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Climate and Agriculture of Malheur-Harney Basin, Oregon

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CLIMATE AND AGRICULTURE OF MALHEUR-HARNEY BASIN, OREGON

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LAND AREA

The Malheur-Harney Basin is an enclosed area of approximately 6,300,000 acres. Several independent but contiguous watersheds drain toward Malheur Lake and ultimately to Harney Lake, a dead saline lake. The major streams are the Silvies River, which drains from the north through the Harney Valley, and the Donner and Blitzen River which flows from the south through the Blitzen Valley (Oregon Department of Environmental Quality, 1976).

The basin is characterized by large valleys at elevations of 4,025 to 4,600 feet, semi-desert foothill sagebrush covered bench lands at about 4,500 feet, and adjacent mountainous areas rising to 9,670 feet. The major portion of the basin floor, about 800 square miles, lies at an elevation of 4,100 to 4,150 feet. Geologically, the basin is the northern extension of the Intermountain Great Basin. Pluvial lakes which once occupied the area drained to the south through an outlet near Princeton, Oregon, until it was blocked by a Pleistocene lava flow.

The basin floor is underlain by lacustrine sediments and the soils are related to old lake terraces, shore deposits, recent lake beds, and alluvium deposits by streams which traverse the valley. Much of the basin is wetland subjected to seasonal flooding and a high water table. Soluble salts have concentrated in sediments of the evaporated lakes and further concentrated in slightly elevated areas through the action of sub-irrigation and evaporation. The soils, generally unclassified, are mainly Fluventic and Cumulic Haplaquolls. The profiles, which are variants of Damon, Stanfield, and Silvies series, have low chromas, mottling, and dark surface horizons high in organic matter. They are predominantly silt loam in texture and basic in reaction with pH of 7.5 to 8.5.

Above the flood plain, the soil is generally light textured, varying from silt loam to fine sand. A dense calcarious hardpan persists at 12 to 18 inches. Because of the hardpan, these soils respond as though they are extremely shallow until the hardpan is broken.

CLIMATE

This high desert country is characterized by low precipitation and a short growing season (Carnahan et al., 1967; Sidor and Tillson, 1968). The annual precipitation is about 10 to 12 inches, but in some years it may be as high as 16 inches or as low as 4.5 inches. Growing season precipitation averages 2.5 inches. The average annual temperature at Burns, Oregon, is about 46°F, with an average daily maximum of 86°F in July and an average daily minimum of 16°F in January. Extremes of -54°F and 107°F have been recorded in the basin (Johnsgard, 1963).

Comparisons of temperature data from the official National Weather Service at Burns, Oregon, 1972-1976, suggest growing seasons considerably longer than those recorded at Winter Headquarters (Section 5), Squaw Butte Experiment Station, 1972-1976 (Table 1) and at the Harney Branch Experiment Station, 1914-1953 (Table 2). See Figure 1 for location of stations. The last dates of spring frost recorded at Burns and at Section 5 are similar, but freezing temperatures in the early fall occurred earlier at Section 5 than they did at the Weather Service recorder. Consequently, the length of growing season as reported by the Weather Service may be a few days to two months longer than it is out in the basin. Admittedly, localized areas in the basin may have slightly higher temperatures and longer growing seasons, and the crop success in these areas should be higher than the Burns data suggest.

Annual summaries of weather records from Section 5 for 1972 to 1977 are given at the end of this report (Tables 3 to 8).

CROPS

Climate dictates the type of crops grown but extremes in weather dictate the reliability and success of annual production. In the Burns, Oregon, area, the average frost-free period is about 83 days. The longest periods were 116 days in 1940 and 1975, and the shortest was 20 days in 1954. Since 1925, there does not appear to be any significant trend change.

Native Meadow

Historically, much of the meadow hay in the Malheur-Harney Basin was and is produced using a primitive system of wild flooding. Seasonally, the water is diverted from streams with dams and spread over the land by means of ditches and dikes. The meadows remain flooded through the irrigation season which may extend from mid-February to mid-July.

Typically, the plants native to the wild-flood meadows are water-loving hydrophytes, principally rushes, sedges, and grasses. The depth of water and length of the saturation period determine which species dominates.

The average production of native meadows in eastern Oregon is about 3/4 ton/acre (Powers and Johnston, 1920; Cooper, 1955; Rumburg, 1961). Reports from California, Colorado, Idaho, Montana, Nevada, Utah, and Wyoming also suggest similarly low yields from native untreated meadows.

