the stubble, but is not so rich in phosphoric acid and nitrogen; the manurial value of the roots per acre is about $16. 58. Without assigning any value to the organic matter we have $35.90 as the value of the alfalfa stubble and roots. This food is within the reach of ordinary plants; wheat for example. If the alfalfa roots were removed, the soil would be found poorer than before the alfalfa was grown on it, especially in nitrogen, the first nine inches of soil excepted, page 61.

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THE LEAVES AND STEMS AS A TOP DRESSING . . . . . 61-63

The leaves and stems which fall on the ground to become incorporated with it amount to about one ton a year, which accounts for the fact that the first nine inches of soil in which alfalfa had been grown was found to contain more than half the nitrogen contained in the soil to a depth of nine feet, 8.9 pounds out of 17.0 pounds in all. There is an accumulation of plant food in the upper portions of the soil which is of material benefit. Elements of plant food contained in 1,000 pounds of leaves, page 36. Fodder analyses of leaves, p 27. Analyses of ash of leaves, p. 92. Fodder analyses of stubble and roots of alfalfa, p. 63. Analyses of ashes of stubble and roots, page 92. Elements of plant food in 1,000 pounds of stubble and roots, page 63.

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OTERO COUNTY GROUND WATER AND LARIMER COUNTY SEEPAGE WATER STATED IN GRAINS PER GALLON. 72

The ground and seepage waters differ wholly from the river waters used in irrigation. These waters do not sustain the same relation to plant feeding that solutions do in water cultures. Analyses of ashes of the Weld county and Otero county hays given for comparison, page 74.

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ANALYSES OF COLORADO ALFALFA HAYS AND PARTS OF PLANTS . . . . . 90

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COMPILATION OF ANALYSES PUBLISHED PRIOR TO 1896 . . 9[illegible]

ASH ANALYSES—ALL COLORADO SAMPLES . . . . . 9[illegible]

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*Plate I.*—The largest individual plant found in Colorado. Diameter of top. 18 inches, stems 360.

*Plate II.*—Exhibits face of opening thirteen feet deep in alfalfa field on Experiment Station farm at Rocky Ford, showing root system and distribution in soil.

*Plates III. and IV.*—Largest roots dug out, 11 feet nine inches long.

*Plates V. and VI.*—Show typical root system of alfalfa as it grows in Colorado.

*Plates VII. and VIII.*—Show alfalfa roots which have branched to a very unusual degree.

*Plate IX.*—Yearling alfalfa plants grown in rich soil. Three feet nine inches.

*Plate X.*—Alfalfa seedlings nine months old; roots nine feet three and three-fourths inches long.

*Plate XI.*—Shows lower end of tap root nine feet eleven inches long. Shows tubercles at this depth.

*Plate XIII.*—Shows mass of fibrous roots taken from gravel filled with water.

*Plate XIV.*—Shows large clusters of tubercles 2½ inches across as they were found at a depth of from three to five feet.

*Plates XV., XVI. and XVII.*—Show the progressive decay of the crown of the alfalfa plant.

*Plate XVIII.*—Shows gopher eaten roots with the small adventitious roots thrown out by the alfalfa plant.