STATION BULLETIN 241 DECEMBER, 1928

Cost and Efficiency in Producing Alfalfa Hay in Oregon

Agricultural Experiment Station
Oregon State Agricultural College
CORVALLIS

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ALFALFA HAY IN OREGON

A quarter million acres of alfalfa in Oregon produces annually a crop of hay worth nearly ten million dollars, approximately a tenth of the total value of all crops produced in the state.

The weighted average cost of production for the six principal alfalfa regions in the state, for the three years 1925, 1926, and 1927, was $7.96 per ton. This figure is based on 629 survey records covering 27,927 acres of alfalfa, with a production of 93,982 tons of hay.

A reduction of 8 percent in the average cost of producing alfalfa hay in Oregon would amount to half a million dollars annually. This study indicates that the principal factors that influence the cost of producing alfalfa hay, and that can be controlled to reduce cost, are (1) harvesting efficiency, (2) yield, and (3) method of establishing the stand.

CONTENTS

SUMMARY

1. This bulletin presents information on the cost of producing alfalfa hay in Oregon, the factors affecting it, and ways of reducing it. It has two objectives: first, to establish facts and principles for the use of (1) prospective and present alfalfa growers, (2) teachers and students of agriculture, and (3) those concerned with public problems and policies; second, to indicate to present alfalfa hay producers possibilities of reducing their costs.

2. The facts presented were obtained in a state-wide study by the survey method of costs and practices in producing forage crops in Oregon during 1925, 1926, and 1927. This bulletin deals chiefly with alfalfa hay in the six principal alfalfa regions—Malheur, Baker-Union, Umatilla, Deschutes, Klamath, and Rogue River—which represent 80 percent of the alfalfa acreage in the state.

3. The average cost of production, weighted by the census acreage of alfalfa in each region, was $27.06 per acre and $7.96 per ton. The average cost of harvesting a ton of hay was $3.42 for the farms using wagons or slips, and $2.94 for those using buckrakes.

4. In considering or using these cost figures, as well as the detailed figures given in the cost summaries, three points should be kept in mind: (1) They include non-cash as well as cash items of expense, and give the grower wages for his work and 5 percent interest on his investment. (2) They are averages of widely varying costs of individual growers, and consideration should be given to the range and variation in cost. (3) Cost of production is only one of several factors affecting alfalfa hay production, all of which should be considered in connection with the crop.

5. Averaging the six regions together, cash items were 41 percent of the total cost; the unpaid labor of the operator and his family was 22 percent; depreciation was 9 percent; and interest was 28 percent.

6. There was little variation in the average cost in each region from year to year, but considerable variation in costs on different farms in the same year, and in different years on the same farm. This variation in costs is caused partly by factors that the grower cannot control—for example, climatic conditions—and partly by management factors that he can control.

7. The factors affecting cost are classified and discussed in four groups, as follows:

(1) Harvesting Methods and Equipment: Slips were little, if any more efficient than wagons, the ease of loading apparently being offset by the smaller loads. Hauling and stacking crews using slings stacked a third of a ton more hay per man per day than crews using Jackson forks. Crews using buckrakes stacked 5 tons per man per day as compared with 3½ tons for crews using wagons or slips. A hay derrick with outstanding features of construction was found and a plan for making it is given.

(2) Other Factors in Efficient Haying: With an increase from a ton to a ton-and-a-half in yield per cutting there was a decrease in man labor for harvesting of an hour per ton. Haying crews hauling for 80 rods and over, averaging 108 rods, stacked a third of a ton less per man per day than crews hauling less than 80 rods, averaging 40. There was wide varia-

tion in size and organization of the haying crews, but no greater efficiency was apparent for either large or small crews, or for crews with any particular organization.

(3) Yield: With yields of less than 2 tons per acre the average cost was $15.34 per ton, as compared with $5.78 per ton with yields of 6 tons or over. Stands of alfalfa that were 90 percent or over in thickness yielded 4.2 tons per acre as compared with 2.8 tons for stands of less than 75 percent thickness. There is probably more opportunity to reduce the cost of alfalfa hay by plowing up poor stands of alfalfa and replacing them with good stands than by any other way. In general the older stands were the poorer, but many old stands were still good, and many new stands were thin and should be plowed up. Alfalfa that was fertilized yielded 3.8 tons per acre as compared with 3.0 tons for that not fertilized.

(4) Method of Establishing the Stand: Seeding alfalfa with grain cost only $5.43 per acre as compared with $21.33 per acre for seeding alone. Under certain conditions, however, seeding alone is necessary, and for as long-lived a crop as alfalfa the extra cost is justified if it gives a materially better stand.

8. Data on labor practices and requirements are given to show (1) the amount of each labor operation in each region; (2) the total labor requirement of each operation; (3) the labor requirement for an acre of each operation on the average farm, on the more efficient farms, and on the less efficient farms; and (4) the seasonal distribution of the labor. The seasonal distribution is characterized, of course, by the high peak labor requirements for harvesting.

9. Alfalfa comprised 90 percent of the hay acreage and 50 percent of the total crop acreage on the farms that were studied, and the type of farming followed was based to a large extent on alfalfa production. Other farm enterprises were usually combined with the alfalfa production, however, for (1) it is desirable to have other crops to rotate with the alfalfa, (2) other enterprises combined with alfalfa give a sufficient volume of business for a good income with less land and with less hired help, and (3) feeding the hay provides remunerative winter work and manure to help maintain fertility. Three-fifths of the hay was fed by the growers, the remainder being sold.

10. The weighted average of the prices received was $10.03 per ton as compared with the average cost of $7.96, but as the capital investment averaged $156 per acre the percentage return on capital was not large, and an extensive acreage was necessary for a satisfactory income from alfalfa alone.

Cost and Efficiency In Producing Alfalfa Hay In Oregon

By
H. E. SELBY

INTRODUCTION

A quarter million acres of alfalfa in Oregon produces annually a crop of hay worth nearly ten million dollars, a tenth of the total value of all crops produced in the state. The acreage of alfalfa is exceeded by that of only two other crops, wheat and oats; and the value of the crop is exceeded only by that of wheat.

With the increasing attention to the business side of farming and the economics of agriculture there is need for reliable information about the cost of producing such an important crop as this. Such information is needed by both prospective and established farmers who contemplate raising

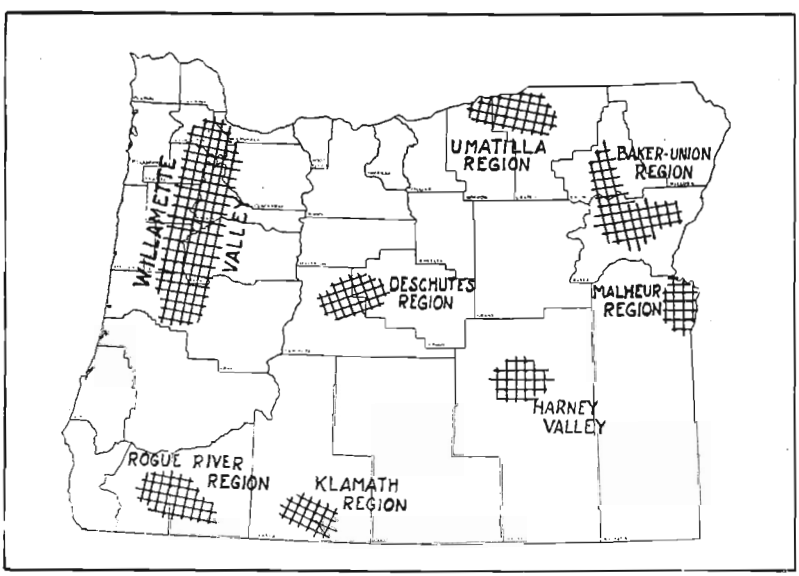

Fig. 1. Regions in which forage cost studies were made.

Acknowledgments: The author thanks the many farmers, county agents, and others whose willing cooperation has made this bulletin possible. Credit is due to numerous individuals for helpful suggestions and assistance, particularly to Professor H. D. Scudder, under whose supervision the study has been conducted; to A. S. Burrier, E. B. Starkey, and C. D. Schoolcraft, who have assisted in the field work; and to Miss Helen Boyer for assistance in the tabulation. The departments of Animal Husbandry, Farm Crops, and Dairy Husbandry have given helpful cooperation in the study.

alfalfa; by teachers and students of agriculture; and by those concerned with such public problems as price control, land development and reclamation, freight rates, and taxation. Especially important are any possibilities of reducing the cost of such an extensive crop as this, for even a very small reduction in the average cost per ton would aggregate a large economic saving.

Method of study.* The facts that will be presented have been obtained in a study by the survey method of costs and methods of producing forage crops in Oregon during 1925, 1926, and 1927.† Data were obtained from typical farms in important forage producing regions of the state (Fig. 1). With the assistance of county agents and others familiar with local conditions effort was made to select farms in each region that were truly representative of the farming of the region, and to avoid too large a proportion of either the better or poorer farms or farmers.

The same farms were included each year as much as possible, but a few were dropped and others added each year in order to obtain more representative farms or because absence or illness of the operators or other conditions compelled the dropping of certain farms.

The number of farms was also increased or decreased from year to year in some of the regions in accordance with the relative importance of the region as brought out by the continued study. A total of 549 farms cooperated in the study, 217 for all three years, 133 for two years, and 199 for one year. The number of farms averaged 143 per year in the Willamette Valley, and 36 per region per year in the other regions.

The data were obtained in personal interviews with the operators of the farms during the winter following each crop season. Books or records were used whenever available, although most of the data are based on estimates by the growers. As the study was continued for the three years many growers voluntarily kept labor and expense records in order to give more accurate information.

During the three years 1,505 enterprise records of individual crops of forage were obtained. These covered in the aggregate 49,547 acres producing 146,805 tons of forage. In addition there were 400 records on the cost of seeding alfalfa and clover. In 1926 196 records on the cost of horse labor were obtained in a supplemental study.‡

The six irrigated regions—Malheur, Baker-Union, Umatilla, Deschutes, Klamath, and Rogue River—are the principal alfalfa producing regions of the state, and this bulletin deals chiefly with these regions. According to the 1925 census 80 percent of the alfalfa acreage of the state was in these six regions. Data on alfalfa were obtained also in the Willamette Valley and in the Harney Valley, however, since alfalfa is a hay crop of minor but increasing importance in both of these regions. Data for these two regions will be found in Appendixes D and E, respectively. Data on costs of producing wild hay are also presented for the Harney Valley, which is the most important wild-hay region in the state.

Including the Willamette and Harney Valley records, a total of 699 records on alfalfa were obtained, covering 29,675 acres producing 99,807 tons.

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* For details of the methods used in the study see Appendix A.

† The cost of producing hay crops, silage crops, and kale in the Willamette Valley will be presented in separate bulletins.

‡ The costs of horse labor are presented in Ore. Agric. Exp. Sta. Bulletin 250.

Brief description of the soil, climatic, and irrigation conditions of the several regions is given in Appendix B. It should be kept in mind that three of the principal alfalfa regions—Malheur, Umatilla, and Rogue River—have lower altitudes and longer growing seasons and commonly produce three crops of alfalfa; while the other three regions—Baker-Union, Deschutes, and Klamath—have higher altitudes and shorter growing seasons and commonly produce only two crops.

COST OF PRODUCING ALFALFA HAY

Cost summary. The itemized average cost of producing alfalfa hay in each of the six principal alfalfa regions is shown in Table I. An average cost for the state, obtained by weighting the average cost in each region by the acreage of alfalfa in the region according to the 1925 Census, is also shown. Corresponding costs per ton are given in Table XXXIII.

TABLE I. AVERAGE COST PER ACRE OF PRODUCING ALFALFA HAY IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON
1925-1927

	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River	Average*
Number of records	111	90	100	132	87	112	632
Number of acres	3323	6483	5571	5374	4148	3028	27927
Number of tons	16572	18448	17530	15700	13996	11736	93982
Direct man labor	$12.82	$6.50	$8.21	$8.57	$9.98	$10.64	$8.85
Overhead man labor	2.81	1.35	2.46	2.40	1.82	2.54	2.13
Horse labor	3.08	2.20	3.34	2.23	2.38	2.55	2.63
Machinery	1.86	1.32	1.93	1.15	1.49	1.81	1.58
Automobile	.37	.28	.29	.36	.17	.08	.27
Fertilizer	.04	.21	.04	1.07	.47	.71	.36
Irrigation water	5.90	.11	2.25	2.42	3.05	2.40	2.23
Taxes	2.63	1.44	1.78	1.73	.97	2.86	1.85
Interest on land	7.48	5.85	7.55	5.95	6.72	11.49	7.26
Depreciation of stand	.71	.92	1.21	.96	.94	2.44	1.16
Miscellaneous	.05	.20	.40	.01	.17	.08	.18
Total	$37.75	$20.38	$29.46	$26.85	$28.16	$37.60	$28.50
Credit for pasture	1.70	.93	.95	1.74	1.67	2.61	1.44
NET COST PER ACRE	$36.05	$19.45	$28.51	$25.11	$26.49	$34.99	$27.06
TONS PER ACRE	5.0	2.9	3.2	2.9	3.4	3.9	3.4
COST PER TON	$7.29	$6.65	$9.03	$8.66	$7.87	$9.03	$7.96

* State average computed by weighting each regional average by the acreage of alfalfa in the region according to the 1925 census.
For explanation of cost items see Appendix A.

In considering or using these figures (Table I) three points should be kept in mind. First, these figures represent the total cost of production, including not only items paid for in cash by the grower, such as hired labor, fertilizer, and taxes, but also non-cash items such as the value of the grower's own labor, depreciation of machinery, and interest on investment. In other words, these costs not only cover all expenses incurred, including depreciation of equipment, but in addition give the grower wages for all of his time on the crop and 5 percent interest on the value of his land and equipment used in producing it.

Second, these figures are averages of many widely varying costs of individual growers, and consideration should be given to the range and variation in these costs, which will be discussed. It is apparent that the average cost varies between regions; it also varied between different years

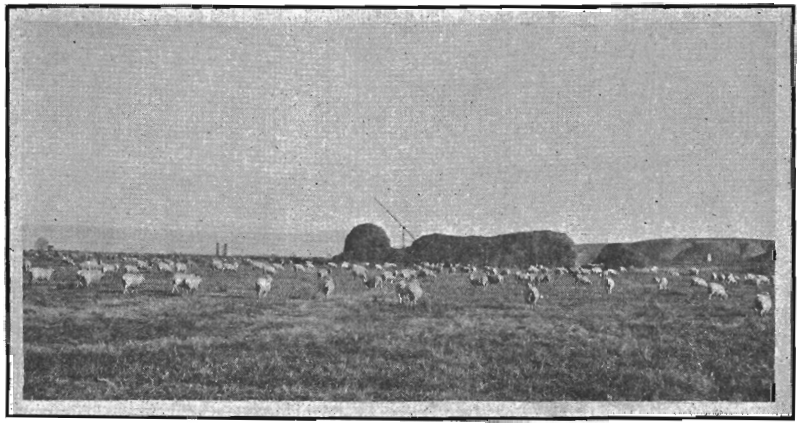


Fig. 2. Sheep pasturing on alfalfa stubble. An average value of $1.44 per acre was placed on the alfalfa aftermath pasture in the fall.

in the same region. Costs on the individual farms vary both above and below the average of the region, and also from year to year. The average figures do not indicate the possibilities, or what could be done, in raising alfalfa in the several regions, but rather what actually was done, on the average, during the three years studied.

Third, cost of production is only one of several factors affecting alfalfa hay production. Other factors, such as soil and climatic conditions, markets and prices, feeding values, maintenance of fertility, and utilization of surplus labor and equipment, must also be considered. Cost figures alone cannot be used to judge the comparative profitableness of the alfalfa enterprise in the several regions or as compared with other crops, nor to prove that alfalfa growing should be increased in one region or decreased in another.

But while these limitations on the use of average cost figures must be recognized and understood, there are many ways in which these figures are valuable and useful. They indicate the return that must be received from the hay in each region to give the average grower wages for his work and pay 5 percent interest on present land values. They show the variation between the regions both in total cost of production and in the amounts of the various items such as labor, fertilizer, irrigation water, taxes, and interest on land value. They indicate comparative advantages and disadvantages of the various regions in producing alfalfa. By comparison with similar data from other states they make possible a comparison of alfalfa production in Oregon with other parts of the country. And these facts, together with the information on other factors that have been mentioned, and amplified by the additional facts and details in the following pages, are important when considering the comparative profitableness of crops, probable trends of crop and livestock production, land values, land development or reclamation, credit facilities, freight rates, taxation, and similar subjects.

Cost of harvesting. A figure that frequently is wanted by growers in addition to the total cost of production is the cost of harvesting a ton of hay. This is of interest especially when considering contract prices or share

arrangements for harvesting. The average harvesting cost obtained in this study was $3.42 per ton for the farms using wagons or slips, and $2.94 for those using buckrakes. Details of this cost are given in Table XXXIV. The methods of harvesting are discussed later.

Costs are not all cash expenditures. It has been pointed out that in the total cost of producing alfalfa there are both cash and non-cash items. A strict classification of all items as to whether they are cash or non-cash is difficult to make, and any such classification must be arbitrary. The reason for this is that some items are cash in one sense and non-cash in another.

In Table II the items of cost of producing alfalfa in each of the six regions have been classified into four groups. In the first group are the items commonly thought of as cash cost of production, such as hired labor, machinery repairs, and taxes. With these items is included the item of horse feed, consisting largely of feed produced on the farm, the cost of which is made up partly of cash items such as hired labor and taxes, but also of non-cash items such as interest on investment. The item of board is similar, as it consists partly of products raised on the farm. These products produced on the farm have a cash value, however, and are readily convertible into cash, the non-cash element in them is relatively small, and their general nature is similar to the other strictly cash items; and for these reasons they have been included in this group. Likewise, the value of the pasture, which on some farms is sold for cash and on other farms is used for the farm livestock, has been deducted from these cash items; even when used for the farm livestock it brings a cash return in the form of livestock or livestock products sold.

The second group includes the value at prevailing wages of the labor of the grower and members of his family that is not paid for in cash. These items are non-cash in the sense that no cash wages are paid for them. For this labor to be available, however, the grower and his family must incur certain living expenses. It is probable that the proportionate part of the necessary family living expenses of most of the growers cooperating in this study, including food, clothing, doctor bills, and similar expenses, equals or exceeds the value placed on this unpaid labor. The use of this labor, therefore involves this cash expenditure and in this sense might be considered a cash cost.

The third type of cost item is depreciation. This is incurred as the cost of new machinery or equipment that is purchased from time to time, and is pro-rated as cost of production over the period of years that the piece of equipment lasts. It is a cash expense in the sense that cash must be expended from time to time in replacing equipment that wears out. It is non-cash in the sense that in any particular year there may be no actual cash expenditure of this kind, the expenditure having been made in previous years. Theoretically the average annual cash expenditure for new equipment and replacements should equal the average total annual charges for depreciation.

The fourth and last type of cost item is interest on investment. Unless the grower is using borrowed money on which he is paying interest this is a strictly non-cash cost.

How much should the return be? Table II shows that, averaging the six regions together, the cash cost amounts to only 41 percent of the total

TABLE II. CASH AND NON-CASH COSTS PER ACRE OF PRODUCING ALFALFA HAY IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON, 1925-1927

Items	Malheur		Baker-Union		Umatilla		Deschutes		Klamath		Rogue River		Average percent of total
	Amount	Percent of total	Amount	Percent of total	Amount	Percent of total	Amount	Percent of total	Amount	Percent of total	Amount	Percent of total	
Hired labor	$4.96		$3.68		$3.42		$3.09		$4.06		$4.33		
Board	2.09		1.22		.91		1.12		1.61		.81		
Horse feed and maintenance	2.21		1.55		2.30		1.61		1.69		1.81		
Hired horse labor	.05		.08		.20		.03		.06		.07		
Machine repairs, fuel and oil	.53		.38		.68		.26		.36		.52		
Machinery hired	.03		.02		.07		.01		.02		.08		
Automobile operating expense	.23		.19		.17		.22		.10		.06		
Fertilizer	.04		.21		.04		1.07		.47		.71		
Irrigation water	5.90		.11		2.25		2.42		3.05		2.40		
Taxes	2.63		1.44		1.78		1.73		.97		2.86		
Miscellaneous	.05		.20		.40		.01		.17		.08		
TOTAL	18.72		9.08		12.22		11.57		12.56		13.73		
Credit for pasture	1.70		.93		.95		1.74		1.67		2.61		
NET TOTAL CASH COSTS	17.02	47%	8.15	42%	11.27	40%	9.83	39%	1089	41%	11.12	33%	41%
Operator's direct labor	4.27		1.32		3.60		3.88		3.39		4.74		
Overhead labor	2.81		1.35		2.46		2.40		1.82		2.54		
Unpaid family labor	1.50		.28		.28		.48		.92		.76		
TOTAL OPERATOR'S AND UNPAID FAMILY LABOR	8.58	24%	2.95	15%	6.34	22%	6.76	27%	6.13	23%	8.04	23%	22%
Depreciation of horses, barn and harness	.56		.39		.57		.41		.43		.46		
Depreciation of machinery	.99		.70		.92		.65		.77		.88		
Depreciation of automobile	.11		.07		.10		.11		.05		.01		
Depreciation of stand	.71		.92		1.21		.96		.94		2.44		
TOTAL DEPRECIATION	2.37	7%	2.08	11%	2.80	10%	2.13	9%	2.19	8%	3.79	10%	9%
Interest on horses, barn and harness	.26		.18		.27		.18		.20		.21		
Interest on machinery	.31		.22		.26		.23		.34		.33		
Interest on automobile	.03		.02		.02		.03		.02		.01		
Interest on land	7.48		5.85		7.55		5.95		6.72		11.49		
TOTAL INTEREST	8.08	22%	6.27	32%	8.10	28%	6.39	25%	7.28	28%	12.04	34%	28%
TOTAL COST PER ACRE	$36.05	100%	$19.45	100%	$28.51	100%	$25.11	100%	$26.49	100%	$34.99	100%	100%

For explanation of cost items see Appendix A.

cost. Some people think of this as cost of production. A return sufficient to cover only these items, however, would give the grower no wages for his labor, no allowance for equipment worn out in producing the crop, and no return on his capital investment.

