

State Cooperative Soil - Vegetation Survey

CALIFORNIA DIVISION OF FORESTRY
 Department of Conservation, The Resources Agency
 PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION
 Forest Service, U.S. Department of Agriculture
 DIVISION OF AGRICULTURAL SCIENCES
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SOIL FERTILITY STUDIES: NO. 4 - Sehorn series

W. Robert Powell

Department of Agronomy, University of California, Davis

This leaflet, a product of the Soil-Vegetation Survey, is one of a series giving results of greenhouse pot tests and field fertilizer trials on soils primarily associated with range lands. The data indicate fertility status with regard to nitrogen, phosphorus, and sulfur. Field trials also give preliminary data on potential range forage production and species changes resulting from fertilizer treatments. Methods are detailed in: Powell, W. Robert. 1964. Procedures used in range land soil fertility studies. State Cooperative Soil-Vegetation Survey, Calif. Division of Forestry, Sacramento, 15 pp.

GREENHOUSE POT TESTS

Sample A (FA55-52-3)
 Tehama County
 Plot 14 of Quad 31D-2
 SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 27, T27N, R7W, MDBM
 South - 35%; 1400 feet
 Grassland
 Collected 6 October 1955
 Tested 9 January - 5 March 1956

Sample B (FA55-52-7)
 Tehama County
 Plot 19 of Quad 31A-4
 SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 12, T28N, R7W, MDBM
 North - 20%; 750 feet
 Open woodland - grass
 Collected 6 October 1955
 Tested 9 January - 5 March 1956

Treatment	Yield
Check	13.5 a
S	14.5 a
P	11.8 a
PS	12.5 a
N	35.0 b
NS	34.2 b
NP	40.8 c
NPS	30.8 b

Treatment	Yield
Check	14.8 a
S	11.8 a
P	12.8 a
PS	22.0 b
N	31.0 c
NS	34.8 c
NP	42.0 d
NPS	36.5 cd

(N = 100, P = 88, S = 100 lb/A)

(N = 100, P = 88, S = 100 lb/A)

Sample C (FA55-11-1)
 Glenn County
 Plot 4 of Quad 42D-4
 NW¼ NE¼ Sec. 22, T20N, R6W, MDBM
 North - 40%; 1000 feet
 Woodland - grass - brush
 Collected 12 September 1955
 Tested 9 January - 5 March 1956

Sample D (FA55-11-14)
 Glenn County
 Plot 8 of Quad 42A-4
 NW¼ NW¼ Sec. 14, T22N, R6W, MDBM
 Northwest - 50%; 950 feet
 Woodland - grass
 Collected 4 October 1955
 Tested 9 January - 5 March 1956

Treatment	Yield
Check	16.0 a
S	15.2 a
P	21.2 b
PS	18.2 ab
N	38.2 c
NS	40.0 c
NP	38.2 c
NPS	42.0 c

(N = 100, P = 88, S = 100 lb/A)

Treatment	Yield
Check	9.5 a
S	8.5 a
P	9.5 a
PS	10.8 a
N	31.2 b
NS	31.5 b
NP	30.2 b
NPS	35.2 b

(N = 100, P = 88, S = 100 lb/A)

Sample E (FA57-11-2)
 Glenn County, Quad 41C-3
 NW¼ NW¼ Sec. 13, T20N, R6W, MDBM
 North - 35%; 950 feet
 Grassland
 Collected 17 October 1957
 Tested 12 February - 15 April 1958
 (Site of Field Trial No. 11-3)

Sample F (FA57-52-2)
 Tehama County, Plot 3 of Quad 42A-1
 SW¼ NW¼ Sec. 33, T25N, R6W, MDBM
 South - 20%; 1075 feet
 Grassland
 Collected 5 June 1957
 Tested 27 June - 12 August 1957
 (Site of Field Trial No. 52-3)

