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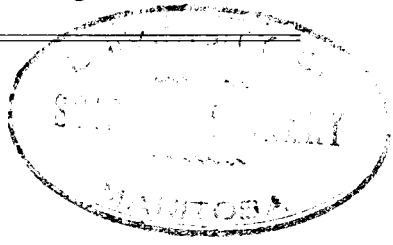

THE AUSTRALIAN SALTBUSH

Its Composition and Digestibility

NOTES ON RUSSIAN THISTLE

BY

WM. P. HEADDEN

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AUSTRALIAN SALTBUSH (*Atriplex semibaccata*)

ITS COMPOSITION AND DIGESTIBILITY

NOTES ON RUSSIAN THISTLE

By WM. P. HEADDEN

The California Experiment Station received the seed of this saltbush from Baron Von Mueller in 1888. In 1899, Charles H. Shinn, in Bulletin 125, states as the result of eighteen years' experimentation with saltbushes at that station, "that the *Atriplex semibaccata*, is the most generally useful species of all that have been planted, although others are worthy of cultivation."

Very favorable reports concerning the value of this plant gained currency, and it seemed that it might be of value to Colorado, as it would furnish a desirable fodder for the stock in the eastern part of the State, where the rainfall is sometimes insufficient for the production of good corps of other forage plants. This view was entertained by the writer previous to the appearance of the bulletin above referred to and seemed to be confirmed by the facts set forth therein. A small quantity of seed was procured in the spring of 1900 and planted on land previously used for experiments with sugar beets. The seeds were drilled in very shallow, but still too deep according to subsequent experience and a very poor stand was obtained—except in spots, where the plants were too thick.

The growth of the plants was entirely satisfactory, some of them attaining a diameter of seven feet and they bore an abundance of seed. I left the plot till the next spring, hoping to learn whether the seed would germinate and furnish me plants enough for the work of the ensuing year. In the meantime, however, a change had been made in the chair of agriculture and the new incumbent, knowing nothing about my work, plowed up my plot. This will explain why some of the statements in this account of the plant in Colorado are based on a garden experiment.

So far as the general culture of the plant is concerned the only question that presents any trouble is in getting it established; when once established it will seed itself abundantly. The best way to obtain a stand of this plant, in the beginning at least, is by transplanting; one can, of course, drill the seed. If this is done, the drills should be at least eight feet apart. The young plants, if well hardened and stocky, will need a little water when first set out to start them well, but when once established they will stand neglect, drought, and more abuse than most plants.

The seed, if they are plump, and fairly fresh, will germinate freely, but will rot if covered deeply. If they are sown in boxes, it is best to firm them and scarcely cover them at all. Good results

may be obtained by simply firming the seed on the soil and covering for a day or two with a thin cloth of any sort which can be kept moist. A similar observation concerning the depth of sowing is made by the California Station in Bulletin 125.

The first season's experience with this plant was on a poorly drained, alkali soil, and while for reasons already given, the experiment was not as satisfactory as one might wish, the results sufficed to show that the plant will do well under such conditions and furnish a large amount of fodder. Some of the single plants attained a diameter of seven feet. The garden experiment was in the main more successful, though less attention was paid to it. The plants seeded heavily and were not gathered, but left where they grew. They proved to be easily killed by freezing—it is stated in the California bulletin that the plants will endure a temperature of 14° F. below the freezing point.

My plants in the garden plot all perished during the winter, but the seed came up very freely the following spring, and this little plantation maintained itself for the next five seasons with but little care and without other water than our usual rainfall.

The California station made observations on the amount of rainfall necessary for this plant to make some growth, not a luxuriant growth whereby single plants attain a diameter of twelve or more feet, but sufficient when planted in rows two feet apart to cover the ground. They state that "one-fifth of an acre, sown in December, yielded 100 pounds of seed. This plot was cut in September and, cured for fodder, yielded at the rate of five and one-half tons of hay per acre. Three such cuttings were practicable on this light, granitic, sandy loam, underlaid by hard pan, during the driest season known." The rainfall for this season, 1897-'98, is given as 4.75 inches. The plant makes a remarkable growth with a very small supply of water. The writer of the bulletin referred to states further that, "on unirrigated land there was no green fodder-plant excepting saltbush (*A. semibaccata*), in the entire region." The rainfall during the seasons that the plant grew in my garden without irrigation was not noted, and while it was certainly larger than this recorded at one of the California sub-stations, it was not sufficient for the growth of our ordinary grasses.