The value of the operator's and unpaid family labor amounts to 22 percent. Added to the cash expenses this makes 63 percent of the total cost. With his living expenses to pay, the grower must get a return of about this much to cover his cash outgo, or as is commonly said, to "keep from going behind." He still would have no return to use for replacing worn-out equipment and no return on his capital To obtain prevailing wages for his labor, allowance for depreciation, and 5 percent interest on his capital, he must get a return equal to the total cost of production.

Now, it is possible that some farmers may be willing to raise alfalfa for a return of less than prevailing wages for their labor. They may have no way to get a better return and may prefer to have some return than none at all. It is possible that some equipment used for alfalfa may be necessary on the farm for other purposes, the use of it on alfalfa may involve no extra cost, and perhaps therefore the alfalfa should not be charged for the use of it. It is possible that land values may be too high for a return of 5 percent on capital to be expected; or it is possible that owners may be satisfied with a return of less than 5 percent on the value of their land.

The making of allowance for possible differences in attitude toward cost of production such as these is facilitated by the classification of cost items in Table II, since any part or parts of the cost may be considered as desired. For example, those who object to including a charge for use of land as part of the cost of production, on the ground that profits determine land values instead of land values determining costs and thus profits, can easily deduct the charge of interest upon the value of the land.

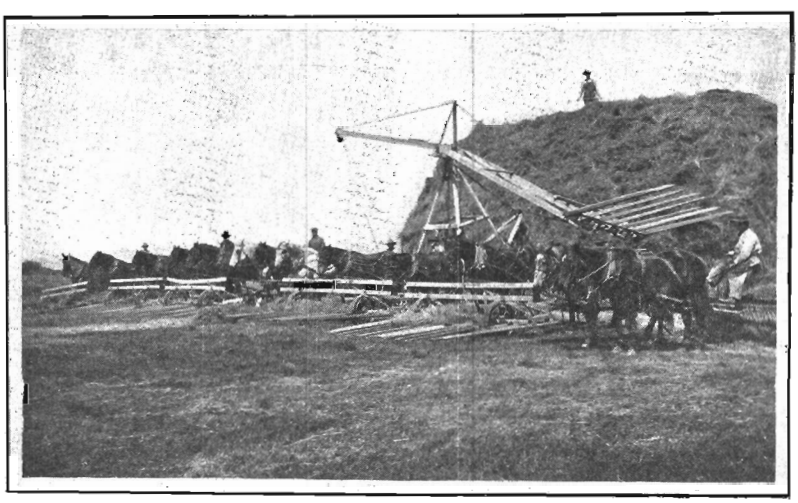


Fig. 3. Many growers use large haying crews. Six buckrakes and a Jenkins stacker. Outfit of Ward Brothers, Baker. (*Photograph by courtesy of R. E. Ward.*)

It is thought that in general a return of much less than the total cost of production as it has been computed will tend to reduce alfalfa acreage or decrease land values, and that a much greater return will tend to stimulate alfalfa production or increase land values.

Costs are different on every farm. Considerable variation is characteristic of farm cost-of-production data. Illustrations of various phases of this variation in the data under consideration are given in tables III and IV, and in Fig. 4.

There is considerable variation between the average costs in the different regions, as we have seen, and as would be expected with the wide variation in conditions between the regions; but average costs in the different years in the same region are quite consistent (Table III). In only one instance does the cost in any one year vary from the three-year average by more than 7 percent; this exception is the high cost per ton in the Baker-Union region in 1926, caused by injury by a freeze late in May.

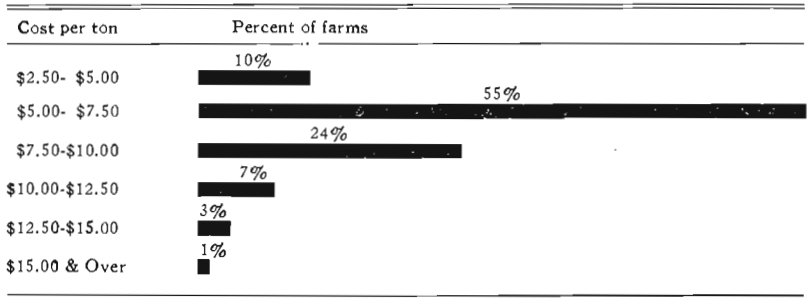
TABLE III. VARIATION IN AVERAGE TOTAL COST PER ACRE AND PER TON IN EACH YEAR IN EACH REGION

Region	Average cost per acre				Average cost per ton			
	1925	1926	1927	Average	1925	1926	1927	Average
Malheur	$38.23	$34.09	$35.81	$36.05	$7.47	$6.77	$7.61	$7.29
Baker-Union	19.81	18.67	19.89	19.45	5.82	7.84	6.64	6.65
Umatilla	28.67	28.27	28.58	28.51	9.63	8.66	8.88	9.03
Deschutes	26.23	24.43	24.66	25.11	8.71	8.34	8.95	8.66
Klamath	25.04	27.74	26.68	26.49	7.97	7.65	7.99	7.87
Rogue River	35.00	35.02	34.95	34.99	8.70	9.42	9.00	9.03
AVERAGE*	$27.52	$26.54	$27.12	$27.06	$7.83	$8.13	$8.00	$7.96

* Weighted by 1925 Census acreage of alfalfa in each region.

There is wide variation in costs on individual farms in the same region (Table IV). This variation is caused by differences in a large number of factors that affect costs. These factors are of two types. The first type consists of conditions such as kind of soil, amount of irrigation water, crop pests, and value of land. Most factors of this type cannot be changed or controlled by the grower to influence his costs, except by changing his location. The effect of factors of this type on costs of production is of

TABLE IV. VARIATION IN COST ON DIFFERENT FARMS
90 Records, Baker-Union Region, 1925-1927



For similar data for other regions see Table XXXV, page 62.

particular interest to prospective growers who are selecting conditions that will be favorable, or who are considering the adaptability of conditions that they already have.

The second type of factors affecting costs are factors of management. These are factors such as the acreage of the crop; methods of seeding, cultivating, fertilizing, and harvesting; efficiency in use of labor; kind of equipment used; and control of crop pests. Most of these factors can be changed or controlled by the grower to influence his costs.

Costs also change from year to year on the same farm. Out of thirty-six farms in the Deschutes region there were only three that ranked in the lowest sixth of the farms in cost per ton in all three years (Fig. 4). This variation is caused by changes in different years in the many factors affecting costs that have been mentioned. Changes occur from year to year both in conditions and in management. Certain farms in a region in one year may get more rain at a critical time than others, and in another year they may get less; crop pests are worse on different farms in different years. Growers also change their management practices from year to year—they

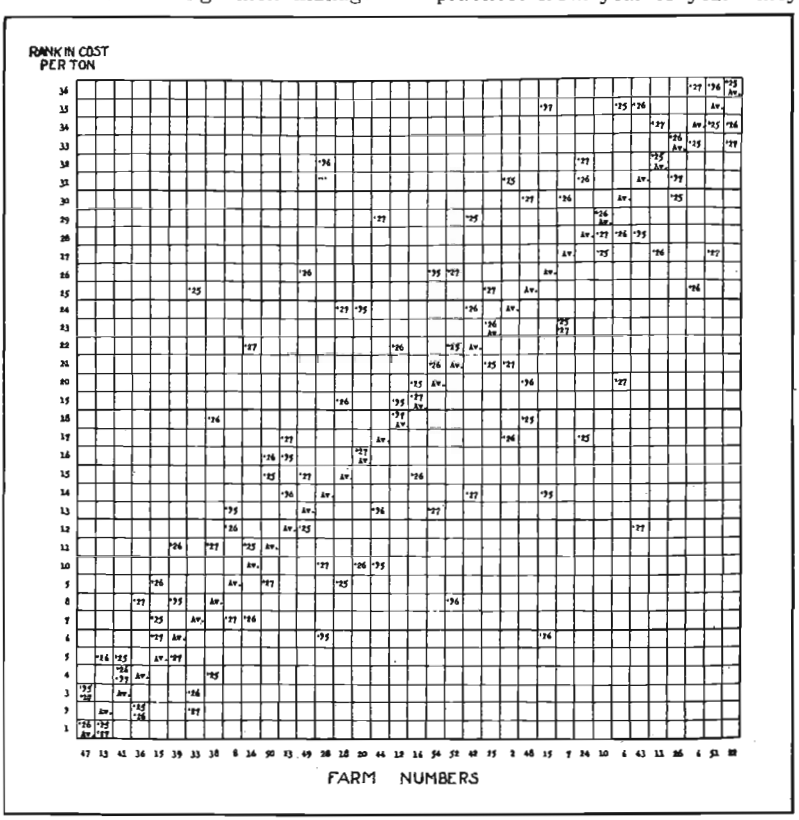


Fig. 4. Rank in cost per ton in each year, and average rank for the three years, for 36 farms in the Deschutes region. With less variation from year to year, the yearly ranks would be more closely bunched along the diagonal line of average rank.

change their acreage; they change their practice in cultivating and fertilizing; they adopt new equipment or methods—and these changes affect their costs from year to year.

Because of the large number of factors affecting farm costs and the many complicated combinations of them, different on every farm and in every year, it is difficult to analyze farm cost data and determine the effect and importance of individual factors. In the following pages, however, a number of factors will be discussed that have discernible effects on the costs of alfalfa hay obtained in this study.

FACTORS AFFECTING THE COST OF ALFALFA HAY

The factors that this study indicates affect the cost of producing alfalfa hay have been classified, and will be discussed, under four main headings. These are: (1) harvesting methods and equipment, (2) other factors in efficient haying, (3) yield and factors that influence it, (4) cost of establishing a stand of alfalfa.

An average reduction in the cost of producing alfalfa hay in Oregon of a fraction of a cent per ton would pay big dividends on this investigation. It is hoped that many growers will obtain suggestions that will enable them to reduce their cost by dollars per ton.

1. HARVESTING METHODS AND EQUIPMENT

Those familiar with hay harvesting methods in Oregon know that there is wide variation in the methods of different individuals and in the methods used in different communities and regions. At one extreme two men haul with a wagon and handle the hay by hand. At the other extreme stacking crews of a dozen men, with six or eight teams and a thousand dollars' worth or more of specialized haying equipment, handle the hay entirely with machinery except for the men on the stack.

Some of these various methods are much more efficient than others; and as harvesting averages a third of the total cost of production the efficiency of harvesting methods has an important effect on cost.* These methods also vary in their suitableness for different sets of conditions.

Mowing and raking. The variation in methods in harvesting alfalfa does not begin until after the hay has been mowed and raked. Mowing and raking operations are quite uniform and standardized. The five-foot mower and the ten-foot sulky dumprake are used almost exclusively, although there are a few exceptions of wider and narrower sizes of these implements. Side-delivery rakes and hay loaders are found only occasionally; they do not seem to be entirely suited to fields that are cut up by irrigation ditches and levees. No mowing of alfalfa with tractors was found in the course of this study.

Hauling and stacking. In all of the principal alfalfa regions except Rogue River, alfalfa hay is mostly stacked in the open instead of being

* For the 132 records in the Deschutes region, for the three years, the coefficient of multiple correlation between cost per ton as the dependent factor and man hours of harvesting labor per ton and yield per acre as independent factors was .757 $\pm$ .025. The coefficients of determination (Smith, B. B. "Forecasting the Acreage of Cotton." Jour, Am. Stat. Assn, 20:42) were .224 for harvesting labor and .349 for yield, indicating that the amount of harvesting labor accounts for about a fifth of the variation in cost and that yield accounts for about a third. As the relationships are not strictly linear these values can be taken as only roughly indicative.

stored in barns. Some of it is baled directly from the field, but more of the baling is from the stack, so as to allow the hay to go through a stack sweat.

According to the kind of equipment used for hauling, methods of hauling and stacking may be divided into three groups, as follows: (1) hauling with wagons; (2) hauling with slips, (3) hauling with buckrakes (Fig. 5).

Fig. 5. Methods of harvesting alfalfa hay may be classified into three groups, according to the method of hauling from the field. (1) Hauling with wagons. (2) Hauling with slips. (3) Hauling with buckrakes.

The percentage of the hay that was hauled in each way in each region is shown in Table V. In the aggregate 45 percent was hauled with wagons, 25 percent with slips, and 30 percent with buckrakes.

Wagons. Hauling with wagons, the most common of the three methods, is used particularly for small to medium sized acreages and for farms

TABLE V. PERCENTAGE OF ACREAGE IN EACH REGION THAT WAS HAULED BY EACH METHOD, 1925-1927

Method of hauling	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River	Aggregate
	%	%	%	%	%	%	%
Wagons	71	17	10	49	83	95	45
Slips	23	35	15	41	15	4	25
Buckrakes	6	48	75	10	2	1	30
Total	100	100	100	100	100	100	100

where the hay is hauled for a considerable distance from the field to the stackyard or barn. The hay is usually cocked by hand from the windrows, pitched on to the wagons by hand, and unloaded with a hay fork or with slings. Home-made derrick stackers are commonly used for stacking.

Slips. Hay slips are home-made contrivances commonly consisting of eight 1x12's sixteen feet long nailed together with a crosspiece at each end. These simply slide over the hay stubble and obviously are not adapted to long hauls nor to traveling through lanes or roads (Fig. 6).

Some growers add a pair of low wheels to the slip to lighten the draft (Fig. 7). These are usually set a little ahead of the center so that the rear end of the slip drags lightly on the ground. The wheels are not desirable, however, where the alfalfa is corrugated or furrowed for irrigation, as they break the corrugations and make the slip pull unevenly.

Slips are used for hauling on many small to medium sized farms as well as on many large farms. The hay is usually cocked and pitched by hand, as with wagons, and the same methods of unloading and stacking are used as with wagons.

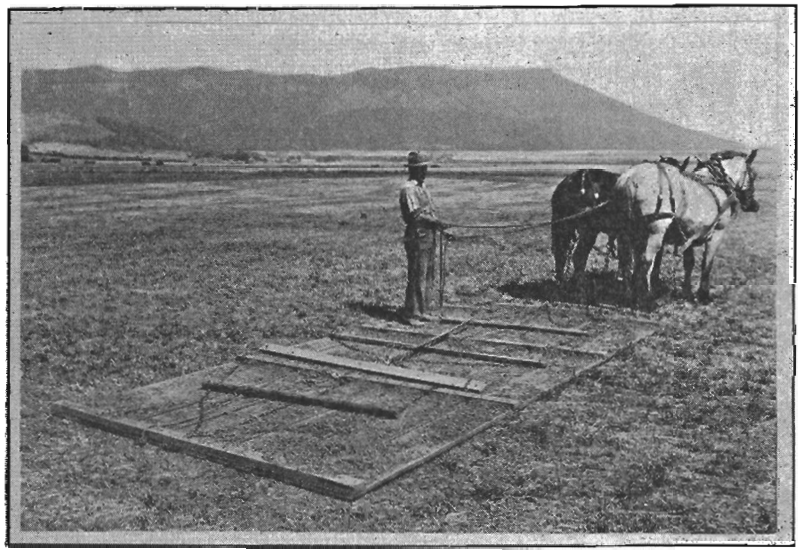


Fig. 6. Hay slip. The biggest advantage of the hay slip is ease of loading.

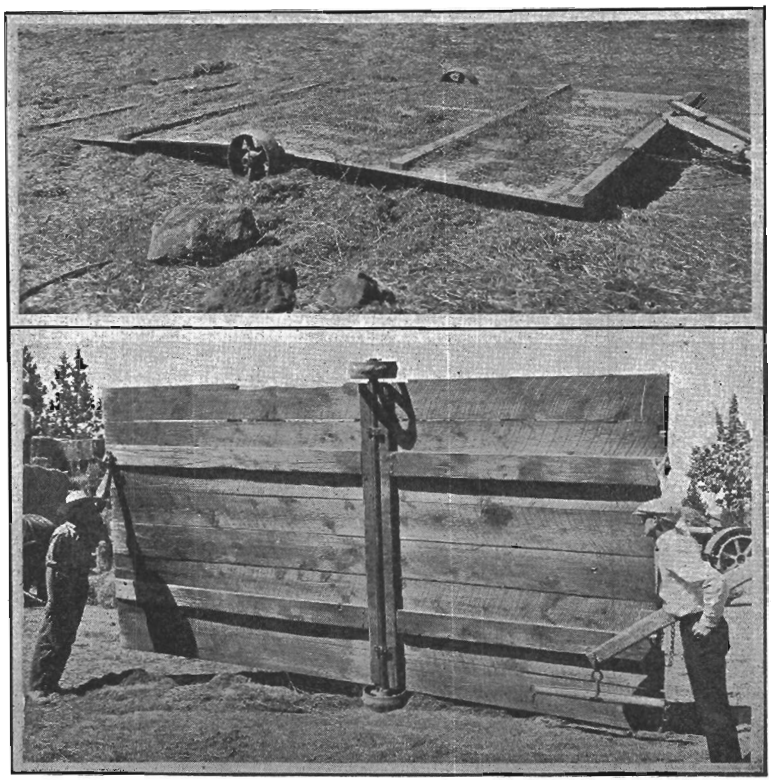


Fig. 7. A pair of low wheels makes the hay slip pull easier. Wheels are 14 inches in diameter with 5-inch face. They are set 6 inches ahead of center on a 2-inch pipe axle.

Table VI shows that slightly less man labor per ton was used with slips than with wagons. With slips, however, the average length of haul was only 42 rods as compared with 65 rods with wagons. Taking this into consideration there appears to be very little, if any, labor advantage for slips as compared with wagons.

Slips have the advantage of being easily loaded by one man. They have the disadvantage of hauling smaller loads than wagons, and apparently

TABLE VI. WHICH IS THE CHEAPEST WAY TO MAKE HAY?
632 Records, All Regions, 1925-1927

Method of hauling	Man hours per ton to haul and stack
Wagons	3.0 hrs.
Slips	2.7 hrs.
Buckrakes	2.0 hrs.

For supplementary data see Table XXXVI, page 63.

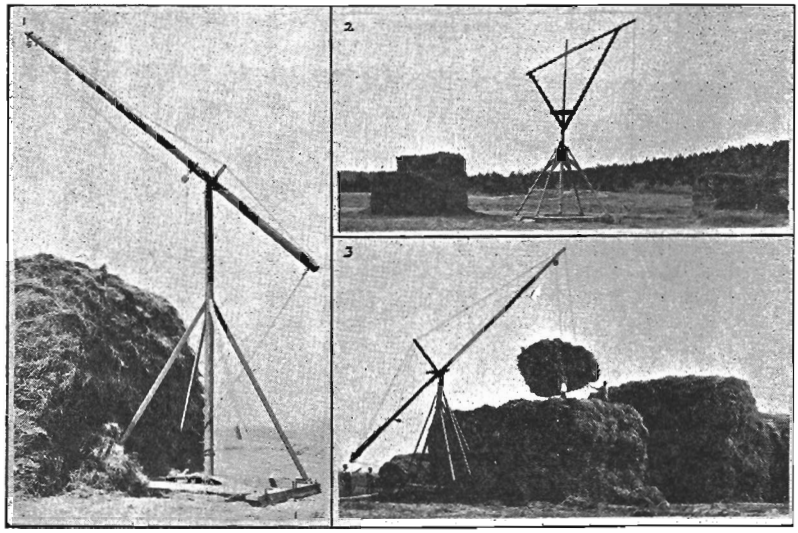


Fig. 8. The Mormon derrick and variations. (1) The stacker that is generally known as the Mormon derrick. (2) "Braced Mormon derrick," also called the "Stubblefield derrick." The mast and boom turn together, the mast being pivoted at the lower end. (3) "Header derrick" used in the Grande Ronde Valley.

this largely offsets the ease of loading. Since slips are quickly and cheaply made, however, many growers who do not have enough wagons will make and use them rather than buy, borrow, or rent extra wagons.

Forks vs. slings. Of the growers who hauled with wagons and slips, 51 percent unloaded with forks, 45 percent with slings, and 4 percent by hand. The kind of fork that was used almost exclusively was the Jackson fork.

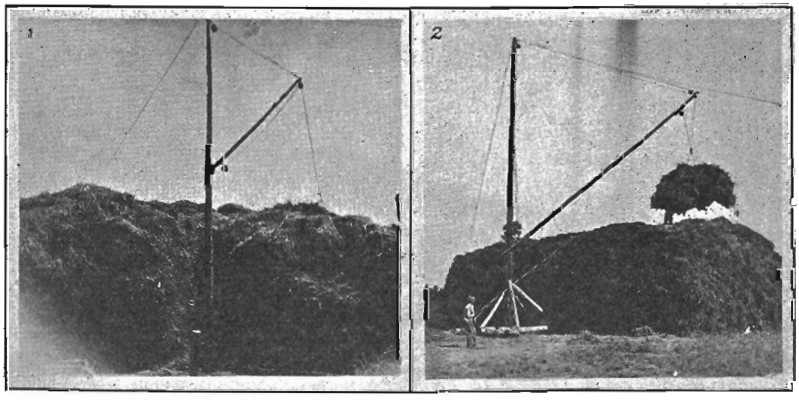


Fig. 9. The mast-and-boom derrick. (1) Note the stack built around the derrick. More hay can be stacked without moving the derrick, but snow drifting into the center sometimes spoils considerable hay. (2) Mast-and-boom derrick with a base, which has been called the "Wilson Derrick."

With Jackson forks 3.0 man hours per ton were required for hauling and stacking as compared with 2.7 man hours per ton with slings. This is an advantage of a third of a ton more hay per man per day for hay crews using slings.

Derricks. The home-made derrick stackers that are used for stacking with wagons and slips are of a great variety of designs. Most of them are of two general types. The first and most numerous is the so-called Mormon derrick type, the distinctive characteristic of which is that the boom is pivoted upon the top of the mast. The second is the mast-and-boom type, in which the boom extends from the side of the mast. A third type of stacker, found less frequently, is the cable stacker, consisting of a cable stretched between two poles or other supports, on which a hay carrier is used.

