



*Nitrogen Fertilizers in the Erosion Control
Program for the Palouse*

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ORGANIC MATTER of Palouse soils has been greatly reduced during the period since the virgin sod was first plowed. The soil in many fields has lost as much as 50 per cent of the original organic matter from the surface layer, even where the remaining thickness of the A horizon exceeds the plow depth. This reduction of organic matter has resulted in marked nitrogen-deficiency symptoms in wheat and grass seed-crops, especially where large amounts of carbonaceous crop residues have been returned to the soil. Consequently, there has been considerable interest in the use of nitrogen fertilizers throughout the Palouse region.

The results obtained at the agricultural experiment stations in Washington, Idaho, and Oregon show that the use of nitrogen fertilizers increased the yield of wheat grown in a cropping system of continuous wheat, and also in most cases when grown in alternate years with summer fallow. At Pullman, Washington (1), the average annual yield of wheat when grown every year for the period from 1922 to 1945 was 19.5 bushels per acre on nonfertilized soil, compared with 29.9 bushels on land treated annually with 57 pounds of nitrogen as sodium nitrate, and 31.1 bushels on land fertilized with ammonium sulfate at the rate of 59 pounds of nitrogen per acre. No significant increase in yield was obtained from these treatments on the plots cropped to wheat and summer fallow.

Data obtained at the University of Idaho for an eight-year period ending in 1945 show that an application of 150 pounds of ammonium sulfate per acre to wheat grown continuously, with all residues utilized, gave an increase

in yield of 9.1 bushels per acre over the untreated plots. The effect of nitrogen fertilizers applied to wheat grown after summer fallow in a lower rainfall area is shown by studies (2) conducted at Pendleton, Oregon. With all the straw residues plowed under, the average annual yield of wheat for a fifteen-year period was 43.9 bushels per acre from land fertilized with 150 pounds of ammonium sulfate and 38.6 bushels from the unfertilized. On land where the crop residues were utilized as a stubble mulch, a similar application of fertilizer increased the yield 12.7 bushels during the 1941 and 1942 seasons.

EFFECT OF NITROGEN FERTILIZERS ON WHEAT

A NUMBER OF FIELD TRIALS were conducted from 1944 to 1947 by the Washington Agricultural Experiment Station and the Soil Conservation Service in order to determine the effect of nitrogen fertilizers on the growth of wheat under different conditions. These trials were located on selected farms in Lincoln, Whitman, and Walla Walla counties, and represented a variety of soil types, cropping systems, and tillage practices. The fertilizer was usually applied in the fall on seeded wheat. The plots were narrow strips extending across a portion of the field, with all factors except fertilization kept constant. Crop yields were determined by means of quadrat samples taken at selected locations in each field.

The results for these field trials are given in Tables 1 and 2 and Figures 1 and 2 and are summarized according to the principal soil groups. These data show that the application of a nitrogen fertilizer produced an increase in wheat yields on eastern Washington soils to which wheat straw residues had been returned. The magnitude of the yield-increase varied with the nitrogen level, soil group, season, and degree of erosion. There was an almost linear relationship between the amount of nitrogen applied and the increase in yield of wheat. A considerable variation in response was obtained at the higher rates of fertilization, but much closer agreement occurred with the moderate amounts of nitrogen. In the summer fallow area, represented by the Walla Walla and Athena soil groups, some effect from reduced precipitation was noted in the subnormal moisture years. With deficient rainfall, the Athena soil gave a slightly greater response to nitrogen than the Walla Walla soil.

A greater increase in yield was obtained on moderately severe eroded land than on slightly eroded land. Erosion probably caused a reduction in the

