Fertilizing Strawberries

In the Willamette Valley

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Results of recent field experiments have shown that strawberry yields often can be increased by the proper use of fertilizers.

Experiments were started in 1954 at three locations in the Willamette Valley. Yield data were taken in 1955 and 1956. Both marketable and cull berries were harvested. In addition, effect of fertilizers on certain quality factors of berries was studied.

Experimental Procedure

Experiments were located at the Red Soils Branch Experiment Station at Oregon City and on growers' fields at Salem and Hillsboro. Soil samples were taken before fertilizers were applied. These were analyzed by the Soil Testing Laboratory at Oregon State College so that soil test values could be correlated with fertilizer response. Soil test results appear in Table 1.

Soil type and strawberry variety grown at each location were as follows:

Location	Soil type	Variety
Oregon City	Olympic silt loam	Marshall - non-irrigated
Salem	Willamette silt loam	Northwest - irrigated
Hillsboro	Chehalis silt loam	Marshall - irrigated

Nitrogen was applied as urea (46% N) yearly in the fall unless otherwise specified. Phosphorus was applied as concentrated superphosphate (47% P_2O_5) at planting time in bands six inches deep on either side of the plants. No additional phosphorus was applied. Potassium was applied as muriate of potash (60% K_2O) yearly in the fall. Lime (ground calcic limestone) was worked into the surface six inches of soil prior to planting. All plots received a yearly application of 36 pounds of sulfur per acre as gypsum.

Berries were taken from selected plots at the Oregon City location for quality studies. These included: (a) berry size, as determined by counting the number of berries per pound; (b) soluble solids content, taken as a measure of sugar content; and (c) moisture content.

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Table 1. Soil test results for experimental sites

Location	Soil pH	Lime req. (T/A)	Avail. P (lbs./A)	Exch. K (lbs./A)	Exch. Ca (m.e./100g)	Exch. Mg (m.e./100g)	Total bases (m.e./100g)	Exch. capacity (m.e./100g)
Oregon City	5.2	3.0	10	294	4.8	0.8	5.9	15.2
Salem	5.2	2.5	70	700	5.9	1.5	8.3	17.4
Hillsboro	5.9	1.0	142	450	6.7	1.1	8.4	11.9

Experimental Results

Yields of marketable berries

Yield response to fertilizers and lime occurred at the Oregon City and Salem locations but not at Hillsboro.

Table 1 shows the effect of nitrogen at Oregon City, where yields were increased regardless of whether or not other fertilizers and lime were applied. The 30-pound rate of nitrogen was superior to the 60-pound rate.

Table 2. Yield response to fall-applied nitrogen at Oregon City

Pounds of actual nitrogen applied per acre	Yield (tons per acre)
0	8.4
30	9.4*
60	8.8

*Significantly different from check at 5% probability level.

At the Salem location, yield increase from nitrogen was statistically significant only when phosphorus was not applied (Table 3). Again the 30-pound rate of nitrogen produced highest yields.

Table 3. Yield response (tons per acre) to fall-applied nitrogen and to phosphorus at Salem

Pounds of N applied per acre	Pounds of P_2O_5 applied per acre	
	0	300
0	15.5	18.2
30	17.4	18.0
60	17.1	17.0
120	15.9	15.8
L.S.D. at 5% probability level	1.6	
L.S.D. at 1% probability level	2.1	

Table 3 shows that the yield increase from phosphorus was statistically significant only when nitrogen was not applied.

At Oregon City, applied phosphorus increased yields regardless of other fertilizers, but lime had some influence on phosphorus response. This is shown in Table 4. The biggest response to phosphorus occurred in the absence of lime.

Table 4. Yield response (tons per acre) to phosphorus and to lime at Oregon City

Pounds of P_2O_5 applied per acre	Tons of lime applied per acre	
	0	3
0	8.6	7.8
300	10.3	8.6
L.S.D. at 5% probability level	0.8	
L.S.D. at 1% probability level	1.1	

Potassium increased yields only at the Oregon City location. Nitrogen or phosphorus had no effect on response to potassium, but lime did (Table 5).