One not familiar with these stackers will undoubtedly get a better idea of them by reference to Figs. 8, 9, and 10. Sixty-one percent of the derricks were of the Mormon type, 35 percent the mast-and-boom type, and 4 percent cable stackers.

It is difficult to say which is the best type of hay derrick as there are many good and bad examples of each type and each type has advantages and disadvantages not possessed by the others. The Mormon derricks are made with a base and are the more easily moved from place to place. The mast-and-boom derricks are supported by guy wires or cables from the top of the

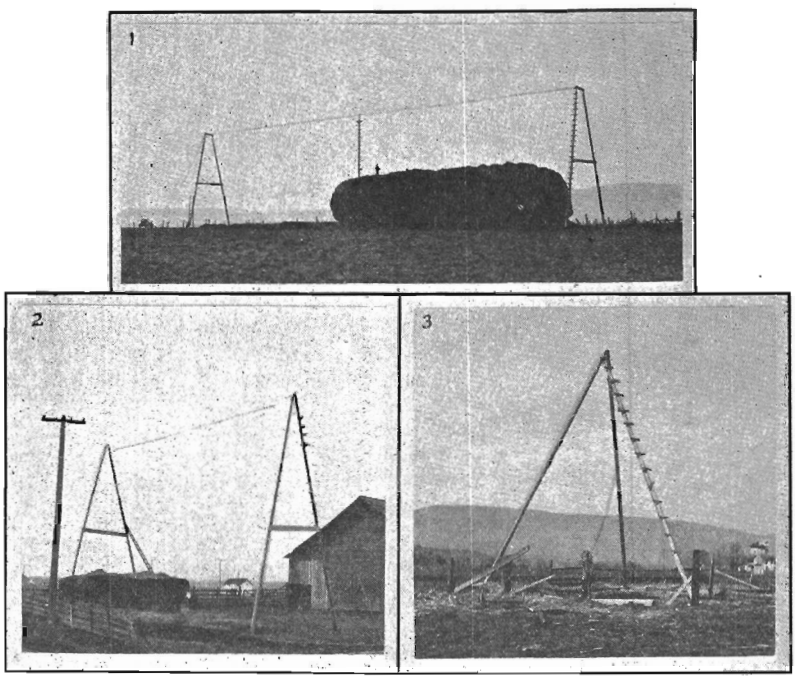


Fig. 10. Other contrivances for stacking hay. (1) and (2) Cable stackers. (3) Tripod stacker.

mast, and as they usually do not have a base they must be lowered and raised when moved. A mast-and-boom derrick with a small base, which has been called a Wilson derrick,* is found occasionally.

Some growers do not use a mast-and-boom derrick simply because they consider the raising and lowering too dangerous. It is sometimes necessary, however, to have a derrick that can be lowered in order to go under light wires or other obstructions. Mormon derricks are sometimes made with a very short mast so that passing under wires will be possible when the boom is lowered to a horizontal position.

Stronger derricks are necessary with slings than with forks as the loads taken up with slings are of course much heavier than those taken

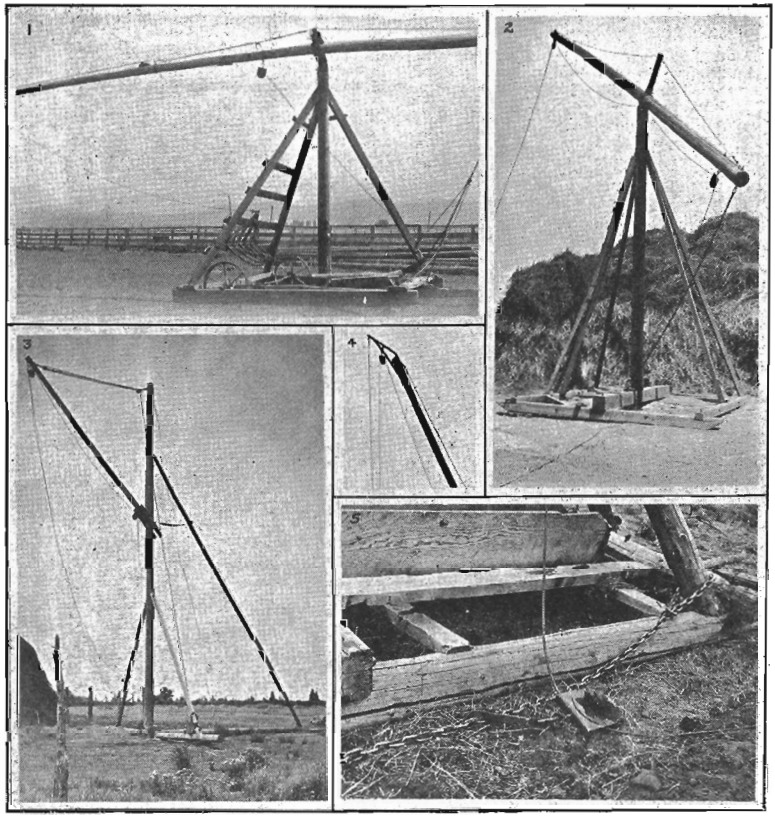


Fig. 11. Hay derrick devices. (1) Mower wheels attached to base for ease in moving. (2) The braces from the two near corners have been moved to the center of the base to permit a wider swing of the boom. (3) Mast and boom derrick with base and braces instead of the customary guy wires, to facilitate moving. (4) "Goose-neck" on upper end of boom to permit of wider stack and to keep cables from twisting. (5) Pulley with grab-hook which can be shifted along chain to adjust swing of boom.

* U. S. Dept. of Agric. Farmers' Bulletin 1525 "Effective Haying Equipment and Practices."

up with forks. Because of the support of the guy cables mast-and-boom derricks are usually stronger and will lift larger loads and build larger stacks than Mormon derricks. This accounts for the fact that slings were used with 80 percent of the mast-and-boom derricks, but with only 35 percent of the Mormon derricks. Many growers, however, find it possible to make their Mormon derricks sufficiently strong to use slings.

In general, the mast-and-boom derricks or the cable stackers seem to be preferred by growers who have only one or two permanent stackyards where they build large stacks. The Mormon derricks seem to be preferred by growers who make several stackyards and to whom ease of moving is therefore important.

There are a number of features in the construction of derricks of which

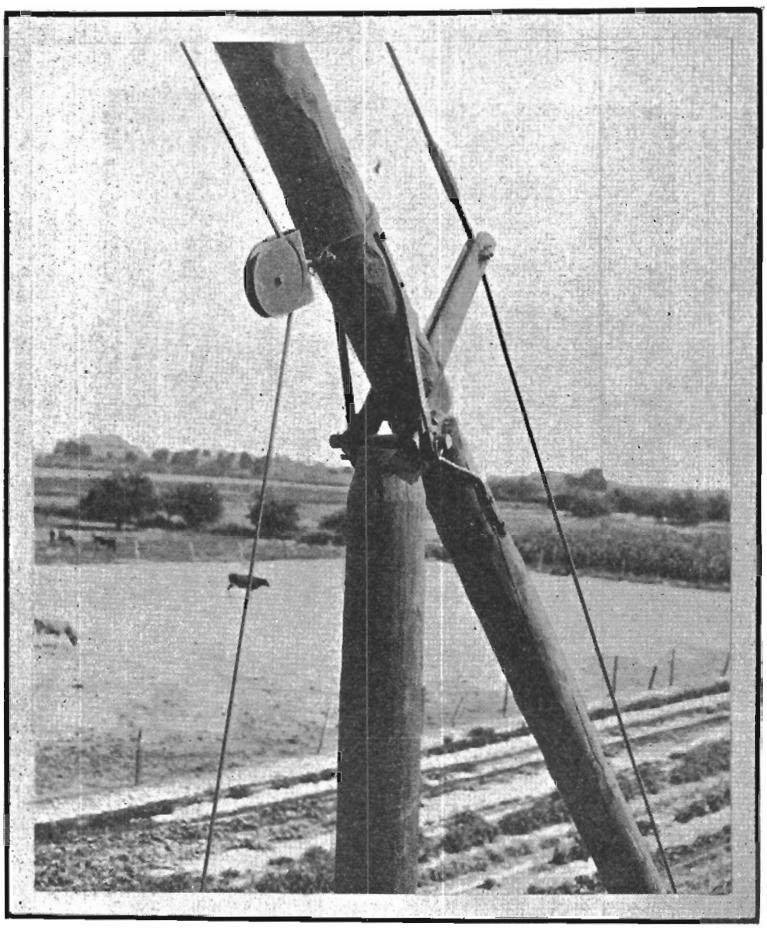


Fig. 13. Turntable, or "rowlock" of Mormon derrick. For diagram of the construction of this see Fig. 12 (back cover).

more general use could advantageously be made. Some of the more outstanding of these are shown in Figs. 11 and 13.

Hay derrick plan. In Fig. 12 (back cover) is shown a plan of a Mormon hay derrick that is commonly used in Malheur county. A local blacksmith in Ontario has been building derricks of this type for 15 years, making an average of 10 or 12 each year during that period. The details of construction shown in this plan are the product of this long experience in building them, and of the experience of the hundreds of farmers in that locality who use this type of derrick. Twenty-five dollars is usually charged for the iron work necessary and the total cost of the derrick for material and labor is usually about $100.

Considerable variation as to size and strength is possible in building these derricks. The plan is designed to be suggestive rather than one that must be followed rigidly. With a derrick of the size indicated in the plan stacks of 30 to 40 tons at one setting are readily made. If it is not desired to build such large stacks the size of the derrick may be reduced accordingly, resulting of course in a derrick somewhat cheaper to construct and also somewhat lighter to move about. A shorter mast and a longer boom pole are sometimes used. The shorter mast is an advantage in moving under low wires or other obstructions, and there is also less vibration of the top of the mast since the batter-post braces extend practically to the top. A stronger pole is necessary for the longer boom.

The Jackson fork is most commonly used with this derrick, but with a strong boom pole and the reinforcing and bracing indicated it is strong

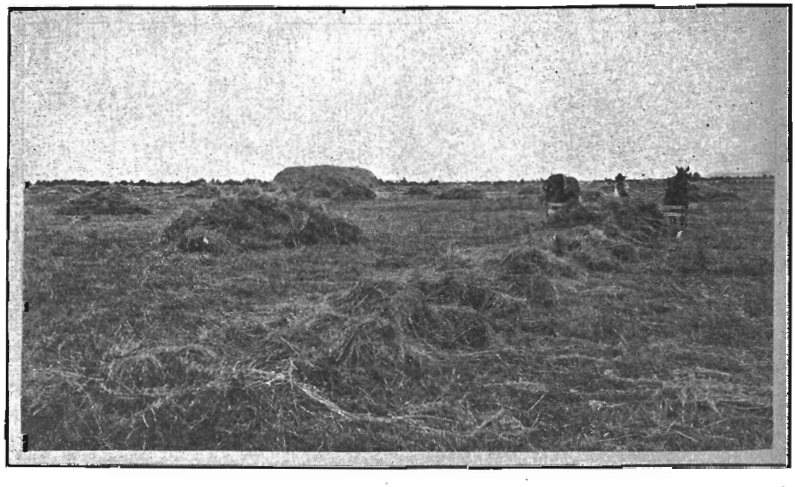


Fig. 14. Bunching alfalfa hay with buckrake. This is a common practice to prevent the hay from drying too rapidly, which usually happens when it is cured in the windrow.

enough for slings, and they are often used. Double blocks are usually used for the pull-up when slings are used. Some growers who use slings add a truss rod on each side of the boom for additional reinforcing. When this is done the support for the side truss rods should be placed at a little more than half the distance from the top of the mast to the end of the

boom, rather than at the top of the mast, as the boom is more likely to break at that point. A second support for the top truss rod may also be provided at that point.

A clamp is used at the point of the boom, rather than an eye bolt as at the heel, so that in case the boom warps and twists the clamp can be loosened and the truss rod straightened up. The truss rod should not be tightened too much. It should be slack when there is no load on the boom, but should take the strain when the load is pulled up.

When the pull-up cable is rigged with the pulley just in front of the mast the derrick is set so that the boom swings over the stack by gravity and is pulled back over the load with the trip rope. The swing of the boom is controlled by raising or lowering one side of the base of the derrick. Some growers prefer to rig the cable with the pulley back of the mast, as shown by the dotted lines in the drawing, so that the pull on the heel of the boom as the load is pulled up swings the boom over the stack. The boom

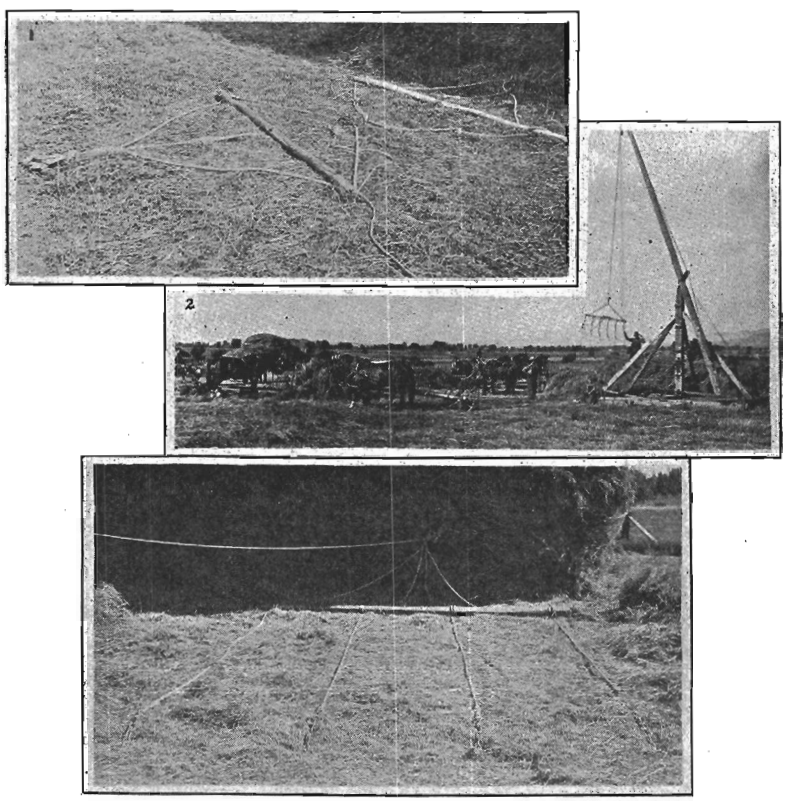


Fig. 15. Stacking with buckrakes and derricks. (1) The hay is sometimes bucked upon a hay sling set in this fashion. (2) Jackson fork used to stack buckraked hay. (3) Hay net set to receive hay from buckrake. The ends of the chains are hooked over iron pegs driven in the ground. When the hay is bucked upon the net the ends of the chains are brought over the hay and hooked into a trip located where the four ropes join at the further end.

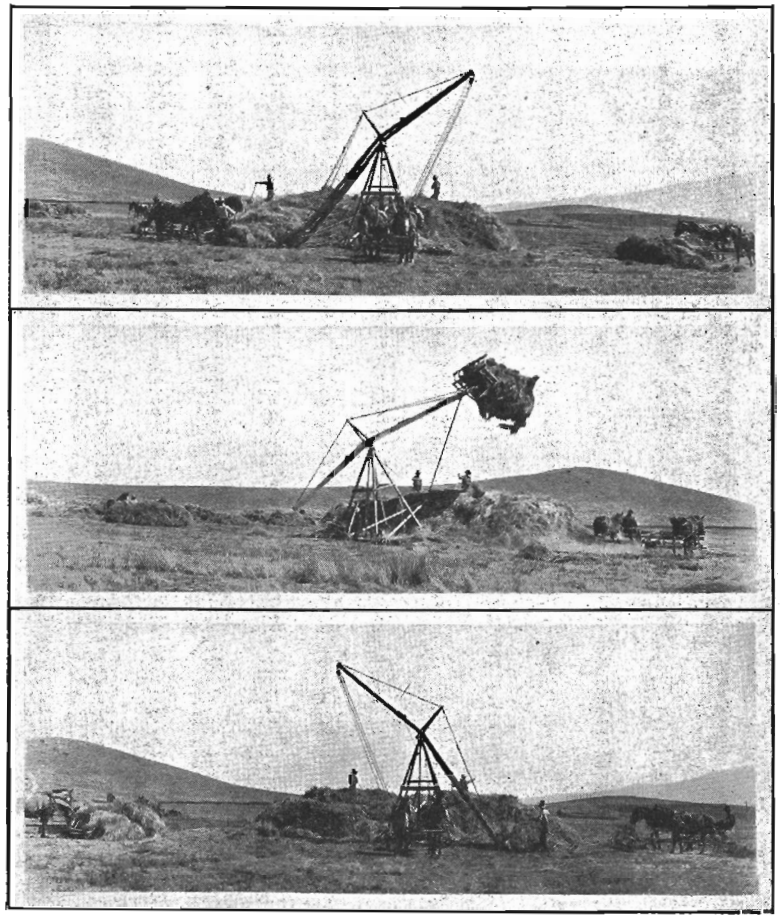


Fig. 16. Jenkins swinging hay stacker. (1) Receiving load on left side. (2) Swung over stack and dropping load. (3) Swung down to receive load on right.

then swings back over the load by gravity. The disadvantage of this method is that the cable rubs past the mast, wearing the cable and sometimes cutting the mast.

Buckrakes. The buckrake method of handling hay is a large-scale method more commonly used for the larger acreages of alfalfa. The hay is sometimes cured in the windrow and then put directly into the stack. More often, however, it is bunched into large piles, sometimes with a dumprake but usually with a buckrake, and allowed to cure in these bunches (Fig. 14). Some growers shape up the bunches by hand.

Handling hay with buckrakes is about 50 percent more efficient in the use of man labor than hauling with wagons or slips (Table VI). Crews using wagons or slips stacked an average of 3½ tons per man per day, while

those using buckrakes averaged 5 tons per man. But offsetting this big labor-saving advantage there is a big question as to the comparative quality of buckraked and hand-shocked hay, which will be discussed shortly.

Patented manufactured stackers were used by three-fourths of the growers who used buckrakes; the others used derricks. Derricks have the advantages of being cheaper and of making large stacks, but they are not quite as efficient as the manufactured stackers. Two methods are employed in using them. One is to buck the hay to the stack, and then fork it with a Jackson fork. The other is to buck the hay on to a net or hay sling spread on the ground, whence it is then lifted to the stack (Fig. 15).

Manufactured stackers. About half of the patent manufactured stackers that were used were of the swinging type, such as the Jenkins and Platner (Fig. 16). The remainder of the manufactured stackers were about equally divided between the Dain overshot type, the Jackson overshot type, and the combination buckrake-stackers (Figs. 17 and 18).

The size of stack made at one setting of the stacker is usually 12 to 20 tons with the Dain overshot type of stacker, 15 to 25 tons with the swing-

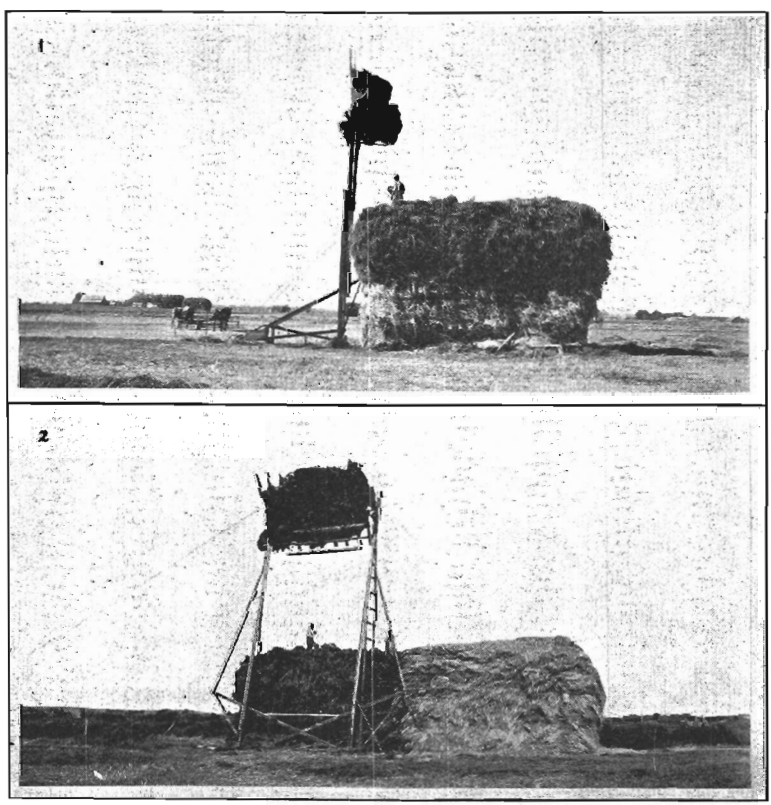


Fig. 17. Overshot stackers. (1) Large-sized Dain stacker. (2) Jackson stacker.

