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## THE CHEMICAL COMPOSITION OF FARM CROPS AS AFFECTED BY SOIL TYPE AND TREATMENT

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Farm crops in Illinois are grown on soils representing a large variation in natural fertility. Little attention has been given the probable effect that these various levels of soil fertility might have on the quality of these crops. Soil treatment, such as adding limestone, phosphates, potash, and legumes, has reached such proportions as to have a decided effect on the production of total crops in the state. Soil treatment is considered almost solely from the standpoint of increasing acre yields. The factor of quality which might be affected by the fertility of soils is as a rule not considered.

A recent publication, "Building Better Pastures,"\* contains some statements which are highly pertinent to the conservation of soil fertility and which sooner or later must be given consideration by all who are interested in farm production. Some of these statements follow: "Good livestock are seldom found in poor soil areas." "Many soils are deficient in plant food elements, and as a result grass is poor and this deficiency is

transferred to animals." "The relationship between soil fertility and health of livestock has been well established by research." "The object of this publication is to supply information regarding pastures to horsemen and stockmen throughout the continent, and in this connection these statements are of great significance."

It is the object of this paper to present briefly chemical data which supply information along the lines of the above quotations and limited to Illinois soil conditions. It is not always possible in chemical work to select all of the constituents which may cause human beings or animals to flourish or not to flourish on certain foods or feeds. It is possible, however, by chemical methods to show deficiencies or abundance of certain constituents or elements which may have considerable nutritive value. Protein is one of the important constituents of foods and its presence often determines the value of the product. Phosphorus is one of the important mineral elements and its deficiency has frequently led to disastrous

\* By W. L. Burlison and R. F. Fuelleman, published by the Horse and Mule Association of America.

results in animal nutrition. This discussion will be limited to these two constituents of foods and feeds.

**Experimental Results.**—The results from three experimental fields are shown in Table 1; one field represents an intermediate while the other two fields represent almost two extremes in soil fertility. The composition of Kentucky bluegrass grown on these soils is also included. The Elizabethtown field represents Ava silt loam with a total nitrogen content of 1,580 pounds an acre on untreated soil. This soil produced bluegrass which had a protein content of 136 pounds per ton and a phosphorus content of 1.6 pounds per ton of air-dry hay. The Clayton field which represents Harrison silt loam containing 3,600 pounds an acre of total nitrogen produced bluegrass which contained 150 pounds of protein and 3.2 pounds of phosphorus per ton of air-dry hay. The Easton field representing the more fertile Harpster clay loam produced bluegrass which contained 162 pounds of protein and 3.6 pounds of phosphorus per ton of hay. The Kentucky bluegrass grown on the Harpster clay loam contained approximately 19 per cent more protein and 125 per cent more phosphorus than did the hay from the low fertility Ava silt loam which is typical of a large area of the southern Illinois hill lands. When differences of such high proportions as these are found it is not unlikely that animals fed too long on this phosphorus-deficient grass may suffer from diseases peculiar to such a deficiency.

The results for the bluegrass on the treated soils for the three fields were not exactly comparable because of variations in the amounts and kinds of fertilizers used. However, these results do indicate the enormous possibilities of these soils when well treated. The protein content was more than doubled by the use of nitrogen fertilizers while the phosphorus

content on the Ava soil was doubled by the use of phosphate fertilization. Ammonium sulfate supplied the nitrogen fertilizer at Easton and Clayton while sodium nitrate was used at Elizabethtown. Superphosphate supplied the phosphorus at Elizabethtown and Clayton while at Easton the phosphorus was supplied by soybean meal.

The Kentucky bluegrass from the three fields (Table 1) was harvested at approximately the same stage of growth—full maturity. It is not probable that any considerable part of the differences was due to variations in the stages of growth of the grass.

The hay values in Table 1 are based alone on protein content at five cents per pound. This value is obtained from the market price of high-protein feeds such as tankage, soybean meal, alfalfa meal, etc.

The results in Table 2 show that soils in a relatively low state of fertility do not always produce grain of a low feeding value. The Kewanee field representing Muscatine silt loam with a total nitrogen content of 7,720 pounds an acre produced corn grain with 2.35 per cent less protein than that on the Enfield field. The last named field represented Bluford silt loam with a total nitrogen content of 3,100 pounds an acre. On the basis of the above protein content and valuation, the corn from the Enfield field was worth six and one-half cents per bushel more than the corn from the more fertile Kewanee soil. The Enfield grain had also a slightly better phosphorus content.

In this experiment, hybrid corn was used with identical soil treatment (RLPK) consisting of residues, limestone, rock phosphate, and potash.

Phosphorus and protein content of wheat grain, presented in Table 3, shows a decidedly lower content for grain grown on soils of relatively low levels of

TABLE 1.—COMPOSITION OF KENTUCKY BLUEGRASS FROM THREE DISTINCT FERTILITY LEVELS REPRESENTING BOTH TREATED AND UNTREATED SOILS

Experiment field	Soil Total N	Hay—Untreated soil			Hay—Treated soil		
		Protein	Ton value	Phos.	Protein	Ton value	Phos.
Elizabethtown.....	lbs./A. 1580	lbs./T. 136		lbs./T. 1.6	lbs./T. 151	\$ 7.55	lbs./T. 3.2
Clayton.....	3600	150	\$6.80	3.2	226	11.30	5.8
Easton.....	4800	162	7.50	3.6	355	17.75	5.0

TABLE 2.—PROTEIN AND PHOSPHORUS CONTENT OF CORN GRAIN FROM TWO SOILS WITH IDENTICAL TREATMENT

Experiment field	Soil treatment	Soil Total N	Corn grain	Protein		Phosphorus Lbs./bu.
				Perct.	Lbs./bu.	
Kewanee.....	RLPK.....	lbs./A. 7720	bu./A. 91	9.25	5.2	.14
Enfield.....	RLPK.....	3100	82	11.60	6.5	.15

fertility. The Minonk field representing Drummer clay loam with a high nitrogen and phosphorus content on untreated land produced wheat grain which had 57 per cent more phosphorus and 13 per cent more protein than wheat grown on the Toledo field which represents Cisne silt loam with a relatively low nitrogen and phosphorus content.

Soil treatment which included a phosphate fertilizer gave an increase in phosphorus content of the grain of 64.2 per cent on the less fertile Cisne silt loam, while on the more fertile Drummer clay loam there was no apparent effect of the treatment on the phosphorus content of the wheat grain.

These data, although somewhat limited in scope, indicate that a decidedly unfavorable nutritional condition may exist in both food material and animal feeds due to low levels of fertility elements in our soils.

The above quotations regarding the effect of soils on the health and welfare of animals may appear to involve rather serious problems. We may be inclined to believe that these statements apply to some far-removed part of the country and dismiss them as problems which do not concern us directly. However, even a limited study of Illinois soil conditions indicates that the foregoing statements, serious as they may be, may at some time apply directly here in this state.

TABLE 3.—PHOSPHORUS AND PROTEIN CONTENT OF WHEAT GRAIN FROM TWO SOILS TREATED AND UNTREATED

Experiment field	Untreated soil		Phosphorus content of grain			Protein content	
	Total N	Phos.	Untreated	Treated	Increase	Untreated	Treated
	lbs./A.	lbs./A.	lbs./bu.	lbs./bu.	perct.	lbs./bu.	lbs./bu.
Minonk.....	6320	130	.22	.22	0	7.8	7.9
Toledo.....	2480	18	.14	.23	64.2	6.9	6.9