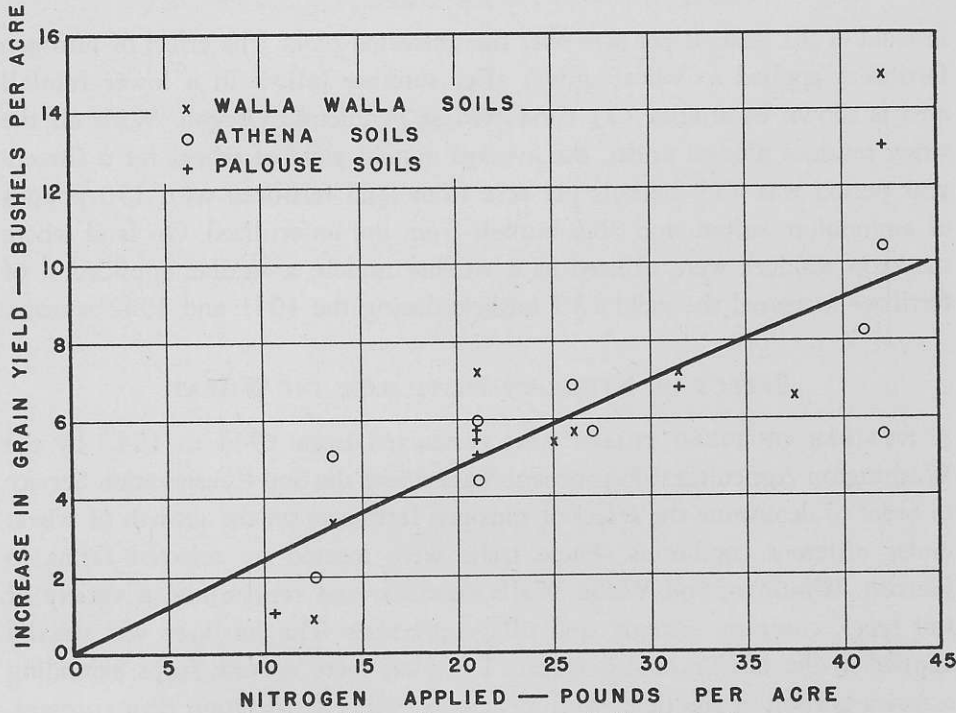


Fig. 1.—Effect of nitrogen on yield of wheat

Table 1.—Effect of nitrogen fertilizer* on the yield of wheat on soils to which the straw of the previous crop has been returned

Date	No. of locations	N	Yield		N	Yield		N	Yield	
			Treated	Incr.†		Treated	Incr.†		Treated	Incr.†
		lb/A	bu/A	bu/A	lb/A	bu/A	bu/A	lb/A	bu/A	bu/A
Walla Walla soils (wheat-fallow)										
1944	4	13.5	30.0	3.4	26.0	31.9	5.7	-----	-----	-----
1945	4	12.5	36.1	0.9	25.0	40.6	5.4	37.5	41.8	6.6
1946	4	-----	-----	-----	21.0	46.4	7.2	42.0	54.2	14.8
1947	11	-----	-----	-----	31.5	35.2	7.2	-----	-----	-----
Athena soils (wheat-fallow)										
1944	8	13.5	32.1	5.1	26.0	35.4	6.9	-----	-----	-----
1945	6	12.5	40.0	2.0	27.0	43.4	5.7	41.0	46.1	8.2
1946	8	-----	-----	-----	21.0	43.1	5.9	42.0	47.7	10.4
1947	6	-----	-----	-----	21.0	41.0	3.6	42.0	43.0	5.6
Palouse soils (wheat-peas)										
1945	5	10.5	42.1	1.6	21.0	46.3	5.5	31.5	47.7	6.8
1946	3	-----	-----	-----	21.0	40.2	5.7	42.0	47.4	13.0
1947	3	-----	-----	-----	21.0	41.0	4.4	-----	-----	-----

*Ammonium sulfate was used, except on part of the 1947 trials, where ammonium nitrate was substituted.
 †Increase in yield over unfertilized area.

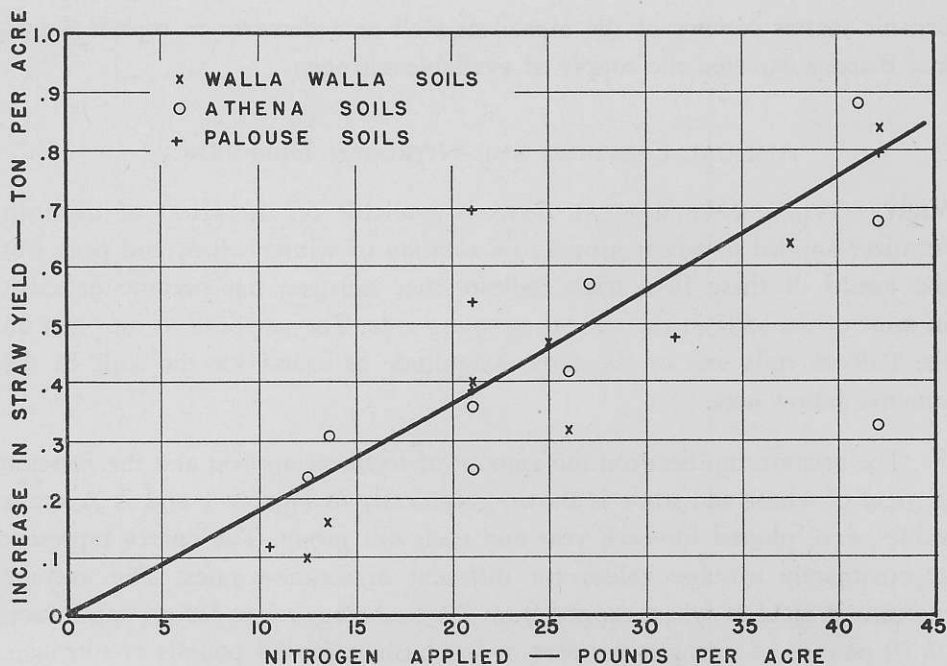


Fig. 2.—Effect of nitrogen on yield of straw

Table 2.—Effect of nitrogen fertilizer* on the growth of wheat straw on soils to which the straw of the previous crop has been returned

