CHAPTER 2

A DESCRIPTION OF THE FIELD SITE IN PROJECT PRAIRIE GRASS

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The observation site was an extensive, virtually level field previously used to pasture cattle. The field was uncultivated and covered with native prairie grasses. Prior to the first observation period, the grass was mowed and little growth occurred thereafter due to arid climatic conditions.

2.1 Location

The experimental site was located about five miles northeast of the center of O'Neill, Nebraska. Geographical coordinates are Latitude, 42° 29.6' North; Longitude, 98° 34.3' West; altitude at gas source, 1980 feet above mean sea level.

2.2 Landscape

The field is part of a nearly-level upland. The land rises moderately to the southeast to a hill about 0.6 miles from the gas source. There is no surface drainage pattern at all. Rain water soaks into the soil immediately, or accumulates in small depressions until it all infiltrates or evaporates. The drainage pattern of Redbird Creek (a tributary of the Niobrara River) has advanced southward to within about a mile of the site. To the west, south, and east, there are not even intermittent streams for several miles.

From the site, then, except for carefully placed project equipment, one has an unobstructed view for miles (Figure 2.1). Since there are no hills or mountains in the distance, there is no distinct horizon. Toward the southeast the hill forms a visibility mask at 1.5 miles. The unobstructed view is felt only when distant thunderstorms, etc., are observed. Otherwise, there is nothing to see in the distance.

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Figure 2.1 View looking southwest from center of observation line at north side of site. Photograph taken in mid-August

Land is laid out in mile-square fields, with a farmstead on many of these "country blocks." There was one farmstead, with its cluster of buildings and trees, about 1300 meters northwest of the gas source.

2.3 Soil

The site was in a hayfield on O'Neill loam, upland phase.[1] This soil has a black, top soil about 25 cm thick. It is loose and friable, and with profuse grass roots forms a tough sod. Organic matter content was determined to be 4 percent. The top soil is underlain by a brown subsoil, about 20 cm thick. Both these layers have good water-holding capacity. From a 45-cm depth to 60 cm, there is a light brown layer of compacted soil. Soil particles are plate-like and horizontal, and this layer is very difficult to cut into from above. However, a small clod of this material may easily be crumbled by lateral compression. Through this compacted layer, few grass roots penetrate.

There are decayed roots, up to 1 cm diameter, of shrubs which once grew here and which did penetrate this layer to the sand below.

Below the compacted layer, from a 60-cm depth to at least a 120-cm depth, the soil is a loose, coarse sand with much gravel. Water held here is only very slowly available to the grass, because few roots penetrate to the sand and water movement upward through the sand and the compacted layer is extremely slow.

Bulk densities of the soil were determined on 10 July, 16 July, 6 August, and 29 August near the Texas A&M instrumentation location. The best values, in grams of dry soil material per cubic centimeter of the natural soil, are given in Table 2.1.

Table 2.1. Values of bulk density

DEPTH (cm)	BULK DENSITY (gm/cm^3)
0 -10	1.05
10-20	1.15
20-30	1.25
30-40	1.34
40-50	1.35
50-60	1.36
60-70	1.41
70-80	1.47
80-90	1.54
90-100	1.60

2.4 Vegetation

The wild hay was cut on 28 June. Through July and August, the field was dominated by the brown stubble 5 to 6 cm high, with some sparse stubble up to 20 cm high. After a rain, the field had a greenish brown appearance for a day or two. This was due to a short, fine, green grass coming up, and to the greening of some species of brownish grass that was still alive. Growth of the vegetation, as a whole, was slight, and the amount of dead and living plants standing up remained fairly constant. In late August, scattered, small, green shrubs became more conspicuous. These shrubs attained a height of approximately 18 centimeters.

There were a few small prickly pears in the field. There was scarcely any litter of plant material lying loose on top of the soil. Dried and weathered cakes of cow dung were spread about rather evenly, about one per three square meters.

2.5 Albedo

Measurements of albedo on 10-11 July; 24-25-26 July; and 8-9 August show that the albedo is lowest at solar noon, and greater near sunrise and sunset. Average values for those days are given in Table 2.2.

Table 2.2. Values of albedo

TIME (CST)	ALBEDO
0605	0.331
0705 & 1805	.254
0805 & 1705	.212
0905 & 1605	.203
1005 & 1505	.190
1105 & 1405	.187
1205 & 1305	0.184

The albedo varies somewhat with solar angle, cloudiness, moisture on the grass, and changes in the vegetation with time.

2.6 General Weather

Precipitation was measured daily from 29 June through 28 August Maximum and minimum instrument shelter temperatures were measured from 10 July onward. These data are given in Table 2.3. On most of the days that precipitation occurred, one or more huge thunderstorms were visible from the site. These were accompanied by many cloud-to-ground lightning flashes. No lightning strikes near the site were observed, although electrical interference sometimes halted the use of the thermoelectric temperature measuring system. The only hail storm of the summer, with hailstones about 2 cm in diameter, occurred on 29 June.