This plant grows on the ground, not erect like alfalfa, but spreads out into a circular mass varying in diameter. Well-grown individual plants in our plot attained a diameter of seven feet, but single plants are recorded as having attained, in California, a diameter of even eighteen feet. The stems are slender and leafy.

The habit of the plant makes it hard to cut, and the leaves are easily lost in making hay—this plant is, of course, not to be considered as a forage plant where alfalfa can be grown—but its drought

resisting power may make it worthy of consideration by some people in this State. In our eastern counties, I have seen Russian thistle hay and have been informed that it was highly prized. I took this statement *cum grono salis* because the hay did not look to me as though it were fit to be eaten by any kind of stock and I saw no proof that the stock liked it. Mr. Payne, of Akron, suggests that Russian thistle hay may have a place in the feed of the plains stock as a laxative, for constipation is not uncommon among them. The Russian thistle is used to a limited extent in other parts of the State for hay making, and inquiry elicited from a thrifty, energetic ranchman the information that he had found it entirely unsatisfactory. Further, I have known the saltbush, *A. argentea*, to have been made into hay not for constant use, but as an emergency fodder for periods when the stock could not obtain enough to eat, or indeed anything by grazing. In sections where forage plants are such a desideratum as in these just referred to, any plant having better qualities than the indigenous ones or such as have been imported would be a blessing. This is really the reason for presenting this bulletin, for in this Australian saltbush, *A. semibaccata*, we have a plant which will reproduce itself freely from seed; the little plants will bear transplanting quite well; it will resist drought after it is well rooted and produce an amount of hay greater than the thistle now occasionally used, and of certainly as good or a better quality. In the sections of the country to which reference has been made small crops of sorghum can be grown, not always enough to be called a crop, but sometimes a fair one. This sorghum is not, especially in the spring of the year, a good fodder. It has no spines, as the thistle hay has, but sheep fed on it—sorghum fodder—lost weight rapidly. I know nothing about either the yield or quality of milo maize, but as compared with the other fodders mentioned, the Australian saltbush hay, though not presenting an attractive appearance, is worthy of consideration and that not as a portion of a ration but as a fodder to be given alone, for the question presenting itself to those persons in Colorado who may find it to their advantage to grow this as a forage plant, will in all probability be, not what they may mix to produce an advantageous ration, but simply as to what they can obtain to feed. The fact that they have used the so-called sand grass of the plains, Russian thistle, sunflower, and the native saltbush, *Atriplex argentea*, for the purpose of hay making indicates clearly that anything as good or better than the best of these, which they can grow, is at least a desirable thing for them.

The study of this plant had another object in view, or perhaps it is more nearly correct to state that in the beginning the object was to study its merits as a fodder and its adaptability to Colorado conditions, but in the end the object was extended to what we may

more properly designate as a chemical study of the fodder. It was advisable then from either standpoint to study the effects of the hay when fed alone, and it is not intended that any statement made shall be construed as indicating that hay made from this plant might not give more satisfactory results than will be presented in this bulletin if properly mixed with some other fodder but, as already stated, the conditions under which it would have to be fed have alone been considered.

So far as the readiness with which this saltbush can be grown is concerned and its ability to make a good growth with a small supply of water it commends itself. The other questions pertaining to it may be succinctly stated in a few words, does it present difficulties in cutting and being made into hay, will animals eat it readily and do they do well on it, *i. e.*, does it furnish sufficient nourishment to maintain or perhaps fatten the animals?

Under our conditions the plant is an annual which forms a spreading mass of growth on the ground, unless planted very thick, as it is apt to be in the case of self-seeding, when it might be feasible to mow it and handle it as we handle alfalfa in hay making. If, however, the plants are single it would seem necessary to adopt some other system of gathering it, probably the best method would be to turn up one side of the row and cut off the root with a chisel-like instrument. It would have to be handled as green as possible as, when dry, the leaves drop off badly.