Date	No. of locations	Straw yield			Straw yield			Straw yield		
		N	Treated	Incr.†	N	Treated	Incr.†	N	Treated	Incr.†
		lb/A	tons/A	tons/A	lb/A	tons/A	tons/A	lb/A	tons/A	tons/A
Walla Walla soils (wheat-fallow)										
1944	4	13.5	1.41	0.16	26.0	1.56	0.32	---	---	---
1945	4	12.5	2.33	0.10	25.0	2.70	0.47	37.5	2.86	0.64
1946	4	---	---	---	21.0	2.54	0.40	42.0	2.97	0.84
Athena soils (wheat-fallow)										
1944	8	13.5	1.66	0.31	26.0	1.85	0.42	---	---	---
1945	6	12.5	2.47	0.24	27.0	2.76	0.57	41.0	3.06	0.88
1946	8	---	---	---	21.0	2.49	0.36	42.0	2.80	0.68
1947	6	---	---	---	21.0	2.07	0.25	42.0	2.15	0.33
Palouse soils (wheat-peas)										
1945	5	10.5	2.13	0.12	21.0	2.42	0.39	31.5	2.52	0.48
1946	3	---	---	---	21.0	2.34	0.54	42.0	2.62	0.80
1947	3	---	---	---	21.0	2.86	0.70	---	---	---

*Ammonium sulfate was used, except on part of the 1947 trials, where ammonium nitrate was substituted.
 †Increase in yield over unfertilized area.

organic matter content of the topsoil as well as a decrease in topsoil depth, and thereby depleted the supply of available nitrogen.

ANNUAL CROPPING AND NITROGEN DEFICIENCY

VERY LITTLE EXPERIMENTAL DATA is available on the effect of nitrogen fertilizer applied to wheat grown in a rotation of winter wheat and peas, but the results of these field trials indicate that nitrogen has become deficient in most of the soils in the annual cropping area. The response to nitrogen on the Palouse soils was of the same magnitude as found for the soils in the summer fallow area.

The relationship between the amount of fertilizer applied and the increase in yield of wheat and straw is shown graphically in Figures 1 and 2. Average values were plotted for each year and each soil group. The curves represent approximately average values for different application rates. The average increase in yield of wheat ranged from 2.4 bushels per acre for an application of 10 pounds of nitrogen per acre to 9.0 bushels for 40 pounds of nitrogen.

Increases in the yield of straw were proportionately greater than the increase in yield of grain. The average increase in yield of straw ranged from 0.17 ton per acre for an application of 10 pounds of nitrogen per acre to 0.76 ton for 40 pounds of nitrogen.

Nitrogen fertilizers are important in the conservation program of the Palouse, in the elimination of decreased wheat yields caused by carbonaceous residues, and in grass seed production. The maintenance of soil organic matter in sufficient quantities is important for the purpose of securing rapid infiltration of water into the soil and increasing the resistance of the soil to erosion. Results from long-time experiments at Pullman (1) show that organic matter is maintained at a higher level when straw and nitrogen are both returned to the soil than when either one is applied alone. In the annual cropping area of the Palouse, the nitrogen can be furnished by the use of legume crops such as sweet clover or alfalfa as well as by commercial fertilizers. However, in the summer fallow area, where the use of legumes is not as feasible as in the higher rainfall sections, the application of nitrogen fertilizers in conjunction with the return of all straw residues to the soil is probably one of the most practical means of maintaining soil organic matter at a favorable level.

LITERATURE CITED

- (1) Smith, H. W., and Vandecaveye, S. C. 1946. Productivity and organic matter levels of Palouse silt loam as affected by organic residues and nitrogen fertilizers. *Soil Sci.* 62: 283-291.
- (2) Stephens, D. E. 1944. Conservation practices on wheat lands of the Pacific Northwest. Mimeograph Bull. Soil Conservation Service, Pullman, Wash.

Charter Member Retires

J. W. HUNGATE, a charter member of the Northwest Scientific Association, retired from active teaching on April 1, 1950, after 45 years of service on one faculty.

Professor Hungate, Head of the Division of Applied Science and Arts at the time of his retirement from Eastern Washington College of Education, has the longest continuous term of active service of anyone who has been associated with the college.

The son of a member of the Washington State Constitutional Convention, Mr. Hungate received his bachelor's degree from The State College of Washington and his master's degree in entomology from Cornell University.

As an active member of the Northwest Scientific Association from the date of its founding, in 1923, he has served at various times as its secretary-treasurer, councilor, trustee, and president.

Mr. and Mrs. Hungate are planning to live for a time at Atascadero, California. The Northwest Scientific Association extends to them congratulations, with appreciation for long service to the Association and for active support of education and science in the Northwest.