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Comparison of Continuous Wheat and Wheat After Fallow in Colorado

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Comparison of Continuous Wheat and Wheat After Fallow in Colorado

K. G. Brengle[1] and B. W. Greb[2]

Two experiments to study the effect of commercial fertilizer on continuous wheat and wheat after fallow were established in 1954. These experiments were designed to determine if the yield of continuously grown wheat with additional fertilizer could compare favorably with yields from wheat after fallow. Growing continuous wheat has been found to be hazardous in most parts of eastern Colorado; however, the effect of fertilizer has not been studied with this cropping system.

Two widely different sites were selected for these studies. One experiment was located in the eastern part of the state on the Timm Brothers farm near Amherst. This site is in one of the highest precipitation zones in the wheat area of eastern Colorado. The annual average precipitation is about 18 inches, with about 80 percent of the moisture falling as rain during the period from April through September. The soil has a loam texture. Comanche was the variety of wheat used at this location.

The second site was at the Frentress farm in northwestern Colorado near Hayden. The annual average precipitation is about 16 inches, with fairly even average monthly distribution of precipitation. Saunders, a variety of spring wheat, was grown at this location. The soil is silt loam. Soil analysis data for both locations are given in table 1.

Nitrogen was applied at 25 and 50 pounds of N per acre to both continuous and fallowed wheat at both locations. These rates are referred to as N and NN, respectively. All nitrogen was broadcast prior to seeding. Phosphorus (P) applications were made at a uniform rate of 100 pounds available P_2O_5 per acre. The phosphorus was disked in prior to planting the first crop and was considered adequate for a 5-year period.

[1] Assistant Agronomist (Soils), Experiment Station, Colorado State University.
[2] Soil Scientist, USDA, Great Plains Field Station, Akron, Colo.

Table 1.—Analyses of surface soils

Location	Soil type	pH	Nitrogen %	Organic matter %	Avail.* P_2O_5 Lbs./A.	Lime %
Hayden	Silt loam	6.8	0.130	1.49	136	0.15
Amherst	Loam	7.0	0.111	1.83	136	0.10

*Sodium bicarbonate method

The first comparisons between cropping systems were obtained in 1955. The experiment at Hayden was discontinued in 1958 and the one at Amherst in 1959.

At Hayden, continuous wheat produced a profitable crop in only one of the four years (fig. 1). In 1958, stand establishment was very poor, with continuous wheat resulting in a complete crop failure.

Crop yields were increased at this location by the use of fertilizer only in 1957. In that year, all nitrogen treatments resulted in increased yields with continuous wheat, and the higher rates of nitrogen (NN and NNP) produced increased yields with wheat after fallow. These yields and the yield responses to nitrogen can be attributed to the distribution of rainfall rather than the total annual amount received (table 2). Good moisture conditions from planting time through the summer were favorable for crop growth. Under these moisture conditions, good weed control was obtained by spraying, and considerable competition with the growing crop was eliminated. In general, the test weight of grain was slightly higher with wheat after fallow but even with this practice it was low in two of the four years (figure 2).

The value of fallow with spring wheat in this area lies mainly in weed control. In the plots that were cropped annually, weed seeds, mainly Russian thistle, accounted for as much as 30 percent of the total weight of grain harvested in some years. Spraying the plots with 2,4-D during early growth reduced the weed competition but did not eliminate it completely. The data from four years of testing clearly indicate that fallow is a desirable and necessary practice with spring wheat in the Hayden area (figure 1).

The yield data comparing the two cropping systems with winter wheat at Amherst do not show as great an influence of the two systems as do the data from the experiment at Hayden (figure 3).

The comparison of annual yields between the two systems at Amherst is graphically presented in figure 3. Theoretically, wheat after fallow should outyield continuously grown wheat by at least 2 bushels to 1, since a given piece of land produces only one crop in two years under a fallow system. However, this rule cannot be rigidly applied, since the risk involved under

