Excerpts 1982 - University of Nebraska
Increase of Microorganism Count

Ammonium Laureth Sulfate. The suggested rate for this liquid substance is 12 ounces per acre as" an aid to improved downward water movement".

Note: 60 % in SSP.

Plus Effect :
Comment: It has been documented that organic substances like propanol and sugars provide a high energy supply for soil micro-organisms, causing an increase in their numbers, but subsequent effects on soil structure or tilth are difficult to measure. Any organic carbon source (manure) chopped alfalfa hay, corn or sorghum lead residue should be equally effective.

Comments :
They did not have proper equipment for measuring microorganisms in the field. However, it is being compared to manure and various other residues. These amounts are not given.

Microorganisms are very important along with the increased porosity for air and water movement through the soil.

They all add up to numerous benefits. These results were also proven by Pen State University.

Excerpts 1982 - Crusting Emergence
Michigan State University

Effect of SSP product on emergence of sugar beets, Saginaw Valley Research Farm, 1981

Plants counted on these dates.	May22	May26	May29	June1	June2	June5
Method of Application			(Number of beets/ 66 foot row)			
Control	130	134	153	136	144	132
Banded	141	153	170	161	164	155
Additional plants with Soil (SSP) Treatment	11	19	17	25	20	23

Result: AVERAGE: 19.1 % more plants per / 66 foot row. Effect would be the same banded over row or entire area. Michigan State University: An average of 19.1 % more emerged plants per 66 feet. Anyone growing beans, beets, or in fact, any crop at all, would derive benefits from the emergence effects of SSP soil treatment. Increased Root growth can also be expected.

Effect of Soil Treatment (SSP) Product on Yield, Quality and Emergence of Sugar Beets.

Donald R. Christenson
Department of crop and Soil Sciences
Michigan State University

The objective of this study was to measure the effect of product (SSP) on yield, quality and emergence of sugar beets.

Methods

The sugar beets were planted on May using 300 pounds 18-46-0 plus 3% Mn and 1 % B as the banded fertilizer.

The area was tilled once with a spring tooth- spike tooth harrow combination. After this tillage the Soil Treatment (SSP) product was applied to the entire plot on the broadcast treatments at a rate of 0.75 pints/ acre in 30 gallons of water. The soil was tilled again and the beets were planted. The banded treatments were applied in a 7-inch band over each row at a rate of 0.75 pints/acre again in 30 gallons of water.

Emergence counts were made on six dates following initial emergence. The beets were planted at a 2-inch spacing and thinned to an 8- inch spacing after the last stand count was made. Sugar beets were harvested October 20.

Results

Method of application of Soil Treatment (SSP) product did not have a significant effect on yield, quality or emergence of sugar beets (Tables 1 and 2). There was a consistent trend for greater emergence of beets with the soil treatment. However, there was a large amount of variability in the data and any differences due to treatment were masked.

Table 1. Effect of Soil Treatment (SSP) product on yield and quality of sugar beets, Saginaw Valley Research Farm,1981.

Method of Application	Yield	Sugar	CP	Recoverable Sugar	Alpha amino	k
	t/a	--------%----		lb/A	-me/100	sugar
Control	27.0	17.3	96.1	8110	5.78	18.6
Banded	26.0	17.6	96.2	8001	5.68	16.8
Broadcast	27.4	17.3	95.8	8186	6.05	18.4
Banded & Broadcast	26.5	17.6	96.2	8153	6.10	17.4
LSD (5%)	NS	NS	NS	NS	NS	NS

Table 2. Effect of Soil Treatment (SSP) Product on emergence of sugar beets, Saginaw Valley Research Farm, 1981.

Method of application	May22	May26	May29	June1	June2	June5
	Number of beets/66 feet of row					
Control	130	134	153	136	144	132
Banded	141	153	170	161	164	155
Broadcast	135	152	141	135	140	138
Banded & Broadcast	128	152	158	154	150	143
LSD 5%	NS	NS	NS	NS	NS	NS

- Average 19.1 more plants per 66 feet of row on crusting and emergence and effect.

Chemical Treatment to Alter Hydraulic Conductivity of Soils

Objective:
To determine whether the application of dilute aqueous solutions of some chemicals as drenches to laboratory soil samples had efficacy in alteration of soil hydraulic conductivity.