Table 5. Yield response (tons per acre) to potassium and lime at Oregon City

Pounds of K_2O applied per acre	Tons of lime applied per acre	
	0	3
0	9.3	7.1
75	9.7	9.3
L.S.D. at 5% probability level	0.8	
L.S.D. at 1% probability level	1.1	

Data show that yield response to potassium was statistically significant only when lime was applied.

Lime decreased yields both at Oregon City and at Salem. In Table 4 lime is seen to have lowered yields more at Oregon City when phosphorus also was applied, while Table 5 shows that the decrease in yield due to lime was statistically significant only when potassium was not applied. In other words, phosphorus accentuated the yield-depressing effect of lime, while potassium overcame it.

At Salem, lime decreased yields regardless of fertilizer applications (Table 6).

Table 6. Yield response to lime at Salem

Tons of lime applied per acre	Yield (tons per acre)
0	17.6
2 1/2	16.1*

*Significantly different from check at 1% probability level.

At the Salem and Hillsboro locations, time of application of nitrogen (fall versus spring) was studied. Yields of marketable berries were influenced only slightly by time of application of nitrogen, but yields of cull or rotten berries were markedly affected.

Yields of cull berries

Phosphorus, potassium, and lime had no effect on cull yields. Nitrogen, depending on when it was applied, did. This is shown in Tables 7 and 8.

Table 7. Effect of time of application of nitrogen on yield (tons per acre) of cull berries at Salem in 1955

Time of application of N	Pounds of N applied per acre	
	60	120
Fall	0.28	0.20
Spring	0.24	--
Half fall - half spring	0.22	0.36
L.S.D. at 5% probability level	0.16	

Table 8. Effect of time of application of nitrogen on yield (tons per acre) of cull berries at Hillsboro

Time of application of N	Pounds of N applied per acre	
	60	120
Fall	1.06	1.15
Spring	1.56	--
Half fall - half spring	1.72	1.81
L.S.D. at 5% probability level	0.34	
L.S.D. at 1% probability level	0.44	

Cull berries were harvested at Salem in 1955, and harvested both years at Hillsboro. Except for the 60-pound rate at the Salem location, spring-applied nitrogen caused an increase in yields of cull berries. Plots which received spring nitrogen also showed heavy vine growth. Nitrogen was not applied at the 120-pound rate in spring.

Effects of fertilizers on berry quality

Table 9 shows influence of fertilizers on berry size, soluble solids (sugar) content, and moisture content. Data represent the average for three sampling dates each year at the Oregon City location where plots received fall applications of nitrogen.

Table 9. Effects of fertilizers on the quality of Marshall stawberries Oregon City location

Treatment (pounds per acre)	Number of berries per pound		Soluble solids (percent)		Moisture content (percent)	
Actual nitrogen	1955	1956	1955	1956	1955	1956
0	71.0	70.1	7.9	7.9	89.4	89.6
60	76.7	68.3	7.8	7.5	89.5	89.9
P_2O_5						
0	72.9	71.4	7.8	7.9	89.6	89.7
300	74.8	67.0*	7.9	7.4*	89.3	89.8
K_2O						
0	74.4	70.2	7.5	7.4	89.9	90.1
75	73.2	68.2	8.1*	7.9**	89.0*	89.5**

*Significantly different from check at 5% probability level.
**Significantly different from check at 1% probability level.

The most outstanding and consistent effects were those of potassium in increasing soluble solids and reducing moisture content. There is little question, however, that seasonal differences in climate can also affect flavor and moisture content to a considerable degree.

Fertilizer Recommendations

The following recommendations are based on results of these experiments. Established fertilizer practices and results from demonstrational field plots have also been considered. Present information is not complete but is considered sufficient for use as a general guide in fertilizing strawberries.

Nitrogen

Rates should be kept reasonably low to avoid excessive vine growth and susceptibility to rot.

1. Apply 30 to 40 pounds of actual nitrogen per acre at planting time (60, if a heavy sod crop has just been turned under) plus 30 to 40 pounds of actual nitrogen per acre annually in the fall. Fall applications of nitrogen are recommended the year of planting.

2. If urea sprays are used, no more than 20 pounds of actual nitrogen per acre should be applied at one time (45 pounds of 46% urea dissolved in 100 gallons of water). If higher rates are desired, make two or more applications. Foliage should be sprayed in late August or early September.

