THE WORK OF THE UMATILLA RECLAMATION PROJECT EXPERIMENT FARM IN 1918 AND 1919

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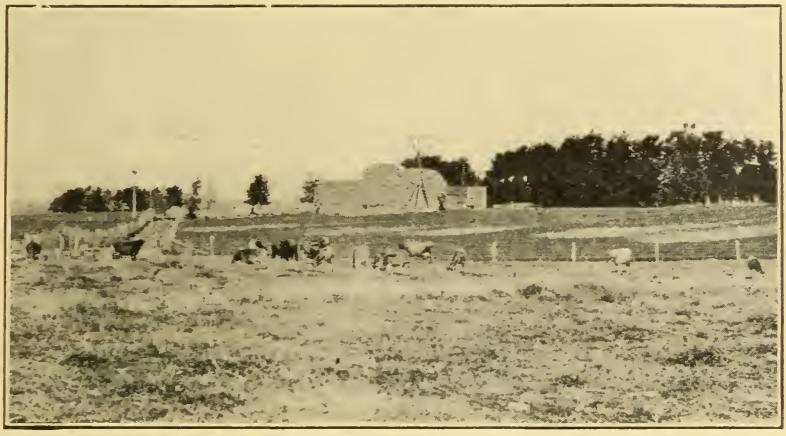

Dairy Herd on an Irrigated Grass Pasture on the Umatilla Reclamation Project

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CONTENTS.

CONDITIONS ON THE PROJECT.

THE Umatilla Reclamation Project, containing 28,100 acres of irrigable land, is located in northeastern Oregon along the Columbia River. The soil is light and the topography somewhat rough. The conditions on the Umatilla project are typical of those on seven other projects in Oregon and Washington, comprising approximately 25,000 acres of irrigated land and several hundred thousand acres of desert land which may be brought under irrigation in the future. The detailed information here presented concerning the Umatilla project applies directly only to this project, but the agricultural conditions on the other projects are very similar in many respects, so this information is largely applicable to them.

THE PROGRESS OF AGRICULTURAL DEVELOPMENT.

The agriculture of the Umatilla Reclamation Project has been in a state of transition for 10 years, but is rapidly becoming settled on the basis of a few staple crops and live stock. The original tendency was toward the development of the fruit industry, but this has now become of secondary importance, giving way to field crops, of which alfalfa and corn are the most important. Alfalfa was grown originally as a hay crop, but during the last two years the alfalfa-seed industry also has become important. Corn is raised both for grain and for silage, but of the two the silage corn is gaining in importance. The acreage of pasture grasses is still small, but the high returns from good grass pasture would indicate that pasture will become more important, particularly on the heavier soils of the project.

Of the live-stock industries, dairying has taken the lead, being definitely established, with alfalfa and silage as a basis for feeding. The hog industry suffered a reverse during 1915 and 1916, probably because the price of grain feeds increased out of proportion to the price of hogs. During the last three years, however, the tendency has been to return to hog production.

IRRIGATION DEVELOPMENT.

Table I presents a summary of the irrigation development of the Umatilla project during the period from 1911 to 1919, inclusive.[1]

During the crop seasons of 1918 and 1919 the quantity of water used per acre was less than during any previous year. This was due to a number of factors which led to the better use of water. The farm irrigation systems are gradually being improved, the border method of irrigation has come into very general use on the newer land, the water has been used in larger heads for shorter periods, and irrigation has received closer attention.

TABLE I.—*Summary of irrigation development on the Umatilla Reclamation Project during the 9-year period from 1911 to 1919, inclusive.*

Item.	1911	1912	1913	1914	1915	1916	1917	1918	1919
Water stored.....acre-feet..	49,800	50,150	48,000	49,800	44,900	44,049	50,422	51,085	47,700
Water delivered to farms:									
Total.....do....	24,100	37,950	42,250	36,300	29,550	31,557	45,365	48,163	55,233
Per acre irrigated.....do....	9.74	8.25	8.45	7.11	5.57	5.73	6.19	5.29	5.24
Land areas:									
Irrigable.....acres..	17,252	17,252	16,652	17,000	17,000	17,000	26,300	26,300	28,100
Irrigated.....do....	3,373	4,606	5,006	5,100	5,306	5,477	7,327	9,100	10,533
Cropped.....do....	2,775	3,218	3,033	3,013	4,603	3,900	5,546	6,819	8,464
Farms irrigated.....number..	242	295	311	311	306	320	411	459	507
Population on each farm, average.....	2.3	2.2	2.4	2.4	2.4	2.4	2.5	2.5	2.6
Total population on all farms....	569	639	740	735	721	763	1,024	1,127	1,313
Owners residing on farms.....	.....	245	212	200	178	184	302	339	414
Tenants living on farms.....	.....	50	99	111	128	136	101	143	93
Financial showing:									
Total value of all crops.....	$58,795	$77,194	$84,078	$88,614	$104,653	$139,801	$311,595	$400,642	$633,380
Value of crops per acre cropped.....	21.19	25.73	27.72	29.41	29.04	35.84	56.15	58.75	74.83
Value of crops per farm.....	242.95	261.67	270.35	284.93	342.00	437.00	759.00	873.00	1,249.29
Value of live stock per farm..	144.00	262.00	506.00	439.00	625.00	489.00	770.00	687.00	563.00

The percentage of land irrigated has gradually increased, until in 1919, 10,533 acres, or 37.5 per cent of the irrigable land on the project, were watered. The average cropped area during the nine years for which data are included has been 71.3 per cent of the irrigated acreage. In 1919 this percentage was 80.4. The irrigated land not cropped was largely in newly seeded alfalfa and nonbearing orchard. The development on the west extension has been especially rapid during the last two years. The number of farms irrigated and the population on the farms have increased very materially and at prac-

[1] The data included in Tables I to V, inclusive, are taken from the annual reports of the United States Reclamation Service.

tically the same rate since 1916. The proportion of the farms operated by tenants increased from 1912 to 1916, but has since declined.

Under the head of financial showing, it will be noticed that the total value of all crops has increased every year, and the value of crops per acre increased each year except in 1915, when there was a slight decrease. The value of crops per farm has increased constantly. The value of live stock per farm has fluctuated, though the tendency has been upward.

ALFALFA PRODUCTION.

During recent years approximately three-fourths of the irrigated acreage of the project has been devoted to alfalfa hay, as will be noticed in Table II, which shows the relative importance of the alfalfa industry to the project. From 1911 to 1919 the cropped area of the project increased 5,689 acres, or 205 per cent, while during the same period the alfalfa acreage increased 287 per cent, which shows a greater rate of increase in the alfalfa acreage than in the total acreage. The total yield increased each year except in 1914, reaching in 1919 25,836 tons of hay. The farm value per acre for alfalfa hay was very nearly equal to the farm value for all crops, because the acreage of alfalfa was so large in proportion to the total irrigated acreage of the project that it largely determines the average value of all crops produced.

The average yield of alfalfa per acre has been 3.7 tons for the last nine years, without material variation from that figure in any one year. This average is low and could be raised considerably by the judicious use of manure; by plowing up, properly grading, and reseeding old fields which are in bad shape; and by the improvement of irrigation systems to permit the more efficient use of water.