Procedure:
Soil samples: All soil samples were dried in a forced-air oven at 30 degrees Celsius for 12 hour prior to treatment. Soil columns comprised a soil volume equal to a depth of 20 cm in a glass column with an inside diameter of 7.6 cm. The base of the glass column was dammed by the use of a fritted glass plate. Above the fritted glass plate finely woven silk was placed to a depth of 1 cm to prevent the loss of soil "fines" (clay fraction). The exit (lower) end of the column was fitted with a 4 mm bore stopcock for control of water flow. The dried soil sample was added to the column in the following manner. A solution containing the treatment chemical in specific quantity was made up to a volume of 500 ml with distilled water. One half of this solution was poured into the empty glass column. The dry soil sample was then added to the column and the remainder of the treatment solution was poured into the column over the soil. The stopcock at the bottom of the column was opened and the liquid level was reduced to ca 1 cm above the soil column surface. A "floater" disk (porous polyethylene) was added to the liquid surface to reduce disturbance of the soil column surface when further liquid was added to the column.

The soil column was then "flushed" with a 500 ml volume of distilled water. When the supernatant water level was ca 1 cm above the soil column surface the water flow was shut off and the column was allowed to condition for 24 hours after which interval measurements of hydraulic conductivity were commenced.

Measurements:
A volume of 500 ml of distilled water (constituting an initial water head of 28 cm over the soil face) was added to the column and the stopcock was opened to allow free water flow. The time required for 500 ml of added distilled water to pass through the soil column was measured (rounded off to the nearest whole minute) using a stopwatch. A total of three such measurements were made on each soil column. From these data an average time for each soil column was derived and used as a single datum.

Replication:
Each treatment was replicated four times. Each replicate was assigned a block number (1-4) to enable statistical treatment.

Statistical:
A standard deviation value for each treatment was derived, along with a standard error term.
Only treatments within a given soil types were tested against each other.
The data were treated by analysis of variance method and least significant differences (LSD)
At the 95 per cent confidence level were computed. LSD values are given in the accompanying
Table 1.

SOIL COMPOSITION:

Soil A : A loamy sand type,	Sand: 83%,	Silt: 3%,	Clay: 14%,	OM: negligible
Soil B : A silty clay loam,	Sand : 20%,	Silt : 37%,	Clay : 40%,	OM : 3%
Soil C : A sandy loam type,	Sand : 51%,	Silt : 25%,	Clay :23%	OM : 1%
Soil D : A clay loam type	Sand : 32%	Silt : 25%	Clay : 39%	OM : 3%

Chemicals:

All chemicals reported here in were supplied by National Ag Products Development, Inc. P.O. Box 8611 - Grand Rapids, Michigan 49508. Composition of each chemical is given as reported to the Principal Investigator by personnel of the above company. Formula was later sold as SSP, currently owned by UAS of America.Inc.

Chemical A: Ammonium laureth sulfate and other special surfactants for soil penetration.

Chemical B: A crystalline preparation (water-soluble) of a mixture of linear alcohol ethoxylate and dodecyl benzene sulfonate (proportions unspecified).

Treatments:

The surface area of a soil column was calculated to be 45.4 cm2 (7.0 IN2) which represents 1.1 8 10(-6) acre (4.046 * 10 (7) cm2/ acre). A control treatment was used in which only distilled Water was added to the column. The chemical treatments specified by personnel of National Ag Products Development, Inc. comprise a 500 ml aqueous solution of chemicals A and B singly and in various combinations. These solutions were added to soil columns as described under Procedure.

Results:

As may be observed in Table 1, application of the specified mixture solution of chemical A to saturated soil columns resulted in a reduced time required for subsequent downward water movement (hydraulic conductivity) through the soil columns. Times were reduced by 31 % in Soil A; 26 % in Soil B; 34% in Soil C; and 21% in Soil D, for an overall reduction of 28% in all soil types.

Effects of drench application of an aqueous solution of chemical A (see Chemicals) on apparent hydraulic conductivity of several soil mixture types. Values are expressed as minutes required for downward movement of 500 ml-distilled water through a 7.6 x 20-cm soil column (see Methods).