Research in Oregon, other states, and foreign countries has shown possible alternatives that could be used to improve the quality and quantity of native forage from these seasonally flooded meadows. Included are 1) controlled irrigation and drainage, 2) harvesting date and methods, and 3) fertilization.

Although protein content of rushes and sedges is about equal to that of grasses but not as high as that of legumes, hay yields of the rushes and sedges are lower. Therefore, management systems which increase these plants and reduce the higher producing grasses and legumes will reduce the overall productivity of the meadow. Because of the low production of rushes and sedges, it is concluded that the control of water level is the most important factor in the management and improvement of wet meadows.

As the forage progresses toward maturity, the crude protein percentage steadily declines, and the hay produced becomes coarse and low in feeding value. To obtain maximum yield of high protein hay, grass forage should be cut at the flowering to soft dough stage of growth. In the Malheur-Harney Basin that stage is reached about July 1 to 15 (Cooper, 1956; Rumburg et al., 1964). Normally, the haying operation can begin as early in the summer as equipment can operate on the meadows. Protein yield declines after the soft dough stage at the rate of about 0.08 percent each day until a low level of 3 to 4 percent crude protein is reached.

The response of meadow plants to fertilization depends on the species and the available soil moisture. Sedges and rushes respond very little to added fertilizers (Cooper, 1956; Rumburg, 1961). With added nitrogen, the grasses increase whereas sedges and rushes decline. With added phosphorous, legumes increase in production. Changes in species composition are fairly rapid but more pronounced after the first year. Fertilizer treatments must be continued annually to maintain a change in composition.

The most economical fertilization rates in eastern Oregon appear to be about 80 to 100 pounds of nitrogen per acre. At these rates, one pound of nitrogen increases forage yields about 20 to 25 pounds and 80 pounds/acre increases yields about 3/4 to 1 ton/acre (Nelson and Castle, 1958; Rumburg, 1961).

About 40 pounds of P_2O_5/acre are adequate to maintain an established stand of clover at optimum production (Cooper, 1957).

The grazing capacity of the native meadow is one acre/yearling or two acres/cow-calf pair for 5 months, equivalent to 2.5 animal unit months (AUM) per acre. Stocked at this rate, one acre of meadow produced 244 pounds of yearling beef. If cut for hay, the meadow would have yielded 1 ton/acre (Cooper et al., 1957). Comparing meadow and range production, average daily gains of yearlings were higher consistently when they were on meadow. Yearling steers on range, however, gained slightly more until about July 10. After July 10, steers on meadow gained 1.2 pounds/head/day more than the steers on range. Total average gains in 153 days were 244 and 180 pounds per steer for those on meadow and range, respectively.

Improved Crops

The time factor is too critical and periodic short seasons too frequent to recommend even short season crops other than forages for this area. In the past, a killing frost typically occurred 75 percent of the time after June 1, 50 percent after June 15, and 25 percent after June 25. Likewise, fall frosts have occurred 25 percent of the time by August 15, 50 percent before September 1, and 75 percent before September 10. Based on these experiences, in 5 years in 10 we can expect a growing period of less than 75 days and in only 1 year in 10 can we expect longer than 100 days. Extreme lengths of growing season have been 20 and 116 days.

Other factors of environment which must be considered are supply of water during the growing season and soil salinity. About a third of the annual precipitation falls during the April-September period (Oregon Department of Environmental Quality, 1976). Clearly, this is an arid zone incapable of producing any but the most drought-tolerant species without additional irrigation. Winter snow accumulates in the mountains, and the runoff consequently floods much of the bottom land producing water-loving rushes, sedges, and grasses.

Besides the 221,000 acres under irrigation in 1967, an additional 1,246,500 acres could be irrigated, making a total of 1,467,500 acres in suitability classes I to III that could be put into more intensified crop production (Lindsay et al., 1969). Because of the present flood irrigation system, it is impractical to consider cultivation and species introduction into the flood meadows until reasonable water control and irrigation are practiced throughout the basin. Much is being done on land above the flood plain. Some of this well-drained land is being irrigated by sprinkling from ground water sources. According to Sidor and Tillson (1968), this basin can develop ground water facilities without any noticable declining water problems during the pumping season. If this is true, the potential exists to develop and irrigate more than 1,000,000 acres; however, Leonard (1970) noted that mutual interference exists among wells in some areas. He also noted problems with sand pumping and high mineralized water.