TABLE II.—*Summarized comparison showing the importance of the alfalfa crop on the Umatilla Reclamation Project during the 9-year period from 1911 to 1919, inclusive.*

Year.	Acreage.		Alfalfa yield, tons.		Farm values.				
						Per acre.		Total.	
	All crops.	Alfalfa.	Total.	Average per acre.	Alfalfa per ton.	All crops.	Alfalfa.	All crops.	Alfalfa.
1911	2,775	1,765	5,825	3.3	$8.00	$17.95	$24.60	$58,795	$46,600
1912	3,218	2,442	8,388	3.4	7.00	17.64	23.80	77,194	58,716
1913	3,033	2,024	8,010	3.9	8.00	27.72	31.66	89,078	64,080
1914	3,013	2,048	7,511	3.7	8.00	29.41	24.34	88,613	60,088
1915	3,603	2,396	9,141	3.8	8.07	29.04	30.78	104,653	77,767
1916	3,900	2,985	11,412	3.8	9.60	35.81	36.70	139,800	109,555
1917	5,546	4,047	14,834	3.7	15.37	56.15	56.32	311,395	277,900
1918	6,819	5,274	19,063	3.6	17.81	58.75	64.48	400,642	340,083
1919	8,464	6,837	25,836	3.8	18.70	74.83	70.66	633,380	483,133

LIVE-STOCK INDUSTRIES.

The number of horses and mules on the project largely represents work stock brought in rather than animals produced, although during the last three years some horses have been raised.

The dairy industry has increased gradually in the number of cows milked, and the quality of dairy stock has been materially improved by the use of pure-bred bulls of the breeders' association, by the introduction of pure-bred cows, and by the elimination of the poorer cows. A very large proportion of the stock is of the Jersey breed. The number of sheep varies greatly from year to year, due to the occasional feeding of range sheep on the project farms. Since 1916 the hog population has increased gradually, and the industry has been firmly reestablished. Table III presents a summary of the live-stock and equipment inventories for the 8-year period from 1912 to 1919, inclusive.

TABLE III.—*Inventory of live stock and equipment on the Umatilla Reclamation Project at the close of each year from 1912 to 1919, inclusive.*

Live stock.	1912	1913	1914	1915	1916	1917	1918	1919
Number:								
Horses	460	545	633	683	571	543	605	808
Mules	15	20	26	42	39	27	21	26
Cattle—								
Dairy	a 260	a 834	641	765	737	822	911	1,143
Beef			206	258	46	70	110	123
Sheep	20	6,544	42	113	4,581	4,360	7,050	7,066
Hogs	1,100	1,276	2,185	1,862	929	1,344	1,509	1,800
Fowls	11,470	10,426	12,189	11,608	10,177	9,384	8,002	11,370
Bees (hives)	175	329	464	773	1,210	2,205	1,877	2,112
Value per head or unit:								
Horses	$95.66	$85.63	$87.37	$86.14	$90.93	$103.04	$98.78	$96.70
Mules	150.00	175.00	128.65	112.98	111.28	154.63	102.86	115.77
Cattle—								
Dairy	a 51.85	a 64.74	61.09	57.80	52.74	59.46	66.00	66.55
Beef			51.07	27.29	42.72	34.00	47.50	45.20
Sheep	4.00	5.14	5.38	5.13	8.03	15.96	9.14	9.14
Hogs	10.00	8.69	8.37	7.09	9.73	19.08	20.45	20.51
Fowls	.50	.54	.63	.59	.74	.81	.90	.92
Bees (hives)	5.00	4.06	4.28	3.98	5.00	5.00	5.00	5.04
Total value:								
Horses	$44,000	$46,667	$55,305	$58,834	$51,921	$55,950	$59,795	$78,134
Mules	2,250	3,500	3,345	4,745	4,340	4,175	2,160	3,010
Cattle—								
Dairy	a 13,480	a 55,632	39,160	44,217	38,870	48,876	60,130	76,066
Beef			10,520	7,041	1,965	2,380	5,025	5,560
Sheep	80	33,640	226	580	36,785	69,411	64,453	64,618
Hogs	11,000	11,090	18,284	13,202	9,039	25,643	30,871	37,050
Fowls	5,735	5,596	7,735	6,826	7,521	7,601	7,198	10,517
Bees (hives)	875	1,375	1,988	3,077	6,050	11,025	9,385	10,644
Total	77,420	157,500	136,563	138,522	156,541	225,061	238,987	285,599
Farm equipment	44,250	48,125	50,951	52,677	54,549	53,170	68,568	84,351
Grand total	121,670	205,625	187,154	191,199	211,290	278,231	307,555	369,950

a Beef and dairy cattle were not segregated in 1912 and 1913.

CLIMATIC CONDITIONS.

The winters of 1917–18 and 1918–19 were unusually mild and therefore especially favorable to land-development work. At no time during these winters was the ground frozen so as to hinder grading work, and there were no severe storms. The spring conditions

in 1918 were very unusual. The precipitation for March, April, and May was extremely light, with the result that much alfalfa planted in March with the idea that the spring rains would carry it until the irrigation water was turned on was lost from drought. On three successive nights during the first week in April the temperature dropped to 25°, 17°, and 18° F., respectively, and killed practically all the fruit on the project. The peaches and apricots were past full blossoming: the plums and prunes were in full bloom; and the pears and apples were well out of the winter buds and some in bloom when killed. The unusually late and low temperature of 29° F. was recorded on May 25 and did some damage to the fruit which had escaped the earlier freezes.

Table IV summarizes the meteorological observations for the 7-year period from 1912 to 1918, inclusive, and gives the records for 1919.

Table V shows the dates of the occurrence of killing frosts for the 11-year period from 1909 to 1919, inclusive, at Hermiston, Oreg., near the Umatilla Experiment Farm.

TABLE IV.—*Summary of meteorological observations at the Umatilla Experiment Farm during the 7-year period from 1912 to 1918, inclusive.*

PRECIPITATION (INCHES).

Year, etc.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Average for 7 years, 1912 to 1918	1.33	0.87	0.53	0.69	1.00	0.64	0.26	0.42	0.21	0.60	0.98	0.84	8.37
1919	1.43	1.46	.58	.68	.26	0	0	.09	.65	.58	1.69	1.05	8.47

EVAPORATION (INCHES).

Average for 7 years, 1912 to 1918	.....	.....	.....	4.09	5.62	7.32	8.41	6.59	4.35	2.46	.....	.....	.....
1919	.....	.....	2.29	4.07	6.00	7.06	8.38	7.21	4.56	3.55	.....	.....	43.147

DAILY WIND VELOCITY (MILES PER HOUR).

Highest, 1912 to 1918	15.3	13.0	16.9	15.7	12.0	14.5	12.1	13.7	11.1	12.3	13.4	15.9	16.9
1919	7.4	8.9	9.9	8.3	11.0	6.7	9.8	11.4	5.3	12.6	9.3	4.0	11.4
Lowest, 1912 to 1918	0	.3	.1	.6	.5	.6	.8	.3	.2	.1	.1	.1	0
1919	.1	.4	.3	0	.2	.2	.1	.1	.1	.1	.1	.2	0
Mean, 1912 to 1918	3.2	2.9	4.0	4.0	3.9	4.5	3.9	2.9	2.7	2.5	2.1	2.6	3.3
1919	1.9	2.6	3.3	3.3	4.1	3.1	2.4	2.3	2.0	2.6	2.2	1.2	2.6

TEMPERATURE (° F.).