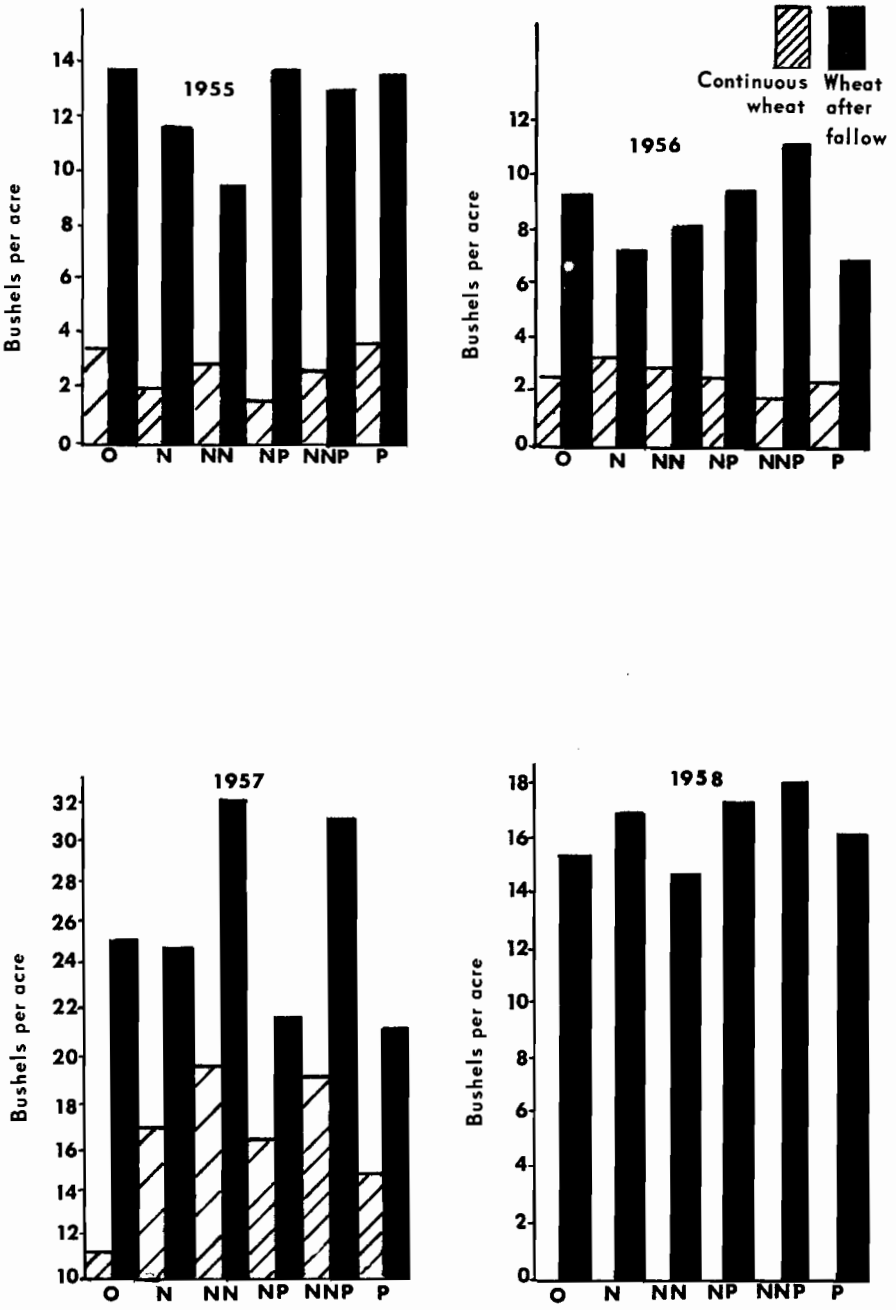

Figure 1.—Yield of spring wheat (Saunders) from two cropping systems with six fertilizer treatments at Hayden, Colo.

Table 2.—Monthly precipitation

Location	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Total
						1954-1955							
Amherst	2.61	0.75	0.15	0.20	0.15	0.25	0.30	1.50	4.80	3.97	2.80	2.70	20.18
Hayden	2.58	1.95	1.23	0.90	1.28	1.71	0.48	0.77	1.00	1.05	0.61	1.03	14.56
						1955-1956							
Amherst	2.50	0.30	0.54	0.25	0.39	0.18	0.21	0.28	2.68	2.61	2.47	1.95	14.36
Hayden	0.56	1.31	1.50	0.61	1.79	0.60	0.70	0.49	0.20	0.53	1.64	1.29	11.22
						1956-1957							
Amherst	0.29	0.37	3.15	0.80	0.29	0.10	1.97	3.23	4.76	2.16	4.24	3.63	24.99
Hayden	0.00	0.81	0.46	1.29	0.57	0.00	0.41	0.65	2.36	2.33	1.06	1.12	11.06
						1957-1958							
Amherst	0.18	1.44	0.43	0.33	0.30	0.45	2.43	4.25	1.55	2.44	6.10	3.41	23.31
Hayden						No record							
						1958-1959							
Amherst	1.46	0.70	0.30	1.40	0.87	0.55	2.88	0.73	5.06	3.57	-----	-----	17.52

Table 3.—Average yield from fertilized treatments for 3-year period (Amherst, Colo.).