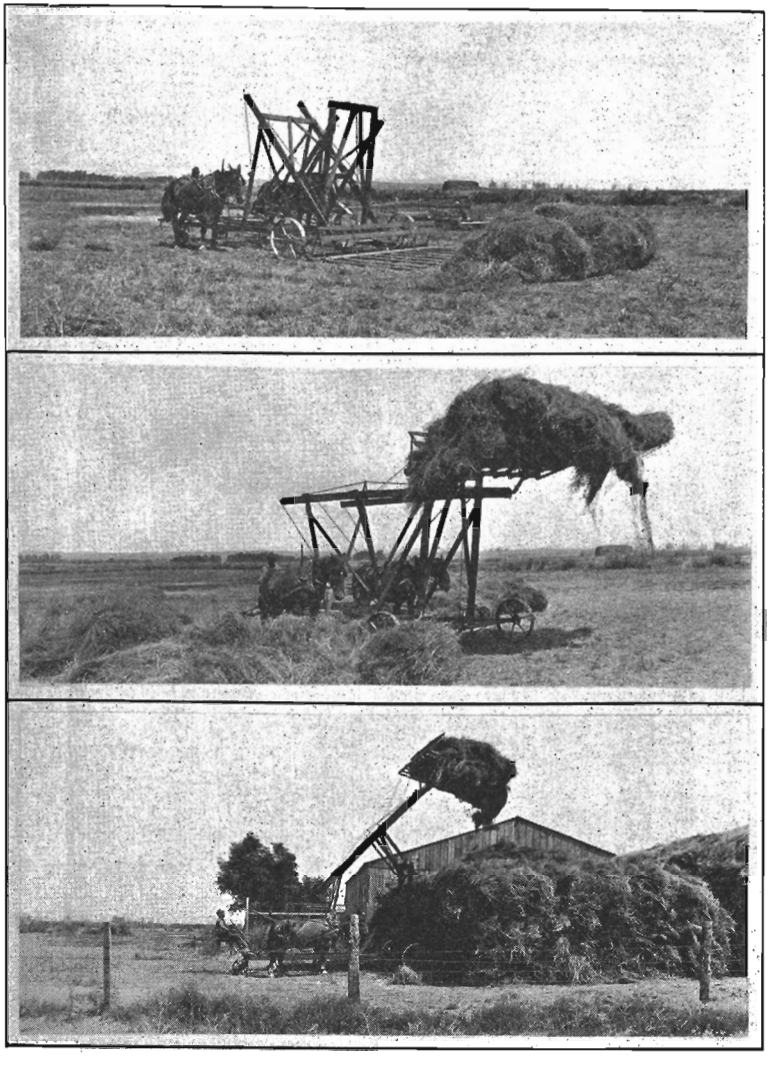


Fig. 18. Combination buckrake-stacker. Adapted to smaller acreages. By yarding his hay beforehand, a grower with this outfit can stack with only one man besides himself.

ing type, and 20 to 30 tons with the Jackson overshot. Many growers prefer the Jackson and the swinging stackers because of this advantage of making larger stacks. Others prefer the Dain overshot type because of its comparative simplicity and the ease with which it is operated and moved. It is used to greatest advantage where numerous stackyards can be scattered over the hay meadow. The swinging stackers have the advantage that the hay can be dropped at different places on the stack, thus facilitating stacking.

The chief complaint about all of the patent manufactured stackers is that they are not made strong enough. After two or three hundred dollars has been paid for a new stacker, forty or fifty dollars is often expended in strengthening and reinforcing it before it is used. There is a demand for a stacker for use with buckrakes that will stand up under heavy loading. Whether hay men, if stronger stackers were available, would still want to overload them just as much, is a question.

The combination buckrake-stackers, although rather high in first cost, have the great advantage for small farms of making it possible to harvest the hay crop with very little extra labor. With a limited acreage the grower can mow, rake, bunch, and yard his hay alone. He can then stack with only one extra man, one man operating the stacker and the other stacking.

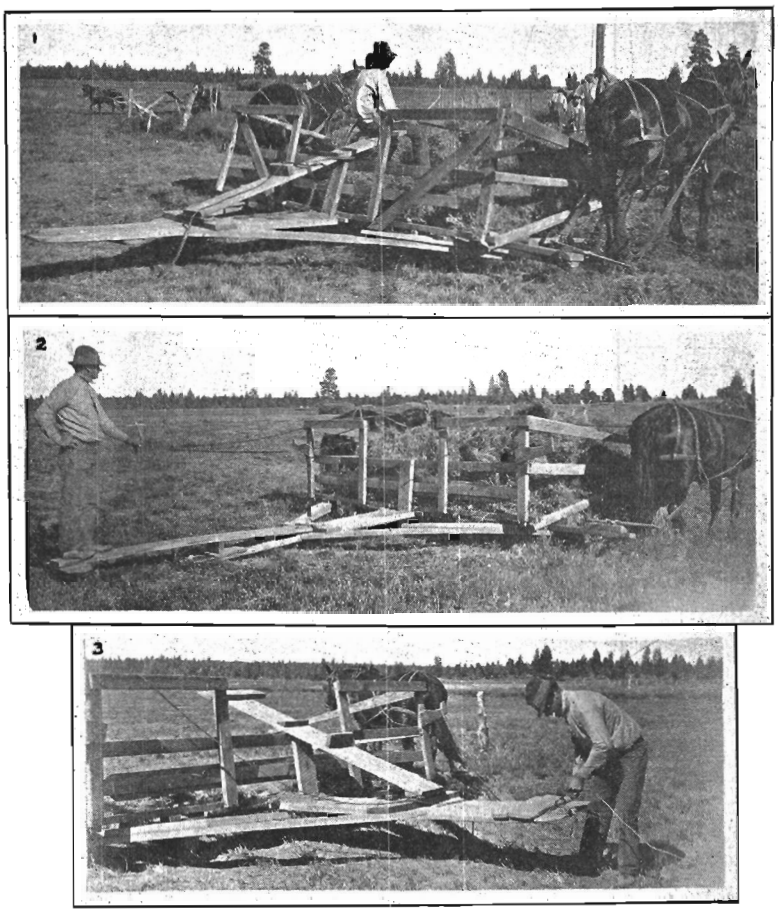


Fig. 19. A home-made buckrake. (1) Position in which hay is gathered. (2) Lever thrown back to raise load from ground when traveling to stack. (3) Each man pulls up his own load as he goes away from the stack. Farm of A. L. Goodrich, Deschutes county.

This seems to be the chief place for this kind of stacker; its principal disadvantage, in addition to its cost, is that it makes small stacks.

Quality of buckraked hay. There is considerable difference of opinion among hay men as to the comparative quality of buckraked and hand-shocked hay. Many claim that it is impossible to make as good hay with buckrakes, while others claim to be able to make just as good or even better hay, by using the right methods.

Undoubtedly it is within the range of possibility to make as good hay with buckrakes, but it is a matter of common observation that in actual practice buckraked hay is often of inferior quality. The cause of some of this poor quality is the tendency of some growers who raise hay for sale to let it get too dry before stacking in order to get a larger stack-measurement; but often the hay becomes too dry unavoidably. This factor of the quality of the hay is of vital importance when it affects the use of such efficient equipment as buckrakes, and hay growers should give careful consideration to methods of securing better quality.

The poorer quality of buckraked hay arises chiefly from (1) the loss of the leaves in handling because of the hay being too dry, and (2) the picking up of dirt as the hay is pushed across the field.

To prevent loss of leaves the hay must not become too dry at any stage of the haying. It should be raked as soon after mowing as possible, and before it becomes too dry in the windrows it should be bunched into large bunches, in which it should cure only enough for stacking (Fig. 14). A better quality of buckraked hay can be made in a region of cooler nights with considerable dew, where the hay will cure more slowly, than in a hot region where the hay dries out rapidly. Care must be taken in bunching and bucking the hay to avoid rolling and mauling it and thus shattering the leaves.

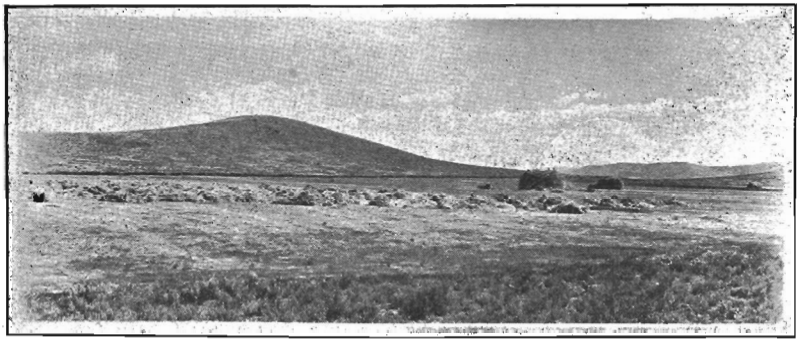


Fig. 20. Alfalfa hay yarded for stacking. The hay in this field was yarded for three stacks, two of which have been completed. This practice eliminates much of the handling of the hay after it is cured sufficiently to stack and also saves one or two men in the stacking crew.

The practice of "yarding" the hay, or moving the bunches together at the time of bunching into a small area around the place where the hay is to be stacked helps to save leaves by making a shorter haul after the hay is cured (Fig. 20). This practice also makes possible a smaller stacking crew, for with the hay close at hand fewer buckrakes are necessary to keep the stacker going at full capacity.

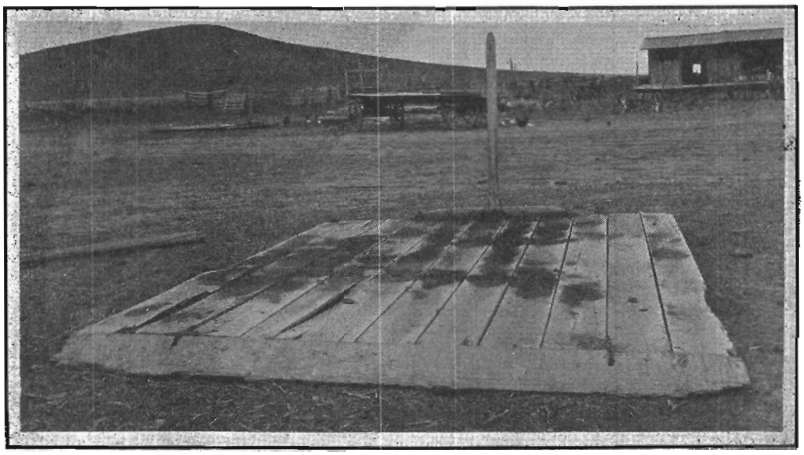


Fig. 21. Apron on end of slip for loading with buckrake. This is a device that is being tried by a few growers to save time and avoid hand pitching.

The amount of dirt in buckraked hay depends on both the condition of the field and the methods used. If the soil is cloddy, more will be picked up than if it is sandy, as the sand sifts out. More will be picked up on a meadow that has been spring-toothed than on an uncultivated field. Very clean hay can be made when the stand of alfalfa is thick and even and has not been cultivated. Irrigating just before haying, so

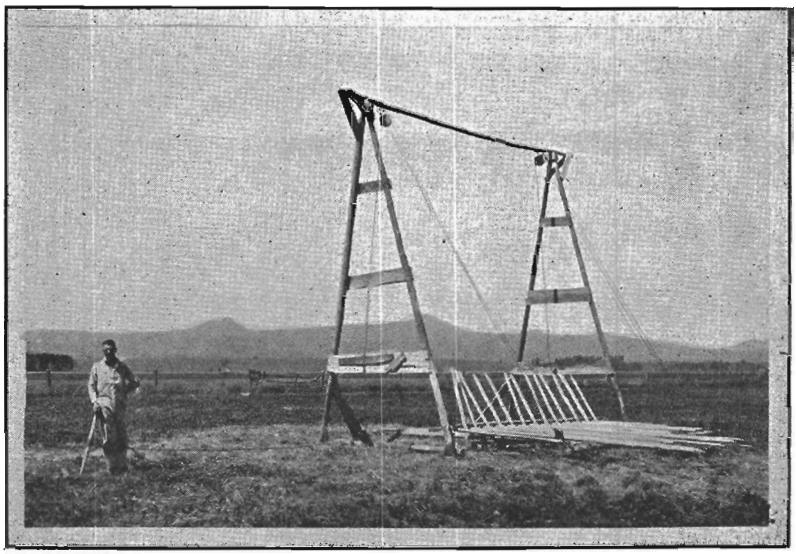


Fig. 22. Device used with buckrakes to load wagons in the field. Farm of Nicholson Brothers, Fort Klamath. (*Photograph by courtesy of Professor G. R. Hyslop.*)

that the ground will be moist instead of dusty, helps considerably. Taking smaller loads that can be lifted clear of the ground with the buckrakes also makes for cleaner hay but to some extent slows down the speed of haying.

A practice being tried by a few growers to avoid pushing the hay across the field with buckrakes, and still avoid hand pitching, consists in using slips for hauling, but loading them in the field with a buckrake (Fig.

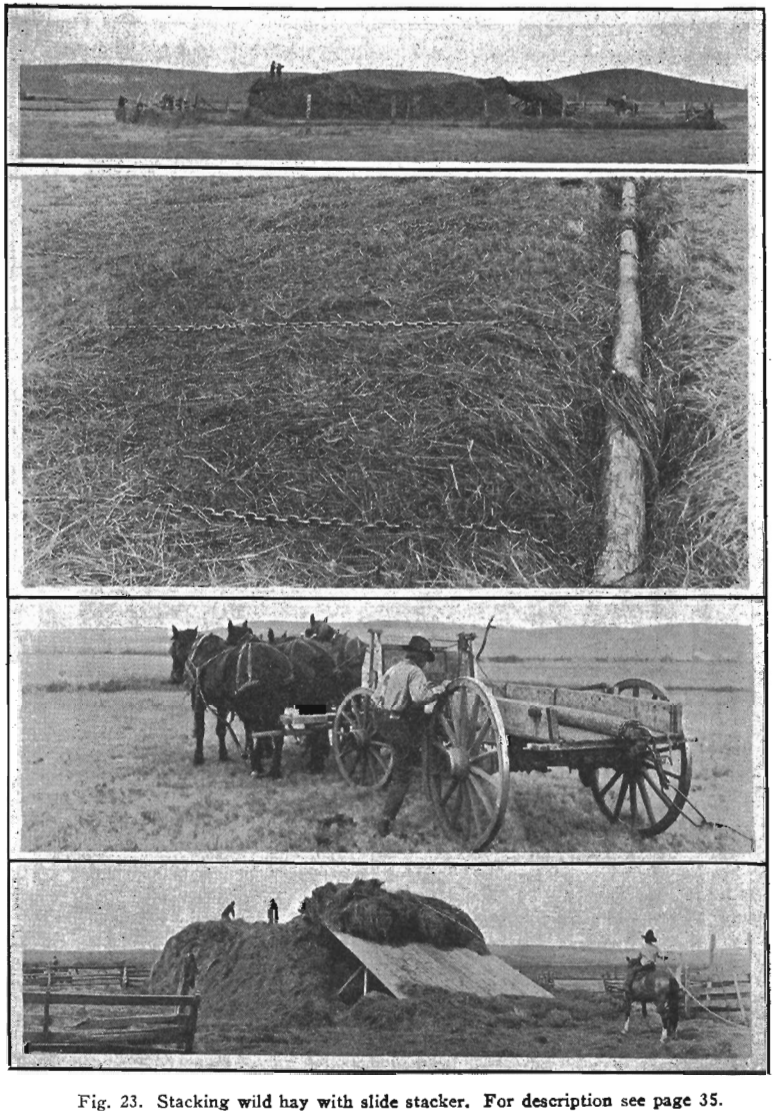


Fig. 23. Stacking wild hay with slide stacker. For description see page 35.

21). A board is attached to the rear end of the slip as an apron so that the buckrake can be driven upon the slip to dump the hay. At the stack the slip is driven upon a net spread upon the ground and a rope is stretched between two posts in front of the load to hold the hay as the slip is pulled out from beneath, dropping the hay upon the net.

The use of buckrakes seems to be decreasing in Oregon despite their labor-saving advantages. The reason for this seems to be the decreasing production of alfalfa hay for market and the breaking up of large acreages of hay with increasing diversification. As the acreages become smaller, expensive machinery is not justified, and many farmers as they begin to feed more of their hay to dairy cows find that they prefer it put up by hand.

Chopping. In a few cases, particularly in the Umatilla region, alfalfa hay is chopped and then restacked. The chopped hay is said to keep satisfactorily in the stack, shedding rain better than unchopped hay. A common custom rate for chopping and restacking the chopped hay is $2.00 per ton. It would seem that costs might be reduced by chopping hay directly from the field into the stack, but no instances of this were found. It would be necessary to cure the hay more thoroughly in the field because of danger of heating in the stack, and perhaps the depreciation in value of the hay from over-drying might be greater than the saving in cost.

Stacking wild hay with slide stackers. In the Harney Valley a unique and interesting method of stacking has been developed and is generally used for wild hay. This is the method of stacking with slide stackers. Although this method is not adapted to alfalfa hay, it is of interest in connection with a discussion of haying methods. Cost figures for the wild hay for which this method is used are given in Appendix E.

The slide stacker used is an incline ten or twelve feet high, built of lumber. This is placed at one end of the stack and the hay is pulled up this "slide" with a large chain net and a cable that extends from the net up the slide and over the stack to the pull-up at the other end (Fig. 23). The net is made of chains, which are spread apart by a wooden pole. In setting the net to receive the hay this pole is placed in a trench dug in the ground, and the hay is bucked over it on to the chains. The larger outfits use four-horse buckrakes, which will handle as much as a ton of hay at a time.

After the hay has been bucked upon the net, the end of the net is thrown over it and the ends of the chains are engaged by a hook on the end of the cable. The load is pulled up by a four-horse team on a wagon known as the "gin-wagon." The cable is fastened to a trip known as the "toggle" at the back end of the wagon. The load of hay is pulled up the slide and along the top of the stack to the position desired; the "toggle" is then tripped and the hay is released by the net. The net and cable are pulled back by a man or boy on horseback, who takes a turn around his saddle horn with the pull-back rope and drags them back at a gallop. The only men in these crews that use pitchforks are those on the stack, and they use them mostly to guide the cable so as to pull the load to the right place on the stack.

The average amount of wild hay stacked per man per day by this method was more than 7 tons, as compared with 5 tons of alfalfa hay with buckrakes and 3½ tons with wagons and slips. The more efficient crews, of course, exceed these average rates of stacking. Unfortunately, the four-horse buckrake and slide-stacker method is not adapted to alfalfa hay, as the leaves are shattered by the rough handling, and the hay is not spread out thoroughly enough in the stack. For wild hay, however, it seems to be quite satisfactory.

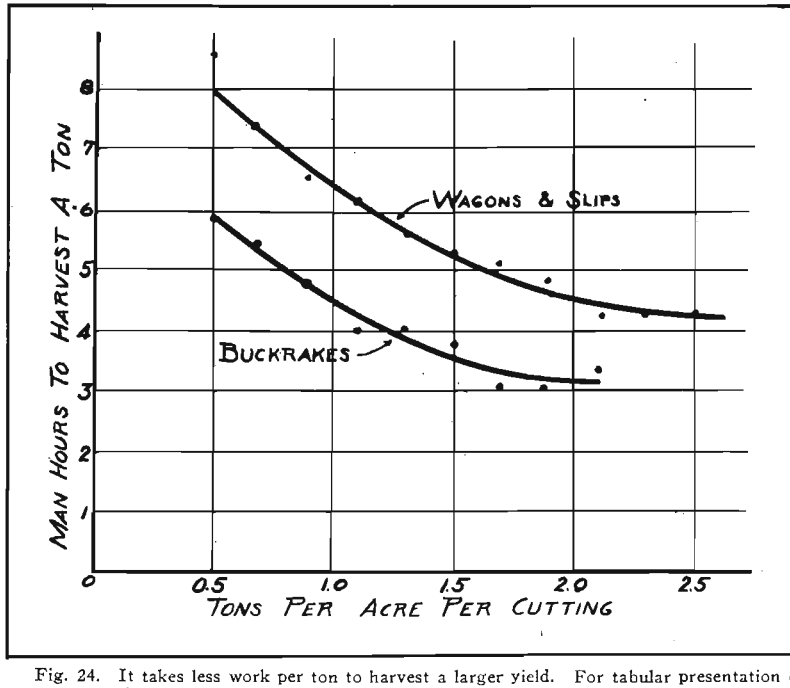


Fig. 24. It takes less work per ton to harvest a larger yield. For tabular presentation of this relationship see Table XL, page 64. The curves have been computed by the method of least squares from all records (632) for the six principal alfalfa regions 1925-1927. The equations are: wagons and slips, $Y = 10.067 - 4.501x + 0.868x^2$; buckrakes, $Y = 7.984 - 4.653x + 1.127x^2$.

2. OTHER FACTORS AFFECTING HARVESTING EFFICIENCY

There are, of course, other factors than the method and kind of equipment used that affect efficiency in haying. We shall consider briefly the most important of these.

TABLE VII. THE LONG HAUL INCREASES THE COST
412 Records, All Regions, 1926-1927

	Length of haul	Man hours per ton to haul and stack
	rods	
WAGONS:	Less than 80	2.8 hrs.
	80 and over	3.1 hrs.
SLIPS:	Less than 80	2.6 hrs.
	80 and over	2.9 hrs.
BUCKRAKES:	Less than 20	1.8 hrs.
	20 and over	2.2 hrs.

For supplementary data see Table XXXVIII, page 63. Length of haul was obtained only for 1926 and 1927.

Yield. The labor requirement per ton decreases considerably as the yield per cutting increases (Fig. 24). With an increase in yield from a ton to a ton and a half there is a decrease in man labor of about an hour per ton.

It is to be expected, of course, that this relationship should exist between yield and labor requirement per ton. It takes just about as long to mow and rake an acre yielding only a ton as an acre yielding a ton and a half; the time required per ton is, therefore, about 50 percent greater. Even the operations of cocking, and hauling and stacking, require less time per ton, since less ground need be covered for the same amount of hay. While this principle is probably quite generally understood, it is thought that many growers do not appreciate its importance.

There will be further discussion of yield as a factor affecting total cost of production.

Length of haul. The effect of difference in length of haul on labor per ton for hauling and stacking is not as great as might be expected (Table VII). With the length of haul found on most farms, the time used in traveling between the field and the stack is small compared with the time used in loading the hay in the field and unloading it at the stack. Difference in length of haul, therefore, affects only a small part of the total time required and has comparatively small effect on the total labor requirement for harvesting.

Size and organization of haying crews. There is great variation in the size and the organization of haying crews. On the 205 farms that were studied in 1927, 41 different combinations of men and horses were used (Table VIII).