Absolute maximum, 1912 to 1918	66	64	75	86	91	104	110	104	95	85	67	70	110
1919	67	56	75	81	91	95	110	102	90	85	66	47	110
Absolute minimum, 1912 to 1918	−27	−6	6	17	29	35	39	39	29	17	3	−4	−27
1919	0	13	21	24	27	34	42	41	27	17	1	−36	−36
Mean, 1912 to 1918	31	35	45	52	58	67	73	73	62	52	42	24	51
1919	32	38	46	53	60	66	75	74	62	49	39	18	51

TABLE V.—*Killing frosts at Hermiston, Oreg., 1909 to 1919, inclusive.*

Year.	Last in spring.		First in autumn.		Frost-free period.
	Date.	Minimum temperature.	Date.	Minimum temperature.	
		° F.		° F.	*Days.*
1909	Apr. 21	27	Oct. 16	30	178
1910	Apr. 30	27	Oct. 15	31	168
1911	Apr. 20	31	Sept. 23	26	156
1912	Apr. 16	31	Oct. 6	31	173
1913	Apr. 23	28	Sept. 24	31	154
1914	Apr. 29	30	Oct. 20	31	174
1915	May 2	31	Oct. 5	30	156
1916	May 14	31	Sept. 28	29	138
1917	May 2	31	Oct. 17	22	168
1918	May 25	29	Oct. 8	31	136
1919	May 4	27	Sept. 29	27	123

AGRICULTURAL CONDITIONS IN 1918.

The year 1918 was one of the most successful in the history of the project. The yield of crops was normal, the acreage was appreciably increased, and very good prices were realized. The crops for the year were valued at $400,642, which was an average of $58.75 per acre. The farmers received $46,563 for 81,388 pounds of butter fat sold to the local creamery, an average price of 57.3 cents per pound. These figures represent only approximately the butter fat produced on the project, as some was received from outside points and some of the butter fat produced on the project was shipped out for sale.

Crops were harvested from 6,819 acres, while young alfalfa and nonbearing orchards brought the irrigated area up to 9,100 acres. Development on the west extension was extremely rapid, the irrigated area there being increased from 1,127 acres in 1917 to 1,936 in 1918 and the cropped area from 724 to 1,306 acres. Table VI gives data on the acreages, yields, and farm value of crops grown in 1918. By far the largest crop was alfalfa, of which 5,274 acres were grown, valued at $340,083. The average price per ton was $17.84 and the average value per acre $64.48, which was slightly more than the average for all crops. The alfalfa-seed industry has become one of considerable importance during the last two years. The seed is mostly grown on land which is difficult to irrigate, which has too poor a stand for hay, or where it is desired to save water. The average return for seed was $54.30 per acre, which was slightly lower than the gross return from hay, but considering the decreased cost of production and harvesting it is probable that the net returns would be about equal. The gross return per acre from saccharine sorghum grown for sirup was high, but it was an expensive crop to produce and harvest, and the farmers who grew it do not consider it a profitable crop. The cost of production is about equal to corn, but the harvesting, including the heading and pressing, and the operation of boiling

down the juice are expensive. The returns from corn grown for grain and for silage are slightly below those of alfalfa, but the facts that corn is indispensable in a rotation and silage is necessary in dairying justify its cultivation.

TABLE VI.—*Acreage, yields, and farm value of crops produced on the Umatilla Reclamation Project in 1918.*

Crop.	Area (acres).	Unit of yield.	Yield.			Farm value.		
			Total.	Per acre.		Per unit of yield.	Total.	Average per acre.
				Average.	Maximum.			
Alfalfa hay	5,274	Ton	19,063	3.6	6.5	$17.84	$340,083	$64.48
Alfalfa seed	117	Bushel	591	5.1	7.6	10.75	6,353	54.30
Apples	418	Pound	103,800				3,322	7.95
Barley	48	Bushel	555	11.6	27.8	1.18	757	15.77
Sorghum sirup	7	Gallon	490	70	120	1.44	708	101.14
Corn (grain)	252	Bushel	6,403	25.4	75	1.53	9,796	38.87
Corn (fodder)	114	Ton	778	6.8	17.5	7.02	5,462	47.91
Fruits (small)	57						3,140	55.09
Garden	66						6,524	98.85
Hay (other)	368	Ton	407	1.1	3.9	8.94	3,639	9.89
Oats	1	Bushel	16			1.00	16	16.00
Peaches [1]	110	Pound					1,135	10.32
Pears	6	do	23,426	3,904		.04	890	148.33
Potatoes	49	Bushel	3,296	65.2	175	1.33	4,397	89.73
Pasture	774	Acre					10,033	12.92
Prunes	2	Pound	6,000			.05	300	150.00
Rye	33	Bushel	175	5.3	5.8	2.15	376	11.40
Vetch seed	23	do	63	2.7	6	13.00	819	35.17
Wheat	31	do	449		20	2.22	997	32.16
Miscellaneous	35						1,671	47.74
Less duplications	970							
Total cropped	6,819						400,642	58.75

[1] Crop failure.

AGRICULTURAL CONDITIONS IN 1919.

The year 1919 was an extremely favorable one for crop production on the Umatilla Reclamation Project. The spring season was comparatively moist, so that new seedings of alfalfa were successful. The summer was long, and mean temperatures higher than normal were recorded. There was a very noticeable absence of winds strong enough to do material damage. The scarcity of irrigation water was acute on some portions of the project during the peak of the season.

Table VII is the crop report for the Umatilla Reclamation Project for 1919. The irrigated area was 10,533 acres, which was 1,433 acres greater than in 1918. By far the largest acreage was alfalfa, of which there were 6,837 acres. The next largest acreage was apples, from which good crops were secured. Some of the apple orchards on the lower land suffered very heavily from late spring frosts, which showed the necessity of orchard heating on these lands. The peaches generally were so far advanced at the time of the frost as not to be damaged, and good yields were secured.

TABLE VII.—*Acreage, yields, and farm value of crops produced on the Umatilla Reclamation Project in 1919.*

Crop.	Area (acres).	Unit of yield.	Yield.			Farm value.		
			Total.	Per acre.		Per unit of yield.	Total.	Average per acre.
				Average.	Maximum.			
Alfalfa hay	6,837	Ton	25,836	3.8	7	$18.70	$483,133	$70.66
Alfalfa seed	68	Bushel	180	2.6	5	17.53	3,155	46.40
Apples	583	Pound	1,389,015	2,382	26,667	.049	68,062	116.74
Barley	38	Bushel	1,673	44	55	1.55	2,593	68.24
Corn (grain)	108	do	3,202	29.6	80	1.43	4,579	42.40
Corn (fodder)	200	Ton	1,098	5.5	16	9.22	10,124	50.62
Fruits (small)	50						6,723	134.46
Garden	69						7,593	110.05
Hay (other)	258	Ton	230	.9	2.5	15.14	3,482	13.50
Pears	13	Pound	86,245	6,634	11,200	.033	2,846	218.92
Peaches	97	do	508,348	5,241	16,000	.025	12,709	131.02
Pasture	539						13,883	25.76
Potatoes	49	Bushel	2,830	57.8	332	1.92	5,434	110.90
Rye	11	do	80	7.3	7	1.96	157	14.27
Watermelons	21	Ton	62	4.4	14	30.11	2,770	131.90
Wheat	18	Bushel	240	13.3	37	2.03	487	27.05
Miscellaneous	87						5,650	64.94
Less duplications	582							
Total cropped	8,464						633,380	74.83

The 6,837 acres of alfalfa yielded 25,836 tons of hay, valued at $483,133. The return from apples was the next largest, being $68,062. Pasture, peaches, and corn fodder gave gross returns next to apples, in the order named, each being valued at more than $10,000. The total crop production for the year was valued at $633,380.

The highest returns per acre were realized from small acreages of pears, small fruits, and watermelons. Peaches and apples gave good returns on larger acreages. The apples from 583 acres returned $116.74 per acre, and the peaches from 97 acres brought $131.02 per acre. It should be remembered, however, that these crops are not reliable from year to year on account of spring frost conditions, and the peaches are liable also to injury from winter freezes.

The crop conditions on the Umatilla project are different from those on the other reclamation projects in that so large a proportion of the cropped area is in one crop, alfalfa, and so large a part of the total income is derived from it. These ratios hold for the near-by projects, with the exception of a slightly higher percentage of fruit on one or two of them.