Table 2.3. General weather

	Maximum Temperature (°F)	Minimum Temperature (°F)	Precipitation (in.)	Notes
29 June	-	-	0.58	Hail 2 cm in diameter
30	-	-	.00	
1 July	-	-	.23	
2	-	-	.00	
3	-	-	.00	
4	-	-	.21	
5	-	-	.00	
6	-	-	.00	
7	-	-	.00	
8	-	-	.00	
9	-	-	.00	
10	90.0	51.0	.00	Moisture determination
11	96.1	69.2	.00	
12	89.7	60.4	.01	
13	88.0	59.6	.00	
14	98.8	64.9	.08	
15	85.0	64.4	.00	
16	87.1	60.3	.00	Moisture determination
17	90.9	57.2	.00	
18	87.0	60.3	.21	
19	77.7	55.6	.04	
20	81.6	50.9	.00	
21	*	52.0	.00	
22	*	*	.00	
23	92.0	*	.00	
24	89.0	65.0	.00	
25	96.0	55.0	.00	
26	103.9	69.8	.00	
27	88.8	69.6	.00	
28	78.3	60.4	.00	
29	85.8	57.2	.00	
30	95.8	69.0	.03	
31	69.2	64.2	.04	
1 August	81.5	63.9	.32	
2	92.8	67.8	.08	
3	96.8	69.0	.19	
4	90.0	69.2	.11	
5	93.1	58.3	0.00	

*Thermometers were not reset.

Table 2.3. (cont.)

	Maximum Temperature (°F)	Minimum Temperature (°F)	Precipitation (in.)	Notes
6 August	88.2	63.0	0.06	Moisture determinatior
7	89.8	61.0	.00	
8	89.0	59.4	.04	
9	89.9	58.5	.01	
10	84.9	56.0	.04	
11	84.5	57.7	.00	
12	90.0	63.5	.01	
13	93.0	60.0	.00	
14	96.2	66.0	.00	
15	100.0	54.1	.25	
16	86.9	65.5	.00	
17	83.2	66.0	.00	
18	68.0	56.0	.20	
19	72.0	43.7	.00	
20	73.8	49.7	.00	
21	88.3	46.2	.00	
22	95.9	51.6	.00	
23	90.4	56.3	.00	
24	92.8	48.9	.00	
25	95.5	58.0	.00	
26	99.8	67.0	.00	
27	95.5	58.4	.01	
28	94.1	58.7	0.00	
29	-	50.3	-	Moisture determinatio

2.7 Soil Moisture

Soil moisture was generally deficient, and no crop of hay was produced after the mowing in late June. Moisture determinations were made on 10 July, 16 July, 6 August, and 29 August along with the bulk density determinations. The values are sufficiently accurate for estimating the heat capacity of the soil. They are not, in themselves, sufficient for specifying availability of soil moisture for evaporation and transpiration. No independent determinations of soil wilting point were made. Due to lateral variability and inadequacy of sampling, these moisture determinations do not permit the computing of changes in soil moisture content for the field.

Values of soil moisture, as percent dry weight, are given in Table 2.4.

Table 2.4. Values of soil moisture as percent dry weight

DEPTH (cm)	10 JULY	16 JULY	6 AUG	29 AUG	AVE OF 4
0-10	7.2	6.8	9.2	6.6	7.5
10-20	7.0	6.3	6.6	6.5	6.6
20-30	3.8	6.3	3.0	6.0	4.8
30-40	4.2	4.9	2.8	4.4	4.1
40-50	5.1	3.9	2.9	5.6	4.4
50-60	3.1	3.7	3.5	6.7	4.2
60-70	1.9	3.4	6.2	3.8	3.8
70-80	1.8	3.2	3.8	2.9	2.9
80-90	2.9	4.8	2.6	2.4	3.2
90-100	5.7	4.8	1.8	2.4	3.7

Most likely all of these values, except those above a 20-cm depth on 6 August, and those of the compacted layer and the sand below, represent the wilting point of the individual samples, or are very slightly higher. These soil samples at the wilting point were dusty and dirty. The loose sand below was cool (about 25°C) and moist to the touch throughout the summer. However, its actual content of water was slight. The high moisture percentages down to 20 cm on 6 August reflect an increase in available moisture from recent rains. The soil in the field, as a whole, appeared to be driest on 29 August although the sample moisture determinations do not bear this out.

Since the soil was near the wilting point all summer, average values of the heat capacity per unit volume are sufficiently accurate for all soil heat computations. These values are given in Table 2.5.

Table 2.5. Values of heat capacity per unit volume

DEPTH (cm)	ρC_p (cal/cm^{3}deg)
0-10	0.26
10-20	.28
20-30	.28
30-40	.30
40-50	.30
50-60	.30
60-70	.31
70-80	.31
80-90	.33
90-100	0.35

REFERENCES

1. Moran, W. J., et al., "Soil Survey of Holt County, Nebraska," United States Department of Agriculture (1938)