In developing these lands it should be kept in mind that 350,000 acres in the basin have been classified as saline-alkaline. Without proper management, irrigation, and drainage, these can be problem areas. However, they can be identified by the persistence of greasewood and alkaligrass or a salt soil crust.

Because of the uncertainty as to when the last frost in the spring will occur, it is risky to plant too early those crops which can be damaged by frost in late June. A light frost occurring at 28 to 30°F may cause sterility in wheat that has headed or is about to head, and a light frost before wheat is fully mature stops further grain development (Martin et al., 1976). Since we can expect that

8 years in 10, regardless of when we get our last spring frost, we will have a frost before September 10 (about 5 years in 10 it will have frozen by September 1), and since wheat flowers about 6 to 7 weeks after planting and requires 100 days to mature, it is risky to plant earlier than May 20 or later than May 25. In this area, a rule-of-thumb is to expect a crop disaster 1 year in 5. Three years in 5, production should be average and 1 year in 5 yields can be expected to be above average. This rule-of-thumb corresponds fairly well with the temperature records.

Except for rye and barley, which require shorter growing seasons than wheat, forage crops are the only crops we can recommend safely. Field peas and seed potatoes also can be grown in areas where the soil is suitable (and if a market is established) but because of spring frost, yields may be limited.

Since most crops other than forages and barley are speculative, the rancher's alternatives should be with these crops. After new land, whether it is broken from sagebrush, range, or meadow has been worked, the rancher has the alternative to keep it in barley or to plant hay or pasture crops.

Hay

Of concern to many farmers when establishing a new planting of alfalfa is whether to start it with a companion crop. This, of course, should be determined by the expected return. Where the growing season is short, where only two cuttings of alfalfa hay matured to the one-third bloom stage can be harvested annually, planting companion crops may be more profitable. The yield of barley will be less than it would have been if seeded alone, but if the grain is harvested as early as possible and the stubble irrigated immediately, a ton-cutting of alfalfa also might be harvested. The straw, containing some alfalfa, also is a reasonably fair feed. The combined value of the grain, straw, and alfalfa hay usually will be greater than a crop of grain alone or of alfalfa alone. Unless the field is chemically sprayed, the first cutting of alfalfa when planted alone also will contain a high percentage of annual weeds. The second year harvest of alfalfa should be similar regardless of whether it was started with a companion crop. In areas where three or more cuttings of hay matured to one-third bloom can be harvested, it may be more advantageous to plant alfalfa without the companion crop.

Before planting alfalfa, the rancher should consider several factors:

1) Is alfalfa the highest-producing forage crop? In this area it has out-yielded all other legumes.

2) Which variety? This will depend on the location, winter hardiness requirements, insect and disease resistance, and lateness of maturity.

3) Has alfalfa been grown in the field before? If not, the seed should be inoculated before planting.

4) How will it be marketed? Dairy producers, on a protein basis, often prefer pure alfalfa. Locally, a mixture of alfalfa and grass may be better and produce more, depending on the grass species.

Once the hay crop is established, the rancher has the alternative of cutting the hay at a prebloom stage to conserve a high level of protein. If marketing on a protein basis, he may realize more protein per acre from three cuttings at prebloom stage than two cuttings at one-third bloom or later stages. If alfalfa weevil is a problem, an early cutting at the prebloom stage may control damage caused by this pest. To let the alfalfa grow to a later stage may allow serious weevil damage unless it is sprayed for control. If the rancher chooses to do so and the hay is fed to his own cattle, he will receive greater return in animal production from the prebloom hay. If he sells it on a tonnage basis, he will realize more total yield/acre and have less harvesting operations by cutting when the alfalfa is in one-third bloom. Cutting more frequently than at prebloom stage will increase the protein level in the hay, but yields will be decreased and the degree of vigor of the plants will be lessened. In subsequent years, production will decline rapidly and weed species will be more likely to invade.

It is important for management, quality, and production to remove cut hay from the field as soon as possible. An investment in proper haying equipment could be paid for in higher hay quality and yields if the hay is not left in the field for more than a few days.