The statement is made that animals eat it readily. To again quote the California Bulletin 125, p. 8: "At Tulare sub-station saltbush was fed to sheep, cattle, horses and hogs. With sheep the ration was increased until some received nearly their whole sustenance for months at a time from this plant, keeping in excellent condition, and being turned off to the butcher as 'fat mutton' without any other food except a little straw."

Other testimony on this point given on the same page, but by correspondents, is by no means so favorable, for some say "stock won't eat it." All shades of opinion between these two extremes seem to have been expressed by the correspondents in regard to the readiness with which it is eaten. On page 26 of the same bulletin, Prof. Jaffa states: "It is not advisable to feed the saltbush alone, particularly in the air-dried state, owing to the high percentage of the saline ingredients, and the general uninviting appearance and condition of the saltbush hay. In cases of emergency, however, sheep and cattle have existed altogether on this material through an entire season." These quoted statements, at least some of them, are general statements which contemplate other saltbushes as well as the *A. semibaccata*, which is the one had in mind in this bulletin.

We have fed it both green and dried, but almost exclusively to sheep. In one experiment we fed it to a horse. When fed green we had no trouble in inducing a lot of three sheep to eat it. The horse had been pasturing on it to some extent before we began feeding it to him as his only fodder. The sheep were fully matured animals in good condition; the weather during the time of the experiment, as well as all other conditions under which it was made, were altogether favorable. The time of feeding between weighings was three weeks. The result was that the lot had neither gained nor lost. The horse was not weighed, but we assumed that he had not lost materially, if at all; he ate the green fodder readily. At first the sheep showed the laxative qualities of the saltbush to a slight etxent, but this was of short duration and was at no time serious; the horse also showed it at first, but in this case it was also of short duration. There is doubtlessly a difference in individual animals in regard to the effects of this as well as any other fodder and it may be of a little interest to some to know that of the three sheep fed in this experiment, one gained a pound, one lost a pound, and the third just maintained its weight.

The green fodder was not analyzed, nor was there any account taken of the amount of the green fodder eaten; the only care taken was that they should have as much of the fresh fodder as they would eat. Samples of hay, however, were prepared from plants taken from different portions of the plot, as it varied considerably in the character of its soil. This feature of the experiment will not be mentioned further, but it is probably the cause of the very considerable variations shown in the analyses of these samples.

The plot of ground on which the saltbush grew was in parts as strongly alkalized as any of which I had knowledge and was poorly drained, still we had previously grown sugar beets on the plot and obtained a yield of 19 tons to the acre and the beets were of excellent quality. Some portions of the plot, too, had been manured, so that it is quite right that the samples of saltbush hay should vary somewhat in their composition if these things have any influence on the composition of growing plants.

As to the amount of hay we would be justified in expecting to obtain from an acre, I can give no opinion, as no data on this point was obtained.

I have grown some of this plant for the past eight seasons, but at no time since the first season have I had it on a measured plot, and the first season I obtained nothing like a good stand. On this point I will again quote Bulletin 125 of the California Station: "In February, 1896, saltbush seed was drilled here on the surface, in rows eight feet apart, and by September, when visited, the surface

was nearly covered. A part of the crop was cut twice, yielding at the rate of four tons of hay per acre." This is a very modest yield compared with those indicated by some of the correspondents, which would figure out at least one-half more. This may all be interpreted when applied to our conditions that the saltbush may be expected to yield a large crop of hay per acre provided the stand is good.

The composition of the crop of 1900 is given in the following table:

COMPOSITION OF SALTBUSH (*A. scmibaccata*) HAY.