TABLE VIII. VARIATION IN SIZE AND ORGANIZATION OF HAYING CREWS ON THE 205 FARMS STUDIED IN 1927

Haying crew		Number of farms using each crew	Haying crew		Number of farms using each crew
men	*horses*		*men*	*horses*	
2	2	20	6	5	7
3	2	17	6	6	15
3	3	6	6	7	6
3	4	16	6	8	7
4	4	12	7	7	12
4	6	5	7	8	22
5	5	7	8	10	5
5	6	17	26 other combinations		45

It would seem that certain combinations of men and horses for haying crews should be more efficient than others. The data obtained in this study, however, give no conclusive evidence that any particular crew is more efficient on the average than any other. That the crew combinations vary so greatly in itself indicates that there are no especially efficient combinations; if there were, more farmers would have discovered and adopted them.

The size of the crew also apparently has little effect on its efficiency. On the average the small crews and large crews stacked about the same amount of hay per man per day. Apparently the only advantage of large crews is completing the haying more quickly.

It is thought that most men will heartily agree that the next factor to be mentioned—the kind of men in the crew—is far more important than the number of men.

Kind of men, management of crew, condition of equipment, and weather. These factors all affect efficiency in haying, probably more than the other

factors that have been mentioned, with the exception of yield. Unfortunately, it is difficult if not impossible to measure these influences numerically or to determine their effect by a statistical study of this kind.

A haying crew composed of good hard-working experienced hay hands will turn out far more work, of course, other things being equal, than a crew composed of inexperienced help. This factor is largely beyond the control of the grower; he must use whatever help is available. It is an important problem. Many growers complain that it is increasingly difficult to obtain satisfactory labor for haying; many growers are reducing their acreages for this reason alone. The causes of the condition and remedies for it are beyond the scope of this investigation. It is noticeable, however, that this problem has caused many growers to adopt labor-saving methods and equipment.

One man will get more work out of a haying crew than another, other things being equal, simply because of better management—because he is a better boss. This factor depends on the ability of each individual man; it deserves careful study and consideration.

Equipment that does not work well or that is constantly breaking down or getting out of order is a frequent cause of lost time and efficiency in haying, and this factor is entirely within the control of the grower. Equipment should be in good order and repair before haying is begun; repairs or replacements should be on hand for any possible breakdowns so that delay will be minimized. As has been mentioned there are both good and poor derricks; a poor derrick can slow down a haying crew that might otherwise be efficient.

TABLE IX. IT PAYS TO GET A GOOD YIELD
632 Records, All Regions, 1925-1927

Tons per acre	Cost per ton
Less than 2.0	$15.34
2.0 - 3.9	$8.84
4.0 - 5.9	$7.06
6.0 and over	$5.78

For supplementary data see Table XL, page 64.

A shower of rain at an inopportune time can greatly increase the work and cost of haying. In most of the alfalfa regions, however, rain is not a serious problem.

TABLE X. AVERAGE YIELD PER ACRE IN EACH REGION IN EACH YEAR

Year	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River	Average*
			Tons per acre				
1925	5.1	3.4	3.0	3.0	3.1	4.0	3.5
1926	5.0	2.4	3.3	2.9	3.6	3.7	3.3
1927	4.7	3.0	3.2	2.8	3.3	3.9	3.4
AVERAGE	5.0	2.9	3.2	2.9	3.4	3.9	3.4

* Average weighted by Census acreage of alfalfa in each region.
For average yield of each cutting see Table XXXIX, page 64.

3. YIELD AND FACTORS THAT INFLUENCE IT

Yield is usually the chief factor affecting the cost per unit of any farm product, cost per unit meaning cost per ton, per bushel, per gallon, etc. Accordingly, we find that yield per acre of alfalfa hay has a marked relationship to the cost per ton of the hay* (Table IX). Low yields are associated with high costs per ton, and high yields with low costs.

The reason for this relationship between yield and cost is that a large part of the cost is a fixed amount per acre and is just the same whether the yield is high or low. For example, the work of cleaning ditches and irrigating is about the same whether a large or small crop is obtained, the cost of the water is the same, taxes and interest on the land remain constant, and there is the same investment in machinery. With a high yield, then, the cost of these items per ton will be less than with a low yield. More work is necessary, of course, for harvesting a larger crop; but we have already seen that even harvesting labor is less per ton with larger yields (page 35).

Now the yield of alfalfa hay is determined by a large number of things. Some of the things that have the greatest effect on yield the grower cannot control—for example, climatic and soil conditions, anount of irrigation water, insect pests, and diseases. Other things—notably the various cultural practices—he can control, to a certain extent, to influence his yield and thus influence his cost of production.

TABLE XI. GOOD STANDS GIVE GOOD YIELDS
205 Farms, All Regions, 1927

Thickness of stand	Tons per acre
Under 75%	2.8 tons
75% - 89%	3.2 tons
90% - 100%	4.2 tons

For supplementary data see Table XLI, page 65.

Thickness of stand. Naturally a good, thick stand of alfalfa will yield more hay than a poor, thin stand. The growers estimated the percentage thickness of stand of their alfalfa, considering as 100 percent a stand as thick as would be desired. These estimates are necessarily rough and inaccurate because of the difference in standard and judgment of different individuals.

TABLE XII. AGE, THICKNESS, AND ESTIMATED TOTAL LIFE OF ALFALFA STANDS IN EACH REGION

Region	Age (Average 1925-1927)	Thickness (1927)	Estimated total life
	yrs.	%	*yrs.*
Malheur	4.8	82	7.9
Baker-Union	5.7	80	8.3
Umatilla	9.8	85	10.1
Deschutes	6.5	80	9.7
Klamath	6.7	87	9.9
Rogue River	6.6	81	9.9

* See footnote page 18 for multiple correlation results.

They serve, however, to illustrate in a general way the importance of this factor (Table XI).

There is probably more opportunity to reduce the cost of alfalfa hay by plowing up poor stands of alfalfa and replacing them with good stands than in any other way. The grower who goes on year after year harvesting hay from a poor alfalfa stand is simply throwing money away. The only reason that he can do it is that a large part of the cost of production is non-cash or indirect-cash expense, as has been pointed out, and consequently the high cost per ton of the hay is not apparent.

TABLE XIII. NUMBER OF FARMS WITH YOUNG AND OLD STANDS OF ALFALFA THAT HAD STANDS OF GIVEN THICKNESS IN EACH REGION IN 1927, WITH AGGREGATE AVERAGE YIELD FOR EACH GROUP

Regions	YOUNG STANDS (1-5 years)		OLD STANDS (Over 5 years)	
	Over 75% stand	75% stand and under	Over 75% stand	75% stand and under
	farms	*farms*	*farms*	*farms*
Malheur	18	4	1	5
Baker-Union	18	5	11	12
Umatilla	2	3	5	22
Deschutes	11	4	8	14
Klamath	11	2	8	6
Rogue River	9	3	10	13
TOTAL	69	21	43	72
Average yield per acre	4.17 T	2.91 T	4.04 T	2.89 T

The principal reason for the comparatively low production and the comparatively high cost in the Umatilla region is undoubtedly the generally poor stands in that region (Table XII). It must be admitted that reestablishing stands of alfalfa in that region is more difficult than in most other places, chiefly because of the very sandy soils, but it has been demonstrated at the Experiment Station at Hermiston that reestablishing stands is entirely possible and feasible. Many growers seem reluctant to give

TABLE XIV. HIGHER-PRICED LAND GIVES HIGHER YIELDS
62 Records, All Regions, 1925-1927

Value of land per acre	Yield of hay per acre
Less than $100	3.2 tons
$100 - $149	3.3 tons
$150 - $199	3.5 tons
$200 - $249	4.2 tons
$250 and over	5.1 tons

For supplementary data see Table XLII, page 65.

up the idea that a stand of alfalfa once established should ever have to be renewed.

Age of stand. Alfalfa stands deteriorate with age and in general the older stands are poorer. There are many young stands, however, that are

poor, and many old stands that are still highly productive (Table XIII). It is obvious, therefore, that the time to plow up alfalfa should be determined by the condition of the stand rather than its age, unless, of course, it is being grown in regular rotation that involves plowing up at certain times.

Value of land. The average value per acre placed upon land used for alfalfa in each region was as follows: Malheur, $150; Baker-Union, $117; Umatilla, $151; Deschutes, $119; Klamath, $135; Rogue River, $230. The average for the state, weighted by the census acreage of alfalfa in each region, was $145 per acre; for the five Eastern Oregon regions, omitting Rogue River, it was $132 per acre.

There was of course considerable variation in the land values of individual farms in each region. In general, yields were higher on the lands on which the higher market values were placed (Table XIV). Costs per acre were higher on the higher priced land, but because of the higher yields costs per ton were about the same. Evidently in general the higher yielding

TABLE XV. PERCENTAGE OF ACREAGE FERTILIZED WITH EACH KIND OF FERTILIZER, AND AVERAGE APPLICATION PER ACRE, 1925-1927

Region	Manure		Sulfur		Land-plaster		Superphosphate	
	Percent of acres	Loads per acre	Percent of acres	Pounds per acre	Percent of acres	Pounds per acre	Percent of acres	Pounds per acre
Malheur	3	8	—	—	—	—	—	—
Baker-Union	6	7	—	—	14	207	—	—
Umatilla	8	9	1	100	—	—	—	—
Deschutes	6	10	69	57	13	89	—	—
Klamath	14	10	12	98	—	—	—	—
Rogue River	7	10	13	85	14	150	3	162

land costs enough more just about to offset its greater production, while the poorer land is enough cheaper that alfalfa can be produced at about the same cost per ton.

These inferences are, of course, generalities based on averages of many cases. In many individual cases high-priced land is cheap, and low-priced land is dear, when judged by its production of hay.

Fertilization. Prevailing practice in fertilizing alfalfa is widely different in the different regions (Table XV). This is to be expected, for the effect of fertilizers is different under different conditions and what will pay in one region will not pay in another.

In the Malheur and Umatilla regions there was not enough fertilization to give an indication of its effectiveness or profitableness. In the other four regions the farms that were fertilized gave higher yields at lower costs per ton, on the average, than those that were not (Table XVI). The

TABLE XVI. FERTILIZING INCREASES YIELD AND DECREASES COST
145 Farms, Baker-Union, Deschutes, Klamath, Rogue River, 1927

Part of acreage fertilized annually 1925-1927	Yield per acre, 1927	Cost per ton
⅓ and over	3.8 tons	$7.71
Under ⅓	3.0 tons	$8.32

For supplementary data see Table XLIII, page 66.

indicated profitableness of fertilization is not as great as some might expect, but this may be because irregularities caused by other factors obscure the effect of fertilization.

The probable profitableness of fertilization must be determined by each grower for himself, from fertilizer trials on his own farm or under comparable conditions.

Cultivation. It is a common practice to cultivate alfalfa, mostly with the spring-tooth harrow, to control weeds and grasses. This cultivation is done either before or after the growing season in all of the irrigated regions, but in the Willamette Valley a few growers make a practice of cultivating after each cutting.

The data obtained in this study indicate, although not as definitely as might be desired, that growers who cultivated obtained somewhat higher yields, apparently enough higher to pay for the cultivation and give slightly lower costs per ton besides (Table XVII).

TABLE XVII. CULTIVATION PAYS
205 Farms, All Regions, 1927

Percent of acreage cultivated	Yield per acre	Cost per ton
80% and over	3.7 tons	$8.10
Under 80%	3.1 tons	$8.49

For supplementary data see Table XLIV, page 66.

Size of acreage. No correlation is apparent between size of acreage and cost of production. Slightly lower yields for the larger acreages are offset by lower harvesting costs resulting from greater use of the buck-rake method of haying.

4. COST OF ESTABLISHING A STAND OF ALFALFA

An element of cost in producing alfalfa hay that is sometimes overlooked is the part of the original cost of establishing the stand of alfalfa that should be charged against the current year's crop as depreciation of stand. Unfortunately, in most cases it is impossible to determine this item for the present stands of alfalfa because they were established too long ago to obtain reliable estimates of their cost. This item has been estimated, therefore, on the basis of present costs of establishing a stand of alfalfa.

Methods of seeding. Several methods of seeding alfalfa are practiced in Oregon, but these may be divided into two general methods. The first is seeding alone, or with only a light seeding of grain that is strictly for a nurse crop to the alfalfa and not for the production of either threshed grain or grain hay. The alfalfa is sown in the spring or early summer, mostly in April and May, and the land is used for no other purpose during the entire year than to start the young alfalfa.

The other general method is seeding with grain, and obtaining from the land a crop of threshed grain or grain hay in addition to starting the young alfalfa. There are two common ways of doing this: first, sowing with spring grain, the more common practice in all of the regions except Malheur; and second, sowing in the stubble in August or early September after removing the grain crop, which is the more common practice in Malheur

and is followed to some extent in the other regions. There is very little sowing with fall grain. Of the acreage sown with spring grain 38 percent was with wheat, 40 percent with barley, and 22 percent with oats. When sown either with spring grain or in stubble in late summer, alfalfa usually produces enough hay in the following calendar year to be considered an established stand, although maximum production usually is not reached for two or three years.

The percentage of the acreage of new seeding in each region that was seeded alone and with grain is shown in Table XVIII. The difference in the proportionate amount of each method in the different regions is caused

TABLE XVIII. PERCENTAGE OF ACREAGE OF NEW SEEDING THAT WAS SEEDED ALONE AND WITH GRAIN IN EACH REGION, 1925-1927

	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River
Number of records	43	29	19	28	27	23
Number of acres	539	819	390	264	433	234
	%	%	%	%	%	%
Seeded alone	11	37	29	17	24	83
Seeded with grain	89	63	71	83	76	17
Total	100	100	100	100	100	100

by differences in conditions that affect the success of obtaining a stand of alfalfa with grain, which seem to be chiefly as follows:

(1) *Amount of irrigation water and season that it is available.* In seeding with grain summer irrigation is usually necessary for the young alfalfa after the grain has been harvested, and is also essential for germinating the alfalfa seed when it is sown in the stubble in late summer or fall.

(2) *Kind of soil.* In seeding with grain on heavy land, the soil has a tendency to bake and harden after the grain is harvested, thus injuring the young alfalfa. On very sandy land the soil dries out so quickly that it is difficult to keep the young alfalfa from burning.

(3) *Amount of weeds.* Seeding alone gives an opportunity to control weeds by thorough cultivation during the spring, but on the other hand some growers think that they have fewer weeds in their alfalfa when they seed with grain because the grain helps to smother them out.

Quality of stand obtained. Growers who seeded alone estimated on the average that the stands that they obtained were only 86 percent perfect, while growers who seeded with grain estimated theirs at 89 percent. Undoubtedly this was because the seeding alone was under the less favorable conditions.

When conditions are favorable for seeding with grain most growers think that they obtain satisfactory stands by that method. A few, however,

TABLE XIX. PERCENTAGE OF ACREAGE OF NEW SEEDING THAT WAS SOWN TO EACH VARIETY, 1925-1927

	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River
	%	%	%	%	%	%
Common alfalfa	85	57	96	45	14	97
Grimm alfalfa	15	39	4	52	86	3
Baltic alfalfa	—	4	—	3	—	—
Total	100	100	100	100	100	100

seed alone even under favorable conditions for seeding with grain, because they think that they obtain stands enough better to pay for the extra cost. With as long lived a crop as alfalfa, and with thickness of stand as important as has been shown, the extra cost of seeding alone undoubtedly is justified if it gives a materially better stand.

Varieties sown. Grimm and Common alfalfa were sown almost exclusively (Table XIX). The proportion of Grimm was comparatively small in Malheur, Umatilla, and Rogue River, the lower-altitude regions, and comparatively large in Baker-Union, Deschutes and Klamath, the higher-altitude regions.

Cost of each method. The cost of seeding alone is much higher than that of seeding with grain (Table XX). This is because in seeding alone the alfalfa must be charged with all of the labor and with the entire cost

TABLE XX. COSTS PER ACRE OF SEEDING ALFALFA ALONE AND WITH GRAIN, IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON, 1925-1927

Items	Seeding alone	Seeding with grain
Number of records	56	113
Number of acres	914	1765
Direct man labor	$6.06	$1.53
Overhead man labor	1.42	.51
Horse labor	2.72	.73
Tractor	.50	.01
Other machinery	.84	.29
Alfalfa seed	3.52	2.96
Other seed	.11	.01
Fertilizer	.22	.04
Irrigation water	1.82	.19
Taxes	2.14	.10
Interest on land	8.09	.38
Total	$27.44	$6.75
Credit for hay	4.99	.53
Credit for pasture	1.12	.79
TOTAL NET COST PER ACRE	$21.33	$5.43

For explanation of cost items see Appendix A.

of irrigation water, taxes, and interest on the land for the year; whereas, in seeding with grain, all or a large part of these costs are chargeable to the grain crop.

In computing the cost of seeding with grain, any extra labor because of sowing the alfalfa with grain, such as extra harrowing or leveling, has been charged entirely to the alfalfa. If a full crop of grain was obtained, no charge has been made against the alfalfa for the regular work for the grain crop nor for the irrigation water, taxes and interest. In a few cases where it was estimated that the grain was reduced from a full crop to some extent, as by a fourth or a third, a corresponding proportion of the cost of the labor and other costs has been charged to the alfalfa. These cases of reduction of the grain crop, were caused by excessive irrigation for the young alfalfa, by lighter than normal seeding of the grain, or by early harvesting of the grain. For all of the seeding with grain this estimated reduction of the grain crop averaged only 7 percent. The average yields of threshed spring grain in which alfalfa was seeded were: wheat, 32 bushels; barley, 43 bushels; oats, 47 bushels.

Fig. 25. A good stand of young alfalfa in wheat stubble. Seeding in connection with a grain crop is the cheapest way to establish a stand of alfalfa in most regions. Farm of L. E. Sullivan, Hermiston.

An average of 12 pounds of seed per acre was used in seeding alone, and 11 pounds in seeding with grain. The small item of "Other Seed" is chiefly for nurse crop seed in the seeding alone, and for a small amount of other grass seed sown with the alfalfa in the seeding with grain. Credit is allowed for the hay harvested from the new seeding and also for the value of pasture obtained from it. This credit is much larger for the seeding alone, as would be expected, but it far from offsets the additional cost of this method. An average of .7 ton of hay per acre was obtained from the seeding alone, and .1 ton from the seeding with grain. The yield from the

TABLE XXI. MAN HOURS AND HORSE HOURS PER ACRE FOR OPERATIONS UPON ALFALFA SEEDING ALONE AND WITH GRAIN, 1925-1927

Operations	Seeding alone		Seeding with grain*	
	Man labor	Horse labor	Man labor	Horse labor
	hrs.	*hrs.*	*hrs.*	*hrs.*
Fertilizing, manuring	.3	.8	.2	.3
Plowing	2.3	5.3	.2	.7
Disking, rolling, harrowing	3.0	9.3	.5	1.6
Leveling, bordering, ditching	1.4	2.2	.7	2.5
Spreading straw	.1	.2		
Seeding	1.0	2.7	.5	1.0
Irrigating	3.4		1.3	
Harvesting	4.5	6.6	.8	1.2
TOTAL	16.0	27.1	4.2	7.3

* Only labor charged to the alfalfa is shown.

seeding alone was increased in some cases, of course, by the nurse crop which was harvested with the first clipping of the new alfalfa.

The amounts of man and horse labor per acre for the various operations in seeding alone and the amounts of labor charged to the alfalfa in seeding with grain are shown in Table XXI. Of the acreage seeded alone, 86 percent was sown with seeder attachments on grain drills or with special alfalfa drills, and 14 percent was sown with hand seeders. Of the acreage seeded with grain, 70 percent was sown with drills or drill attachments and 30 percent was sown with hand seeders.

The average difference in cost between seeding alone and seeding with grain, $15.90 per acre, is an important consideration in the cost of producing alfalfa hay. With the average life of stand, 9.3 years, it would amount to $1.71 per acre annually. This with the average yield per acre, 3.4 tons, would be 50 cents per ton, which is 6 percent of the average total cost.

It is probable that most of the growers who are seeding with grain could seed alone somewhat more cheaply than those who are now seeding alone, because their conditions are more favorable, which would reduce this

TABLE XXII. COST OF ESTABLISHING A STAND OF ALFALFA, AND LIFE AND DEPRECIATION OF STAND, IN EACH REGION, 1925-1927

	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River
Number of records	43	29	19	28	27	23
Number of acres	539	819	390	264	433	234
Direct man labor	$2.54	$2.09	$3.62	$3.08	$2.55	$5.29
Overhead man labor	.60	.52	1.25	.82	.63	1.92
Horse labor	.72	1.38	2.10	.91	1.46	2.32
Tractor		.20				.81
Other machinery	.30	.43	.48	.33	.58	.87
Alfalfa seed	2.45	2.85	3.11	3.08	3.32	3.35
Other seed		.02	.16	.09	.04	.02
Fertilizer				.22		.58
Irrigation water	.80	.11	.83	.69	.41	1.84
Taxes	.33	.82	.48	.50	.24	2.59
Interest on land	.72	2.48	2.25	1.70	1.59	10.31
Total	8.46	10.90	14.28	11.42	10.82	29.90
Credit for hay	1.53	2.35	1.76	1.14	.89	3.91
Credit for pasture	1.30	.93	.33	.95	.58	1.88
TOTAL NET COST PER ACRE	$5.63	$7.62	$12.19	$9.33	$9.35	$24.11
Expected life of stand (yrs.)	7.9	8.3	10.1	9.7	9.9	9.9
ANNUAL DEPRECIATION PER ACRE	$.71	$.92	$1.21	$.96	$.94	$2.44

For explanation of cost items see Appendix A.

difference in cost between the two methods. But on the other hand many growers plan to rotate their alfalfa in less than 9.3 years, and the extra cost per ton would consequently be greater.

Then there is the question whether seeding alone would give enough better stand to give enough greater yield to compensate for the additional cost. This study sheds no light on this phase of the problem. More experimental data are needed on the relation between thickness of stand and yield, and on the production of stands seeded alone and with grain under various conditions.

Regional costs and depreciation of stand. The cost of establishing a stand of alfalfa in each region, the life of the stand, and the annual deprecia-

tion charge are shown in Table XXII. The expected life of the stand is the average estimate of all of the growers interviewed in each region. Some growers make a practice of rotating alfalfa before it begins to run out, and the shorter expected life in the Malheur region is because of more rotation in that region. The annual charge for depreciation of stand for each region has been determined by dividing the total net cost of establishing the stand by the expected life.