NOXIOUS WEEDS.

During the past few years a number of weed pests have become prevalent on the Umatilla project. These weeds are mostly grasses which appear in alfalfa and cultivated fields. Entirely erroneous names have been used locally for a number of them. The most common (*Bromus tectorum*), locally known as cheat and also known as downy brome-grass, slender chess, and early chess, is a worthless

member of the same genus as smooth brome-grass. It is widely distributed on the dry land of the project and in the alfalfa fields, where it does its greatest damage by reducing the yield and quality of the first cutting of hay. It is not present in harmful quantities in the later cuttings. Cheat can not be entirely eradicated, but it may be greatly reduced by the use of a spring-tooth harrow. It has been found that in alfalfa fields not harrowed the proportion of this grass was as high as 50 per cent of the yield of alfalfa, that harrowing it once early in the spring reduced it to 15 per cent, and that harrowing after the alfalfa was 2 to 4 inches high reduced the proportion of cheat-grass to approximately 2 per cent. Late harrowing may hold the alfalfa crop back slightly, but it is believed that the increase in the quality of the hay will much more than offset the reduced yield. The second and third cuttings are often badly infested with *Setaria viridis*, locally known as pigeon grass and also commonly called green foxtail, foxtail, and wild millet. It does not damage the hay so much as cheat-grass, but probably reduces the yield where it is present in large quantities. The grass inaccurately known locally as foxtail is *Hordeum jubatum*, which has the common names of squirrel-tail grass, skunk-tail grass, and wild barley. This weed is now usually limited to wet ground, but great care should be taken to prevent its spreading to hay land, as the barbed beards are extremely injurious to the mouths of horses, cattle, and sheep, and it consequently reduces the value of the hay. Squirrel-tail grass may be successfully controlled by cutting every year before it goes to seed and by thorough harrowing, as it is a biennial or perennial. *Echinochloa crus-galli*, which has the common names of Japanese barnyard millet, billion-dollar grass, barnyard grass, and is sometimes wrongly called Johnson grass, grows in moist cultivated fields and in alfalfa which is on seepage ground. It may be controlled by harrowing late in the spring in alfalfa and by frequent cultivation while young in fields that are cultivated. It is essential that cultivation be given while the weed is young, as it rapidly becomes so large and tough that it can not be successfully controlled.

CHINESE PHEASANTS.

During the last two or three years the Chinese pheasant has become common on the project, and these birds have caused a material reduction in the yield of corn by digging up the young plants and eating the seed. Attempts have been made to prevent such injury by treating the planting seed with such materials as nicotine sulphate, crude oil, sheep dip, and oil of pine tar. In one case a hundred hills of corn were planted with seed treated with each of the above-named substances. Ten days after planting records were taken of the number of plants growing and of seeds missing. The pheasants were credited with taking the seeds only where their

tracks were actually found. It was found that none of the treatments prevented these birds from eating the seed, of which 51 per cent was eaten, 39 per cent grew, and 10 per cent was unaccounted for. On one farm a contrivance consisting of rags 3 feet long tied to a string 6 feet above the ground between two poles 6 feet apart was also used. There was no evidence that any of the seed in this field was eaten, although pheasants were plentiful in the vicinity.

CROP EXPERIMENTS.

The results of the work of the Umatilla Experiment Farm dealt with in this paper bear mainly on the irrigation and soil-fertility experiments and also include variety tests of corn and pasture grasses and summaries of orchard-cultivation experiments. The principal problems worked on during the past two years were irrigation, experiments with borders, varying intervals of irrigation and quantities of water, lysimeter investigations, rotation experiments with manure and commercial fertilizers, variety tests of corn and pasture grasses, and tests of miscellaneous field crops.

At a conference of representatives of the Office of Western Irrigation Agriculture and the Oregon Agricultural College on the future policy of the farm, held in 1918, it was decided to discontinue the horticultural experiments as rapidly as definite results were secured and to undertake experiments concerning methods of soil improvement and the production of field crops. These experiments are planned chiefly to ascertain the value of various rotations, to determine the duty of water on various crops, and to test different varieties of crops which have been found suitable under these conditions. In accordance with this policy, at the close of the 1918 season the following experiments were discontinued: (1) Orchard cultural-method experiment with peaches in field D5, (2) apple-irrigation experiment in field D1, (3) small-fruit variety test in field B4, and (4) ornamental nursery D1. The commercial-fertilizer rotation experiment in field A4 was revised. The trees in fields C1, D5, and D1 were removed during the fall, and work was started to regrade fields C1, D5, and A4 for the new experiments. (See maps, figs. 1 and 2.)

TEST OF SILAGE CROPS.

Extensive trials of silage crops were conducted in 1918 and 1919. (Fig. 3.) These tests included 51 varieties of corn and a variety of sunflowers. The test was conducted in 1918 on land which had been in cultivated crops for a number of years but had green-manure crops turned into it, while the 1919 test was on land which had grown alfalfa for a number of years. Two rows of each variety were planted together, and the varieties were triplicated in 1918 and duplicated in 1919. The yields probably were not so large as

they would have been had irrigation water been available at more frequent intervals, especially in 1919, but all the varieties had an equal opportunity. The varieties were all cut on the same dates—September 12 in 1918 and September 30 in 1919. There was some difference in the maturity of the different varieties, varying from the dough stage to well-ripened crops. The fodder was weighed

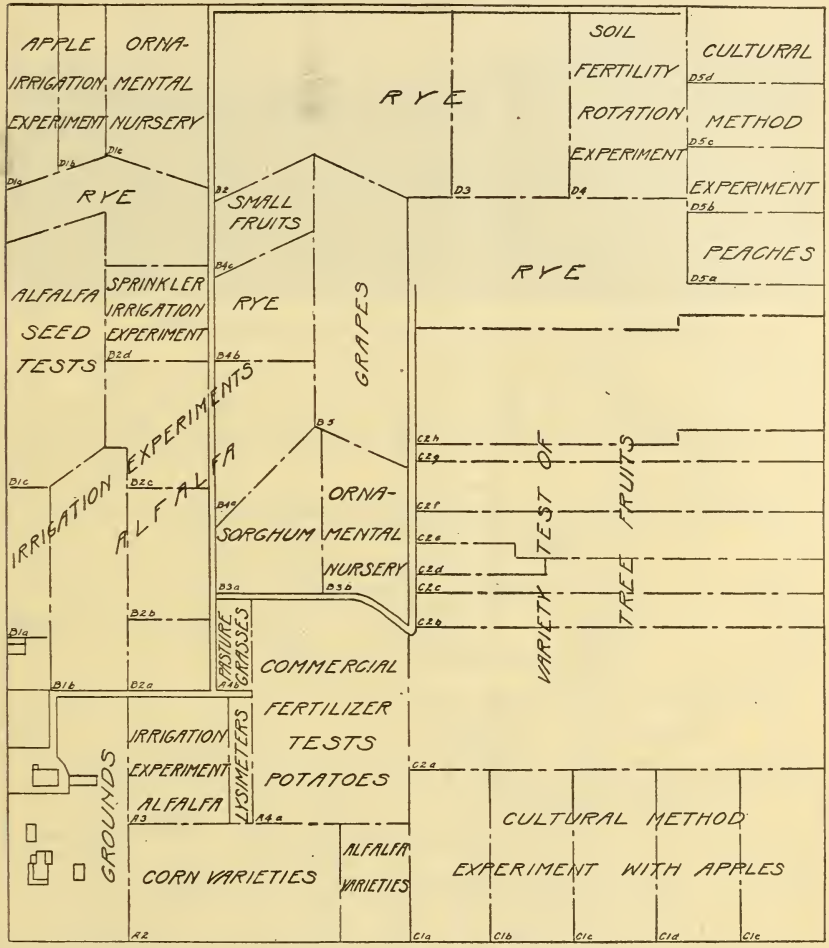

FIG. 1.—Diagram of the Umatilla Experiment Farm, showing the arrangement of the fields and the location of the experiments in 1918.

for the total silage weight and then the ears were removed and weighed separately. The ear yields were not reduced to bushels, on account of the difference in moisture content. Table VIII gives a list of the varieties and the weight of fodder and ears produced by each.