	Moisture.	Ash.	Fat.	Protein.	Fibre.	N-Free Extract.
Sample 1	6.16	17.90	1.18	13.21	23.79	37.76
Sample 2	7.94	19.48	1.09	13.70	24.34	33.45
Sample 3	8.34	17.02	1.17	9.41	28.31	35.75
Sample 4	8.45	15.07	1.12	8.70	28.00	38.66

For the leaves and stems we obtained the following:

	Moisture.	Ash.	Fat.	Protein.	Fibre.	N-Free Extract.
Leaves	6.42	24.29	1.66	15.92	8.99	42.72
Stems	5.25	8.75	0.72	6.46	44.67	34.15

The ratio of leaves to stems in a sample grown in 1906, which we may assume to be representative, was 8.6 to 6.5, or in round numbers, 60 per cent. leaves and 40 per cent. stems, according to which an average hay should contain about 12.2 per cent. proteids based on the analyses of leaves and stems given above, but the average percentage of protein indicated by the analyses of the four samples of hay is 11.26 per cent. This average is probably too low, owing to the low percentage of this constituent in samples three and four, both of which contain about or even less than one-half the amount of proteids found in later samples.

The four analyses, as previously indicated, serve to show how this hay may vary in quality even from the same field when no other condition than the variation in soil conditions can be appealed to as suggesting a plausible explanation; this is apparently a sufficient cause for the lack of uniformity in the published analyses of this hay, which is evident from the following, which are all of such analyses that I have been able to find:

	Moisture.	Ash.	Fat.	Protein.	Fibre.	N-Free Extract.
Arizona Rep. 1903	6.30	17.90	2.11	14.13	20.75	38.81
California Bulletin 125	7.05	19.37	2.01	11.64	15.88	44.05
California Bulletin 125	10.00	17.74	1.47	14.14	20.18	36.54
South Dakota Bul. 69	7.40	13.09	2.05	18.87	25.97	32.62

In our analyses of the samples grown in 1900, we notice a variation of five per cent. in the protein content, but an extreme of

seven per cent. in the four analyses above quoted. In other samples which will be described later we will find that this hay may contain even a higher percentage of protein than is shown by the South Dakota sample.

A little over two years ago I thought the time opportune to publish these observations on the probable value of this saltbush, especially to those sections of the State where the rainfall is usually too scant to grow good crops of other forage, but on looking up the literature there seemed to be so little positively established, particularly concerning its digestibility and feeding value, that it seemed wise to defer publishing them until additional data relative to these points had become available. We, therefore, began anew and grew another crop of the saltbush and determined its coefficients of digestion, using three sheep, wethers going on two years old, for this purpose.

This crop was started by raising the seedlings in boxes and transplanting them, but owing to a number of things, over which I had no control, it was very late in June before the seedlings were transplanted to the plot set aside for this experiment. The soil was of good quality and in good condition and free from alkali, and the water used for irrigation was likewise free from these salts. The plants grew very well and seeded abundantly, though set out so late in the season. We had no intention of trying to establish the minimum length of the season sufficient to grow a fair crop of this hay, but the accidents happening to this experiment show that if the plants get a good start by July 1st they will do well in this portion of the State. This crop was gathered and cured on sheets under the direction of Mr. F. Knorr, assistant in Agronomy, so that we had the whole plant, leaves and stems, to feed.

The sheep were taken from fattening pens, where they had been receiving a full feed of alfalfa hay and some grain. They at first received alfalfa hay alone, then alfalfa and saltbush hay, the latter being gradually increased till they received saltbush alone, when the preliminary period of the feeding began. The sheep had in the meantime become somewhat accustomed to being handled and also to their harness. The sheep did not seem to really like this hay, one in particular, sheep No. 1, continued to protest against it, but in the end the experiment proceeded quite satisfactorily. In the preceding experiment it will be recalled that we had sheep at last three years old. They were accustomed to the person feeding them, to the pens in which they were fed, and wore no harness to annoy them and were not handled. The result of feeding them green saltbush, a period of three weeks elapsing between weighings, was that the lot just maintained its weight with a variation of only one pound in any sheep. The fodder was green and more inviting