Time (min/ 500 ml)

Treatment	Soil A	Soil B	Soil C	Soil D
Control	342 + 84	449 + 104	369 + 74	483 + 112
ALS***	236+63	334+110	242+52	381+87
LSD 0.05	98	101	98	104

*** Ammonium laureth sulfate chemical at field application rates of 12 ounces per acre.

Visual observation of soil friability (Table 2) yielded an index value of 3 for Soil A; 2 for Soil B; 2 for Soil C ; and 3 for Soil D. Overall value of friability was 2.5.

Table 2.

Effects of drench applications of an aqueous solution of chemical A (see Chemicals) on Apparent friability of several soil mixtures types.

FRIABILITY INDEX

TREATMENT	SOIL A	SOIL B	SOIL C	SOIL D
CONTROL	1	1	1	1
ALS	3	2	2	3

*Soil samples were removed from columns after determination of hydraulic conductivity see (methods) and carefully placed into Petri dish tops (150mm dia). The samples were placed into 30 oc forced-air oven for 24 hours until dry. Soil were visually (subjective) examined as to their degrees of friability and then ranked on a scale of 1 to 5 (1= non -friable; 5=very friable). Values for replicates within a treatment were averaged**.**

NON-TRADITIONAL NEW PRODUCT ASSESSMENT

Once again a flush of new activity to sell a new product registered in the state. Here is some product information we have gathered in the past few weeks.

1. SSP. SOIL CONDITIONER. The labels states its active ingredient is Ammonium laureth Sulfate, 60%; The suggested rate for this liquid substance is 12 ounces per acre as "an aid to improve downward water movement."

<u>Comment:</u> It has been documented that organic substance like propanol and sugars provide a high energy supply for soil microorganisms, causing an increase in their numbers, but subsequent effects on soil structure or tilth are difficult to measure. Any organic carbon source (manure) chopped alfalfa hay, corn or sorghum leaf residue should be equally effective.

ABSTRACTS OF ATTACHED SUPPORTING DATA
FOR SOIL TREATMENT EFFICACY
OFFICIAL REPORT OF
TEST BY PENNSYLVANIA STATE UNIVERSITY

DEPARTMENT OF AGRONOMY

SECTION 1.
A theoretical basis is proposed which could account for the observed effects on soils. Theories are based upon the imparted properties of viscosity and surface tension.

SECTION 2.
Some work was done relative to septic drain fields. These tests are not applicable to the product.

SECTION 3.
Cementing agents for agglomeration of particles appear unnecessary. This experiment indicates that treatment effects are not due to flocculation of particles. Data shows no significant difference in particle size between treated and untreated samples.

SECTION 4
Tests show significant improvement in water retention and completeness of drainage in treated soil cores. Sample cores were taken from poorly drained soils. Improved drainage is reflected as increased porosity in tabular data. Effects are still apparent after re-wetting and "tension drainage". Table shows comparison with check samples (untreated).

SECTION 5.
Field application of two soil conditioners was made on spring corn planting at germination. Subsequent penetrometer measurements were not made until fall. results showed wide variability within untreated check fields and within both treated fields. The values obtained in these delayed tests were not useful in drawing conclusions.

SECTION 6.
Favorable reference is made to a " Soil Science Newsletter" (April 20, 1979) from the University of Nebraska, by extension Agronomist, R.A. Wiese in which the following statement is made: " It has been documented that organic substances like propanol and sugars provide a high energy supply for soil

microorganisms, causing an increase in their numbers". Pennsylvania State University also plans more work in this area.

LIQUID SOIL CONDITIONERS: SHOULD FARMERS USE THEM

Betsie Blumberg, graduate assistant in Agronomy: Christina Hunt, research assistant in Agronomy: and Dale E. Baker, professor of Soil Chemistry.

Liquids containing organic compound claimed to improve air-water relations of soil are being marketed in Pennsylvania as soil conditioners. Like soil activators and plant growth substances, liquid soil conditioners are non-conventional additives, but these liquids are claimed to improve soil drainage and loosen the soil. From the research data accumulated, it is not possible to make a blanket recommendation to Pennsylvania farmers regarding their use or non-use.