Mammoth Russian sunflowers gave a far larger yield than any variety of corn. A stand of sunflowers was not secured in 1919, due to

poor seed. The results of feeding sunflowers obtained at several experiment stations vary considerably. In some instances it is reported that live stock relishes the silage and in others that it does not eat it readily. It is entirely possible that the stage at which it is cut has something to do with its feeding qualities. The sunflowers raised in a width-of-planting test in 1919 were placed in the silo of a farmer

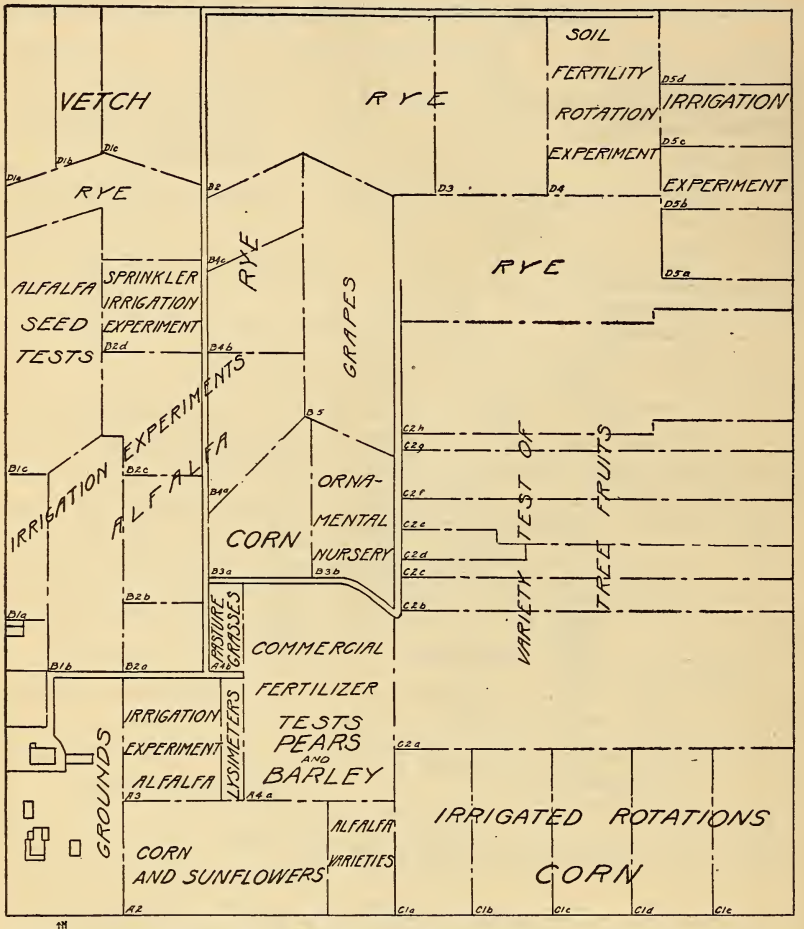

FIG. 2.—Diagram of the Umatilla Experiment Farm, showing the arrangement of the fields and the location of the experiments in 1919.

located near the farm, and a careful record will be kept of its value under these conditions.

The highest yielding variety of corn both years was the Hopi, a southwestern Indian variety. The Pueblo, Colorado Giant Fodder, and Barry Golden Tip varieties each yielded over 8 tons per acre. The Hopi variety in 1918 produced also the highest grain yield, but in 1919 the yield was comparatively low. The Bloody Butcher

variety produced the next highest grain yield and 5.50 tons of fodder. Sullivan White Dent, a strong-growing local variety, produced 1.43 tons of ear corn and 5.68 tons of fodder. The average yield per acre of fodder for all varieties was 5.78 tons of fodder and 1.06 tons of ear

FIG. 3.—Silage-crop test on the Umatilla Experiment Farm in 1918.

corn. These tests were merely preliminary, but from present indications the most promising varieties are the Hopi, Bloody Butcher, Colorado Giant Fodder, Sullivan White Dent, and Dependable Yellow Dent.

TABLE VIII.— *Yield of sunflowers and corn for forage and ear corn in silage-crop tests on the Umatilla Experiment Farm in 1918 and 1919.*

Season and rank.	Variety.	Yield per acre (tons).		Season and rank.	Variety.	Yield per acre (tons).	
		Forage.	Ears.			Forage.	Ears.
Season of 1918:				Season of 1919—Contd.			
1	Sunflower (Mammoth Russian)	28.4	.....	13	Mastodon field	5.81	1.16
2	Hopi	10.8	2.60	14	Johnson County White	5.73	.68
3	Barry Golden Tip [1]	8.18	1.56	15	Kaw Chief	5.73	.65
4	Pride of Oregon	7.97	.67	16	Sullivan White Dent	5.68	1.43
5	Winslow Squaw	7.46	1.25	17	Silver King	5.63	1.43
6	Navajo	6.61	.70	18	Brazilian Flower	5.56	1.37
7	Pueblo	6.18	1.12	19	Bloody Butcher	5.50	1.66
8	Silver King	6.13	.46	20	Pride of Oregon	5.47	1.23
9	Pride of the North	5.67	.51	21	Longfellow	5.42	1.13
10	Swadley	5.67	.09	22	Kilbury Yellow Hybrid	5.32	.88
11	Minnesota No. 13	4.38	.92	23	Golden Beauty M	5.26	.97
12	Pawnee Blue	3.47	.41	24	Golden Surprise	5.16	1.27
13	Northwestern Dent	3.27	.25	25	Neller's cattle	5.15	.85
Season of 1919:				26	Clarage	5.07	1.54
1	Hopi	8.93	.85	27	Yellow Dent	5.06	.76
2	Pueblo	8.73	.65	28	Diamond Joe's Big White	4.89	1.06
3	Colorado Giant Fodder	8.39	.82	29	Red Cob Fodder	4.88	.64
4	Dependable Yellow Dent	7.57	1.21	30	Elephant Fodder	4.84	.95
5	Golden Beauty B	7.32	.55	31	White Cap Yellow Dent	4.79	.95
6	Hickory King	6.53	.88	32	Droughtproof Yellow Dent	4.75	.89
7	Eureka Silage	6.41	.45	33	Navajo	4.44	1.01
8	Boone County White	6.41	1.06	34	Sugar Forage	4.41	1.12
9	Golden Dent	6.29	.64	35	Tribrid	4.36	1.28
10	Leaming	6.09	1.19	36	Minnesota Ideal	4.31	.88
11	Mammoth White Dent	6.02	1.07	37	Australian White Flint	4.16	1.43
12	Silver Mine	5.90	1.51	38	Ninety-Day	3.83	1.31
				39	Minnesota King	3.29	.97

[1] Probably Bloody Butcher.

IRRIGATION EXPERIMENTS.

For five years past experiments have been conducted to determine the most profitable periods at which to apply water to alfalfa and the depth of the most economical applications of water. Table IX gives a summary of the water used and the hay produced in the frequency-of-irrigation experiments with alfalfa. These experiments have been conducted on three $\frac{1}{5}$-acre plats on a medium sandy soil. It is felt that the experiments have continued long enough and that the results are uniform enough to justify very definite conclusions as to the quantity of water required and the proper intervals for irrigation on this type of soil.

