Soil Conditioners – A Problem or A Solution?

J.W. Bauder

Within the past decade the demand for increased efficiency in agricultural production has increased many fold. This increased demand is the result of several socio-economic and technological developments. Probably the most significant single development has been the international control and regulation of petroleum products and more specifically machinery fuel. The increased costs of management that have resulted from rising fuel costs have naturally been reflected in the increased concern and awareness for resource use efficiency.

As a means of counteracting increased management costs, farmers and ranchers are continuously revising and up-grading production practices to include the most efficient management schemes. One management practice that is receiving considerable attention is the use of so-called soil conditioners and additives. Although the promotion of soil conditioners and additives is not new, the increased cost of fertilizers has brought about an increased interest in the use of conditioners and additives to, hopefully, produce strikingly profitable yield increases. Naturally, concern has been expressed for the possible benefits derivable from the incorporation of such products into existing management programs.

Many questions and uncertainties have arisen in the recent past. Consequently, research was undertaken to provide answers to some of these questions and to determine the possible benefits of soil conditioners.[1]

Some Descriptive Information

The many soil additives and so-called conditioners on the market today can be classified on the basis of two criteria: (1) origin of the materials, and (2) composition of the materials. With regard to origin, materials being marketed are SYNTHETIC or NATURALLY OCCURRING. In terms of composition, materials are either ORGANIC or INORGANIC (Figure 1).

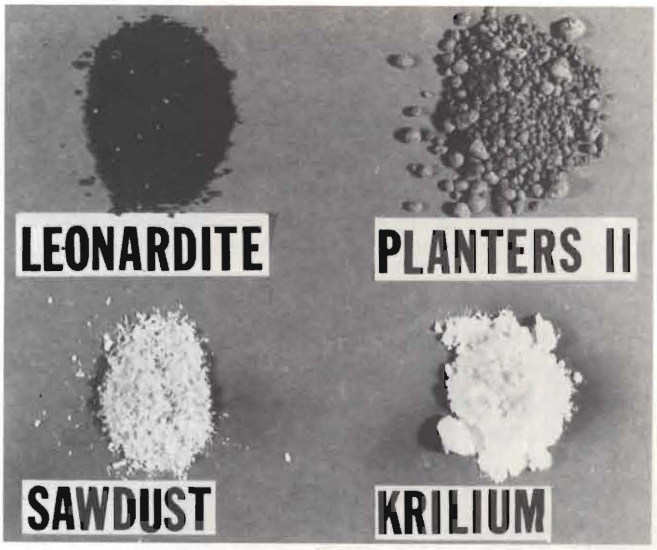

Figure 1. A wide array of materials are presently being marketed as soil conditioners and additives. Properties and composition vary: organic vs. inorganic; synthetic vs. natural.

Often a question arises as to the distinction between soil conditioners and soil additives. Presently it is common to find individual products marketed under both the descriptive titles of ADDITIVES and CONDITIONERS. Definitions to distinguish between soil conditioners and additives are:

ADDITIVES—materials that when added to the soil may serve as supplements to or replacements for conventional fertilizers; these materials may affect soil structure and/or they may condition the soil, depending on their composition.

CONDITIONERS—materials that when added to the soil may affect soil properties to the point that some conditioning occurs; materials may affect the physical and/or chemical conditions of the soil, depending on their composition.

The terms ADDITIVES and CONDITIONERS have been frequently interchanged when describing materials presently on the market. With that being the case, it is difficult to determine the purpose or usefulness of a product simply by its descriptive title or product name.

When considering the role and function of soil additives and conditioners in crop production, it is important to realize that many soil properties may be affected, either favorably or adversely, by the addition of such materials to the soil. Some of the

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Dr. Bauder is assistant professor, Department of Soils.

[1]**Product names are used here solely to more clearly identify the types of products that have been studied. Neither inclusion nor omission of trade names implies approval or disapproval by the author.**

soil properties that can in theory be affected by the addition of materials to the soil include: (1) water holding capacity, (2) aeration, (3) temperature, (4) nutrient holding capacity and availability, (5) structure and aggregate stability, (6) micro-organism population and behavior, (7) organic matter chemistry, and (8) animal, including insect, behavior. Each of these properties can be considered from several aspects. For instance, soil structure and aggregate stability affect surface water runoff, wind and water erosion, water intake rates and water transport rates.