Improved Irrigated Pastures

Irrigated pasture in the western range area can be an important part of the range livestock operation. Properly used, it can give the rancher a degree of flexibility in management that could reduce his production costs. The amounts of pasture and kind of pasture will be determined by particular needs. The species in the seeding mix will depend on the class of animals to use the pasture; the species used will determine the management imposed. Our experience has been that the stocking rate of fescue-legume pasture is 10 AUM's/ acre. This is equivalent to 2 cow-calf pairs, 3 yearlings, or 6 weaned calves per acre for 5 months.

The rancher has the option to graze pastures with his breeding herd, cow-calf pairs, yearlings, or weaned calves. With the high cost of privately owned land, it is unlikely that he could afford to keep breeding stock on irrigated pasture if native rangeland is available. Pastures, however, can be used to advantage seasonally by mature stock during breeding and calving when more intensive management of the herd is required. Similarly, it is unlikely that cows with their calves can make the best use of pasture except seasonally.

Since the return to pasture is through marketable beef, grazing the forage with yearlings or weaned calves likely will give the highest returns per acre because most of these animals will be marketed. Therefore, the more gain per head and per acre, the higher will be the return per unit of production.

In a management system in which calving occurs in the early morning, calves can be weaned onto pasture in the late summer, leaving the mother cow on the range. If born in the fall, calves can be weaned onto pasture in the spring, allowing the mature herd to go onto range. Yearling stock can be put on pasture in the spring to grow for replacement, as feeders, or they can be fattened.

The class of stock that will graze the pasture should determine the species in the mix. If mature cows are used, the grass should be a high producer of relatively coarse-textured forage. Tall fescue (Fawn) is a good species for this class of animal. At this station, mature cows pastured on tall fescue with their spring-born calves gained 1.9 pounds/day while their calves gained 1.8 pounds. In 112 days of grazing, these gains equaled 425 pounds/acre for cows and 404 for their calves. Yearling steers gained 1.7 to 2.0 pounds/head/day. In addition to the 700 pounds/acre of weight gained by yearlings, the pastures provided 2 AUM's/acre of late fall grazing during which the animals gained 1.1 pounds/head/day. During the same 112-day period, calves born the previous fall gained 1.3 pounds/head/day, producing 875 pounds/acre.

Tall fescue, apparently too coarse for weaned calves, is known to contain alkaloids which may interfere with maximum rate of gain. Weaned calves gained better and produced more on a per acre basis from orchardgrass-legume mixtures than from tall fescue-legume pastures. Yearling steers showed similar gain advantages from the orchardgrass pastures.

With yearling stock on tall fescue, we have learned that the grass should not be rested between grazing periods for more than 14 days. Heifers lost weight on tall fescue which had been allowed to head, although the plants were green and leafy and the pasture was a good mixture with clover.

Fertilization with nitrogen is necessary to obtain maximum forage production from pastures, even when the mixture contains a high level of alfalfa or clover. Split application of nitrogen, 60 pounds/acre applied June 1 and 60 pounds applied again July 15, has returned highest gains. Less than these amounts reduced carrying capacity, and 120 pounds/acre applied June 1 reduced gains because of the greater growth rate of the grass which was coarse and mature when grazed. Fertilizing at these rates has not reduced the survival of alfalfa plants but did increase the proportion of grass in the forage.

We have learned also that tall fescue pastures in this area are borderline deficient in copper and excessive in molybdenum. Consequently, cattle grazing pasture forage may show symptoms of molybdenum toxicity. This can be corrected by supplying one-half pound finely ground copper sulfate in 100 pounds of loose salt fed free choice. Yearlings receiving copper supplement gained 0.4 pounds/head/day more than those not receiving copper.

SUMMARY

Basically, the rancher in the Malheur-Harney Basin, because of climatic limitations, has the following alternatives in managing his agricultural land:

1) Harvest meadow hay at 3/4 to 1 ton/acre of 7 percent protein annually, graze meadows at 0.5 acre/AUM, and graze sagebrush range at 10 acres/AUM.

2) Control water management, keep native species, and increase hay yields by 1 to 1 1/2 tons/acre annually.

3) Control water management, introduce species, and increase hay yields by 2 to 4 tons/acre annually.

4) Fertilize native meadows with nitrogen fertilizer and increase yield about 1 ton/acre.

5) Plow sagebrush lands and plant to crested wheatgrass, if dryland, or plant to improved forage crops if it is to be irrigated. The feasibility of these alternatives depends on long range benefits. Planting crested wheatgrass should increase the grazing capacity from 10 acres/AUM to 2 acres/AUM. Range plantings may need retreatment after 15 to 20 years to control sagebrush. Planting alfalfa for hay and sprinkle irrigating should produce 4.5 to 5.5 tons/acre for 6 to 8 years.