Treatment	Yield
Check	25.2 a
P	26.8 a
N	49.8 b
NS	64.0 c
NP	52.0 b
NPS	73.5 d

(N = 200, P = 88, S = 100 lb/A)

Treatment	Yield
Check	27.2 a
P	25.5 a
N	60.2 b
NS	63.0 bc
NP	58.5 b
NPS	70.2 c

(N = 200, P = 88, S = 100 lb/A)

Sample G (FA60-11-1)
 Glenn County, Quad 41C-3
 NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 16, T20N, R5W, MDMB
 North - 40%; 800 feet
 Grassland
 Collected 5 May 1960
 Tested 10 June - 22 July 1961
 (Site of Field Trial No. 11-5)

Treatment	Yield
Check	8.2 a
S	18.6 b
P	14.6 ab
PS	18.8 b
N	53.0 c
NS	66.2 d
NP	70.6 d
NPS	68.8 d

(N = 200, P = 88, S = 100 lb/A)

Sample H (FA61-45-136)
 Shasta County, Plot 15 of Quad 31A-1
 NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 6, T29N, R6W, MDMB
 Southwest - 15%; 810 feet
 Grassland
 Collected 20 September 1961
 Tested 27 February - 17 April 1962

Treatment	Yield
Check	9.2 a
S	8.2 a
P	10.2 a
PS	9.0 a
N	30.8 c
NS	45.2 d
NP	23.0 b
NPS	60.5 e

(N = 200, P = 88, S = 100 lb/A)

Sample I (FA60-45-101)
 Shasta County
 Plot 12 of Quad 31A-2
 SW corner Sec. 23, T30N, R7W, MDMB
 North - 40%; 1100 feet
 Grassland
 Collected 13 May 1960
 Tested 10 June - 22 July 1961
 (Site of Field Trial No. 45-1)

Treatment	Yield
Check	21.0 a
S	24.5 a
P	19.0 a
PS	29.8 a
N	74.2 b
NS	80.8 b
NP	82.0 b
NPS	81.2 b

(N = 200, P = 88, S = 100 lb/A)

Sample J (FA60-45-102)
 Shasta County
 Plot 13 of Quad 31A-2
 NW corner Sec. 26, T30N, R7W, MDMB
 South - 30%; 1100 feet
 Grassland
 Collected 13 May 1960
 Tested 10 June - 22 July 1961
 (Site of Field Trial No. 45-2)

Treatment	Yield
Check	21.2 a
S	25.4 a
P	22.8 a
PS	22.2 a
N	76.8 b
NS	78.6 b
NP	90.6 c
NPS	93.8 c

(N = 200, P = 88, S = 100 lb/A)

COMMENTS:

Samples A, B, C, and D were tested at Albany, the remainder at Davis.

Sample A: a strong primary response to nitrogen; a good second order response to phosphorus; sulfur seems to neutralize a response of phosphorus with nitrogen.

Sample B: similar to A except the additional response to phosphorus with sulfur in absence of nitrogen.

Sample C: individual responses to nitrogen and phosphorus, the nitrogen strong but the phosphorus rather weak.

Sample D: a strong response to nitrogen alone.

Sample E: a strong primary response to nitrogen; second order response to sulfur; a medium third order response to phosphorus.

Sample F: a strong response to nitrogen alone; second order response to sulfur; very weak indication of phosphorus third order response.

Sample G: a medium and strong primary response to sulfur and nitrogen, respectively; second order responses to sulfur with nitrogen and phosphorus with nitrogen; no apparent complementary effect of sulfur and phosphorus with nitrogen.

Sample H: a strong primary response to nitrogen; second order response to sulfur; third order response to phosphorus; phosphorus without sulfur appears to inhibit the nitrogen response.

Sample I: a strong response to nitrogen.

Sample J: a strong primary response to nitrogen; second order response to phosphorus.

Summary: all samples were responsive to nitrogen, seven were responsive to phosphorus, and six were responsive to sulfur. Field trials were conducted at the locations where five of these samples were collected.