The comparatively high cost in the Rogue River region is chiefly because of the high proportion of seeding alone in that region (Table XVIII). For most of the growers there, one or more of the limiting factors of heavy soil, lack of water, or weeds, probably make seeding alone necessary. Some of them, however, have conditions that are favorable for seeding with grain, but apparently seed alone merely because it is the prevailing practice; these growers perhaps could obtain satisfactory stands and reduce their cost by seeding with grain.

Amount of failure. Estimates were obtained from the growers as to the percentage of failure in securing a stand that they expect. This averaged less than ten percent in all regions except Umatilla, where it was twenty-five percent. The high figure for Umatilla is because of the difficulty of securing a stand on some soils in that region that are very sandy. The average expected percentage of failure for all seeding alone was seven percent, as compared with eight percent for all seeding with grain. It should be remembered, however, that the two methods are not used under comparable conditions.

LABOR PRACTICES AND REQUIREMENTS IN PRODUCING ALFALFA HAY

Certain operations, particularly fertilizing and harvesting, have been discussed to some extent in the preceding pages. We are now ready to summarize and consider in more detail all of the various labor operations on alfalfa hay. Four phases of these operations will be considered: first, the practices in the several regions; second, the relative importance of each operation in each region; third, labor requirment, or duty of labor, for each operation; and fourth, seasonal distribution of the operations.

Practices in each region. In Table XXIII are summarized the percentage of the acreage covered and the number of times over for each operation in each region. This shows how much each operation is used in each region and differences in methods and practices between the regions. In addition to the differences in practice in fertilizing and harvesting, which have already been discussed, it is interesting to note the larger amount of corrugating in Malheur and Deschutes; the irrigation of only one-half of the acreage in Baker-Union and three-fourths of the acreage in Rogue River; the small amount of cocking by hand and the large amount of bunching in Umatilla; and the considerable use of the practice of yarding in Umatilla.

Relative importance of operations. In Table XXIV is summarized the amounts of man and horse labor on an average acre of crop for each operation. This shows for each region the relative importance in labor cost of each operation. The differences in amounts of labor between the regions are caused chiefly by the difference in practice as shown in the preceding table.

TABLE XXIII. PERCENTAGE OF ACREAGE COVERED AND NUMBER OF TIMES OVER FOR EACH OPERATION, 1925-1927

Operations	Malheur		Baker-Union		Umatilla		Deschutes		Klamath		Rogue River	
	Percent covered	Times over	Percent covered	Times over	Percent covered	Times over	Percent covered	Times over	Percent covered	Times over	Percent covered	Times over
Fertilizing	—	—	14	1.0	1	1.0	77	1.0	12	1.0	29	1.1
Manuring	3	1.0	6	1.0	7	1.0	6	1.0	14	1.0	7	1.0
Spring-toothing	21	1.7	60	1.8	90	2.8	48	1.8	43	1.7	69	2.5
Other cultivation	13	1.1	38	1.2	34	1.4	5	1.1	13	1.9	12	1.7
Cleaning ditches	91	1.2	46	1.0	95	1.3	86	1.0	91	1.0	70	1.1
Corrugating	39	1.0	5	1.0	16	1.0	43	1.0	—	—	1	1.3
Irrigating	100	5.0	52	2.2	96	4.0	100	4.3	100	3.0	73	3.8
Mowing	100	3.0	100	2.3	100	2.8	100	2.2	100	2.1	100	3.0
Dump raking	100	3.0	100	2.3	97	2.8	100	2.2	98	2.1	100	3.0
Side-delivery raking	—	—	—	—	3	3.0	—	—	2	2.0	—	—
Tedding	3	1.0	1	1.0	—	—	—	—	—	—	3	1.3
Cocking by hand	93	3.0	45	2.3	21	2.9	78	2.2	100	2.0	98	3.0
Bunching:												
Dump rake	4	1.6	51	2.2	15	3.0	43	2.1	14	1.9	2	2.1
Buckrake	2	3.0	—	—	61	2.6	—	—	3	2.0	—	—
Yarding	2	3.0	1	1.5	29	2.4	—	—	1	2.0	—	—
Haul and stack:												
Wagons	69	3.1	21	1.9	10	2.9	50	2.2	83	2.1	95	3.1
Slips	25	2.8	37	2.2	15	2.9	43	2.1	16	2.0	4	3.3
Buckrakes	6	3.0	53	2.1	77	2.7	12	2.0	2	2.0	1	3.0

TABLE XXIV. TOTAL HOURS OF MAN LABOR AND HORSE LABOR USED PER AVERAGE ACRE OF CROP FOR EACH OPERATION, 1925-1927*

Operations	Malheur		Baker-Union		Umatilla		Des-chutes		Klamath		Rogue River	
	Man labor	Horse labor	Man labor	Horse labor	Man labor	Horse labor	Man labor	Horse labor	Man labor	Horse labor	Man labor	Horse labor
	hrs.	*hrs.*	*hrs.*	*hrs.*	*hrs.*	*hrs.*	*hrs.*	*hrs.*	*hrs.*	*hrs.*	*hrs.*	*hrs.*
Fertilizing	—	—	.1	.2	—	—	.5	1.0	.1	.1	.2	.3
Manuring	.2	.4	.4	.7	.6	1.1	.5	.9	1.2	2.4	.6	1.1
Spring-toothing†	.4	1.4	.8	3.1	1.7	9.1	.9	2.7	.7	2.5	1.6	3.4
Other cultivating	.1	.5	.2	.7	.3	1.4	.0	.1	.2	.8	.2	.5
Cleaning ditches	1.3	1.0	.5	.2	1.4	.5	.9	.3	.9	1.0	1.0	.2
Corrugating	.5	1.0	.0	.1	.2	.3	.4	.9	—	—	—	—
Irrigating	5.8	—	1.3	—	4.8	—	5.3	—	3.6	—	3.5	—
Miscellaneous	.2	.1	.2	.2	.1	.3	—	—	.0	.1	.1	.1
TOTAL EXCEPT HARVEST	8.5	4.4	3.5	5.2	9.1	12.7	8.5	5.9	6.7	6.9	7.2	5.6
Mowing	3.8	7.6	2.8	5.5	3.5	7.0	2.4	4.7	2.2	4.4	3.2	6.5
Raking	1.8	3.5	1.1	2.3	1.6	3.1	1.2	2.3	1.1	2.2	1.5	3.1
Cocking by hand	4.8	—	1.8	—	.6	—	2.2	—	3.7	—	5.0	—
Bunching with rake	.0	.1	.3	.5	1.2	2.5	.3	.7	.1	.2	—	—
Haul and stack	14.2	15.6	7.4	8.6	6.7	8.1	8.1	8.7	9.4	10.2	11.3	10.2
TOTAL HARVEST	24.6	26.8	13.4	16.9	13.6	20.7	14.2	16.4	16.5	17.0	21.0	19.8
TOTAL	33.1	31.2	16.9	22.1	22.7	33.4	22.7	22.3	23.2	23.9	28.2	25.4

* The amounts of labor in this table are not for an acre once over of each operation but for the total amount of each operation on an average acre of crop, which may be more or less than an acre once over of the operation. For labor requirements per acre once over see tables XXV and XLV.

† Tractor work, amounting to .1 hour per acre in Baker-Union, .1 hour in Umatilla, and .5 hour in Rogue River was also used for spring-toothing.

Variations in practice between individual farms in the same region cause considerable variation in individual costs. Growers should carefully consider whether, under their conditions, it would be profitable to increase or decrease the amount of any operation.

Labor requirements for each operation. Table XXV shows the amount of each operation accomplished in a day, on the average farm, on the 10 percent of the farms that did the most in a day, and on the 10 percent of the farms that did the least in a day. In general, the highest 10 percent did about twice as much as the average, and the lowest 10 percent about half as much; but certain operations are exceptions to this. On irrigating, for example, the high 10 percent of the farms accomplished four times as much as the average; in mowing, on the other hand, the high 10 percent did only 50 percent more.

TABLE XXV. HOW MANY ACRES IS A DAY'S WORK?

Operations	Acres covered per man in 10 hours		
	All farms	10% of farms covering the most acres	10% of farms covering the fewest acres
Fertilizing with spreader	15	31	6
Fertilizing by hand	7	17	4
Manuring (spreader)	1	3	½
Spring-toothing with horses	10	22	5
Spring-toothing with tractor	16	32	8
Disking	10	19	5
Spike harrowing	18	37	9
Cleaning ditches	8	50	3
Corrugating	9	24	5
Irrigating	8	32	3
Mowing	8	12	6
Raking (dump rake)	19	28	13
Cocking	6	16	4
Bunching with dump rake	32	83	17
Bunching with buckrake	16	31	9
Hauling with wagons	2	5	1
Hauling with slips	3	6	1½
Hauling with buckrakes	4	9	2

For additional data see Table XLV, page 67.

This variation in acreage covered on different farms is caused partly by differences in natural conditions and partly by the efficiency with which the operation is performed. The extreme variation in irrigating is caused chiefly by extreme variation in conditions for irrigating, such as the lay of the field and the head of water available, rather than by differences in efficiency of the irrigators, although the latter factor undoubtedly has its effect. Improvement in the lay-out and surfacing of fields for more efficient irrigating is an important means of reducing irrigation costs. On the other hand, in an operation like spring-toothing, although the condition of the field has some effect, factors such as the size of the outfit used and the condition of the horses are more important.

The minimum variation is found in the operations of mowing and raking, for in these operations the effect of conditions is comparatively less important and there is also practically no variation in the size of the outfits used.

Growers who would reduce their cost of production, or keep it at a minimum, must keep their labor requirements as low as possible. They should endeavor to attain the maximum efficiency indicated in the table to the extent that their conditions permit.

Seasonal distribution of operations. Labor on alfalfa may be divided into three classes according to its seasonal distribution. The smallest class

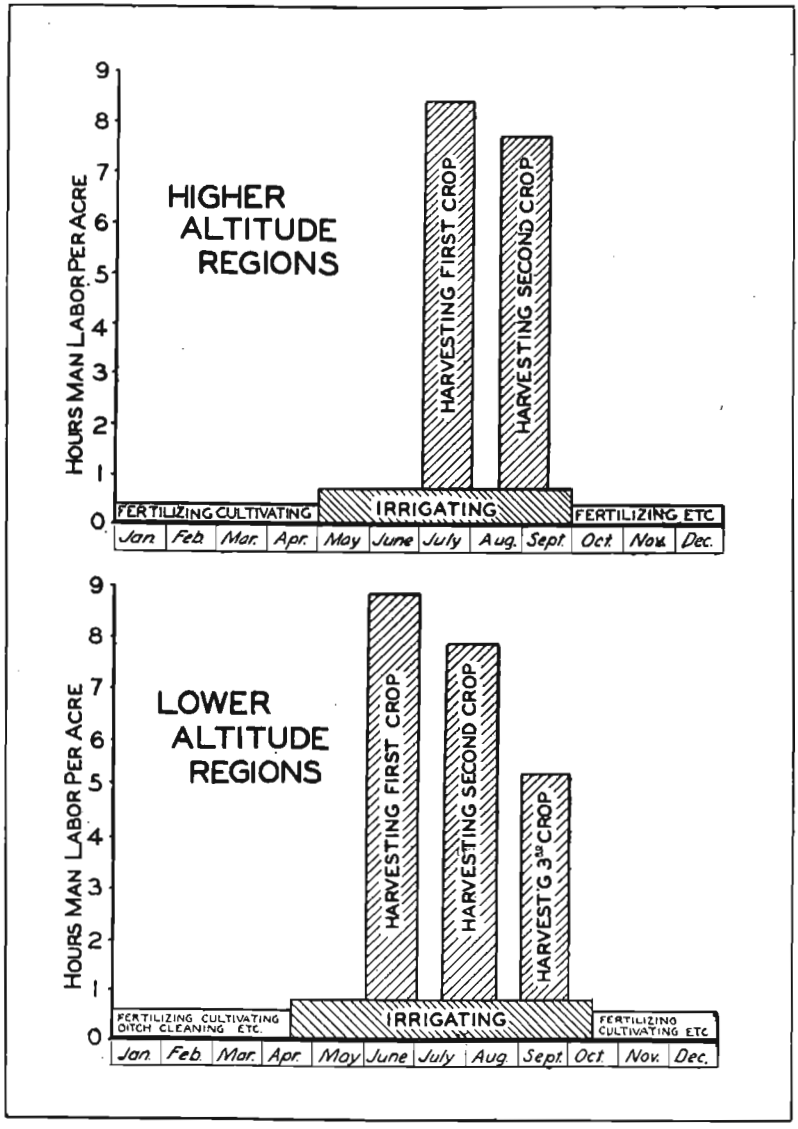


Fig. 26. Seasonal distribution of labor on alfalfa hay.

consists of the operations of cultivating, fertilizing, manuring, ditch cleaning, corrugating, seeding to thicken stand, and other miscellaneous operations. These operations are performed during the fall, winter, and spring. Considerable leeway is possible in the time at which these operations are performed and usually they are fitted in according to seasonal conditions and other work on the farm. Cultivating is done more commonly in the spring than in the fall, and wet springs sometimes interfere with it.

The second class of labor from a seasonal standpoint is irrigation. On most farms where irrigation water is available all summer this is done throughout the growing season. It must be done when needed, of course, but as a general rule it can be fitted in with other work. In some localities it must be done at certain specified times when the water is made available for the farm. In some cases it is even necessary for the grower to put in 24 or 36 hours at a stretch at irrigating while he has the water. On many large farms it is common for one man to devote practically all of his time throughout the season to irrigating.

These two classes of seasonal work that have been considered constitute less than a third of the total labor on alfalfa hay. The third class, harvesting labor, is more than two-thirds. Harvesting differs from the other operations in that it must be done within certain relatively short periods instead of being spread over long periods.

The seasonal distribution of labor on alfalfa is shown graphically in Fig. 26. These diagrams are necessarily rather arbitrary, as there are countless variations from them on individual farms and in different seasons. They represent in a general way, however, the typical seasonal distribution in the lower-altitude and in the higher-altitude regions.

The high peak labor requirements for harvesting are apparent. Because of these peak labor requirements it is necessary for growers with more than a few acres to have extra help for haying, as is of course well known, and obtaining satisfactory help is often difficult. The work on irrigated alfalfa other than the harvesting labor can be distributed fairly uniformly throughout the year, and with a large enough acreage can afford practically full-time employment for the grower.

ALFALFA IN THE FARM BUSINESS

In the six principal alfalfa regions that have been discussed alfalfa hay is the most important crop that is raised, and to a large extent the farming business in these regions is based on alfalfa production.

TABLE XXVI. ACREAGE PER FARM USED FOR VARIOUS PURPOSES IN EACH REGION, 1925-1927

	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River
	acres	*acres*	*acres*	*acres*	*acres*	*acres*
Alfalfa hay	32	76	58	41	51	31
Other hay	10	16	0	4	6	4
Grain	28	113	10	12	41	19
Cultivated crops	12	4	4	4	9	9
Total crops	82	209	72	61	107	63
Summer fallow	0	30	1	5	12	7
Irrigated pasture	10	21	4	21	38	4
Non-irrigated pasture	26	125	8	26	55	42
Farmstead and waste	10	14	26	47	28	28
TOTAL FARM ACREAGE	128	399	111	160	240	144

Type of farming. A general idea of the organization of the farms that were studied in each region may be obtained from Tables XXVI and XXVII. In general alfalfa constitutes about 50 percent of the total crop acreage and nearly 90 percent of the acreage of hay.

TABLE XXVII. NUMBER PER FARM OF EACH KIND OF LIVESTOCK IN EACH REGION, 1925-1927

	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River
Horses	6	14	6	4	7	3
Milk cows	7	10	7	10	9	8
Other cattle	13	34	8	10	27	19
Sheep*	90	191	26	66	92	11
Hogs	24	30	12	7	6	14
Chickens	125	75	74	97	129	107
Turkeys	10	5	11	15	18	11

*Including range sheep handled as part of the farm business.

It is apparent that there is considerable variation in type of farming between the regions. The farms in the Baker-Union and Klamath regions are the largest and have the most pasture. Those in the Umatilla region are the smallest and have the least pasture, and the largest proportion of alfalfa. The most livestock is found in the Baker-Union and Klamath regions, corresponding with the largest amounts of pasture. The least livestock is found in the Umatilla region with the least pasture.

Specializing on alfalfa hay exclusively as a farm business is found only occasionally and is not very practicable or desirable for several reasons. For one thing, it is desirable to have livestock to utilize the hay, putting the manure back on the land to maintain fertility. It is also desirable to rotate alfalfa with other crops, in order to control weeds and maintain better soil conditions.

And then, enough alfalfa hay to give a sufficient volume of business for a good income involves an extensive acreage and a large amount of extra help for harvesting; whereas combining other crop and livestock enterprises with the alfalfa gives a sufficient volume of business with a smaller acreage of land and with much less extra hired help. The work required by the other crops can be fitted in with hay harvesting during the summer, and feeding provides remunerative work during the winter.

It is for these reasons that, although in return to land, labor, and capital combined, alfalfa may be the most profitable major crop in these regions, and although it is raised to a considerable extent for sale as a cash crop, it is usually combined with other crops and with dairying or sheep or cattle feeding, as indicated by tables XXVI and XXVII. Dairying was the leading livestock enterprise, but sheep and cattle feeding, and hog raising, were important in most of the regions. The principal crop enterprise other than alfalfa was grain raising, with potatoes also important, particularly in the Deschutes and Klamath regions, and corn an important crop in the Malheur region.

Capital investment in the alfalfa enterprise. The average capital investment involved in raising alfalfa hay, which has been indicated in the discussion of cost by the interest charges, is shown per farm and per acre of alfalfa in Table XXVIII. These figures of course represent only the part of the total farm investment that was used for the alfalfa; they do not

include the part of the total investment in land, buildings, and equipment that was used for other farm enterprises. It is apparent that the capital investment for alfalfa raising consists chiefly of the value of the land used for the crop. For the state, the average total investment per acre of alfalfa, weighted by the census acreage of alfalfa in each region, was $156 per acre.

TABLE XXVIII. AVERAGE CAPITAL INVESTMENT IN THE ALFALFA ENTERPRISE, PER FARM AND PER ACRE OF ALFALFA, 1925-1927

Region	Investment per farm				Investment per acre of alfalfa			
	Land	Machinery (including automobile)	Horses, barn, harness	Total	Land	Machinery (including automobile)	Horses, barn, harness	Total
Malheur	$4480	$204	$156	$4840	$150	$7	$5	$162
Baker-Union	8424	345	259	9028	117	5	4	126
Umatilla	8411	312	301	9024	151	6	5	162
Deschutes	4831	211	146	5188	119	5	3	127
Klamath	6411	343	191	6945	135	7	4	146
Rogue River	6204	184	113	6501	230	7	4	241

Utilization of alfalfa. The percentage of the hay that was fed or held for feed by the grower at the time that the records were taken and the percentages that were sold or held for sale in various ways are shown in Table XXIX. This is not a complete and final picture of the disposition of the hay, however, for weather conditions may later have changed plans to feed or sell it, and some that was held for sale in the stack was doubtless later baled out for shipment. The figures indicate, however, that on the average about three-fifths of the hay is fed by the growers while about two-

TABLE XXIX. PERCENTAGE OF ALFALFA HAY FED OR HELD FOR FEED, AND SOLD OR HELD FOR SALE, IN EACH REGION, 1925-1927

	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River
	%	%	%	%	%	%
Fed or held for feed by grower	56	71	41	74	62	62
Sold loose in field	1	3	2			11
Sold or held for sale in stack or barn	43	22	47	22	33	18
Sold baled from field			2			5
Sold baled from stack or barn		4	8	4	5	4
TOTAL	100	100	100	100	100	100

fifths is sold as a cash-crop, and that the proportion that is baled and shipped out of the region where it is grown is comparatively small. No alfalfa was shipped out of the Malheur region during these years because of the quarantine for alfalfa weevil. The kinds of livestock to which the hay was fed may be judged from Table XXVII.

Measuring and selling. More alfalfa hay is sold loose in the stack by stack measurement than is baled out and sold by weight. The rule most

generally used to determine the cubic contents of a stack is the Frye rule, which is to subtract the width from the overthrow, divide by 2, and multiply by the width and then by the length $\left[\frac{O-W}{2} \times W \times L\right]$. In the Deschutes region, however, the Quartermaster rule is used more commonly, which it to add the width to the overthrow, divide by 4, square the result, and multiply by the length $\left[\left(\frac{O+W}{4}\right)^2 \times L\right]$. Other rules are used occasionally.*

To determine the number of tons the cubic contents are usually divided by 512 ("8-foot measurement") for hay that has settled, which usually means 30 days or more in the stack. After 60 to 90 days, 422 cubic feet per ton ("7½-foot measurement") is more commonly used, and after six months 343 cubic feet ("7-foot measurement") may be used.

It is evident that a "ton" of hay is not a very definite unit when measured in the stack. Because of the variation in measurement that is possible, prices paid for hay in the stack often vary with the method of measurement.

Comparatively little consideration is given to quality when hay is bought and sold in the stack. This is unfortunate, as it discourages effort to put up good quality hay and is an incentive to let the hay get too coarse and too dry in order to get larger stack measurement. When shipped and sold by grade the better quality hay often brings considerable premium.† Feeders who buy hay in the stack could well afford to pay a similar premium and should be willing to do so.

Prices. Average prices received for alfalfa hay in each region during the years of the study are shown in Table XXX. These are prices received in actual sales made by the growers included in the study. The prices are

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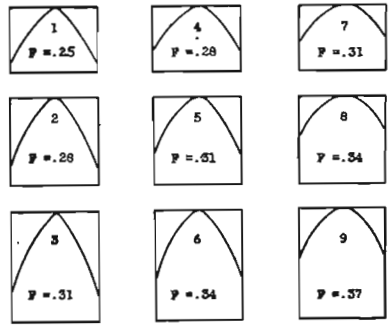
* The following information on measuring haystacks is obtained from Circular 67, Office of the Secretary, United States Department of Agriculture:

The Frye rule is accurate only for stacks of shape number 4 as indicated in the diagrams below; it varies from 13 percent too low to 12 percent too high for the other shapes. The Quartermaster rule is accurate only for shape number 7, varying from 17 percent too low to 7 percent too high for the other shapes.