TABLE IX.—*Summary of water applications and yields of alfalfa in the frequency-of-irrigation experiments on the Umatilla Experiment Farm during the 5-year period from 1914 to 1918, inclusive.*

Items of comparison.	1914	1915	1916	1917	1918	Average.
Maximum (1-week interval):						
Number of applications	24	21	21	21	15	.....
Acre-inches per application	6.75	4.00	4.00	3.00	4.00	.....
Total water.....acre-feet..	9.69	7.00	7.00	5.25	5.00	6.79
Yield per acre.....tons..	5.57	5.69	6.72	5.95	6.13	6.01
Yield per acre-foot.....do....	.575	.813	.960	1.134	1.225	.885
Average (2-week interval):						
Number of applications	12	11	11	11	15	.....
Acre-inches per application	5.26	4.00	4.00	4.00	3.00	.....
Total water.....acre-feet..	5.26	3.67	3.67	3.67	3.75	4.00
Yield per acre.....tons..	5.31	4.63	6.36	5.97	5.48	5.55
Yield per acre-foot.....do....	1.010	1.260	1.773	1.625	1.472	1.388
Minimum (3-week interval):						
Number of applications	6	7	7	7	8	.....
Acre-inches per application	4.69	4.00	4.00	5.00	5.00	.....
Total water.....acre-feet..	4.38	2.33	2.33	2.92	3.33	3.06
Yield per acre.....tons..	4.03	3.50	4.25	4.10	4.40	4.06
Yield per acre-foot.....do....	.920	1.500	1.825	1.404	1.322	1.327

In 1914, 1915, 1916, and 1917 the maximum plat received water once a week, the medium plat once in two weeks, and the minimum plat once in three weeks, while in 1918 the medium and maximum plats received water once in 9 days and the minimum once in 18 days. In 1914 the plats were irrigated with varying quantities of water at each application, but with as much as was thought to be a good irrigation. The soil-moisture results showed that more water was applied than the soil could hold against percolation, so in 1915 and 1916 the applications were limited to 4 acre-inches each, with the result that much less water was used, without reducing the yields. In 1917 the maximum plat was irrigated with 3 acre-inches, the medium plat with 4 acre-inches, and the minimum plat with 5 acre-inches. The increased quantity did not increase the yield on the minimum plat, and the decreased amount on the maximum plat resulted in a saving of water and did not reduce the yield materially. In 1918 the minimum plat received 5 acre-inches once in 18 days, the medium plat 3 acre-inches, and the maximum plat 4 acre-inches at 9-day intervals, with the result that slightly less water was used

on the maximum plat and the yields were not changed. The results of this experiment show that on this type of soil not more than 4 acre-inches should be applied for an irrigation and that the interval of once in two weeks has always given the greatest net returns. When water was applied each week the additional labor cost of applying it and the additional water charge were not justified by the increased yield. Figure 4 represents graphically the water applications and the alfalfa yields for these frequency-of-irrigation experiments.

BORDER IRRIGATION.

In the early years of irrigation on the Umatilla project furrow irrigation and wild flooding were generally used. The furrow method was undesirable because the head of water was divided so that the loss from deep percolation beyond the root zone was excessive and it was difficult to get the water across the fields. The wild flooding

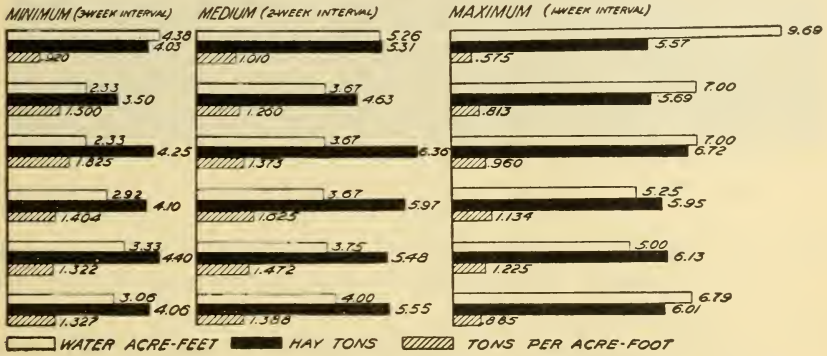

FIG. 4.—Diagram showing water applications and yields of alfalfa hay in the frequency-of-irrigation experiments at the Umatilla Experiment Farm during the 5-year period from 1914 to 1918, inclusive.

method was unsatisfactory because parts of the field were irrigated more than once and the higher portions were not irrigated. These objections were overcome by the border method, because the head was not divided and so could be forced over the land quickly without excessive loss from percolation. The duplication of irrigation was avoided by means of dikes controlling the water, and when a border is properly constructed there are no high spots which are difficult to cover.

In the border method of irrigation the land is laid out in strips from 20 to 40 feet wide and from 100 to 250 feet long, the size depending upon the type of soil and the slope of the land, the water being controlled by a dike between the strips. This method has come into very general use on the Umatilla project, largely through the efforts of the experiment farm and the local representative of the Office of

Demonstrations on Reclamation Projects of the United States Department of Agriculture. (Fig. 5.) The advantages of the system are that it is a comparatively economical means of preparing land for irrigation, that economical applications of water may be made with it, that the distribution of water is uniform, and that the

FIG. 5.—Newly prepared borders for border-irrigation experiments on the Umatilla Experiment Farm in 1919.

labor of irrigation is greatly reduced as compared with the flooding or furrow methods. The results of these border experiments are given in Table X.

TABLE X.—*Water application on size-of-border irrigation experiments on the Umatilla Experiment Farm during the 4-year period from 1916 to 1919, inclusive.*

Size of border.	Number of applications.				Total water applied per acre (acre-feet).					Average application per acre (acre-inches).				
	1916	1917	1918	1919	1916	1917	1918	1919	Average.	1916	1917	1918	1919	Average.
Length-of-border experiment:														
100 by 22 feet..	21	11	8	11	5.86	4.02	2.55	4.28	4.18	3.35	4.38	3.83	4.66	4.05
175 by 22 feet..	21	11	8	11	5.88	5.03	3.20	5.34	4.86	3.36	5.49	4.79	5.82	4.86
250 by 22 feet..	21	11	8	11	8.51	5.54	4.21	7.55	6.45	4.86	6.04	6.86	8.20	6.49
Width-of-border experiment:														
20 by 200 feet..	.....	12	10	9	.....	3.18	4.41	3.86	3.81	.....	3.28	5.29	5.15	4.57
25 by 200 feet..	.....	12	10	9	.....	3.88	3.83	3.74	3.81	.....	3.99	4.60	4.98	4.52
30 by 200 feet..	.....	12	10	9	.....	4.76	4.28	4.78	4.61	.....	4.64	5.13	6.37	5.38
35 by 200 feet..	.....	12	10	9	.....	4.14	4.73	6.00	4.95	.....	4.17	5.68	8.00	5.95
40 by 200 feet..	.....	12	10	9	.....	4.65	4.93	6.90	5.49	.....	4.60	5.92	9.19	6.57

The border irrigation experiments consist of length-of-border and width-of-border experiments. The length-of-border experiments have three borders, 100, 175, and 250 feet long and 22 feet wide, while the width-of-border experiments have five borders 20, 25, 30, 35, and 40 feet wide and 200 feet long.

The average quantity of water used in the length-of-border experiments increased with the length of border, but this increase was much less for the first 75 feet of additional length than for the second 75 feet, the average water requirement in acre-feet per acre being 4.18 for the short plat, 4.86 for the second length, and 6.45 for the long plat.