6) Convert native meadow or sagebrush land to irrigated pastures. The feasibility of this alternative also depends on long range benefits derived from improvements. Improved pastures should return 10 AUMs/acre of grazing or 700 pounds/acre of marketable beef.

Table 1. Freeze data for Squaw Butte Experiment Station - Section 5 and the National Weather Service, Burns, Oregon

	Date of last low temperature occurrence in the spring		Date of first low temperature occurrence in the fall		Days between last spring and first fall temp. occurrence	
Year	28°F	32°F	32°F	28°F	28°F	32°F
			Weather Service (Post Office Building)			
1972	May 1	June 11	Sept. 20	Sept. 20	142	112
1973	June 18	June 18	Sept. 26	Oct. 2	106	100
1974	May 15	June 8	Sept. 27	Oct. 6	144	111
1975	May 25	May 25	Oct. 8	Oct. 8	136	136
1976	May 20	June 26	Oct. 4	Oct. 17	150	99
Avg.	-	-	-	-	136	111
			Squaw Butte Section 5 (6 miles SSE of Burns)			
1972	May 1	June 11	July 23	Sept. 13	135	43
1973	June 18	July 1	Aug. 26	Sept. 26	100	56
1974	May 15	May 19	Aug. 21	Sept. 14	122	94
1975	May 25	May 25	Sept. 18	Sept. 18	116	116
1976	June 26	June 26	Sept. 7	Oct. 16	113	73
Avg.	-	-	-	-	117	76

Table 2. Length of growing season near Burns, Oregon

Time period	Length of avg. frost-free period[1/] (days)
Harney Branch Station (29°F)	
1914-1918	55
1919-1923	57
1924-1928	74
1929-1933	76
1934-1938	74
1939-1943	89
1944-1948	89
1949-1953	82
Computed from Weather Service data (WS 32° season period X 0.784)[2/]	
1951-1955	84
1956-1960	90
1961-1965	79
1966-1970	92
1971-1975	90
Average 1924-1972	83

1/ Except for 1915-1925, the length of growing season has remained about the same, averaging about 83 days.

2/ Estimate is based on data from similar year-period (1951-1953) of the Harney Branch Station and the National Weather Service, Burns, Oregon.

Table 3. Weather data for Section 5 headquarters, Squaw Butte Experiment Station - 1972

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Avg
Avg ly/day (clear day)	----	----	----	----	580	690	654	570	456	306	198	168	----	----
Avg max temp °F	----	----	----	----	68.3	75.2	82.4	83.2	66.9	60.8	43.4	28.4	----	----
Avg min temp °F	----	----	----	----	42.5	46.7	47.9	48.6	32.7	29.6	27.0	12.5	----	----
Avg mo temp °F	----	----	----	----	55.4	61.0	65.2	65.9	49.8	45.2	35.2	20.4	----	----
Highest temp °F	----	----	----	----	83	89	92	98	87	77	52	59	----	----
Lowest temp °F	----	----	----	----	27	32	33	34	15	11	12	-26	----	----
Days above 90°F	----	----	----	----	0	0	2	7	0	0	0	0	----	----
Days below 32°F	----	----	----	----	2	1	0	0	14	20	23	28	----	----
Date of 32°F (season)	----	----	----	----		11	23						(43 days)	
Date of 29°F (season)	----	----	----	----	1				7				(130 days)	
Avg humidity (min)	----	----	----	----	37.4	36.4	33.0	30.0	33.5	36.2	58.9	64.5	----	----
Ppt total (inches)	1.42	1.68	.86	.15	.34	.37	.02	.23	.76	.31	1.48	1.61	9.23	
Days ppt[1/]	2	1	1	0	1	1	0	0	1	0	3	2	11	
Avg windspeed (mph) at 40 inches	----	----	----	5.4	3.3	1.9	2.5	2.3	2.3	2.6	1.3	2.1	----	2.5
Avg windspeed (mph) at 80 inches)	----	----	----	6.6	4.7	3.4	3.6	3.3	3.3	3.8	2.3	3.0	----	3.8

1/ Effective storms of 1/4 inch or more in 24-hour period.