Each of these properties can be affected individually; some may also be inter-related to others. Because of the inter-relating nature of these properties, it is difficult to single out the exact effects of certain additives and conditioners. It is known that some materials do act as binding agents, while others serve as emulsifiers and dispersing agents. Still others may act as growth stimulators. However, the relative importance and effectiveness of many of the additives and conditioners on the market today depends on the conditions under which such materials are used.

Status to Date

Each year many new products are promoted and marketed as soil conditioners. As a result, questions relating to the effectiveness of such materials are being directed continuously to agricultural researchers.

In response, researchers initiated studies to evaluate the effects of some of these materials on both the physical and chemical properties of the soil. Additional studies focused on the effects of these materials on crop production. This report presents a summary of information relating to midwestern states research on soil additives and conditioners as they may influence crop production.

E.P. Adams (1964) reported on research conducted in South Dakota with the organic soil conditioners SUPERGRO and FERTILAID. The yields of oats and corn under several treatments were compared in a five-year study. Treatments included these two organic soil conditioners and three conventional N sources: (1) NH_4NO_3 (ammonium nitrate), (2) NH_3 (anhydrous ammonia), and (3) $CO(NH_2)_2$ (urea). The conditioner plots each received 300 lb. conditioner/acre, respectively, while each of the N-treated plots received 40 lb. N/A along with 20 lb. P. The plots treated with the anhydrous N source produced the highest corn grain yield, approximately 73 bu/A (five year average). Both conditioner plots yielded approximately 50 bu/A. The check plot, receiving no conditioner or conventional fertilizer, averaged 55 bu/A. The oat yields, although different in magnitude, demonstrated the same general trends.

In a similar study conducted by Holcomb, et al. (1973), University of Minnesota researchers evaluated the effectiveness of two materials, WONDER LIFE and SHUR-GRO. Additive treatments were compared with check and conventional fertilized plots at both Morris and Lamberton, Minnesota, during 1971 and 1972. The crop was corn. Treatments were compared on plots with and without a broadcast application of P and K. WONDER LIFE and SHUR-GRO were applied at rates of 250 and 300 lb./A, respectively. At Lamberton, N was applied at a rate of 114 lb./A along with P and K, while at Morris the N application rate equalled 120 lb./A. The highest yield at both Lamberton and Morris was on plots receiving conventional fertilizer. The lowest yields occurred on the plots treated with the soil conditioner, WONDER LIFE. In some instances yields on plots receiving either the soil conditioner (WONDER LIFE) or the organic specialty fertilizer (SHUR-GRO) were below those from the check plots.

Additional studies by other researchers have resulted in similar findings (Christy, Falloon, and Preston, 1965; Rauschkolb, Halderman, and True, 1970; Engelbert and Walsh, 1962; Weaver, et al., 1974; Grabouski and Wiese, 1963).

North Dakota Studies

As a means of evaluating the effectiveness of several different types of so-called soil conditioners on crop production, North Dakota State University researchers recently initiated investigations on a Maddock fine sandy loam. Study plots were established at Oakes, North Dakota, under both dryland and irrigation management. The crop was corn. Preliminary soil tests (NDSU Soil Testing Laboratory) indicated the study site soil was low in N and P and medium in K. Half of the dryland and

Table 1. Soil conditioner treatments under dryland and irrigation management with and without conventional fertilization (N,P,K), Oakes, N.D. 1975.

Soil conditioner[1]		Rate of application
Type	Product name[2]	(lb./A)
No additives		0
Trace element fertilizer	Planters II	400
Oxidized lignite	Leonardite	100,300
Humic acid + N-P-K	Humite	200,400
Lignite + N-P	Humiphos	200,400

[1] *Product names are used here solely to more clearly identify the types of products that have been studied. Neither inclusion nor omission of trade names implies approval or disapproval by the author.*

[2] *Product analysis as provided by suppliers or manufacturer available upon request from NDSU or State Testing Laboratory, Bismarck.*

irrigated plots were treated with a pre-plant broadcast of 140 lb. N, 99 lb. P_2O_5, and 45 lb. K_2O. The conditioner treatments were implemented as split-split plots, with whole plots being irrigated and dryland and split plots being broadcast N, P and K and no conventional fertilizer. Table 1 includes the treatments and the conditioner application rates applied to the split-split plots within the water-fertilizer combination plots.