than the hay, and all of the conditions under which the experiment was conducted were favorable. In this second experiment we also used three sheep, young ones, and made them just as comfortable as possible, and again the results indicate that this hay fed alone will simply maintain the weight of the lot. In this case sheep No. 1 gained ¼ of a pound; sheep No. 2 gained ¾ of a pound, and sheep No. 3 lost ¼ of a pound. The total weight at the beginning of the feeding period was 243.25 pounds, at the end of the period 244.0 pounds, a gain of three-quarters of a pound. It was rather surprising that sheep No. 1 should show any gain, for the animal evidently did not like the hay and ate much less of it than the others, about two-fifths only of the average of the other two sheep. I will not go into the details of this case, but do not think that it should be included in averaging the results. The only good purpose that it serves is to show how very different the results with some individual animals may be from the average, and further to emphasize the fact that some individual animals do not take kindly to this fodder. Though the general tenor of the statements regarding this point would lead me to infer that sheep take to it better than other animals. The composition of this hay, made from quickly grown plants, the feeding data, composition of the feces and the coefficients of digestion are given below:

COMPOSITION OF THE SALTBUSH HAY, ORTS, AND FECES.

	Moisture.	Ash.	Fat.	Protein.	Fibre.	N-Free Extract.
Hay	3.645	18.635	1.370	20.600	16.382	39.368
Orts—						
Sheep No. 1	3.610	21.668	1.460	20.820	15.233	37.209
Sheep No. 2	3.595	24.251	1.400	20.310	13.287	37.157
Sheep No. 3	3.485	22.156	1.400	20.500	14.502	37.957
Feces—						
Sheep No. 1	4.560	14.974	2.350	7.940	35.417	34.759
Sheep No. 2	4.525	15.894	2.240	8.090	32.142	37.109
Sheep No. 3	4.820	17.848	2.880	7.750	31.205	35.497

Experimental Data—Sheep No. 1 received 6,577 grams of hay.

	Dry Matter.	Ash.	Fat.	Protein.	Fibre.	N-Free Extract.
Hay	6337.27	1225.62	90.11	1354.86	1077.44	2589.24
Orts	4192.00	942.34	63.50	905.46	662.48	1618.22
Consumed	2145.27	283.28	26.61	449.40	414.96	871.02
Voided	1089.93	171.03	26.83	90.67	404.46	396.94
Digested	1055.34	112.25	-0.22	358.73	10.50	574.08
Coefficients of Digestion	**49.19**	**39.57**	.....	**79.74**	**2.53**	**58.85**

This animal weighed at the beginning of the experiment 78¼

pounds, and at the end 78½ pounds.

Sheep No. 2 received 7,938 grams of hay.

	Dry Matter.	Ash.	Fat.	Protein.	Fibre.	N-Free Extract.
Hay	7648.66	1479.30	108.76	1635.20	1300.40	3125.00
Orts	2056.32	517.28	29.86	433.21	283.41	792.56
Consumed	5592.34	962.02	78.90	1201.99	1016.99	2332.44
Voided	2195.93	365.57	51.52	186.07	739.26	853.51
Digested	3396.41	596.45	27.38	1015.92	277.73	1478.93
Coefficients of Digestion	**60.87**	**62.00**	**34.70**	**84.52**	**27.31**	**63.41**

This sheep weighed at the beginning of the experiment 79¼ pounds, and at the end 80 pounds.

Sheep No. 3 received 7,938 grams of hay.

	Dry Matter.	Ash.	Fat.	Protein.	Fibre.	N-Free Extract.
Hay	7648.66	1479.30	108.76	1635.20	1300.40	3125.00
Orts	2565.37	588.91	37.21	544.89	385.45	1008.89
Consumed	5083.29	890.39	71.55	1090.31	914.95	2116.11
Voided	2028.29	380.34	61.37	165.94	664.98	755.66
Digested	3055.00	501.05	10.18	924.37	249.97	1360.45
Coefficients of Digestion	**60.10**	**57.28**	**14.23**	**84.78**	**27.29**	**64.29**

This animal weighed at the beginning of the experiment 85.75, at the end 85.5 pounds.

The average coefficients of digestion for sheep Nos. 2 and 3 are, for the dry matter, 60.48; ash, 59.64; fat, 24.46; protein, 84.65; crude fibre, 27.30, and for the nitrogen free extract, 63.83.