On the width-of-border experiments the quantity of water in acre-feet per acre required to irrigate the 20 and 25 foot borders was the same, and the 30-foot border did not require excessive amounts of water, but the 35 and 40 foot borders required more water than is consistent with good irrigation practice. The water required for a single application was in the same proportion as the total quantity used. The optimum size of border must be governed by the type of soil, the slope of the land, and by the head of water available; in other words, every piece of land has its peculiar problems, and the way it is to be laid out will depend on these factors. The above results as to size should be kept in mind.

LYSIMETER INVESTIGATIONS.

The study of soil moisture in the rather sandy soil of the Umatilla Experiment Farm led to the installation of eight lysimeters in order to trace more closely than was possible under field conditions the relation of the moisture to the soil and to crops. The lysimeters are concrete tanks 3.3 feet square and 6 feet deep. The soils were taken from the field in 6-inch layers and placed in the tanks in the same order and as nearly as possible the original density.

The five types of soil used are fine sand, medium sand, coarse sand, silt, and silt loam. Of the medium-sand lysimeters, one has no crop and another has soy beans in the summer and vetch in the winter, both crops being turned into the soil; another has alfalfa without manure, and the fourth has alfalfa with manure applied annually. The fine sand, coarse sand, silt, and silt-loam soils grow alfalfa continuously. The detailed figures for the water applied to the soil and for the percolation from it are given in Table XI. The figures for 1915 are from May 22 to the end of the year, for the new lysimeters in 1917 from May 26 to the end of the year, while the other figures are for the whole year. The application figures are for the water applied by irrigation and for the rainfall. Figure 6 illustrates graphically the quantity of water applied and the extent of its percolation.

The percolation from the medium-sand lysimeters has each year been greatest from the one not growing a crop, with the one growing soy beans and vetch as second, and the alfalfa and alfalfa manured following in the order named. The percolation from the other lysimeters growing alfalfa has been lowest from the fine sand, greater from the medium sand, and greatest from the coarse sand. The silt and silt-loam soils have held all the water applied to them. The

rate of percolation from the "no crop" and from the "soy bean and vetch" lysimeters increases very rapidly within 8 to 10 hours after irrigation and has reached a maximum flow within an hour after the first increase has begun. From the maximum rate of flow, it has gradually decreased until after the next irrigation. In the case of the other sands in the lysimeters the increase in percolation begins in 20 to 24 hours after irrigation and does not reach as high a rate as from the "no crop" and "vetch and soy bean" lysimeters. The results show that there is a tendency for the percolation to decrease as the soils are cropped continuously.

TABLE XI.—*Water application and percolation in the lysimeter experiments with various types of soil and crop treatment on the Umatilla Experiment Farm during the 5-year period from 1915 to 1919, inclusive.*

Year.	Medium sand.											
	No crop.			Soy beans and winter vetch.			Alfalfa.			Alfalfa, manured.		
	Water applied.	Percolation.		Water applied.	Percolation.		Water applied.	Percolation.		Water applied.	Percolation.	
		Actual.	Comparative.		Actual.	Comparative.		Actual.	Comparative.		Actual.	Comparative.
	Acre-inches.	*Acre-inches.*	*Per cent.*	*Acre-inches.*	*Acre-inches.*	*Per cent.*	*Acre-inches.*	*Acre-inches.*	*Per cent.*	*Acre-inches.*	*Acre-inches.*	*Per cent.*
1915	38.75	26.04	67.2	38.75	19.47	50.2	38.75	13.24	34.4	38.75	13.48	34.8
1916	56.87	44.56	78.3	56.87	27.21	48.8	56.87	12.40	21.8	56.87	12.06	21.2
1917	62.86	43.00	68.4	64.86	25.88	39.8	62.86	17.96	28.6	62.86	12.02	19.1
1918	65.33	43.17	66.1	65.33	33.41	51.2	65.33	11.41	17.5	65.33	9.79	15.0
1919	66.00	41.45	62.8	66.00	32.54	49.3	66.00	9.72	14.7	66.00	6.83	10.3
Average..	57.96	39.64	68.5	58.36	27.70	47.6	57.96	12.94	22.3	57.96	10.83	18.7

Year.	Water applied, alfalfa crop.							
	Fine sand.			Coarse sand.			Silt.	Silt loam.
	Application.	Percolation.		Application.	Percolation.			
		Actual.	Comparative.		Actual.	Comparative.		
	Acre-inches.	*Acre-inches.*	*Per cent.*	*Acre-inches.*	*Acre-inches.*	*Per cent.*	*Acre-inches.*	*Acre-inches.*
1917	48.76	6.25	12.8	48.76	14.05	28.8	47.76	51.76
1918	65.33	8.80	13.5	65.33	16.85	25.8	65.33	65.33
1919	66.00	5.10	7.7	66.00	13.86	21.0	66.00	66.00
Average	60.03	6.72	11.2	60.03	14.93	35.0	59.69	61.03

SOIL FERTILITY.

The extremely low content of humus and nitrogen of the virgin soils of the Umatilla project make the subject of soil fertility one of first importance. A number of experiments now being conducted deal indirectly with soil fertility and two bear directly on the fertility of the soil as measured by their crop-producing power when treated with commercial fertilizers and barnyard manure and green-manure crops.

The crop rotations with green and stable manure have been the following: (1) Alfalfa continuously, (2) alfalfa for four years followed by corn one year, (3) corn in the summer with a green-manure crop of vetch in the winter, and (4) corn in the summer with a winter green-manure crop of rye. Each of these crop systems includes plats with no manure and plats receiving, respectively, 8 and 32 tons of manure per acre annually.

The average production of alfalfa for four years on plats having no manure was 3.83 tons per acre, on plats having 8 tons of manure per acre, 5.17 tons, and on plats having 32 tons of manure, 6.12 tons. The plats having 8 tons of manure produced 1.33 tons more

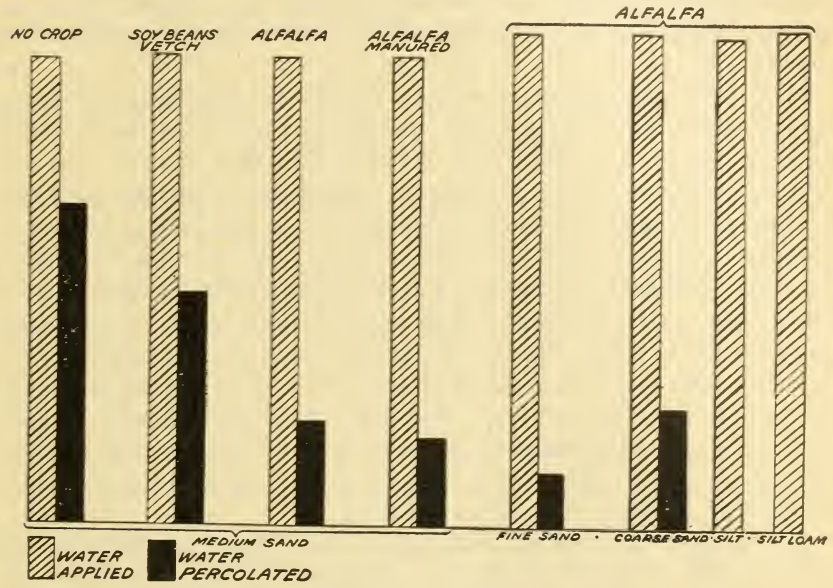

FIG. 6.—Average application and percolation for all lysimeters, Umatilla Experiment Farm.

hay than the check plats, while those receiving 32 tons of manure showed an increased yield of 2.29 tons of hay. If the hay is valued at $15 a ton, the increased yields were worth $19.95 and $34.35, respectively. Had the 32 tons of manure been spread over 4 acres at the rate of 8 tons per acre instead of over 1 acre, the increased yield might have been 5.32 tons, valued at $79.80, or an increased return of $45.45 over that realized when the 32 tons were applied on a single acre; or, stated another way, if the hay is valued at $15 per ton, the manure applied at the rate of 8 tons, by increasing the yield, was worth $2.49 per ton, while that applied at the rate of 32 tons was worth only $1.07 per ton, showing very definitely that the greater returns from the manure are obtained by lighter applications. Since manure can be had only in limited quantities it should be sparingly applied.