The most accurate rule for determining the volume of a haystack according to Circular 67 is the "FOWL" rule, the formula for which is:

Volume = F x O x W x L



F is a fraction varying from .25 to .37 according to the shape of the stack as indicated in the diagrams; O is the overthrow or distance over the stack from the base on each side; W is the average width; and L is the average length. To find the volume of a stack in cubic feet, first determine the value of F by comparing the shape of the stack with the diagrams, multiply this by the overthrow in feet, multiply the product by the width in feet, and multiply this product by the length in feet.

† For discussion of important factors in producing high quality hay see United States Department of Agriculture Farmers' Bulletin 1539, High Grade Alfalfa Hay, by Edward C. Parker.

for hay loose in the stack, but include a number of sales of hay that was baled out for shipment; in such cases the price in the stack was determined by deducting the cost of baling and hauling from the f.o.b. price of the baled hay. In round numbers the price averaged $10 per ton in all of the regions except Malheur, where it was $8, and Rogue River, where it was $12. It is probable that prices in the Malheur region have been depressed by the quarantine for alfalfa weevil which has prevented shipments from that region.

Alfalfa hay is often sold to cattle men or sheep men who bring their stock and feed the hay on the place. When this is done, the grower of course gets the manure, which is a worth-while consideration. Growers who furnish good feeding grounds or lambing sheds usually get $0.50 or $1.00 per ton extra for their hay. Some growers feed their hay to the buyer's stock at a certain price per ton, thus providing remunerative winter work for themselves. In summarizing the average prices in Table XXX extra prices such as these for feeding the hay or for furnishing feeding facilities have not been included.

TABLE XXX. PRICES RECEIVED FOR ALFALFA HAY IN THE STACK OR BARN IN EACH REGION, 1925-1927

Region	Average price per ton				Range in prices
	1925	1926	1927	3-year average	
Malheur	$ 8.97	$ 7.68	$ 8.10	$ 8.25	$ 7.00-$10.00
Baker-Union	10.69	9.70	9.16	9.85	8.00- 12.00
Umatilla	11.20	9.73	9.07	10.00	7.00- 12.00
Deschutes	10.05	10.89	9.68	10.21	7.00- 12.00
Klamath	8.85	10.70	10.24	9.93	8.00- 13.00
Rogue River	10.62	12.80	13.18	12.20	9.00- 15.00

Comparing the average prices with the average cost figures that have been given indicates a comfortable margin of profit. In judging this profit, however, two considerations are important. First, the prices probably include too large a proportion of premium prices for better quality hay. Second, although the average price indicates a fairly large profit over cost of production per ton, with the average yield 3.4 tons per acre, neither the profit in dollars per acre nor the percentage return on the total capital investment of $156 per acre would be large. Even adding this profit to the return for his labor and 5 percent interest on his investment that have been included in the cost of production, the grower must have a rather large acreage and capital investment to make a satisfactory income or else combine other enterprises with his alfalfa growing.

In storing hay in the stack there is some wastage in the stack tops and bottoms, which would also tend to reduce the returns that are indicated. With well-built stacks, however, this loss is normally small, seldom exceeding 5 percent.

There is considerable range in the prices received, as indicated in the last column in Table XXX. This range in prices is caused by several things. The better quality hay that is shipped brings a premium, as has been mentioned. Differences in the methods of measuring cause differences in prices, as has also been mentioned. Hay sold to town trade or in small lots

usually brings higher prices. Some growers have developed special markets for their hay, such as logging camps or construction companies, which pay higher prices. Prices sometimes vary considerably in different communities because of local under- or over-production, although cattle and sheep feeding tends to equalize local prices.

It is noticeable that in the Malheur region where the hay was practically all sold in the stack to feeders the price spread was considerably less than in other regions where some hay was shipped. Prices paid by cattle and sheep feeders in the other regions were mostly in the lower part of the price range.

Appendix A

DETAILS OF METHODS USED IN THE STUDY

Considerable difference of opinion is possible on many practices in computing and analyzing farm costs. In this study effort has been made to conform in general with commonly accepted procedure, such as there is, in studies of this kind; but the primary aim has been to accomplish the objectives of the study and any procedure that has promised to facilitate this has been adopted. It is thought that such defensible differences in procedure as might be suggested would have no appreciable effect on the validity of the conclusions that have been drawn.

Sampling. With the assistance of county agents and others familiar with local conditions, representative farms were selected in each region from the different sets of conditions and different types of production in the region. Effort was made to avoid too large a proportion of either the larger of smaller farms, or the better or poorer farms or farmers. It is the judgment of those associated with the work in the several regions that a representative cross-section has been obtained of the production of alfalfa hay in each region. With the number of records that could be taken, and the variation that exists in conditions and types of production, the samples are probably as reliable as could be obtained by any other method of sampling.

Method of analysis. The data have been analyzed chiefly by the method of grouping and cross-tabulating. It was thought that the modification of conclusions, or additional conclusions, that might be reached by mathematical correlation methods would hardly justify the procedure involved, especially since the data on several of the factors are not adapted to such methods. In studying a given causal factor effort has been made to tabulate with it any other factors that might be correlated with it, and to consider any correlation thus indicated when drawing conclusions.

Discarding and omitting records. Records of farms with unquestionably abnormal conditions and records that for any reason appeared unreliable were discarded. Except for such records, however, all records have been used in all of the tabulations unless otherwise definitely indicated.

Averaging. The general principle has been followed of averaging per-acre values rather than values per farm or per ton. In averaging together more than one year or more than one region the general principle has been to average the records for each year in each region separately, and then average together the unweighted annual regional averages, in order to avoid undue weighting from irregularity of numbers of records in individual groups.

Quantity costs. Items in the cost of alfalfa hay that can be expressed in quantity as well as in cash value are limited to direct man labor, horse labor, and fertilizers. Hours of man and horse labor are given in Table XXIV and amounts of fertilizer in Table XV.

Cost in stack or barn. The cost of the hay is figured up to and including putting it into the stack or barn. In a few cases of baling from the field the cost is figured as delivered to the baler. In a few cases where a small

part of the crop was sold standing, or loose from the field, the cost of stacking it was estimated on the basis of the hay that was stacked, so as to include the hay so sold with the rest of the crop.

Renters computed as owners. Most of the cooperators were owners. In all cases of rented land, to make the records comparable, the cost is computed as though the land were owned by the grower, charging the irrigation water, taxes, and interest on the value of the land instead of the cash or share rent paid.

Direct man labor. This is all of the man labor expended directly on the crop including the work of the grower himself, members of his family, and hired labor, valued at prevailing wages for farm labor. If board was furnished in addition to wages its value has also been included. The average total cost per hour for direct man labor, both hired and operator's, for all farms was 38c in 1925, 39c in 1926, and 39c in 1927.

Overhead man labor is the amount chargeable to alfalfa for indirect and overhead labor such as general repairing and upkeep, general supervision, and attending to general farm business matters. A careful estimate was made of the proportion of the grower's total year's work that was chargeable to alfalfa. The difference between this and his direct labor on the crop is charged as overhead labor. It amounts on the average to 8 percent of the total net cost.

Horse labor. The work of the growers' own horses has been charged at 10c per horse hour in all regions except the Willamette Valley, where a rate of 12½c has been used. These rates are supported by a supplementary study of the cost of horse labor that was made in 1926.* A small amount of work by horses that were hired is charged at the actual price paid.

Machinery, tractor, and automobile. For each piece of equipment an estimate was obtained as to the proportion chargeable to alfalfa of the fuel and oil, repairs, depreciation, and interest, for that piece of equipment. Depreciation is based on the original cost and total life of the implement or machine. Interest is computed at 5 percent on its present value. The cost of rented machinery is also included. Because of the small amount of tractor work on alfalfa, tractor costs have been included with the general machinery costs in the cost summaries instead of given separately.

Fertilizer. Commercial fertilizers are charged at the actual cost to the grower. Manure is charged at the value placed on it by the grower. Most of the growers figure manure as worth only the labor of putting it upon the field, which is included under man and horse labor. In some places, however, manure has well-established cash values, and these values have been charged for manure used in such localities.

Irrigation water. The cost of irrigation water is the actual total charge paid by the grower during the year. It consists chiefly of maintenance and interest charges. Charges for retirement of bonded indebtedness or construction costs are negligible, on the average, except on the government projects where no interest charge is made. The growers in general seem to regard irrigation costs much the same as taxes. For a few farms with private pumping plants the cost per acre was computed as for other equipment and charged at so much per acre, to correspond to the irrigation-water charges for the other farms.

* Ore. Agric. Exp. Sta. Bul. 250.

Taxes. The charge for taxes is the actual state and county tax paid on the land used for the crop as determined from the report of the growers and assessors' records. In the Malheur region the taxes include an average charge of 72c per acre for cost of drainage.

Interest on land value. Interest at 5 percent has been charged on the value of the land used for the crop, as given by the growers. The value for which the growers were asked was the present asking price in the locality for land of comparable value.

Depreciation of stand. The cost of establishing a stand of alfalfa has been computed separately from the cost of producing hay from an established stand of alfalfa. The average cost per acre of establishing a stand in each region has then been charged uniformly as depreciation of stand to all of the alfalfa hay in the region, the annual charge being based on the average estimated life of a stand in the region The costs were computed in this way because of the impossibility of obtaining data on the cost of seeding many of the stands of alfalfa that were established several years previously, and also because there are advantages in analyzing the data in using a uniform average charge for depreciation of stand rather than a different cost for every farm. A total of 225 records were obtained upon the cost of establishing a stand of alfalfa, covering 3,384 acres of new seeding.

For costs of establishing a stand and charges for depreciation of stand in the six principal alfalfa regions see page 46. Since in the Harney Valley it was not possible to obtain enough data on seeding costs to compute a separate charge for depreciation of stand, the average of the charges for the five Eastern Oregon alfalfa regions, amounting to 95c per acre, has been used. In the Willamette Valley, 47 records on the cost of seeding 436 acres of alfalfa gave an average cost of $29.95 per acre. This has been divided by an estimated life of seven years to get the annual depreciation charge of $4.28 per acre. Continued experience with this crop in the Willamette Valley may show the average life of a stand to be more or less than seven years, which of course will change this charge for a depreciation of stand.

Miscellaneous. This includes both alfalfa seed and seed grain used for thickening the stand, spray material, salt used in stacking, material for fencing stacks, and gopher poison.

Credit for pasture is a credit for the value of the pasture that is obtained in spring or fall in addition to the hay crop, valued at the price received, if sold, or as estimated by the grower if used by him.

Yield. Weights or measurements were used whenever available, but in many cases the yield had to be estimated by the grower. This is an item on which the estimate of the grower is quite reliable, however, as it is of particular interest to him and he gives it much consideration.

Appendix B

CLIMATIC, SOIL, AND IRRIGATION CONDITIONS IN EACH REGION

Malheur, Umatilla, and Rogue River are regions of lower altitudes and longer growing seasons, which in general produce three cuttings of alfalfa hay in a season; Baker-Union, Deschutes, and Klamath have higher altitudes and shorter growing seasons and in general produce only two full cuttings (Table XXXI). In the Harney Valley the growing season is still

TABLE XXXI. ALTITUDE; AND AVERAGE ANNUAL RAINFALL, MEAN TEMPERATURE, AND GROWING SEASON, 1925-1927; AT REPRESENTATIVE POINTS IN THE REGIONS STUDIED.*

Region	Point of observation	Altitude	Annual rainfall		Mean temperature		Growing season
			Amount	Departure from normal	Temperature	Departure from normal	
		ft.	*in.*	*in.*	*(F.)*	*(F.)*	*days*
Malheur	Kingman	2200	9.07	+ .42	52.4°	+ .8°	171
Umatilla	Hermiston	451	8.89	+ .40	53.9°	+1.4°	188
Rogue River	Medford	1425	17.20	+ .79	54.6°	+1.2°	169
Baker-Union	Baker	3471	11.01	—2.19	46.7°	+1.4°	130
Deschutes	Bend	3629	14.86	+1.29	48.5°	+2.0°	94
Klamath	Klamath Falls	4100	14.32	+1.28	48.5°	+ .8°	123
Willamette Valley	Corvallis	266	40.66	—1.30	53.2°	+1.4°	191
Harney Valley	Harney Branch Experiment Station	4100	10.20	——	45.2°	——	79

* From United States Weather Bureau data.

shorter, and only two crops are obtained, while in the Willamette Valley, with the longest growing season of all, three cuttings can be obtained but lack of moisture often prevents the development of the third crop. Some third crop is harvested in the two-crop regions, of course, and some fourth crop in the three-crop regions (see Table XXXIV page 62).

With the exception of a late May freeze in the Baker-Union region in 1926 there apparently were no marked irrigularities from normal in the climatic conditions in the several regions during the period of the study.

The predominating soils on which alfalfa is raised are the lighter types in all regions except Malheur, Baker-Union, and the Harney Valley, where they are medium to heavy (Table XXXII). In general there is irrigation throughout the season in the Malheur, Deschutes, and Klamath regions; in Baker-Union half the acreage is not irrigated and part that is irrigated has only spring flood water; in Umatilla a few farms have only spring flood water; in Rogue River a fourth of the acreage is not irrigated, but most of the irrigated acreage has water throughout the season. In the Willamette Valley there is practically no irrigation of alfalfa; and in the Harney Valley only flood water is available, although irrigation by pumping from wells is contemplated.

TABLE XXXII. TYPES OF SOILS ON WHICH ALFALFA IS RAISED IN EACH REGION, AND PROJECTS FROM WHICH THE FARMS STUDIED IN EACH REGION OBTAINED THEIR IRRIGATION WATER

Region	Soils	Irrigation projects
Malheur	Mostly silt loam Some sandy loam	Boise-Payette, Kingman Colony, Payette-Oregon Slope, and Warm Springs Irrigation Districts; Snake River District Imp. Co.; Riverside Irrig. Co.; Owyhee Ditch Co.; and Ontario-Nyssa Canal Co.
Baker-Union	Sandy loam to heavy clay loams Mostly medium to heavy	Farmers' ditches (Half of acreage not irrigated)
Umatilla	Mostly sandy loam Some heavier loam and some very sandy	Umatilla and Stanfield Irrigation Districts, Western Land Co., and private ditches
Deschutes	Mostly sandy loam	Mostly Central Oregon Irrigation District. Also Tumalo and Squaw Creek Districts, and Arnold Ditch Co.
Klamath	Mostly sandy loam	Mostly Klamath Irrigation District. Also Enterprise and Shasta View Districts and Van Brimmer Ditch Co.
Rogue River	Sandy to heavy clay Mostly lighter types	Medford, Grants Pass, Fort Vannoy, and Talent Irrig. Districts, Little Butte and Mt. Pitt Irrig. Cos., and private ditches. (One fourth of acreage not irrigated)
Willamette Valley	Mostly sandy and light loam soils	Not irrigated
Harney Valley	Mostly heavy silt and clay loam soils	Flood water. Private ditches

Appendix C

SUPPLEMENTARY AND DETAILED TABLES

TABLE XXXIII. AVERAGE COST PER TON OF PRODUCING ALFALFA HAY IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON, 1925-1927

Items	Malheur	Baker-Union	Umatilla	Deschutes	Klamath	Rogue River	Average*
Direct man labor	$2.59	$2.22	$2.60	$2.96	$2.96	$2.74	$2.60
Overhead man labor	.57	.46	.78	.83	.54	.66	.63
Horse labor	.62	.75	1.06	.77	.71	.66	.79
Machinery	.38	.46	.61	.40	.44	.47	.47
Automobile	.07	.10	.09	.12	.05	.02	.08
Fertilizer	.01	.07	.02	.37	.14	.18	.11
Irrigation water	1.19	.04	.71	.83	.90	.62	.60
Taxes	.53	.49	.57	.60	.29	.74	.54
Interest on land	1.51	2.00	2.39	2.05	2.00	2.96	2.15
Degree of stand	.15	.31	.38	.33	.28	.63	.35
Miscellaneous	.01	.07	.12	.00	.05	.02	.06
Total	7.63	6.97	9.33	9.26	8.36	9.70	8.38
Credit for pasture	.34	.32	.30	.60	.49	.67	.42
NET COST PER TON	$7.29	$6.65	$9.03	$8.66	$7.87	$9.03	$7.96
TONS PER ACRE	5.0	2.9	3.2	2.9	3.4	3.9	3.4

* Average weighted by Census acreage of alfalfa in each region.

TABLE XXXIV. AVERAGE COST OF HARVESTING A TON OF ALFALFA HAY, FOR FARMS THAT USED WAGONS OR SLIPS AND FARMS THAT USED BUCKRAKES, 1925-1927

	Wagons or slips	Buckrakes
Number of records*	501	94
Number of acres	18,022	7,528
Number of tons	64,431	23,251
Items	Per ton	Per ton
Direct man labor	$2.00	$1.50
Overhead man labor	.47	.24
Horse labor	.55	.60
Machinery	.34	.46
Automobile	.06	.14
TOTAL HARVESTING COST PER TON	$3.42	$2.94
Average yield per cutting	1.3 tons	1.2 tons

* Farms using more than one method of hauling were omitted from this tabulation.

TABLE XXXV. PERCENT OF FARMS IN EACH REGION WITH GIVEN COSTS PER TON, 1925-1927

Cost per ton	Malheur	Baker-Union	Umatilla	Dechutes	Klamath	Rogue River
	%	%	%	%	%	%
Under $5.00	5	10	1	1	1	—
$ 5.00-$ 7.49	54	55	15	24	42	27
$ 7.50-$ 9.99	32	24	25	38	36	27
$10.00-$12.49	7	7	34	21	19	25
$12.50-$14.99	1	3	16	10	1	12
$15.00 and over	1	1	9	6	1	9
TOTAL	100	100	100	100	100	100

TABLE XXXVI. COMPARISON OF HAULING ALFALFA HAY WITH WAGONS, SLIPS, AND BUCKRAKES IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON, 1925-1927

	Wagons	Slips	Buckrakes
Number of records	409	147	113
Labor for hauling and stacking:			
Man hours per ton	3.0	2.7	2.0
Horse hours per ton	3.0	3.2	2.4
Yield per acre per cutting (tons)	1.4	1.3	1.2
Average length of haul (rods)*	65	42	22
Acres alfalfa per farm	32	50	78
Average size of crew:			
Number of men	5	6	5
Number of horses	5	7	7

* Data for length of haul are for 1926 and 1927 only.

TABLE XXXVII. RELATION OF YIELD OF ALFALFA TO HARVEST LABOR PER TON IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON, 1925-1927

Method of hauling	Yield per cutting	Number of records	Average yield per cutting	Harvest labor per ton		Average length of haul*
				Man labor	Horse labor	
	tons		*tons*	*hrs.*	*hrs.*	*rds.*
WAGONS	Less than 1.0	51	.8	7.0	7.6	66
	1.0-1.4	172	1.2	5.8	6.6	70
	1.5-1.9	123	1.7	5.1	5.1	64
	2.0 & over	63	2.2	4.1	4.2	63
	ALL	409	1.4	5.3	5.4	65
SLIPS	Less than 1.0	27	.7	6.9	8.9	38
	1.0-1.4	65	1.2	5.2	6.5	36
	1.5-1.9	43	1.7	4.3	5.0	42
	2.0 & over	12	2.3	3.5	2.6	11
	ALL	147	1.3	4.9	5.9	42
BUCKRAKES	Less than 1.0	34	.8	4.8	8.1	22
	1.0-1.4	53	1.2	3.9	6.1	20
	1.5-1.9	22	1.7	3.0	5.2	22
	2.0 & over	4	2.0	2.9	2.7	28
	ALL	113	1.2	3.8	6.2	22

* Data for length of haul are for 1926 and 1927 only.

TABLE XXXVIII. RELATION OF LENGTH OF HAUL TO AMOUNT OF LABOR PER TON FOR HAULING AND STACKING, 1926-1927*

Method of hauling	Length of haul	Number of records	Average haul	Labor per ton for hauling and stacking		Yield per cutting
				Man labor	Horse labor	
	rds.		*rds.*	*hrs.*	*hrs.*	*tons*
WAGONS	Less than 80	160	40	2.8	2.8	1.4
	80 or over	102	108	3.1	3.2	1.4
SLIPS	Less than 80	84	32	2.6	3.1	1.3
	80 or over	10	86	2.9	3.4	1.0
BUCKRAKES	Less than 20	40	11	1.8	2.2	1.2
	20 or over	42	34	2.2	2.5	1.2

* Data for length of haul are for 1926-1927 only.

TABLE XXXIX. PERCENTAGE OF ACREAGE CUT AND AVERAGE YIELD PER ACRE* FOR EACH CUTTING IN EACH REGION, 1925-1927

Cutting	Malheur		Baker Union		Umatilla		Deschutes		Klamath		Rogue River	
	Percent of acreage	Yield per acre	Percent of acreage	Yield per acre	Percent of acreage	Yield per acre	Percent of acreage	Yield per acre	Percent of acreage	Yield per acre	Percent of acreage	Yield per acre
	%	tons	%	tons	%	tons	%	tons	%	tons	%	tons
First	100	1.8	100	1.4	100	1.4	100	1.5	100	1.8	100	1.6
Second	100	1.9	91	1.2	100	1.1	98	1.2	99	1.5	97	1.2
Third	95	1.3	41	.8	79	.7	25	.9	8	.9	80	1.0
Fourth	6	.7	—	—	1	.4	—	—	—	—	27	.7
TOTAL	100	5.0	100	2.9	100	3.2	100	2.9	100	3.4	100	3.9

* The yield shown is the average yield for the part of the acreage cut, not the average for the total acreage.