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SOIL FERTILITY STUDIES: NO. 5 - Sehorn series

W. Robert Powell

Department of Agronomy, University of California, Davis

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FIELD NUTRIENT TRIAL NO. 11-3

Glenn County

Quad 41C-3

NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 13, T20N, R6W, MDMB

North - 35%; 950 feet

Grassland

Fertilized 17 October 1957

(Greenhouse soil sample No. FA57-11-2)

Table 1. Herbage Yields, pounds per acre, oven-dry

Fertilizer Treatment ^{1/}	Date of sampling			
	27 May 1958	22 April 1959	6 May 1960	29 April 1961
Check	2186 a	1597 a	1776 a	2052 a
S	2992 ab	2246 ab	2658 b	3211 b
P	3536 bc	1814 ab	2118 ab	-
PS	4704 de	2637 b	3354 c	2400 a
N	4150 cd	1709 a	1734 a	-
NS	5386 ef	2160 ab	1800 a	-
NP	5786 f	1709 a	2058 ab	-
NPS	6342 f	2272 ab	1860 a	-

^{1/} N = 150 lb/A in urea, P = 88 lb/A in triple super phosphate, S = 100 lb/A in elemental sulfur.

Table 2. Percent ground cover of herbaceous species, 27 May 1958.

Species	Fertilizer Treatment							
	Check	S	P	PS	N	NS	NP	NPS
----- percent -----								
<u>Grasses</u>								
Avena fatua	11	13	11	6	47	59	62	63
Bromus mollis	5	4	1	1	9	15	17	13
Bromus rubens	1						2	2
Festuca spp.	9	9	4	1	13	7	10	4
Koeleria phleoides	1	1	1		1	1		
Lolium multiflorum		1			2	1	1	5
Taeniatherum asperum (= Elymus caput-medusae)	7	1	1		2	3	1	
<u>Forbs</u>								
Achyrrachaena mollis	2	1	1		1			1
Brodiaea spp.	1	1						
Centaurea solstitialis	5	3	1		1	3	1	2
Erodium botrys					3	1	1	
Lupinus nanus		1	1	1				
Medicago hispida	22	50	65	88	2	5	2	10
Micropus californicus	9	1	1		6	1		
Navarretia spp.	1				1			
Plantago hookeriana								
californica	2							
Plantago lanceolata	1							
Potentilla sp.	1	1		1				
Other species			1					
TOTAL HERBACEOUS COVER	78	87	88	98	92	96	97	100

Table 3. Percent ground cover of herbaceous species, 22 April 1959.

Species	Fertilizer treatment							
	Check	S	P	PS	N	NS	NP	NPS
	----- percent -----							
<u>Grasses</u>								
Avena barbata	3	4	3	5	4	3	1	3
Avena fatua	9	12	14	19	20	20	21	28
Bromus mollis	7	14	12	6	15	17	22	16
Bromus rigidus	+			1	1			1
Festuca spp.	9	7	8	6	3	5	4	3
Koeleria phleoides					1		1	3
Lolium multiflorum		1	1	2		1		3
Taeniatherum asperum	+	1	1			+		+
<u>Forbs</u>								
Achyrrachaena mollis	5	3	4	2	1	1	1	1
Amsinckia intermedia								1
Erodium cicutarium	+			2	1			1
Lepidium nitidum				1				1
Lupinus nanus	+							
Medicago hispida	7	21	5	28	1	4	1	3
Micropus californicus	5	3	2	1	6	2	1	
Navarretia spp.				1		1		
Plagiobothrys nothofulvus		1	1	2		+	1	1
Plantago hookeriana								
californica					+		1	
Ranunculus californicus			1		+	1	+	
Other species	2	1	1	5	+		+	
TOTAL HERBACEOUS COVER	47	68	53	81	53	55	54	62

Table 4. Percent ground cover of herbaceous species, 6 May 1960.