Corn grain yields for several treatments in combination with irrigation-dryland and fertilizer-non fertilizer treatments are presented in Figures 2, 3, 4 and 5. The results of statistical analysis performed on both the grain and silage yields indicated that significant yield differences could be attributed to both irrigation and fertilization treatments. Within any particular irrigation-fertilizer treatment combination, grain and silage yields were not significantly different as a result of conditioner treatments. As was expected, irrigated plots outyielded dryland plots, regardless of the fertilizer and/or conditioner treatment combination. This is evident in the corn grain yields of Figure 2. Within the dryland whole plots, the no-additive treatments produced more than any conditioner-treated plots, both with

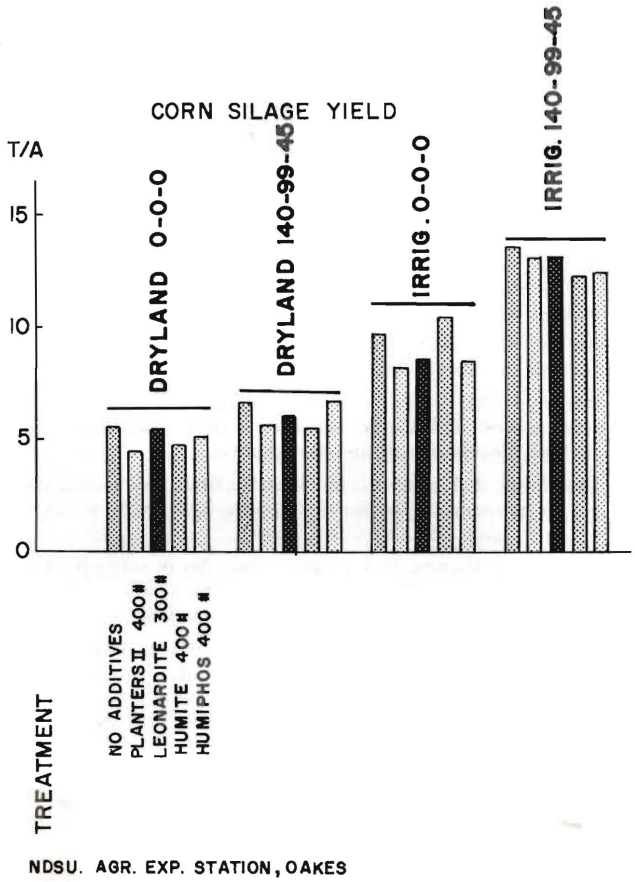

Figure 2. Corn grain yield as affected by water regime, fertilization, and soil conditioner application, Oakes, N.D., 1975.

