EFFECT OF HEAVY APPLICATIONS OF GYPSUM ON PLANT GROWTH

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The owner of land adjoining the Fort Dodge plant of the United States Gypsum Co. recently ascribed the rundown condition of his farm to injury by gypsum dust from the plant. Since the areas near the plant were obviously receiving considerable deposits of dust over a period of time, we were asked to investigate the possibilities of direct or accumulative injuries.

Injury from dust deposits on growing crops was considered improbable on a number of grounds:

1. Gypsum ($CaSO_4 \cdot 2H_2O$) is a stable, neutral salt with a solubility at saturation of about 0.2 per cent. A saturated solution of gypsum is frequently used as a source of Ca and SO_4 in nutrient solutions, and such slight contact as might be made with the mesophyll cells through the cuticle and epidermis of the leaves could not be expected to be injurious.

2. Gypsum dust might reduce diffusion through the upper stomata of leaves, but the relatively large size of the dust particles and the readiness with which they form larger crystals when exposed to dew, together with the predominance of hypostomatal leaves, makes any important clogging improbable.

3. Dust layers would partially shade the leaves, particularly during hot, dry periods, but many published experiments indicate that 30 per cent. of full sunlight is near optimum for photosynthesis. Unpublished data for maize show little or no increase in photosynthesis above 25 per cent. of full sunlight. Since the dust would ordinarily be removed by rainfall during periods of cloudy weather, the probabilities of beneficial action from shading appear to be as good as or better than those of injury.

Experimentation

Pot tests of gypsum applications

Possible accumulative effects of gypsum dust on the soil were investigated from two angles; the possible beneficial effects of potassium applications in balancing excess calcium accumulations, and the effects of large additional quantities of gypsum to soil from the area receiving the maximum dust deposits. Soil was collected from the plowed layer of a field adjoining the gypsum plant, after discarding 3–5 cm. of surface clods, stubble, etc., and used to fill gallon jars. Thirty-two hundred grams of dry soil was used, and salts added on an area basis and mixed with the soil for the various treatments. The data of the first experiment with oats are shown in table I. Yields are total shoot and grain growth per pot.

Potassium chloride appeared to hasten maturity of the plants and thus to reduce their green weight at harvest but showed no effect on total dry

TABLE I

YIELDS OF OATS ON FORT DODGE SOIL

TREATMENT	WEIGHT PER POT, AVERAGE OF DUPLICATES	
	GREEN WEIGHT	DRY WEIGHT
	gm.	*gm.*
None	8.05	2.45
1000 lb. gypsum per acre	8.75	2.50
200 lb. KCl	6.75	2.50
1000 lb. KCl	6.00	2.50
400 lb. $CaH_4(PO_4)_3$ + 200 lb. KCl	7.85	2.75
200 lb. $NaNO_3$ + P & K	13.75	4.55
N–P–K + 100,000 lb. gypsum	15.30	4.65

matter production, and thus no indication of antagonizing injurious accumulations of calcium. The only significant response obtained was that from the nitrogen and phosphorus combination which nearly doubled the yields, although it is important from the standpoint of the investigation that 100,000 pounds of gypsum, equivalent to 2 cm. of dust, had at the least no injurious effect.

In later experiments the same soil was used and the same procedures followed except that dust-bin gypsum from the Fort Dodge plant was substituted for the chemically pure salt. Three crop plants, oats, corn and soybeans were used. Yields in grams of dry matter, average of two pots, are shown in table II. All gypsum applications were at the rate of 50 tons per acre, with 500 lb. of KCl tried for its antagonistic effect. The N–P–K treatments represented acre rates of 200 lb. $NaNO_3$ to supply nitrogen, 400 lb. $CaH_4(PO_4)_2$ for phosphorus, and 200 lb. KCl for potassium.

Oats showed a slight tendency to respond positively to these very heavy applications of gypsum on soil which had already received gypsum dust deposits over a series of years. Corn and soybeans gave erratic, non-significant responses.

A third series with oats grown on an acid Clarion fine sandy loam from Ames, again showed a marked response to combinations of nitrogen and

TABLE II

YIELDS OF OATS, CORN AND SOYBEANS IN POTS OF FORT DODGE SOIL

TREATMENT	AVERAGE YIELD, DRY MATTER		
	OATS	CORN	SOYBEANS
	gm.	*gm.*	*gm.*
None	1.80	3.10	6.35
100,000 lb. gypsum	2.05	2.80	5.95
500 lb. KCl	2.15	3.20	5.80
KCl + gypsum	2.35	3.80	5.85
N–P–K	4.20	7.10	9.90
N–P–K + gypsum	4.50	6.95	9.40

phosphorus, but no significant response to applications of 100,000 lb. of gypsum per acre.

Summary

The application of gypsum to potted crop plants at a rate equivalent to 100,000 lb. per acre did not significantly affect the growth of corn or soybeans. In ten paired tests the yield of oats was increased 4.83 ± 1.64 per cent., a value which just exceeds the 5 per cent. level of significance. The data suggest that heavy and long continued application of this neutral calcium salt will not injuriously affect the yields of crop plants on these soils.

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