Species	Fertilizer treatment							
	Check	S	P	PS	N	NS	NP	NPS
----- percent -----								
<u>Grasses</u>								
<i>Avena fatua</i>	27	25	21	37	23	27	29	23
<i>Bromus madritensis</i>				1	+	+	1	2
<i>Bromus mollis</i>	3	9	6	6	8	6	12	8
<i>Bromus rigidus</i>				2				
<i>Festuca</i> spp.	5	7	6	9	3	3	5	3
<i>Hordeum hystrix</i>							+	
<i>Lolium multiflorum</i>							+	
<i>Taeniatherum asperum</i>	1		1					
<u>Forbs</u>								
<i>Achyrachaena mollis</i>	7	5	7	3	2	2	1	2
<i>Amsinckia intermedia</i>		1				+		
<i>Brodiaea</i> spp.					1	1		
<i>Clarkia gracilis</i>		2	4	1		+	2	+
<i>Erodium cicutarium</i>			+					+
<i>Lomatium</i> sp.				+	+	+	+	
<i>Lupinus nanus</i>	1	3	1	1		+		
<i>Medicago hispida</i>		15		21		+		
<i>Micropus californicus</i>	10	5	5	1	9	2	3	
<i>Navarretia</i> spp.			+			+		
<i>Plagiobothrys nothofulvus</i>			+	4				+
<i>Ranunculus californicus</i>		2			+			
Other species	3		1	1	+	+		
TOTAL HERBACEOUS COVER	57	74	52	87	46	41	52	38

Table 5. Percent ground cover of herbaceous species, 29 April 1961.

Species	Fertilizer treatment		
	Check	S	PS
	- - - - - percent - - - - -		
<u>Grasses</u>			
Avena fatua	20	23	19
Bromus mollis	6	8	16
Bromus rigidus		1	2
Bromus rubens		1	
Festuca spp.	3	3	5
<u>Forbs</u>			
Achyrachaena mollis	13	13	11
Brodiaea spp.	+		3
Lomatium sp.			1
Lupinus nanus	5	14	3
Medicago hispida	+	23	27
Micropus californicus	8	2	+
Navarretia spp.	+		
Orthocarpus sp.		1	
Plagiobothrys nothofulvus		+	
Ranunculus californicus		1	1
Rigiopappus leptocladus	+		
TOTAL HERBACEOUS COVER	55	90	88

COMMENTS:

Strong responses to nitrogen and sulfur are indicated in this trial. The phosphorus response is not clear cut, however, because the phosphorus source--triple super phosphate (TSP)--contains about one percent sulfur. The rate of TSP used would supply about 4½ pounds of sulfur per acre, an amount quite adequate to produce a response in a sulfur-deficient area.

Yield responses to sulfur alone (S), were measured in the third and fourth seasons after application. The response to phosphorus (P) and phosphorus plus sulfur (PS) in the first two seasons may be the result of the

readily available sulfur in the TSP. The principal species involved was bur clover (Medicago hispida). The 1957-1958 season was very good for this species. On S and SP treatments bur clover was the principal species for all years measured.

Responses to application of nitrogen alone (N) and in combination (NS, NP, NPS) were found the first year only. The dominant species were wild oats (Avena fatua), soft chess (Bromus mollis), and annual fescues (Festuca spp.). Medusahead (Taeniatherum asperum) was prominent on the Check plots the first year but was very minor throughout the trial area in subsequent years. That NS, NP, and NPS had yields not significantly different is further evidence of effectiveness of sulfur in the TSP of the NP treatment.

It was assumed all nutrients were dissipated after four years. However, in the sixth and seventh years all treatment plots with sulfur (S, PS, NS, NPS) were clearly distinguishable from the remaining trial area by greater total ground cover, higher bur clover content, and greener color. Thus, the elemental sulfur was very slowly available at first and continued to be available after seven years.