Table 4. Weather data, Section 5, 1973

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total	Annual Avg.
Avg ly/day (clear day)	208	276	450	557	669	678	624	573	480	319	264	177		440
Avg max temp °F	33.0	41.4	46.6	57.0	68.2	74.1	86.4	82.4	73.1	60.5	41.3	38.8	----	58.6
Avg min temp °F	18.4	25.8	25.9	29.1	39.2	42.2	49.0	44.6	38.3	29.6	27.7	26.3	----	33.0
Avg mo temp °F	25.7	33.6	36.2	43.0	53.7	58.2	67.7	63.5	55.7	45.0	34.5	32.6	----	45.8
Highest temp °F	46	52	58	74	84	91	96	92	91	80	59	48	----	72.6
Lowest temp °F	6	8	15	17	26	26	31	32	26	17	10	16	----	19.5
Days above 90°F	0	0	0	0	0	1	14	6	1	0	0	0	22	----
Days below 32°F	30	28	29	25	5	3	1	1	6	21	20	29	198	----
Date of 32°F (season)							1	26						(56 days)
Date of 29°F (season)						18			3					(77 days)
Avg humidity (min)	63.3	58.2	40.3	33.7	35.7	35.3	29.7	29.7	33.4	37.7	60.9	66.7	----	43.7
Ppt total (inches)	.94	.46	.39	.41	.85	.08	0	.61	.89	.82	2.13	1.90	9.48	----
Days ppt[1/]	2	0	1	0	2	0	0	1	1	2	4	3	16	----
Avg windspeed (mph) at 40 inches	3.1	2.7	3.9	3.6	3.3	2.0	2.3	2.2	2.0	2.0	3.9	2.8	----	2.8
Avg windspeed (mph) at 80 inches	4.1	3.6	4.8	4.5	4.4	3.2	3.2	3.2	2.8	3.1	5.0	3.6	----	3.8

1/ Effective storms of 1/4 inch or more in 24-hour period.

Table 5. Weather data, Section 5, 1974

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total	Annual Avg.
Avg ly/day (clear day)	186	330	440	556	606	631	594	525	426	318	210	161		415
Avg max temp °F	33.9	40.8	45.7	53.7	62.1	79.0	82.2	83.1	79.9	63.6	48.7	37.8	----	59.2
Avg min temp °F	20.6	24.3	28.0	33.2	39.5	48.5	49.3	45.8	36.7	27.9	22.5	20.1	----	33.0
Avg mo temp °F	27.2	32.6	36.8	43.4	50.8	63.8	65.8	64.4	58.3	45.8	45.6	29.0	----	47.0
Highest temp °F	50	48	58	69	78	90	93	92	88	80	63	49	----	71.5
Lowest temp °F	3	14	5	27	27	35	40	33	26	16	10	5	----	20.1
Days above 90°F	0	0	0	0	0	2	7	6	0	0	0	0	15	----
Days below 32°F	26	27	24	15	6	0	0	0	8	24	27	30	130	----
Date of 32°F					19			21					(94 days)	
Date of 29°F					15				14				(122 days)	
Avg humidity (min)	60.7	50.3	51.3	39.6	38.7	37.1	33.4	31.1	30.3	40.3	46.0	61.4	----	42.5
Ppt total (inches)	.45	.65	1.81	1.07	.20	.09	.79	.16	0	.40	.05	1.29	6.99	----
Days ppt1/	1	1	2	1	0	0	2	0	0	1	0	2	10	
Avg windspeed 1M	3.8	3.4	3.8	4.7	3.0	0.8	1.6	1.7	1.6	1.4	2.1	3.3	----	2.6
Avg windspeed 2M	4.8	4.3	4.7	5.8	4.4	3.1	3.2	3.1	3.4	2.9	3.2	3.6	----	3.9

1/ Effective storms of 1/4 inch or more in 24-hour period.