Nitrogen fertilizers can be broadcast following harvest when rows are trimmed, then irrigated. On dryland plantings, nitrogen should be applied prior to the first fall rains. If plants have been winter damaged, a spring application of 15 to 20 pounds of actual nitrogen per acre is recommended.

Phosphorus

Strawberries may respond to phosphorus when soil test values are considered adequate for many other crops. Either of two methods has generally been used to supply phosphorus.

Annual applications (the first plan outlined) have been used successfully by many growers in western Oregon. Heavy initial application to last the life of the planting is also used by growers in both western Oregon and western Washington. This method has been used in most fertilizer experiments in western Oregon.

a) Annual application

1. Apply 100 to 120 pounds of phosphorus (P_2O_5) per acre at planting time, plus 80 to 100 pounds of phosphorus (P_2O_5) per acre annually in the fall, when the soil test values are less than 20 pounds of phosphorus (P) per acre.

2. Apply 60 to 80 pounds of phosphorus (P_2O_5) per acre at planting time, plus 60 to 80 pounds of phosphorus (P_2O_5) per acre annually in the fall, when the soil test values are between 20 and 40 pounds of phosphorus (P) per acre.

3. Apply 40 to 60 pounds of phosphorus (P_2O_5) per acre at planting time, plus 40 to 60 pounds of phosphorus (P_2O_5) per acre annually in the fall, when the soil test values are above 40 pounds of phosphorus (P) per acre.

b) Heavy initial application

If this method is used, the above rates should be modified as follows: 300 pounds of phosphorus (P_2O_5) per acre on soils testing less than 20 pounds of phosphorus (P) per acre; 120 to 160 pounds of phosphorus (P_2O_5) per acre on soils testing from 20 to 40 pounds of phosphorus (P) per acre. Soils testing above 40 pounds of phosphorus (P) per acre should not require heavy initial applications for satisfactory production of strawberries. Band application of phosphorus fertilizers is recommended. Bands should be placed on each side of the row, 3 to 4 inches from the plants and 4 to 6 inches deep, at planting time or at the edge of mat when rows are trimmed following harvest. If rows are over 12 inches wide, it may be desirable to place an additional band down the center of the row, using a double-disked opener running 3 inches deep. If the broadcast method of application is used, recommended rates should be increased 50 to 100%.

Potassium

1. Apply 120 pounds of potassium (K_2O) per acre when the soil test values are less than 150 pounds of potassium (K) per acre.

2. Apply 60 to 80 pounds of potassium (K_2O) per acre when the soil test values are from 150 to 300 pounds of potassium (K) per acre.

3. Apply 30 to 40 pounds of potassium (K_2O) per acre when the soil test values are more than 300 pounds of available potassium (K) per acre.

If lime has been applied immediately prior to planting, yearly fall applications of 60 to 120 pounds of potassium (K_2O) per acre are recommeded, regardless of potassium soil test values. Potassium fertilizers can be broadcast along with nitrogen fertilizers. Both can be applied with irrigation water.

Lime

Lime is not recommended at the present time. If soil test values for available calcium are low, lime may be applied on a trial basis. However, the full lime requirement should not be applied. Do not apply more than 1 1/2 tons of lime per acre.

Sulfur

Use of ammonium sulfate and superphosphate or most mixed fertilizers to supply nitrogen and phosphorus at the recommended rates should provide sufficient sulfur. If materials are used which do not contain sulfur, apply 15 to 20 pounds of actual sulfur per acre as gypsum in the fall.

Boron

If the soil test shows less than 1 ppm of boron, apply 1 pound of actual boron (10 pounds of agriculture grade borax or its equivalent) per acre in the fall, either broadcast or with irrigation water.

Magnesium

Trial applications can be made when the magnesium soil test values are below 1.0 m.e. per 100 grams of soil or when the calcium soil test value is 16 times more than the magnesium soil test value.

Proper use of fertilizers is only part of the most successful strawberry management program. Well-drained soil with good structure, disease-free planting stock, weed and insect control practices, and irrigation are also necessary for highest yields.