The deportment of sheep No. 1 and the data showing the results obtained with this animal do not justify the inclusion of these results in stating the average coefficients found. We notice that the animal consumed only 2,145.27 grams of dry matter and digested 1,055.34 grams in five days and still maintained its weight or a little better, as it gained one-quarter of a pound. This animal was a light eater, even of alfalfa. In addition to these facts the coefficients of digestion are altogether too low in comparison with those found for the other sheep and can simply serve to show that the protein and nitrogen free extract have high coefficients of digestion, while the crude fibre is very difficultly digestible.

A comparison of these coefficients with some of our well known fodders may be of some service. The coefficients for alfalfa, timothy and native hay have been taken from Bulletin 93 of this Station. Those given for the oat hay are averages taken from Bulletin 77, p. 20, U. S. Department of Agriculture.

	Dry Matter.	Ash.	Fat.	Protein.	Fibre.	N-Free Extract.
Alfalfa	62.05	57.67	29.86	72.54	49.93	72.88
Timothy hay	51.03	65.63	69.32	43.35	36.08	54.99
Native hay	50.53	42.52	20.55	62.33	55.56	51.30
Oat hay, average....	49.30	34.60	54.20	43.50	52.00	61.90
Saltbush hay (A. semibaccata)..	60.48	59.64	24.46	84.65	27.30	63.83

It will be observed that the composition of the saltbush compares very favorably with that of our best fodders. The proteids are high, especially in the South Dakota sample and the one used in our digestion experiments, 18.87 per cent. in the former and 20.60 per cent. in the latter. While the nitrogen free extract is lower than in the hay made from grasses it is quite as high as in the leguminous hays, alfalfa, or pea-vine hay. The crude fibre is low and the ash exceptionally high. The proteids present are not only high in percentage, but they also have a very high coefficient of digestion—84.65—which is, I believe, a higher coefficient than has been found for the proteids in any other hay and which has been approached in the case of but few hays. The ash is present in large quantities and is highly digestible, as one would expect, because it consists very largely of alkali salts. No apparent inconvenience was caused the sheep by the ingestion of these large amounts of ash constituents, except in the early part of our first feeding experiment, when the saltbush was fed green, but in this case the trouble was of short duration and did not recur. The crude fibre is not very abundant and has a low coefficient of digestion.

In spite of all of these good points the results of our two experiments with sheep indicate that the saltbush, when fed alone, will just maintain the animal. The results were the same whether it was fed green or in the form of hay. The leaves are not greedily eaten by the sheep; perhaps the very large amount of ash constituents present in them has something to do with this. There would seem to be no question but that in order to get the best effects out of a fodder containing 20 per cent. of protein it should be mixed with another poorer in nitrogenous substances.

This plant is supposed to grow particularly well on alkali soils. I found that it does well on soils which are considered as free from alkali, but remarkable differences seem to exist in the composition of the plant and also in that of the ash. The samples 1 to 4 inclusive were gathered from the same plot of ground; the soil varied, and we find that the proteid content varies by five per cent. Again, one of the California samples contained 11.64 per cent., while the South Dakota sample carried 18.87 per cent., and our last sample used in the digestion experiment contained 20.60 per cent., an extreme difference of 11.90 per cent., which, I believe, to indicate

the ability of this plant, to vary in composition according to the soil conditions under which it may be grown. Climate has nothing or very little to do with this case, as two of the samples referred to were grown at this Station.

The high content of mineral matter—ash—leads directly to the inference that the plant makes a heavy draft on the soil, especially as the plant is not only rich in ash but also yields a heavy crop. The California Experiment Station cut at the rate of 5½ tons of hay per acre, (Cali. Ex. Sta. Bul. 125, p. 6.); others give a much larger crop (ibib. p. 7), where a green crop is given as approximately 30 tons, which would not be less than 6.5 to 7 tons of hay. The hay made from this saltbush carries about 17 per cent. of ash, the sand and dust deducted. This would mean the removal of from 900 to 1,200 pounds of lime, magnesia, potash and soda from each acre of land, of which, according to my analyses, from 288 to 384 pounds would be potash and from 252 to 336 pounds would be soda. There would further be removed from 64 to 83 pounds of phosphoric acid.