	Continuous wheat						Fallowed wheat					
	O	N	NN		NNP	P	O	N	NN	NP	NNP	P
Hayden	5.6	7.3	8.5	6.6	7.8	6.6	16.0	15.2	17.4	14.7	18.3	14.8
Amherst	19.9	26.0	24.1	24.7	23.1	21.0	40.7	33.4	32.5	36.5	31.7	32.2

continuous cropping becomes very great in summer rainfall areas of less than 20 inches. Even in areas with an average annual precipitation up to about 22 inches, fallow is of value in reducing the risk of crop failure. At this location, wheat after fallow outyielded continuous wheat every year that a crop was harvested. In all cases, however, continuous wheat produced more than the 8 bushels per acre considered to be about the minimum yield required to meet the cost of producing an acre of wheat under the fallow system at present wheat prices. By eliminating the cost of fallowing with the continuous systems, this minimum should drop to around 6 bushels per acre.

The only significant differences due to fertilizer applications were obtained at this location in 1955. With the continuous crop, all nitrogen treatments increased the yield. In the fallow-wheat system, the yield was significantly lower than the check for the N treatment and significantly greater with the NP treatment. Phosphorus applications did not increase yields in any of the four years that crops were harvested.

Snowdrifts which accumulated in the fence row north of the experimental area in 1956 caused a moisture gradient from north to south which resulted in a large variation in the yields obtained. To reduce this variability, the yields from all phosphorus treatments were combined with the plots having corresponding nitrogen treatments. This combination of results appeared justified since phosphorus did not have any significant effect on the yield of the crop during the preceding year. Thus the yields for this year are reported as O, N or NN only (figure 3).

During the 5 years that this experiment was conducted, the only crop failure occurred in 1957 under both cropping systems. This crop failure was due to poor moisture conditions at seeding. The favorable rainfall during the spring was too late to benefit the crop. The fact that moisture conditions with the fallow system were not adequate to establish wheat illustrates the increased risk in cropping as the average annual rainfall falls below 20-22 inches. However, over a longer period of time it is quite likely that there would be years when a fallow system would provide some crop while the continuous system would not.

The 3 years 1955, 1958, and 1959, which gave comparable measurements, were combined for statistical analysis. The difference between cropping systems is statistically significant, with an average yield of 23.2 bushels per acre with continuous wheat and 35.0 bushels per acre with wheat after fallow. When the 1956 yields are included, the averages become 20.9 and 33.7 bushels per acre for continuous wheat and wheat after fallow, respectively. These yields indicate that it would be unwise to use

