Potassium Fertility Experiment

The potassium fertility experiment was an exploratory experiment conducted in hopes of gaining a lead on the potato-alfalfa yield decline problem on pumice soils in Central Oregon.

Previous experiments with nitrogen, phosphate, potash and sulfur have indicated that at least at normal fertilization rates these elements were not capable of increasing yields above a certain level of production and that this level was more or less fixed by the cropping history of the farm.

A comparison of soil analysis results between virgin soil and heavily cropped soil indicated that with the exception of pH and potash level, usually the heavily cropped lands were equal to, or superior to, virgin soils. Also soil tests generally show that farms which have had a livestock program in the farm management system were generally more productive in regards to alfalfa and potato yields and generally had a higher level of potash.

However, with the present concept of potash levels developed from soil testing and potash response, very few fields in Central Oregon appear to respond to normal potash fertilization.

A comparison of the soil tests between known problem fields and reasonably high producing fields generally indicates that percentage of total bases (K, Ca, Mg) as K on a low producing field is around 2-3% while a high yielding field has 6-8% K.

With these generalities in mind, it was planned to put out K as sulfate of potash at high rates in the Powell Butte area. Powell Butte is currently a low producing area but once a highly productive portion of Central Oregon.

Two locations were established, one on the farm of Charles Minson and the second on a portion of the land leased from N. L. Weigand.

Soil analysis results of the two fields are as follows:

N. L. Weigand Farm

Soil Depth	pH	Pounds/Acre		me./100 g. soil				PPM	%
		P	K	K	Ca.	Mg.	CEC	B	OM
0-8	6.1	54.5	312	.40	7.1	4.9	15.1	0.62	1.45
8-16	6.3	18.5	312	.40	8.1	6.8	16.6	0.44	0.91

Charles Minson Farm

Soil Depth	pH	Pounds/Acre		me./100 g. soil				PPM	%
		P	K	K	Ca.	Mg.	CEC	B	OM
0-8	5.8	54.5	546	.70	7.1	3.9	14.4	.56	1.77
8-16	6.5	21.5	413	.53	7.3	4.9	15.4	.56	0.96

The percentage of total bases (K, Ca and Mg) as K at the Weigand location was 2.9% for the total depth of soil tested. The same value for the Minson location was 5.0%. The Minson location was higher in K than had been anticipated. The field, according to the farmer, had been a high yielding field, but was declining in yield.

The experiment on the Weigand location was troubled from the start by seepage waters which prevented normal cultivation. The field was troubled some with weeds and was hilled only once. The failure to hill the second time made irrigation more difficult and consequently not uniform. This is reflected in the yields at this location.

The usual problem of early death of the vines did not occur during 1963. Only one field in the Powell Butte area showed the characteristic early die-back.

The yields in tons per acre, average tuber weight, specific gravity and market grade for the two locations are presented in Table Nos. 15 and 16. At neither location were significant differences in yield obtained. The yields without added potash were approximately double the normal yield for the area.

The Minson location (Table No. 16) was the most uniform of the two as far as yield responses are conserned and this location indicated a 1.5 ton increase by the addition of 250 pounds of K and then the yields remained quite constant until 1,000 pounds of K rate was added and the yields increased another 1.5 tons. There was a two ton increase between the zero K and the 1,000 pounds of K treatment on the Weigand location. (Table No. 15)

There was a tendency for the potash rates to increase the weight of the tuber. This tendency was much more consistent at the Weigand location than the Minson location.

At both locations rates of K up to 750 pounds lowered the specific gravity of the potato and at 1,000 pounds the specific gravity increased above the 750 pound level but not significantly.

Considering market grade, the same general trend occurred at both locations; high potash increased the No. 1 potatoes and decreased the percentage of cull potatoes. This relationship was more marked at the Weigand location and was undoubtedly associated with the increase in average tuber weight.

The high potash plots kept the potato vines green considerably longer in the season than the no potash plots. If the early die-back of the vines is associated with potash levels of the soil, then temperature, air, or soil must be associated in some way with the amount of potassium in the soil available to the plants. The growing season during 1963 was long and cool and it was necessary to kill the potato vines before harvest in the middle of October and the average yield of potatoes in the Powell Butte area was approximately double the yield of a normal year. During hot summers die-back occurs early and severe. During some years vine dying is readily apparent by the last week in July.