These facts are of interest principally to show that the plant is a very heavy feeder, more so indeed than most useful plants. While alfalfa is a heavy feeder, removing from 180 to 200 pounds of mineral matter with each ton of hay, it is far behind the saltbush in this respect, which will remove not far from 340 pounds with each ton of hay. This matter is of little interest so far as this bulletin is concerned, still it may be worth while to consider the composition of the ash of this saltbush.

ANALYSES OF THE ASH OF THE AUSTRALIAN SALTBUSH, *Atriplex semibaccata.*

	Alkali Soil.	Alkali Free Soil.	Alkali Soil.*
Carbon	Trace	Trace	
Sand	3.82	10.93	
Silicic acid	1.24	4.60	16.24
Sulfuric acid	3.46	2.14	2.64
Carbonic acid	16.88	21.51	....
Phosphoric acid	3.54	3.43	2.80
Chlorin	20.80	5.82	24.33
Potassic oxid	14.37	16.02	11.42
Sodic oxid	23.79	14.85	35.39
Calcic oxid (lime)	8.54	13.27	5.79
Magnesic oxid	6.94	6.20	3.23
Ferric oxid	1.23	0.90	1.38
Aluminic oxid	Trace	1.21	1.95
Aluminic oxid	Trace	1.21	1.95
	104.75	100.99	105.39
Oxygen equivalent to chlorin	4.69	1.31	5.35
	100.06	99.68	100.04

*California Bulletin 105, p. 13.

The most striking differences are shown in the chlorin content. The California sample shows that almost one-fourth of the ash is represented by chlorin, while our sample, grown upon good, upland soil, considered free from alkali, shows that this element—chlorin—makes up only one-sixteenth of the ash. Again, the California sample shows three times as much soda as potash, while our upland sample shows more potash than soda. It is further clear at a glance that our sample grown on alkali soil approaches much more nearly to the composition of the California sample.

The plant takes up under the conditions of alkali soils a large amount of salt. The data given in the California bulletin show that it takes up, in round numbers, 800 pounds of salt, sodic chlorid, in producing five tons of hay. Our data show that it used about 600 when grown on alkali soil and only 163 pounds when grown on good, non-alkali soil. This hay, with its large percentage of ash, does not seem to be detrimental to animals, but it is an entirely open question whether the large amount of salt may not be a necessary condition for the perfect development of the plant.

The object of this bulletin is to present the facts concerning this plant so far as they are known for the consideration of our ranchmen, who need a forage plant which will produce from a fair to a good yield of reasonably good hay with but little rainfall. This plant seems to promise to fulfill all of these requirements. Though the California Station experimented with saltbushes for eighteen years and unreservedly recommended this one, the *A. semibaccata,* as the most promising one, and the Department of Agriculture at Washington distributed, if I am no mistaken, seeds of this plant, Director Wickson writes me that "the acreage in California is exceedingly small, probably not more than a small fraction of one per cent. of the amount which was contemplated." There may possibly be found an explanation for this failure of the plant to come into the popularity that its free growth and good composition seems to entitle it. They may have some other fodder which supplies their needs and is of easier culture, or easier to handle, but in those sections of our State which are of late years filling up with settlers and where the older inhabitants have had to have recourse to the Russian thistle, the coarse sand grass of the plains, or to the native saltbushes, this plant is worthy of a trial. It will not grow without any care. Even the native saltbushes are not always abundant, and this one will probably be no different except it receives intelligent planting and some nursing.

The following facts seem to have been established concerning this plant: First, when once established it will endure drought and

even make a good crop with less than five inches of rainfall.* Second, that stock will eat it or readily learn to eat it either green or as hay. Third, that it will produce very heavily under favorable conditions. Fourth, that it will, when fed alone, maintain the animals, and even better results are claimed for it. Fifth, that the hay is rich in protein, as rich or even richer than alfalfa. Sixth, that its coefficients of digestion are excellent, except for the fat or ether extract and crude fibre. Seventh, that it has no injurious effects on the animals even when they have no other fodder with it.

The following facts, however, remain, that it has not become popular, and that when fed alone it does not produce the results that its composition and coefficients of digestion would seem to warrant us in expecting. There is no reason for questioning the advisability of feeding something relatively richer in carbohydrates along with it, if they are at hand, but if they are not stock will live on this fodder alone.