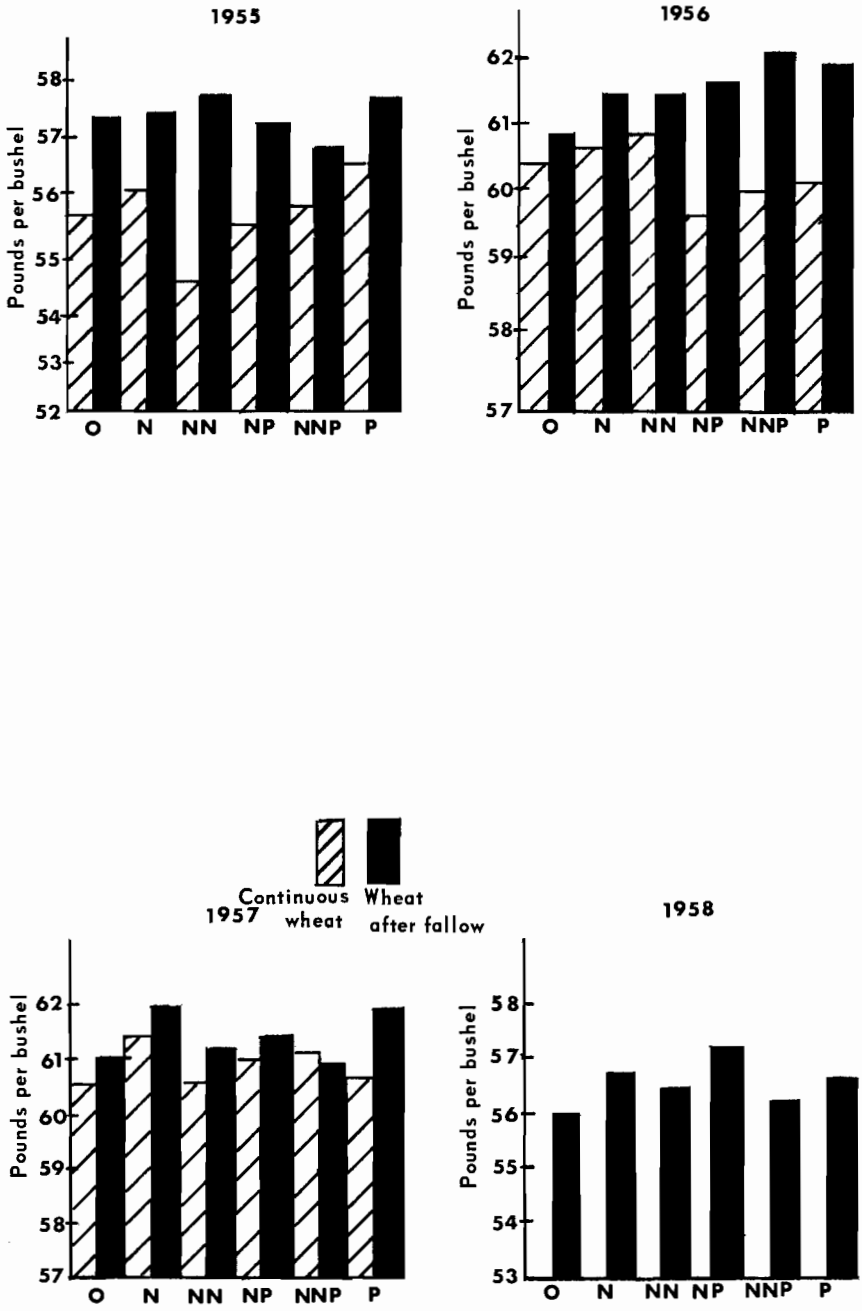

Figure 2.—Test weight of spring wheat (Saunders) from two cropping systems with six fertilizer treatments at Hayden, Colo.

a continuous wheat system in this area under an acreage allotment program in which sufficient land is available for fallow. However, the overall averages for the cropping systems do not give a complete or true picture. The average yields of the unfertilized plots show a definite value to the fallow-wheat system (table 3). Assuming 8 bushels per acre to be the break-even point for wheat after fallow and 6 bushels per acre for continuous wheat, the average annual profit for a given acre of land would be 13.9 bushels for continuous wheat and 16.3 bushels for the fallowed wheat. This comparison is based on a fallow-wheat system in which a given acre of land produces a crop once in 2 years.

Applying the same reasoning to the highest average yield from each cropping system in table 3 (0 for fallowed wheat and N for continuous wheat), the average annual profit for the two systems becomes about 17.0 bushels for continuous wheat and 16.3 bushels for fallowed wheat. The cost of the fertilizer and its application equals approximately 3 bushels per acre; this has been taken into account in the above figures.

Due to the statistical design of the experiment, the nitrogen effect with only one cropping system could not be sufficiently evaluated to provide a basis for specific recommendations. However, the combined results from years in which all fertilizer treatments were analyzed show definite trends. The average yields from fertilizer treatments over this 3-year period indicate a possible benefit from nitrogen with continuous wheat and a decrease with wheat after fallow (table 3). The interaction between nitrogen and cropping systems is statistically significant for the 3-year period. This shows that the effect of nitrogen fertilizer is not the same with the two systems. The influence of nitrogen was more consistent with continuous wheat than it was with wheat after fallow. Fertilizer nitrogen applied to continuous wheat resulted in yields equal to or greater than those of the non-fertilized wheat each year except for the NP and NNP treatments in 1958 (figure 3).

The test weight of grain is, in general, slightly higher with the fallow-wheat system (figure 4). As a rule, fertilizer applications tend to decrease the test weight. Decreases in test weight in 1956 and 1959 due to fertilizer treatments were statistically significant. The weight per bushel of the non-fertilized wheat grown after fallow was enough greater than that of the continuous wheat without fertilizer to place it one commercial grade higher in all years except 1956.