Table 6. Weather data, Section 5, 1975

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total	Annual Avg.
Avg ly/day (clear day)	180	348	396	480	600	660	552	480	420	312	240	180	----	404
Avg max temp °F	34	38	43	48	62	68	83	80	79	58	45	41	----	56
Avg min temp °F	19	22	24	30	39	41	55	46	37	33	24	23	---	33
Avg mo temp °F	26	30	33	39	50	54	69	63	58	45	34	32	----	44
Highest temp °F	48	49	52	58	79	82	94	89	88	82	68	59	----	----
Lowest temp °F	< 5	< 5	5	14	27	38	38	34	28	16	< 5	< 5	----	----
Days above 90°F	0	0	0	0	0	0	6	0	0	0	0	0	6	----
Days below 32°F	29	27	27	20	4	0	0	0	6	16	27	28	184	----
Date of 32°F						25				18			(116 days)	
Date of 29°F						25				18			(116 days)	
Avg humidity (min)	68	65	45	39	38	35	36	30	28	41	46	66	----	45
Ppt total (inches)	.89	1.12	1.46	.98	.14	.78	.73	.09	.04	1.27	.35	1.27	9.12	
Days ppt[1/]	3	3	3	3	0	1	2	0	1	2	1	4	23	
Avg windspeed 1M	2.5	3.3	3.5	4.4	4.6	2.0	1.6	1.9	1.9	2.3	2.6	1.8	----	2.7
Avg windspeed 2M	3.4	4.3	4.5	5.4	5.8	3.9	3.0	3.6	3.2	3.3	3.7	2.3	----	3.9

1/ Effective storms of 1/4 inch or more in 24-hour period.

Table 7. Weather data, Section 5, 1976

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total	Annual Avg.
Avg ly/day (clear day)	204	312	420	552	660	672	672	552	528	336	228	180	----	443
Avg max temp °F	34	37	45	53	66	68	83	77	78	68	59	44	----	59
Avg min temp °F	17	22	22	28	39	42	52	50	44	31	26	10	----	32
Avg mo temp °F	25	29	33	40	52	55	67	63	61	49	42	28	----	45
Highest temp °F	44	50	58	66	84	88	96	91	95	92	73	57	----	----
Lowest temp °F	8	5	5	13	29	28	35	40	32	19	8	10	----	----
Days above 90°F	0	0	0	0	0	0	6	4	2	1	0	0	13	----
Days below 32°F	30	27	31	23	2	1	0	0	1	20	18	31	184	----
Date of 32°F						26			7				(73 days)	
Date of 29°F						26				16			(113 days)	
Avg humidity (min)	66	52	38	32	32	32	31	34	30	30	34	42	----	38
Ppt total (inches)	1.35	.80	.38	.37	.57	.30	.45	2.34	.54	.12	.29	.02	7.53	----
Days ppt 1/	2	2	0	1	2	0	1	6	1	0	1	0	16	----
Avg windspeed (mph) at 40 inches	2.2	3.6	3.6	4.8	3.8	1.6	1.0	1.9	2.2	1.8	1.7	1.2	----	2.4
Avg windspeed (mph) at 80 inches	2.7	4.4	4.7	5.8	5.0	3.4	2.6	2.6	2.9	2.3	1.9	1.7	----	3.3

1/ Effective storms of 1/4 inch or more in 24-hour period.

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Table 8. Weather data, Section 5, 1977

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total	Annual Avg.
Avg ly/day (clear day)	240	276	408	564	660	624	600	564	492	384	264	192	----	439
Avg max temp °F	27	43	43	62	54	77	81	83	70	62	45	41	----	57
Avg min temp °F	12	20	19	25	30	44	45	48	37	29	24	27	----	30
Avg mo temp °F	19	32	31	44	42	60	63	66	53	46	34	34	----	43
Highest temp °F	38	57	62	77	74	89	92	96	88	68	61	52	----	----
Lowest temp °F	5	12	12	13	20	29	29	32	21	19	10	13	----	----
Days above 90°F	0	0	0	0	0	0	3	13	0	0	0	0	16	----
Days below 32°F	31	28	30	27	24	1	2	2	9	24	27	24	229	----
Date of 32°F						2	6	27					(52 days)	
Date of 29°F						2	5		1				(57 days)	
Ppt total (inches)	.08	.36	.13	0	2.25	.60	.19	.57	.57	1.03	1.64	1.46	8.88	----
Days ppt 1/	0	1	0	0	6	1	0	1	2	1	2	3	17	----
Avg windspeed (mph) at 40 inches	1.2	1.8	4.6	3.8	3.4	2.8	2.0	2.4	2.1	2.1	2.5	3.8	----	2.8
Avg windspeed (mph) at 80 inches	1.7	2.4	5.4	4.9	4.2	3.5	4.2	3.0	2.6	2.7	3.2	4.7	----	3 5

1/ Effective storms of 1/4 inch or more in 24-hour period.

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LIST OF FIGURES

Fig. 1. Generalized map of Malheur-Harney Drainage Basin, Oregon.