

## Madras Farms Experiment

The Madras farms location was on the Little Agency Plains southwest of Madras, Oregon, and known locally as the Julum farm. The experimental site was on a Madras loam soil.

The field had been in bentgrass for 7-8 years prior to 1974 and because of the wet fall, winter, and early spring, it was impossible to work the soil early as would normally be done. Under these circumstances, previous experiences would indicate serious problems with irrigation. Poor infiltration rates would be expected.

The soil test taken at the time of establishment (mid-May), (Table 32) indicates a pH of approximately 6.0 in the surface 8 inches, adequate phosphate, and relatively good potassium. The Ca and Mg values of the first replication would appear to be interchanged between soil depth. Sodium, Boron and Salts would not appear to be a problem on this field.

The experiment was established in two replications with three salt treatments across four tillage treatments as split plots. The tillage treatments were; (a) normal tillage, (b) a treatment designated as scalped, or sod removed, was created by rototilling the grass sod to a depth of 2½ inches cutting the sod just below the crowns of grass plants. This organic material was raked and removed and composed the organic material added to the (c) organic matter treatment. Lime and gypsum were applied and the area plowed. The field was rototilled once after plowing to smooth the seed bed. The heavy tillage treatment (d) was imposed shortly before planting by rototilling these plots four additional times.

The irrigation of the field proved to be difficult but the problem was too much water instead of too little. At the end of August, when soil samples were taken for Manganese, the date of sampling had to be postponed because of free water under the hill. These conditions were bad where lime was applied and most severe where lime was combined with heavy tillage. Under these circumstances, the lime and gypsum improved water infiltration and the heavy tillage created a tillage pan which resulted in a perched water table and at harvest, extreme water rot was encountered.

The yield losses due to water rot are reflected in the yields (Table 33) for individual treatment effects and for the average effects. Individual plot yields varied from 9.01 tons per acre for the gypsum and heavy tillage treatment to 22.43 tons for organic matter added with no salt (lime or gypsum). The high percentage of No. 1 potatoes would indicate that the moisture level had been uniform during the early stages of tuber development.

The average effect of salt treatment indicates that lime actually reduced yield when compared to the check treatment. In view of other experiments, this cannot be explained other than improvement of moisture infiltration; a greater portion of the tubers rotted in relation to gypsum and the check.

The tillage treatments reflect that which is generally known but not always given proper credence. The extra grass straw plowed down apparently improved aeration of the soil and aided the movement of water through the soil and the heavy tillage created a tillage pan and, by compaction, reduced soil aeration thereby seriously reducing yield.

On August 20, 1974, plant and soil samples were taken to check the pH, and manganese levels at maximum vine growth. The plant samples were taken in the usual manner, the first mature leaf down from the tip of the plant (fourth petiole) and the leaf blade stripped from the petiole. Both parts were saved for chemical analysis.

The soil samples were taken with a soil sampling tube, inserting the tube at a 45° angle with reference to level soil or almost perpendicular to the slope of the hill and midway from the top of the hill and the furrow, the objective being to miss the fertilizer band placed below and on both sides of the tuber.

The soil samples taken were chilled in a camp freezer containing dry ice and frozen in a freezer shortly after being taken from the field. The samples remained frozen until they were prepared for a manganese soil test.

The results of the pH, Mn soil test, plant chemical analysis for petioles and blades are shown in Tables 34, 35, 36, and 37.

The soil pH, depending on the treatment, either stayed nearly the same as the sample taken in May or dropped nearly a full pH. Lime held the pH up to 5.7-5.9 while the pH of the gypsum and check treatments were generally 5.1-5.2. The tillage treatments had little effect on pH.

The soil test for manganese (Table 35) reflects the effect of lime on raising pH and that of heavy tillage destroying the structure of the soil and creating a hardpan. In destroying soil structure and creating a hardpan, heavy tillage slows the movement of water in the soil, reduces aeration and tends to perch water above the hardpan thus creating the reducing conditions necessary to convert  $Mn^{+++}$  to  $Mn^{++}$ . The relationship can be observed in the individual treatments affected by heavy tillage. The check with heavy tillage resulted in Mn values of 8.98 ppm while both lime and gypsum reduced Mn values by improving infiltration and the lime had a greater effect by lowering the pH as well.

The chemical analysis of the petiole sample taken August 20, 1974, (Table 38) reflects a slight increase in Mn, however, the leaf samples indicate toxic or nearly toxic levels of Mn at this time. The other elements tested show a near normal concentration for the time of year except that usually the phosphate level would be lower than those shown. It is interesting that the plant concentration of Mn in the leaves for heavy tillage does not correspond to the soil Mn levels. Perhaps, restricted growth imposed by hard soil and too much water actually limited plant uptake of elements later in the season.