While the above experiment is not conclusive, it does offer the first solid lead in the solution of declining yields of alfalfa and potatoes, both heavy users of potassium.

Appendix Table Nos. 20 and 21 present the yields for the two fields in tons per acre.

Table No. 15

The Effect of High Rates of Potassium Fertilization on Yield, Average Tuber Weight, Specific Gravity & Market Grade of Russet Burbank Potatoes
N. L. Weigand Farm, Powell Butte, Oregon, 1963

Fert. (1) Application K Pounds/Acre	Yield Tons Per Acre	Tuber Wt. Oz.	Specific Gravity	(2) Specific Gravity Sig. @ 5%	Market Grade		
					No. 1 %	No. 2 %	Culls %
0	20.3	3.64	1.0989	a	36.50	11.00	52.50
250	19.0	3.74	1.0968	a b	35.88	9.88	54.25
500	21.9	4.24	1.0952	a b	48.50	11.63	39.38
750	20.7	4.25	1.0934	b	44.83	11.33	43.83
1,000	22.2	4.45	1.0941	b	49.00	13.75	37.25

(1) K applied as Potassium sulfate in addition to 70 pounds of K_2O in 700# 15-10-10 per acre.

Potassium sulfate surface applied May 13, 1963--disced into the soil before planting potatoes on May 30, 1963.

(2) Coefficient of Variation for specific gravity .21%.

Potatoes harvested October 21, 1963.

Table No. 16

The Effect of High Rates of Potassium Fertilization on Yield, Average Tuber Weight, Specific Gravity & Market Grade of Russet Burbank Potatoes Charles Minson Farm, Powell Butte, Oregon, 1963

Fert. (3) Application K Pounds/Acre	(1) Yield Tons Per Acre	Tuber Wt. Oz.	(2) Specific Gravity	(4) Specific Gravity Sig. @ 5%	Market Grade		
					No. 1 %	No. 2 %	Culls %
0	20.6	5.1	1.0946	a	59.8	13.1	27.1
250	22.1	5.8	1.0940	a	64.9	14.9	20.3
500	22.2	5.2	1.0929	a b	62.6	13.3	24.1
750	22.4	5.8	1.0902	c	63.8	15.5	20.8
1,000	23.7	5.7	1.0907	b c	63.8	19.3	17.0

(1) Yield difference not significant at 5% level.
Coefficient of Variation for yield 6.5%.

(2) Coefficient of Variation for Specific Gravity .15%.

(3) K applied as Sulfate of Potash
K was surface applied on May 9, 1963--disced and plowed after application.
These rates in addition to 113 pounds of K_2O in farmer's fertilizer application.

(4) Any two treatments followed by same letter are not significantly different.

Potatoes planted around May 20, 1963.
Potatoes harvested October 25, 1963.

Appendix Table No. 20

Effect of High Rates of Potassium Fertilization on the Yield of Russet Burbank Potatoes. N. L. Weigand Farm, Powell Butte, Oregon, 1963 Yields are Shown in Tons Per Acre by Replication and Average

Pounds/Acre K	Yield in Tons Per Acre				
	Replicate				Average
	I	II	III	IV	
0	20.45	23.60	18.85*	18.27	20.3
250	15.85	23.11	17.79	19.24	19.0
500	16.94	23.35	25.41	21.78	21.9
750	19.24	21.42	25.89	16.32*	20.7
1,000	23.72	24.08	21.54	19.48	22.2

*Corrected Yields

Appendix Table No. 21

Effect of High Rates of Potassium Fertilization on the Yield of Russet Burbank Potatoes. Charles Minson Farm, Powell Butte, Oregon, 1963 Yields are Shown in Tons Per Acre by Replication and Average

Pounds/Acre K	Yield in Tons Per Acre				
	Replicate				
	I	II	III	IV	Average
0	22.15	23.72	18.76	17.76	20.6
250	23.48	23.30	22.03	19.63	22.1
500	23.36	22.03	23.12	20.11	22.2
750	23.12	21.07	24.56	20.95	22.4
1,000	24.44	22.76	24.92	22.76	23.7