TABLE XL. RELATION OF YIELD PER ACRE OF ALFALFA TO COSTS AND LABOR REQUIREMENTS IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON 1925-1927

	Yield per acre	Number of records	Average yield	Total cost per acre	Total cost per ton	Man hours per acre	Man hours per ton
	tons		tons				
Average 6 regions	Less than 2.00	43	1.5	$23.16	$15.34	16	10
	2.00-3.99	342	3.0	26.57	8.84	22	8
	4.00-5.99	200	4.6	30.61	7.06	28	6
	6.00 & over	47	6.6	37.81	5.78	33	5
Malheur	Less than 2.00	1	1.5	$32.20	$21.43	22	14
	2.00-3.99	10	3.5	32.00	9.06	27	8
	4.00-5.99	75	4.9	36.98	7.53	34	7
	6.00 & over	25	6.5	38.15	5.87	34	5
Baker-Union	Less than 2.00	13	1.5	$14.18	$9.70	10	7
	2.00-3.99	56	2.9	18.95	6.61	16	6
	4.00-5.99	18	4.4	25.10	5.66	24	5
	6.00 & over	3	7.4	34.50	4.66	37	5
Umatilla	Less than 2.00	5	1.5	$24.69	$16.52	16	10
	2.00-3.99	76	2.9	28.16	9.80	23	8
	4.00-5.99	19	4.5	30.69	6.84	26	6
	6.00 & over	—	—	—	—	—	—
Deschutes	Less than 2.00	18	1.5	$22.37	$15.28	18	12
	2.00-3.99	93	2.8	24.51	8.67	22	8
	4.00-5.99	20	4.4	31.09	7.13	29	7
	6.00 & over	1	6.0	33.16	5.53	24	4
Klamath	Less than 2.00	3	1.6	$20.78	$12.68	15	9
	2.00-3.99	55	3.1	25.62	8.29	23	8
	4.00-5.99	29	4.7	19.92	6.81	25	6
	6.00 & over	—	—	—	—	—	—
Rogue River	Less than 2.00	3	1.5	$24.77	$16.46	16	10
	2.00-3.99	52	2.8	30.16	10.63	23	8
	4.00-5.99	39	4.8	39.90	8.39	33	7
	6.00 & over	18	6.5	45.43	7.04	39	6

TABLE XLI. RELATION OF THICKNESS OF ALFALFA STAND TO YIELD OF HAY IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON IN 1927

Region	Percent of stand	Number of farms	Average percentage of stand	Yield per acre	Value of land per acre	Average age of stand*
	%		%	tons		yrs.
Average 6 regions	Under 75	46	57	2.8	$141	9
	75- 89	78	77	3.2	148	7
	90-100	81	94	4.2	161	5
Malheur	Under 75	5	59	3.7	$122	7
	75- 89	8	76	4.7	129	4
	90-100	15	93	5.0	173	3
Baker-Union	Under 75	8	58	2.7	$ 83	8
	75- 89	26	78	3.0	128	6
	90-100	12	97	3.1	104	4
Umatilla	Under 75	18	52	3.0	$135	12
	75- 89	9	76	3.1	149	8
	90-100	5	90	4.5	183	8
Deschutes	Under 75	7	54	2.3	$119	10
	75- 89	13	76	2.1	110	8
	90-100	17	95	3.7	124	6
Klamath	Under 75	2	62	2.3	$176	8
	75- 89	9	78	2.9	134	7
	90-100	16	96	3.7	152	6
Rogue River	Under 75	6	55	2.8	$209	8
	75- 89	13	77	3.3	235	8
	90-100	16	95	5.0	229	5

* Age when records were taken.

TABLE XLII. RELATION OF VALUE OF LAND PER ACRE TO YIELD AND COST OF ALFALFA HAY IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON, 1925-1927

Region	Value of land	Number of records	Average value of land	Yield per acre	Total cost per acre	Total cost per ton
				tons		
Average 6 regions	Less than $100	25	$ 76	3.2	$25.27	$9.04
	100-149	262	109	3.3	26.08	7.85
	150-199	164	154	3.5	27.28	8.46
	200-249	104	200	4.2	33.01	7.97
	250 and over	77	312	5.1	40.96	8.53
Malheur	Less than $100	5	72	5.9	$37.85	6.53
	100-149	22	106	4.3	33.39	7.79
	150-199	46	156	5.1	35.98	7.05
	200-249	29	201	5.3	38.28	7.27
	250 and over	9	256	5.8	40.92	7.15
Baker-Union	Less than $100	10	77	2.2	$14.63	7.75
	100-149	57	109	2.9	19.33	6.78
	150-199	19	154	3.2	22.75	7.22
	200-249	3	200	4.3	26.25	6.12
	250 and over	1	500	7.7	46.25	6.03
Umatilla	Less than $100	1	75	2.2	$22.98	10.28
	100-149	32	111	3.0	26.62	9.02
	150-199	37	150	2.8	17.48	9.64
	200-249	28	200	3.9	32.80	8.45
	250 and over	2	275	4.1	39.44	9.62
Deschutes	Less than $100	5	63	2.3	$23.06	11.90
	100-149	94	109	2.8	23.70	8.56
	150-199	26	150	3.4	29.33	8.49
	200-249	6	200	3.9	36.16	9.60
	250 and over	1	300	4.5	44.37	9.85
Klamath	Less than $100	4	91	3.2	$27.84	8.76
	100-149	48	109	3.3	24.54	7.37
	150-199	22	153	3.2	26.43	8.38
	200-249	9	200	4.5	34.44	7.86
	250 and over	4	268	4.0	35.38	8.80
Rogue River	Less than $100	—	—	—	—	—
	100-149	9	110	3.8	28.91	7.60
	150-199	14	161	3.4	31.69	10.00
	200-249	29	200	3.6	30.11	8.53
	250 and over	60	276	4.1	39.57	9.73

TABLE XLIII. RELATION OF FERTILIZATION PRACTICE 1925-1927 TO YIELD AND COST PER TON IN 1927 FOR ALFALFA HAY IN FOUR IMPORTANT REGIONS IN OREGON*

Region	Part of acreage fertilized annually 1925-1927	No. of farms	Acres per farm	Average percentage fertilized *	Yield per acre	Cost per ton	Percent of stand	Value of land per acre
			acres	%	*tons*		%	
Average four regions	⅓ and over	49	36	49	3.8	$7.71	89	$156
	Under ⅓	96	53	8	3.0	8.32	79	153
Baker-Union	⅓ and over	12	50	49	3.4	6.63	88	118
	Under ⅓	34	90	10	2.9	6.65	77	122
Deschutes†	¼ and over	8	33	29	3.6	7.62	91	134
	Under ¼	29	38	2	2.6	9.38	78	113
Klamath	⅓ and over	12	41	45	3.6	7.38	91	133
	Under ⅓	15	53	13	3.2	8.41	85	155
Rogue River	⅓ and over	17	22	72	4.5	9.22	88	240
	Under ⅓	18	32	7	3.5	8.82	75	223

* Malheur and Umatilla omitted from this tabulation because the number of farms applying fertilizer was too small to give a reliable average.

† In the Deschutes Region the farms are grouped according to whether more or less than ¼ of the acreage was manured, ignoring fertilization with sulfur because practically 100 percent of the acreage was sulfured.

TABLE XLIV. EFFECT OF CULTIVATION OF ALFALFA ON YIELD AND COST PER TON IN THE SIX PRINCIPAL ALFALFA REGIONS IN OREGON IN 1927

Region	Percentage of acreage cultivated	No. of farms	Acres per farm	Average percentage cultivated	Yield per acre	Cost per ton	Percentage stand	Value land per acre	Percentage farms fertilized*
			acres	%	*tons*		%		%
Average six regions	80% & over	116	48	98	3.7	$8.10	79	$157	33
	Under 80%	89	45	18	3.1	8.49	77	146	21
Malheur	80% & over	8	30	97	4.5	7.85	76	147	25
	Under 80%	20	29	6	4.8	7.52	84	153	5
Baker-Union	80% & over	30	81	96	3.3	6.27	80	127	30
	Under 80%	16	76	30	2.5	7.61	78	107	19
Umatilla	80% & over	26	57	100	3.3	8.78	67	144	19
	Under 80%	6	41	22	2.8	9.64	58	156	0
Deschutes	80% & over	16	34	98	3.1	8.74	82	127	25
	Under 80%	21	40	6	2.5	9.12	79	110	19
Klamath	80% & over	15	45	97	3.5	8.09	87	167	40
	Under 80%	12	52	12	3.2	7.86	88	124	50
Rogue River	80% & over	21	25	99	4.4	8.87	85	230	57
	Under 80%	14	31	32	3.2	9.22	75	228	36

* Percent of farms that averaged ⅓ or more of acreage fertilized annually, 1925-1927 as in Table XLIII.

TABLE XLV. AVERAGE HOURS OF LABOR PER ACRE ONCE OVER ON ALL FARMS PERFORMING OPERATION, ON 10 PERCENT OF FARMS WITH LOWEST MAN LABOR REQUIREMENT, AND ON 10 PERCENT OF FARMS WITH HIGHEST MAN LABOR REQUIREMENT, 1925-1927

Items	Number of records of operation	All farms		Lowest ten percent		Highest ten percent	
		Man labor	Horse labor	Man labor	Horse labor	Man labor	Horse labor
		hrs.	*hrs.*	*hrs.*	*hrs.*	*hrs.*	*hrs.*
Fertilizing with spreader	174	.7	1.3	.3	.7	1.6	2.6
Fertilizing by hand	15	1.4	—	.6	—	2.7	—
Manuring (spreader)	190	9.1	17.2	2.9	6.6	22.4	37.3
Spring-toothing with horses	316	1.0	3.6	.5	2.5	2.1	5.7
Spring-toothing with tractor	49	.6	T .6	.3	T .3	1.3	T 1.3
Disking	37	1.0	4.1	.5	3.7	1.8	6.5
Spike harrowing	62	.6	2.0	.3	1.6	1.1	3.4
Cleaning ditches	517	1.3	.6	.2	.3	3.9	.8
Corrugating	149	1.1	2.2	.4	1.1	2.2	4.4
Irrigating	578	1.3	—	.3	—	3.5	—
Mowing	632	1.2	2.3	.8	1.7	1.6	3.1
Raking (dumprake)	632	.5	1.1	.4	.7	.8	1.5
Cocking	508	1.6	—	.6	—	2.8	—
Bunching with dumprake	139	.3	.6	.1	.2	.6	1.2
Bunching with buckrake	44	.6	1.2	.3	.6	1.1	2.1
Hauling with wagons	401	4.5	4.6	2.1	2.3	8.0	7.7
Hauling with slips	144	3.8	4.6	1.7	2.4	6.6	7.5
Hauling with buckrakes	111	2.4	3.3	1.1	1.4	4.1	4.7

Appendix D

COST OF PRODUCING ALFALFA HAY IN THE WILLAMETTE VALLEY

Alfalfa has been grown by a few farmers in the Willamette Valley for many years, chiefly on sandy river-bottom soils. According to the 1925 census, however, it amounted to less than one percent of the total acreage of hay. In the last few years interest in the possibilities of raising alfalfa on bench and upland soils has been increasing. The acreage has undoubtedly increased considerably since 1924 but it is still an extremely small part of the Willamette Valley hay acreage.

Since the crop is in a state of development, with possibilities and methods not fully worked out, cost figures at this time are of less value than for a well-established crop. The figures that have been obtained are presented, however, for such interest in them as there may be. They represent alfalfa raising chiefly on the lighter types of soils, as it is on such soils that most of the Willamette Valley alfalfa is still raised. The average estimated value of this land was $208 per acre. Grimm alfalfa is raised almost exclusively. It is interesting to note that the total cost per ton was almost exactly the same as the average of the six principal alfalfa regions.

TABLE XLVI. SUMMARY OF COSTS PER ACRE AND PER TON OF ALFALFA HAY, AND COSTS PER ACRE OF ALFALFA SEEDING IN THE WILLAMETTE VALLEY, 1925-1927

	ALFALFA HAY (3.8 tons per acre)		ALFALFA SEEDING
Number of records	43		47
Number of acres	674		436
Number of tons	2540		—
Items	Per acre	Per ton	Per acre
Direct man labor	$7.49	$2.00	$5.22
Overhead man labor	2.58	.69	1.96
Horse labor	3.83	1.02	4.12
Machinery	1.12	.30	.95
Tractor	.09	.02	1.88
Automobile	.07	.02	.02
Lime	.12	.03	1.20
Other fertilizer	.48	.13	—
Seed	—	—	4.21
Inoculation	—	—	.01
Taxes	2.52	.67	2.65
Interest on land	10.42	2.77	10.08
Depreciation of stand	4.28	1.14	—
Total	$33.00	$8.79	$32.30
Credit for pasture	3.23	.86	.98
Credit for clippings	—	—	1.37
TOTAL NET COST	$29.77	$7.93	$29.95

For explanation of cost items see Appendix A.

TABLE XLVII. PERCENTAGE OF ACREAGE COVERED, TIMES OVER, AND HOURS OF LABOR PER ACRE FOR OPERATION ON ALFALFA HAY IN THE WILLAMETTE VALLEY, 1925-1927

Items	Percentage of acreage covered	Times over	Hours of labor per average acre of crop	
			Man labor	Horse labor
	%		hrs.	hrs.
Fertilizing	48	1.0	.3	.4
Manuring	11	1.0	1.3	2.5
Spring-toothing	58	2.7	1.6	5.0*
Other cultivating	12	5.6	.9	1.9
Mowing	100	2.7	3.5	7.1
Raking: dumprake	89	2.3	1.2	2.4
Raking: side-delivery	29	2.0	.3	.6
Cocking by hand	82	2.3	3.4	—
Bunching with rake	6	2.0	.1	.1
Tedding	11	1.0	.1	.1
Turning	8	3.4	.2	.4
Hauling to barn	100	2.6	10.5	10.2
Total	—	—	23.4	30.7

* An average of .1 hour of tractor work per acre was also used in spring-toothing.

TABLE XLVIII. PERCENTAGE OF ACREAGE COVERED, TIMES OVER, AND HOURS OF LABOR PER ACRE FOR OPERATIONS ON ALFALFA SEEDING IN THE WILLAMETTE VALLEY, 1925-1927

Items	Percentage of acreage covered	Times over	Hours of labor per average acre of crop		
			Man labor	Horse labor	Tractor service
	%		hrs.	hrs.	hrs.
Fertilizing	32	1.0	.4	.5	—
Manuring	5	1.0	.7	1.2	—
Plowing	95	1.0	3.0	6.7	.8
Disking	69	3.1	2.5	6.2	.6
Rolling	72	3.6	1.6	3.5	.4
Spike harrowing	90	4.7	2.2	5.5	.3
Spring-toothing	58	3.9	2.0	4.5	.3
Floating	31	2.1	.3	.6	.1
Seeding with horses	57	1.0	.6	1.3	—
Seeding by hand	43	1.0	.3	—	—
Pulling weeds	6	1.0	.4	—	—
Clipping	67	1.4	.9	1.8	—
Raking and haul clipping	30	1.4	.6	1.1	—
Total			15.5	32.9	2.5

Appendix E

COST OF PRODUCING ALFALFA HAY AND WILD HAY IN THE HARNEY VALLEY

The Harney Valley is primarily a wild hay region, producing a fourth of the wild hay in Oregon. There is a considerable acreage of alfalfa, however, and it seems to be increasing. Data were obtained on the cost of both alfalfa and wild hay in this region for 1927. There is much interest in the region in the relative value of the land for wild hay as compared with tame hay production.

The wild hay is harvested from permanent natural meadows of native grass, some of which are very large, running into hundreds and even thousands of acres. The meadows are flooded in late spring, usually May, by spring flood water from the creeks that flow into the valley. One crop of hay is harvested and the meadows are then pastured. The chief agricultural enterprise of the region is range beef-cattle production, and most of the wild hay is used for wintering cattle, but there is also considerable dairying.

The average estimated value of the wild hay land was $39 per acre, and of the alfalfa land $72 per acre. The slide method of stacking wild hay used in this region has been described (page 35).

TABLE XLIX. SUMMARY OF COST OF ALFALFA HAY AND WILD HAY IN THE HARNEY VALLEY IN 1927

	ALFALFA HAY (3.1 tons per acre)		WILD HAY (1.1 tons per acre)	
Number of farms	24		33	
Number of acres	1074		7507	
Number of tons	3285		8365	
Items	Per acre	Per ton	Per acre	Per ton
Direct man labor	$5.95	$1.95	$1.64	$1.47
Overhead man labor	1.07	.35	.32	.29
Horse labor	2.26	.74	.66	.60
Machinery	1.08	.35	.32	.28
Automobile	.11	.04	.06	.05
Taxes	.84	.27	.49	.44
Interest on land value	3.62	1.19	1.96	1.76
Depreciation of stand	.95	.31	—	—
Miscellaneous*	.32	.10	.01	.01
TOTAL	$16.20	$5.30	$5.46	$4.90
Credit for pasture	1.32	.43	.57	.51
TOTAL NET COST	$14.88	$4.87	$4.89	$4.39

* Seed for thickening stand, poison, and materials for fencing stacks and for irrigation dams.

For explanation of cost items see Appendix A.

TABLE L. PERCENTAGE OF ACREAGE COVERED, TIMES OVER, AND HOURS OF LABOR PER ACRE FOR ALFALFA HAY AND WILD HAY IN THE HARNEY VALLEY IN 1927

Operations	ALFALFA HAY				WILD HAY			
	Percentage of acres covered	Times over	Hours per acre of crop		Percentage of acres covered	Times over	Hours per acre of crop	
			Man	Horse			Man	Horse
	%		hrs.	hrs.	%		hrs.	hrs.
Spring-toothing	21	2.0	.3	1.3	—	—	—	—
Other cultivation	53	1.6	.4	1.6	—	—	—	—
Seeding	13	1.0	.1	.3	—	—	—	—
Cleaning ditches	23	1.0	.1	.1	—	—	—	—
Irrigating	100	1.0	.6	.3	100	1.0	.4	.5
Mowing	100	2.0	2.2	4.4	100	1.0	1.0	2.1
Raking	100	2.0	1.0	2.0	100	1.0	.4	.8
Cocking by hand	48	1.9	1.4	—	—	—	—	—
Bunch with rake	95	1.9	.9	1.8	100	1.0	.4	.8
Yarding	29	1.8	.6	1.2	22	1.0	.1	.2
Haul and stack	100	2.0	6.3	9.9	100	1.0	1.5	2.3
Fencing stacks	75	1.0	.4	.0	87	1.0	.2	.0
Poisoning	14	1.0	.2	—	6	1.0	.0	—
TOTAL	—	—	14.5	22.9	—	—	4.0	6.7

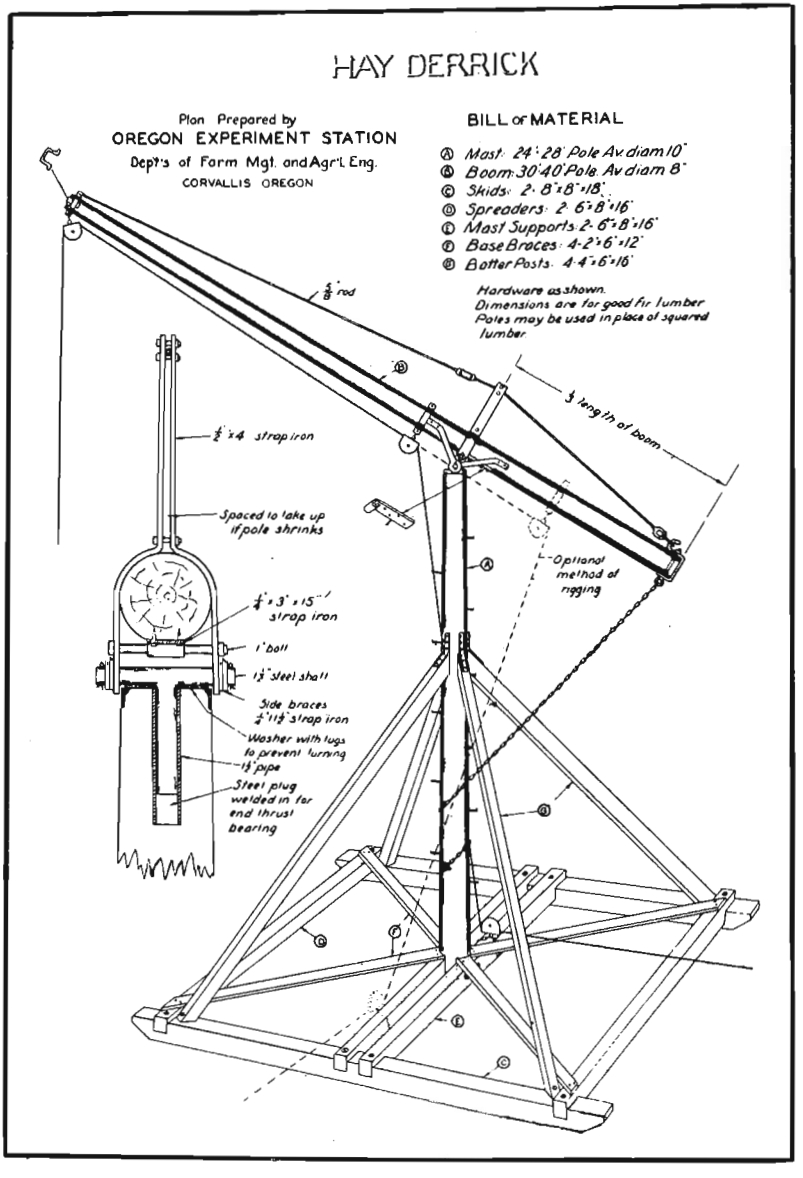


Fig. 12. Diagram of construction of a Mormon derrick. Details of this plan have been obtained from several sources, but particularly from Wm. Reed, blacksmith in Ontario, who has been building derricks of this type for many years. This plan embodies a number of features of which more general use could advantageously be made. A larger scale blue-print of this plan may be obtained from the department of Farm Management, Oregon Agricultural Experiment Station.