This experiment points out the need for research in the area of tillage methods and tillage equipment in soil preparation and in the irrigation of potatoes.

Table 32. Soil test, Madras farms location.

Soil depth in	pH	P ppm	K ppm	Ca meq/100g	Mg meq/100g	Na meq/100g	B ppm	Salts (mmhos/ cm.)
-----Replication I-----								
0-8	5.9	35	274	14.1	8.9	0.39	0.44	0.22
8-16	6.7	9	268	9.9	6.7	0.33	0.44	0.14
-----Replication II-----								
0-8	6.1	40	286	9.5	5.6	0.30	0.45	0.10
8-16	6.5	10	274	11.4	5.7	0.30	0.45	0.10

Table 33. The effect of tillage and salt treatments on the yield, percent no. 1's, size, and specific gravity of Russet Burbank potatoes, Madras Farms, 1974.

Treatment	Total yield tons/a	No.1 %	Size categories of no. 1 %			Spec grav
			4-6oz	6-10oz	10+oz	
No salt						
ck	16.87	84.4	27.1	44.6	11.7	1.095
scalp	12.05	84.5	34.7	37.1	12.6	1.095
added O.M.	22.43	87.4	27.3	46.6	13.6	1.096
hvy. tillage	13.39	86.0	34.6	32.7	18.7	1.096
Lime (2 tons)						
ck	17.44	86.0	28.6	38.9	18.5	1.095
scalp	13.58	83.8	26.8	41.3	15.6	1.095
added O.M.	16.36	85.6	24.6	36.2	24.7	1.095
hvy. tillage	12.40	87.6	27.0	45.6	15.0	1.096
Gypsum (Ca=2 tons lime)						
ck	19.74	91.1	25.2	42.8	23.1	1.097
scalp	19.72	87.5	28.3	37.3	21.9	1.098
added O.M.	22.65	87.5	27.4	43.3	16.9	1.097
hvy. tillage	9.01	88.3	20.8	39.5	28.0	1.088

Average effect of treatment on total yield.

Treatment	Tons/a
Salt	
no salt	16.19
lime	14.95
gypsum	17.78
Tillage	
check	19.45
sod removed	16.70
sod added	22.60
hvy tillage	11.60

Table 34. The effect of tillage and soil amendment treatments on the pH of the soil, Madras Farms, 1974, Madras Loam Soil.

Treatment	pH
Tillage check	
no salt	5.2
lime	5.9
gypsum	5.1
Sod removed	
no salt	-
lime	5.7
gypsum	5.1
Sod added	
no salt	5.2
lime	5.8
gypsum	5.1
Heavy tillage	
no salt	5.6
lime	5.7
gypsum	5.2

Sampled August 20, 1974.

Average effects.

	pH
tillage check	5.4
sod removed	5.4
sod added	5.4
heavy tillage	5.5
no salt	5.3
lime	5.8
gypsum	5.1

Table 35. The effect of tillage and soil amendment treatments on the soil test manganese values, Madras Farms, Madras, Oregon, 1974.

Madras loam soil			
Treatment	Soil test, Mn ppm		
	rep I	rep II	ave
Tillage check			
no salt	3.76	6.09	4.93
lime	0.65	0.70	0.68
gypsum	2.17	2.70	2.44
Sod removed			
no salt	2.49	3.34	2.42
lime	0.53	0.54	0.54
gypsum	2.39	1.69	2.04
Sod added			
no salt	2.82	3.94	3.38
lime	0.53	0.70	0.62
gypsum	2.39	2.39	2.39
Heavy tillage			
no salt	8.93	9.03	8.98
lime	1.19	1.73	1.46
gypsum	2.57	2.22	2.40

Sampled August 20, 1974.

Average effects.

	Mn ppm
Tillage	
check	2.68
sod removed	1.83
sod added	2.13
heavy tillage	4.23
Salt	
no salt	5.05
lime	0.82
gypsum	2.31

Table 36. The effect of tillage and salt treatments on the chemical analysis of the petioles of Russet Burbank potatoes, Madras farms, 1974.