RUSSIAN THISTLE.

On a preceding page reference was made to the use of this plant as a fodder. No one in any irrigated section would think of growing either the saltbush or thistle for forage. Press Bulletin 5 of this Station, by J. E. Payne, reprinted as part of Bulletin 64, reports the use of the Russian thistle in sections where other fodder cannot be raised readily. Some men report that it makes a good fodder, but other men of good judgment who have had experience in feeding this hay do not confirm the claim. Payne views it as an emergency forage. One man told me that he had tried it, feeding forty head of cattle, with very unsatisfactory results, and that many of his cattle died. As it is used to some extent in sections where there is no other available forage plant, or better where the supply of other and better plants is insufficient, I have studied the plant to a limited extent. There are only a few analyses of this fodder available. The following will serve to show the composition of the plant at various stages in its development:

ANALYSES OF THE RUSSIAN THISTLE.

	Moisture.	Ash.	Fat.	Protein.	Fibre.	N-Free Extract.
Cut June 12*	....	22.01	2.20	18.46	17.94	39.39
Cut June 26	....	18.79	1.84	17.72	23.19	38.46
Cut July 12	....	14.30	1.14	9.11	30.82	44.63
Small and tender†	....	20.32	3.91	17.78	16.27	41.72
No thorns	....	21.21	3.18	14.71	22.45	38.45
Thorns out	....	18.25	2.97	13.45	21.62	43.71
Ripe	....	13.75	3.77	12.34	37.70	32.44

*California Bulletin 105.

*Iowa Bul. 26, p. 28, three samples cut June 12, 26, and July 12.

†Report Minnesota Exp. Sta. 1894, p. 35, four samples also Bul. 30.

Green thistle ‡	....	30.10	1.59	20.62	12.92	34.77
Hay	....	22.98	1.36	12.37	18.98	44.31
Hay	....	20.19	1.79	11.88	18.11	48.03
Green	....	29.29	1.79	19.16	12.21	37.55
Hay discolored	....	15.54	1.59	9.42	23.58	49.87
Hay, Fort Collins	5.29	13.77	2.24	10.89	29.66	38.15

The last sample was gathered when the plants had thorns on, but were still green and succulent.

The ash constituents in this plant are high and indicate that it is a heavy feeder, especially on potash, as the analyses show. The composition of this ash seems to vary considerably.

ANALYSES OF THE ASH OF THE RUSSIAN THISTLE.

	Akron, Colorado.	Fort Collins, Colorado.	Minn.* Sample Plants Small.	Minn. Sample Thornes Well Out.	Minn. Sample Ripe.
Carbon	3.95	none			
Sand	11.25	0.90	1.93	2.43	3.95
Silicic acid	0.73	0.49			
Sulfuric acid	2.73	2.64	1.52	1.62	4.39
Carbonic acid	21.56	22.38	19.28	20.25	17.34
Phosphoric acid	3.70	3.19	3.49	4.00	3.11
Chlorin	4.29	13.51	....	....	1.56
Potassic oxid	28.68	44.10	26.82	31.21	27.37
Sodic oxid	0.85	0.82	9.16	4.25	12.46
Calcic oxid	16.44	9.42	26.37	24.55	22.39
Magnesic oxid	5.52	5.17	9.66	7.66	5.56
Ferric oxid	0.89	0.27	0.86	1.01	0.85
Alumnic oxid	0.52	Trace	....	....	....
Manganic oxid (br)	0.07	0.04	....	....	....
	101.16	102.93			
Oxygen equivalent to chlorin	0.98	3.04			
	100.18	99.89	99.09	96.63	98.97

We find the phosphoric, sulfuric and carbonic acids given in the Minnesota analyses as phosphates, etc. I take it that this is a misprint and that the corresponding acid is intended.

These analyses do not agree at all. The chlorin, for instance, varies from 1.56 to 13.51, and my own samples differ by more than nine per cent. The only thing clearly evident is that this plant is a heavy potash feeder.

*Report Minnesota Experiment Station, 1894, p. 36.

‡Report Kansas State Board of Agriculture, 1902, p. 25, five samples.