The results of this test indicate that continuous wheat could possibly compete economically with wheat after fallow in the Amherst area if acreage restrictions were not in effect. The economics of the two systems

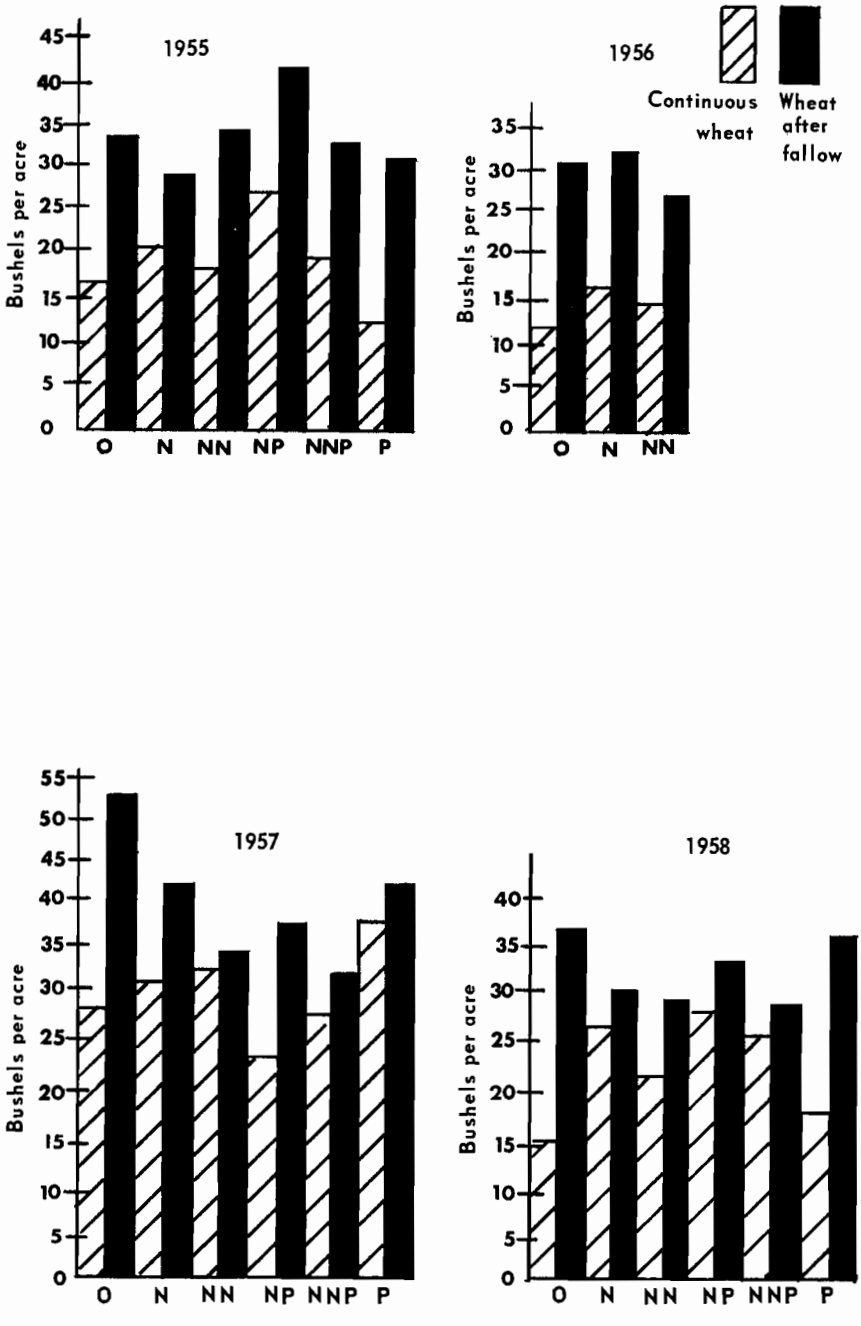

Figure 3.—Yield of winter wheat (Comanche) from two cropping systems with six fertilizer treatments at Amherst, Colo.

need to be fully explored, since quality as well as yield of grain should be considered. The lower test weight of grain with annual cropping may be an economic factor in some years.

It should be emphasized that the results of this test are applicable only to the soil and climatic conditions which occur in the vicinity of Amherst, Colo. Continuous cropping becomes more hazardous as the average annual precipitation decreases, and chances for success with fertilized continuous wheat would be expected to be less in lower rainfall areas of eastern Colorado.

Summary

Wheat grown annually and wheat after fallow were compared at two locations in Colorado. Winter wheat was used at the location near Amherst and spring wheat was used at the location near Hayden. Nitrogen and phosphorus applications were made to both cropping systems.

Fallow was found to be necessary in the production of spring wheat in northwestern Colorado. It is important as a means of controlling weeds which compete with the crop for water. Responses to nitrogen were obtained only once in 4 years at this site.