First sample - pre bloom						
Treatment	Chemical analysis - petioles					
	P %	K %	Ca %	Mg %	Zn ppm	Mn ppm
No salt						
ck	0.26	13.1	0.90	0.96	38	113
scalp	0.26	12.9	1.00	1.00	33	81
added O.M.	0.32	12.8	1.53	0.93	40	90
hvy. tillage	0.30	12.8	0.96	0.95	28	66
Lime (2 tons)						
ck	0.29	12.3	0.96	0.90	31	57
scalp	0.31	12.8	1.06	1.00	30	68
added O.M.	0.33	12.6	0.91	0.87	32	47
hvy. tillage	0.28	13.0	0.99	1.03	32	71
Gypsum (Ca=2 tons lime)						
ck	0.28	13.0	0.78	0.78	34	56
scalp	0.32	13.2	1.14	0.88	40	70
added O.M.	0.32	12.2	0.84	0.81	37	65
hvy. tillage	0.34	12.8	0.96	1.02	38	76

The average effects of tillage and salt treatments.

	-----Chemical analysis - petiole-----					
No salt	0.29	12.9	1.10	0.96	35	88
Lime	0.30	12.7	0.98	0.95	31	61
Gypsum	0.32	12.8	0.93	0.87	37	67
Check	0.28	12.8	0.88	0.88	34	75
Sod removed	0.30	13.0	1.07	0.96	34	73
Sod added	0.32	12.5	1.09	0.87	36	67
Heavy tillage	0.31	12.9	0.97	1.00	32	71

Table 37. The effect of tillage and salt treatments on the chemical analysis of the leaf of Russet Burbank potatoes, Madras Farms, 1974.

Second sample, maximum vine growth, August 20, 1974						
Treatment	Chemical analysis - leaves					
	P %	K %	Ca %	Mg %	Zn ppm	Mn ppm
<b>No salt</b>						
check	0.36	4.6	1.10	0.94	16	191
O.M. added	0.35	4.2	1.10	0.99	14	188
O.M. removed	0.36	3.6	1.04	0.94	12	196
hvy. tillage	0.34	3.8	0.93	0.87	13	134
<b>Lime</b>						
check	0.37	3.7	1.24	0.99	18	144
O.M. added	0.33	3.8	1.30	0.99	15	127
O.M. removed	0.38	3.8	1.18	0.94	15	125
hvy tillage	0.38	3.6	1.30	0.94	12	120
<b>Gypsum</b>						
check	0.37	4.2	1.06	0.90	17	157
O.M. added	0.34	4.0	1.04	0.88	16	171
O.M. removed	0.36	4.0	0.99	0.88	17	150
hvy. tillage	0.37	4.0	0.93	0.84	16	148

Average values for treatment effects.

Treatment	P %	K %	Ca %	Mg %	Zn ppm	Mn ppm
<b>Salt</b>						
no salt	0.35	4.05	1.04	0.94	14	177
lime	0.37	3.73	1.26	0.97	15	129
gypsum	0.36	4.05	1.01	0.88	17	157
<b>Tillage</b>						
check	0.36	4.13	1.12	0.93	17	162
O.M. added	0.34	3.96	1.14	0.94	15	160
O.M. removed	0.36	3.76	1.06	0.91	15	155
hvy. tillage	0.36	3.76	1.04	0.87	14	133



Table 38. The effect of tillage and salt treatments on the chemical analysis of the petioles of Russet Burbank potatoes, Madras Farms, 1974.

Second sample - maximum vine growth, August 20, 1974						
Treatment	Chemical analysis - petiole					
	P %	K %	Ca %	Mg %	Zn ppm	Mn ppm
<b>No salt</b>						
check	0.25	11.2	0.96	0.90	31	99
O.M. added	0.23	14.1	0.94	0.87	25	93
O.M. removed	0.27	10.0	0.76	0.76	25	86
hvy. tillage	0.29	9.4	0.82	0.74	19	82
<b>Lime</b>						
check	0.26	11.0	1.16	1.00	33	78
O.M. added	0.22	10.1	1.28	0.99	23	63
O.M. removed	0.32	9.4	0.92	0.81	24	60
hvy. tillage	0.31	10.0	1.02	0.94	20	66
<b>Gypsum</b>						
check	0.26	13.5	0.88	0.75	35	78
O.M. added	0.23	10.2	1.00	0.74	34	84
O.M. removed	0.29	11.4	0.86	0.72	32	74
hvy. tillage	0.33	12.4	0.75	0.69	30	85
<b>Average values.</b>						
	P %	K %	Ca %	Mg %	Zn ppm	Mn ppm
<b>Salt</b>						
no salt	0.26	11.18	0.87	0.82	25	90
lime	0.28	10.13	1.10	0.94	25	67
gypsum	0.28	11.88	0.87	0.73	33	80
<b>Tillage</b>						
check	0.25	11.78	0.99	0.87	33	84
O.M. added	0.22	11.35	1.06	0.86	27	79
O.M. removed	0.29	10.15	0.84	0.76	27	73
hvy. tillage	0.31	10.49	0.85	0.78	23	77