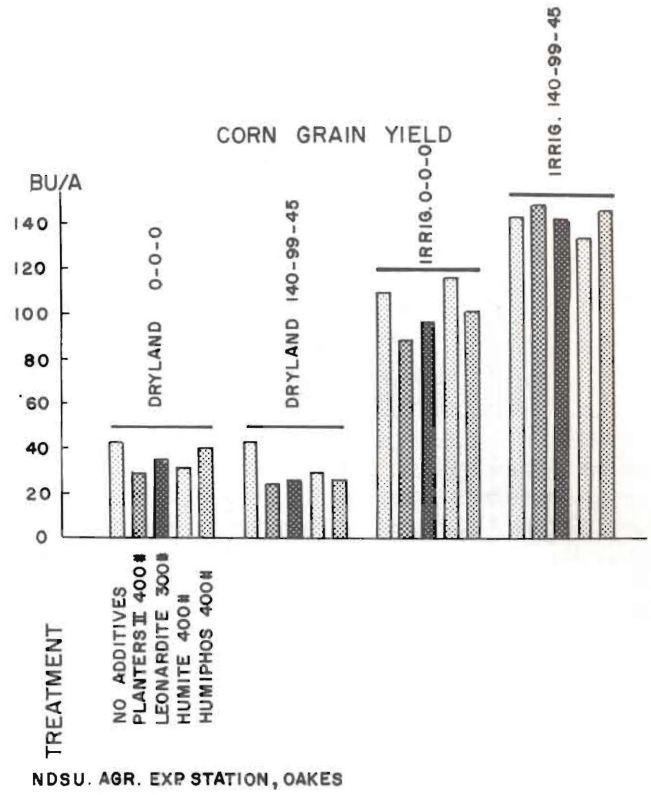

Figure 3. Corn silage yield as affected by water regime, fertilization, and soil conditioner applications, Oakes, N.D., 1975.

and without broadcast N, P and K. Within the irrigated whole plots or blocks, there were no significant yield differences due to conditioner treatments. The plots receiving no conditioners yielded approximately the same as the conditioner plots. Figures 2 and 3 both show the significant response to both irrigation and broadcast fertilization of N, P and K.

The corn silage yields are similar to the grain yields with one exception; the silage yields indicated a positive response to conventional fertilization under both dryland and irrigation, while grain yields were increased by fertilization only under irrigation. The yields from conditioner treatments did not differ significantly from the yields without conditioners.

Figures 4 and 5 are included to demonstrate the relative benefits realized from irrigation, conventional fertilization and incorporation of soil conditioners. First, looking at grain yields for any one soil conditioner treatment (Figure 4), we can see that the greatest yields were measured on the irrigated, fertilized plots. Irrigation without fertilization produced the next highest yielding plots, and in some instances fertilization without irrigation resulted in a grain yield reduction. Looking across all the different conditioner treatments receiving the

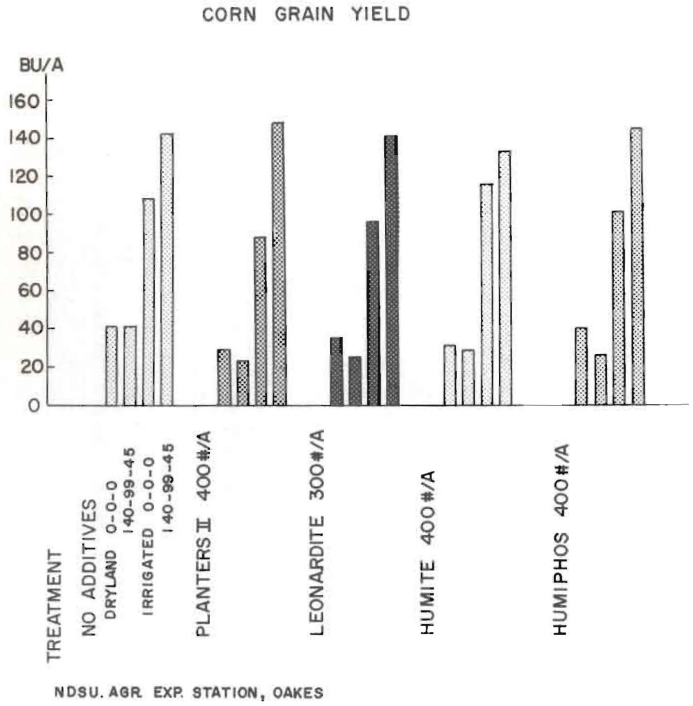

Figure 4. Effect of irrigation and fertilization on the efficiency of selected soil conditioners as evidenced by corn grain yields, Oakes, N.D., 1975.

same water regime and fertilization treatments, the no-conditioner plot yields equalled or exceeded the conditioner plot yields in most instances. Under no combination of treatments did the conditioner-treated plots significantly outyield the plots not treated with a conditioner. The silage yields of Figure 5 indicate the same general trends.