At Amherst, fallowed wheat outyielded continuous wheat when the unfertilized plots were compared over a period of 3 years. For this period there was a significant nitrogen $\times$ cropping interaction. Yields were increased on the continuous system and decreased on the fallowed wheat by the application of nitrogen fertilizer. The statistical design of the experiment did not permit accurate evaluation of the nitrogen effect with one cropping system but the trends shown by this interaction are quite evident. Comparison of the test plot with the highest average yield indicates that continuous wheat with 25 to 30 pounds of nitrogen added as fertilizer may economically compete with fallowed wheat in this area.

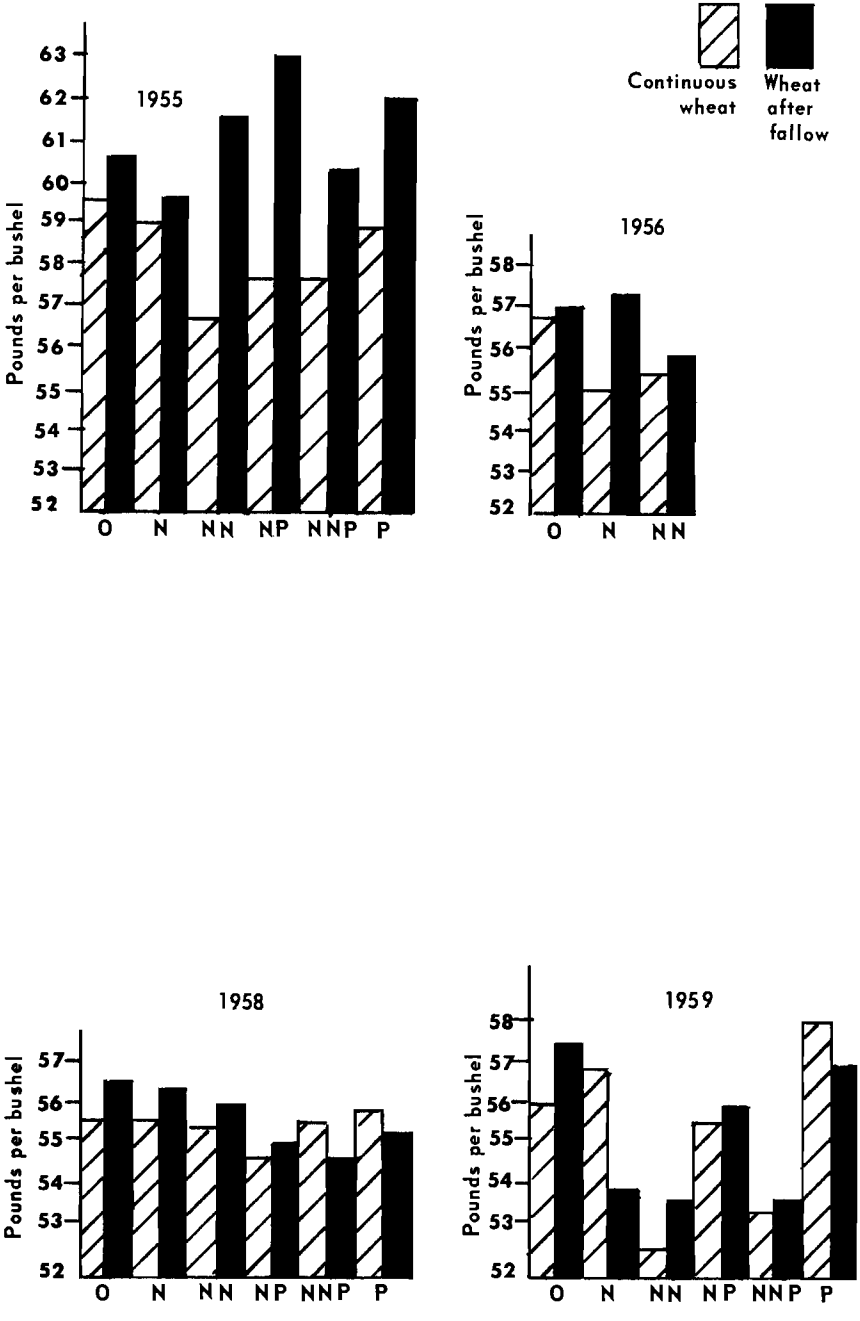

Figure 4.—Test weight of winter wheat (Comanche) from two cropping systems with six fertilizer treatments at Amherst, Colo.