In 1918, without manure, 0.61 ton of cured stover and 2.8 bushels of corn were produced per acre; with 8 tons per acre the yield was 1.36 tons of stover and 13.8 bushels of corn; and with 32 tons the yield was 2.37 tons of stover and 29.4 bushels of corn. The 8 tons of manure increased the yield of corn 4.3 times that of the no-manure plats, which was at the rate of 1.5 bushels of corn per ton of manure. The 32-ton applications increased the yield of corn 9.5 times the yield of the no-manure plats, which was at the rate of 0.83 bushel of corn per ton of manure. The yield of corn per ton of manure again showed that it was more profitable to apply 8 tons of manure per acre than to apply 32 tons. The small yield of corn without manure shows that corn can not be grown with any degree of success without manuring on the coarse soil on which this experiment was conducted.

A rotation experiment in which commercial fertilizers and barnyard manure were applied has completed the second cycle. The rotation consisted of two years of clover, one year of corn, and one year of potatoes. The fertilizers applied were nitrate of soda, muriate of potash, acid phosphate, gypsum, tankage, dried blood, a complete fertilizer, and barnyard manure. There were two plats for each fertilizer, one having a light application and the other a heavy one, each fertilizer being applied each year. In general, although not always, the heavier applications gave a heavier yield than the lighter. The indications were that the plats having some nitrogenous fertilizer produced more than those not having nitrogen, those having acid phosphate more than those not having it, while there was a slight indication that the gypsum produced some increase in the yield, possibly due to the sulphur.

The commercial fertilizer experiment was rather unsatisfactory in that a number of the elements were duplicated in different forms and there were no check plats, so the plan of the experiment has been revised to eliminate duplications and to include checks. The cropping system was changed to a 6-year rotation, consisting of four years of alfalfa, one year of peas and barley to be hogged off, and one year of corn. The lower half of each plat is to be manured each year with 8 tons of manure per acre. The land was somewhat difficult to irrigate, so it was graded into borders in the spring of 1919. The regrading made considerable difference in the soil, so the pea and barley yields have been taken as a measure of the soil variation rather than the effect of the fertilizers.

SHEEP-FEEDING EXPERIMENT.

During the winter of 1918–19 a sheep-feeding experiment was conducted with 29 head of Lincoln-Merino crossbred wether lambs. The lambs were in good condition and averaged 94 pounds in weight when the experiment was started. For one month they were fed

alfalfa hay only, to ascertain the effect of feeding hay alone. They lost an average of 5.4 pounds each during the period. During the remainder of the feeding experiment they were fed 1,690 pounds of ear corn and 500 pounds of shelled corn, which was at the rate of 26 pounds a day or 0.9 pound a day per head. The total hay fed was 5.12 tons, or an average of 83 pounds per day, which was 2.9 pounds per day per head. At the end of the 92-day feeding period the average weight was 103 pounds, making a gain of 9 pounds per head exclusive of 11 pounds of wool per head clipped. The original cost of the lambs was $300.98 and the sale price on the Portland market was $302.20 net, while the wool brought $156.26 net. Since the experiment was conducted primarily to ascertain the returns to be obtained from feeding hay, the other feeds were figured at cost. The net gain of $102.56 was left to pay for the hay. The hay fed thus brought $20.31 per ton at a time when hay was selling for $17 per ton.

TEST OF ALFALFA VARIETIES.

In 1918 and 1919 preliminary row tests of alfalfa were conducted. The varieties included were the Baltic, Common, Cossack, Grimm, and Turkestan. The yields per acre for the Common, Cossack, and Grimm varieties were practically equal, while the Turkestan yielded slightly less and the Baltic variety about 25 per cent more than the average. During the first year the white sweet-clover yields were equal to those of alfalfa, but during the second year they were considerably less.

ORCHARD CULTURE EXPERIMENTS.

An orchard cultivation experiment with apples in field C1 was completed during the year and the trees were removed at the end of the season. The experiment covered 3½ acres and was planted with four varieties of trees—Winesap, Jonathan, Rome Beauty, and Esopus. The five plats which had different treatments were laid out so that trees of each variety were included in each plat.

Plat A each winter grew a legume cover crop, which was turned into the soil, and a cultivated crop in the summer, which was removed from the soil. Plat B grew a winter-legume cover crop, which was turned into the soil. Originally it was planned to turn in each year a summer-grown cover crop, but on account of the poor growth made by these crops the original plan was abandoned and for two years no summer crop was planted; during the last two years a crop of corn was grown. Plat C grew a cover crop of rye, which was plowed under in the spring. No summer crop was grown. Plat D had alfalfa grown between the tree rows, with a clean cultivated strip 6 feet on each side of the tree rows. Plat E grew alfalfa up to the trees.

The results indicate that the trees on land which had a winter cover crop turned under each year and a cultivated crop grown each

summer have made a satisfactory growth and were not materially injured by the cultivated crop grown each summer. The trees where rye was grown in the winter did not make as satisfactory growth as where a legume cover crop was turned under and a cultivated crop removed, possibly partly because the plat growing rye had been heavily graded for irrigation. The trees which had alfalfa grown in the strips between them made a fairly good growth, but the system was objectionable because the soil in the cultivated strips along the trees washed and blew, leaving them lower than the alfalfa strips, thus making the alfalfa strips difficult to irrigate. The method of growing alfalfa up to the trees is not to be recommended for starting young trees, because they make a poor growth, probably on account of the alfalfa robbing them of moisture.

An experiment to ascertain whether better results would follow from starting a peach orchard on virgin soil rather than on old alfalfa land was conducted on 2 acres of the coarser soil of the farm in field D5. On plat A the trees were planted on the raw soil which had had only a crop of rye to protect it from blowing, three crops being grown, followed by four of vetch, all of which were plowed into the soil. On plan B the trees were planted on the raw soil with only rye to protect it from blowing. Four crops of rye were plowed under. Plat C grew alfalfa for two years, after which it was plowed under and the trees were planted. Subsequently, one crop of field peas, two of rye, and two of vetch were plowed into the soil. Plat D grew alfalfa for two years, after which it was plowed under and the trees planted. One crop of field peas and four crops of rye were turned into the soil. The land of plat A was heavily graded to prepare it for irrigation and the trees in the graded portion never made a vigorous growth.

Four varieties of peaches, Alexander, Early Crawford, Elberta, and Triumph, were planted, with the rows running across the plats so that each plat contained eight trees of each variety. The trees were nearly all badly affected with crown-gall, which probably prevented their making as vigorous a growth as they otherwise would have done. The trees produced only one partial crop, having been badly frozen back one year, and the blossoms were frozen in 1918. During the first two years after the trees following alfalfa were planted they made an especially vigorous growth, but following that the growth was slow. At the end of 1918 the trees planted on the virgin soil, which were two years older than the ones following alfalfa, averaged approximately one-fourth larger than those on the alfalfa soil. It is thought that the alfalfa was left on the soil hardly long enough to have produced the maximum benefit possible, from four to five years probably being necessary. The results tend to show that the vetch cover crops were not materially better than the rye cover crops.

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