OXYGEN LEVELS IN SOILS TREATED WITH SUGAR

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When soluble salts are moderately high in soils and leaching is not practical, sugar may be applied at 1 lb. in 5 or 10 gallons of water where 1/2 to 1 quart is applied per square foot. This will cause a microbial population explosion that will tie up the salts in microbial bodies. While this procedure has been suggested for many years for nitrate or ammonium nitrogen reduction (Post, 1949), little data has been published.

A soluble salt reading of 120-150* is generally deleterious to rooted cuttings or seedlings. Sugar treatment will decrease this level by 25 to 50 or more. Along with this reduction in soluble salts, microbial populations may increase more than 10-fold (Koths, et. al. 1971). Behera and Wagner (1973) report a minimum generation time of two hours between 5 and 10 hours after treatment with glucose.

Due to the increase in microbial activity, the soil carbon dioxide (CO_2) level will increase and oxygen (O_2) will decrease. The CO_2 increase was reported as reaching a peak in about 20 hours after treatment (Koths and Linvill, 1969) (Figure 1).

An experiment was conducted to measure the reduction in O_2 levels in sugar treated soils, in the laboratory at 86°F (30°C) in brass tubes fitted with a port into which an O_2 electrode was inserted. The O_2 concentration was measured with a Beckman Model 777 laboratory oxygen analyzer. A greenhouse soil with a soluble salt level of 120 was used. Three hundred grams (10.7 oz.)

*[*mhos x* 10^{-5}, *1:2 soil:water extraction*]

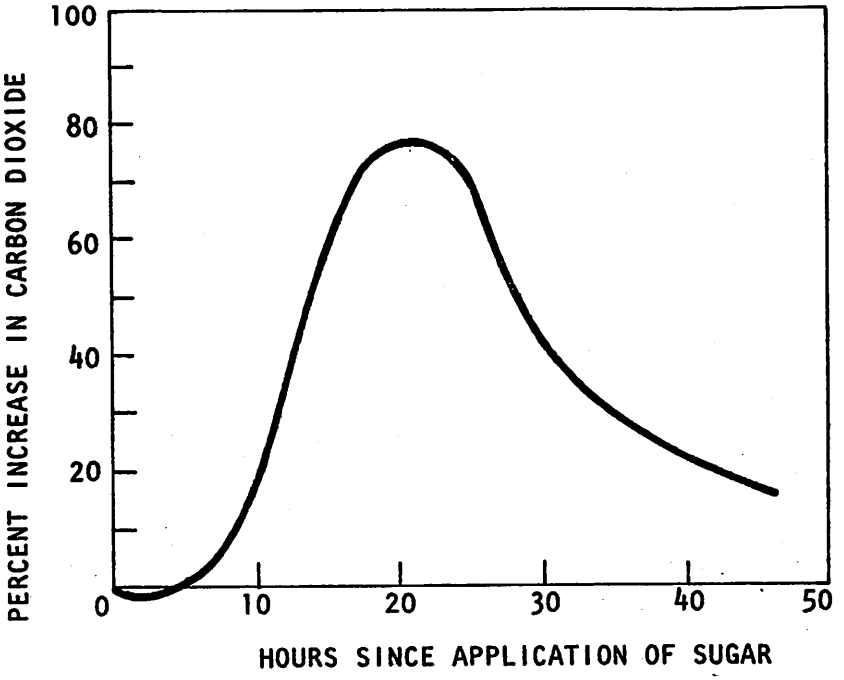

Figure 2. Change in carbon dioxide concentration in the soil atmosphere following sucrose application.

of air dried, 2 mm sieved soil were placed in the cylinder and 85 ml water added. The treatments were as follows:

1. Distilled water
2. Sucrose at 1 lb/10 gals (12 g/l)
3. 33% liquid manure
4. Sucrose plus liquid manure

The liquid manure was obtained from a cattle storage lagoon and contained 1.0% dry matter which was 8% nitrogen.

When a soil is air dried, then rewetted and placed in an enclosed container, the microbes begin rapid respiration and use up the O_2 as

seen in Figure 2. This rate would not be this rapid in a pot where oxygen would be diffusing into the soil.

The addition of liquid manure did not change the rate of 0_2 depletion. Sucrose alone shortened the time of 0_2 depletion from 18 hours to 10 hours. The addition of liquid manure with sucrose further reduced this time to 9 hours.

The soluble salt levels were decreased from 120 to 82 by sucrose, to 85 by manure plus sucrose. This was a surprise since the liquid manure was expected to contribute to salts. Furthermore, the manure plus sucrose was more effective than sucrose alone in speeding 0_2 depression. This can probably be attributed to insufficient nitrogen for microbial growth where sucrose was applied alone.

One might conjecture that in the greenhouse the depletion of 0_2 in the soil would restrict root respiration and interfere with maximum growth. This apparently does not happen. In tests with pot mums (Koths, 1972), rates of 1

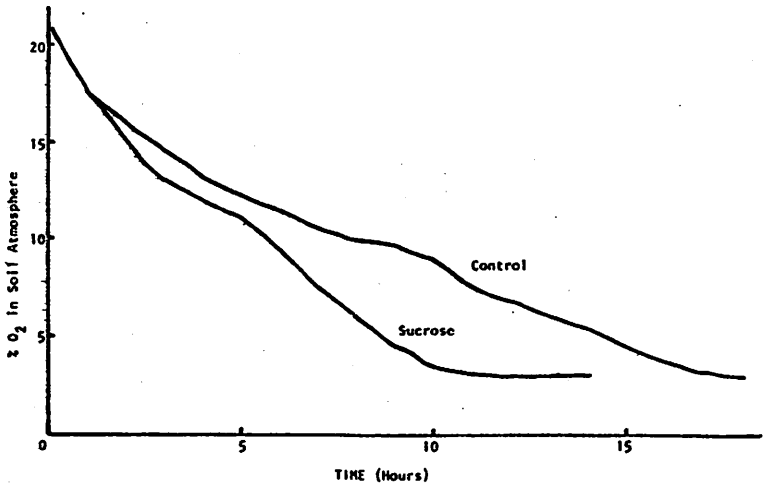

Figure 2. Oxygen depletion in a soil treated with sucrose at 1 lb. per 10 gals.

lb. sucrose to 10 or 5 gals. of water showed no detrimental effects on growth. Rates of 1 to 5 lbs. per gal. were too high. Kiplinger (1972) found that up to 2 lbs. per gallon were tolerated but this high rate was not found necessary.

These results do not add much to our knowledge of how sugar depresses high salt readings and renders such soils safer for plants. But it does accentuate the rapidity of the action whereby soluble salt and ammonium nitrogen toxicities in soils are partially alleviated. And it provides another tool for the grower when marginally toxic levels of soluble salts are found.

References

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AN APOLOGY

The article on the legality of wettable powder dusts referred to Dr. Richard Lindstrom (Connecticut Greenhouse Newsletter No. 90). This was not Dr. Lindstrom, but Dr. Richard Lindquist. At least the address was correct.

Our apologies to both.