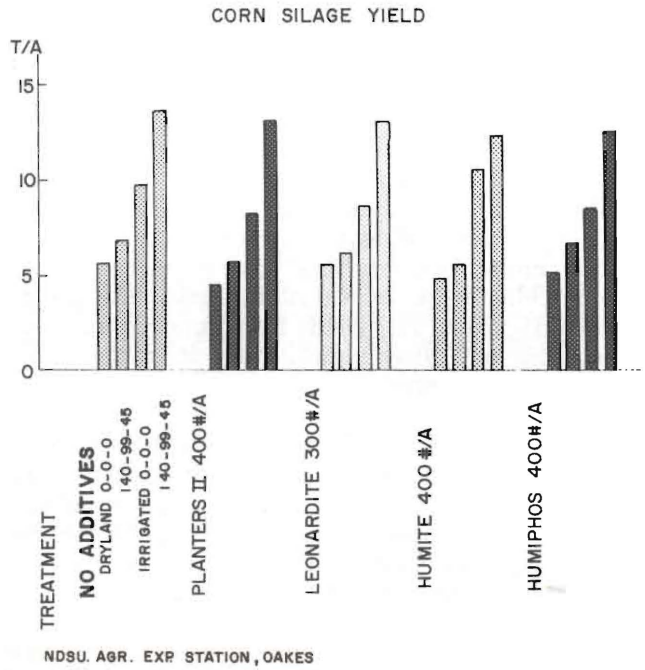

Figure 5. Effect of irrigation and fertilization on the efficiency of selected soil conditioners as evidenced by corn silage yields, Oakes, N.D., 1975.

Summary

Within the past few years, the threat of limited available energy sources has created an increased concern for efficient agricultural management. As a means to increased production, agriculturalists have been considering the use of organic and inorganic soil conditioners and additives to improve agricultural land and increase productivity. The widespread marketing of such materials has resulted in a need for research to quantify the benefits derivable from such products.

Research investigators in several upper midwest states including South Dakota, Minnesota and Wisconsin have measured little or no crop response to selected organic and inorganic soil conditioners and additives under described study conditions. Similar results have been reported by southern and western researchers. Research in North Dakota under dryland and irrigation management has demonstrated no response to selected soil conditioners and additives both in the presence and absence of conventional fertilization. Under the study conditions available, no benefit was realized from the use of several types of soil conditioners.

When considering the use of such products as inorganic and organic soil conditioners, specialty fertilizers and soil additives, agricultural and farm managers should recognize the needs and requirements of their land. Thorough consideration and analysis of the derivable benefits and costs incurred should be made prior to the implementation of management programs. Then a product that will do the job should be selected.

References

1. Adams, E.P. 1964. **Results of five-year soil conditioner study at the South East Research Farm, Menno, SD.** Cooperative Ext. Service, South Dakota State University, mimeo.
2. Adams, E.P. 1970. **Soil conditioner fails in farm trials.** The Farmer, January 3, 1970.
3. Christy, C.M., J. Falloon, and A.L. Preston, Jr. 1965. **Soil conditioners — Missouri results — 1964.** Cooperative Ext. Service, University of Missouri, mimeo.
4. Engelbert, L.E., and L.M. Walsh. 1962. **Soil conditioners versus commercial fertilizers for corn.** University of Wisconsin, Agri. Exp. Sta., Madison, mimeo.
5. Grabouski, P., and R.A. Wiese. 1968. **No benefits from new soil additive in 1967 tests.** Agronomy Views. No. 219. Univ. of Nebraska Cooperative Ext. Service, Lincoln.
6. Holcomb, G.D., S.D. Evans, O.M. Gunderson, W.W. Nelson, and C.J. Overdahl. 1973. **Comparison of a soil conditioner and a specialty fertilizer with a conventional fertilizer.** Univ. of Minnesota. Agricultural Ext. Service, Fact Sheet. Soils — No. 22.
7. Rauschkolb, R., A.D. Halderman, and L. True. 1970. **Evaluation of a biochemical soil additive: Advantages were not found in Arizona vineyard study.** Agrichemical Age, October, 1970: 6-8.
8. Weaver, R.W., E.P. Dunigan, J.F. Parr, and A.E. Hiltbold. 1974. **Effect of two soil activators on crop yields and activities of soil microorganisms in the southern United States.** Southern Cooperative Series Bull. No. 189 Texas Exp. Sta. College Station, Texas.