<u>If a farmer is cropping soil that are poorly drained, especially in the early spring, and his program requires the spraying of a pesticide, then he may find it beneficial to include a soil conditioner at the recommended rate for spraying of a pesticide, It is highly recommended that the soil conditioner be left off at least one 50 to 100 foot strip, and preferably two or three, across each field at observe any differences in crop response.</u>

<u>Liquid soil conditioners may be helpful under very wet soil conditions and are expected to be beneficial on water - repellent soils.</u> However , positive results from existing routine field testing are not available from which predictions may be made. <u>Soils mapped by soil survey as poorly drained are most likely to give positive results when the conditioner is applied in accordance with the manufacturer,s label.</u>

The claims for soil conditioners generally include lowering of the surface tension of the water, to make water wetter. <u>Based on our results, this is a valid claim for the products.</u> other claims which were investigated relate to possible benefits associated with the lower surface tension effect :

1. Helps increase the rate of water penetration into soils.

2. Overcomes water repellency of soils.

3. Reduces runoff and loss of water by evaporation.

4. Assists drainage where standing water ordinarily accumulates.

5. Prevents dry spots due to more uniform water penetration.

6. Improves air-water relationships in soils.

7. Improves soil structure - loosens soil and prevents crusting. This effect is not associated with the surface tension effect, and precise testing methods for it are not developed.

Action of surfactant described. When a surfactant or soil conditioner is added to water, the cohesion between water molecules decreases, surface tension decreases, and droplets tend to spread. The effect that soil conditioners have on surface tension of water may be precisely measured within the laboratory and may be used to determine the potential effectiveness of these products.

At the recommended rates, and assuming that a saturated soil contains 50 percent water by volume, soil conditioners were found to reduce the surface tension of water by about five percent. If surface tension of water was the only effect of these soil conditioners, one would expect them to decrease the capillaries-hollow glass tubes-to simulate soil capillaries, it was found that this effect was very small (minus 0.38, minus 0.85, and minus 4.1 percent) for 1, 10, and 100 times the manufacture's recommended rates, respectively.

When water is absorbed on a wettable surface like mineral soils of Pennsylvania, the forces of adhesion will tend to spread the droplet to give a lower angle of contact between the water and the surface. As this angle decreases, the capillary retention of water is not substantially affected. On the other hand, water-repellent soils with very high wetting angles may have substantially higher infiltration on values when treated with a surfactant.

WHAT BECOMES OF SOIL CONDITIONERS? We must be concerned with the fate of soil conditioners after they are applied. If they are not held at the surface of soil particles, they are available for either leaching or microbial degradation. If the soil conditioner is used as food by soil micro-organisms, their numbers should increase over time.

At very high rates of 1,000 times the recommended rate, the population of soil organisms increases after one day from 310 million per gram of soil for the untreated soil to 350 million. Soil organisms grew to 600 million on the second day, remained higher than untreated soil for eight days, and returned to the same level as untreated soil after 35 days. The rapid growth of soil microorganisms suggests that when soil is above 50 degrees F, the conditioners will be degraded rapidly- thus reducing the claimed benefits as well as the potential to contaminate ground water.

Additional tests related to other claims for soil conditioners showed the following :

1. At two field locations in 1979, the soil conditioners had no measurable effect on penetration resistance of the soil.

2. Under laboratory conditions, water containing very high levels of conditioners slowly penetrated dry soil to greater depths than pure water. Ass penetration of soil water increases, air replaces the water in large capillaries providing more oxygen for plant root growth but simultaneously reduces the amount of available water within the root zone. Using undisturbed soil cores from field plots, it was found that additions of the soil conditioner at very high rates gave a small but significant increase in aeration porosity.

3. Similar results were obtained with laboratory studies of viscosity of clay-water systems. The reduction in viscosity from application of an anionic surfactant was thought to reflect partial negative repulsion due to incomplete coverage of the particles. An anionic surfactant adds to the original negative repulsion forces between particles. The flocculation effect would be equivalent to a random movement of particles from a force acting on one side and as particles hit each other they tend to stick together. This effect could explain the effect of small application rates on reduced viscosity and a small but beneficial effect on soil crusting and soil structure. Published data on the effect of surfactants on aggregate stability indicate variable results

depending upon the rate of application and the nature of the soil being treated.

4. A final field experiment was conducted with soybeans in 1980. The experiment included three soil conditioners, applied at the recommended rate and ten times the recommended rate. The variable treatments and the untreated " check " plot were arranged in a randomized complete block design with each of five replications containing seven plots measuring 30 feet by 25 feet.

Amsoy 71 soybeans were planted in 30 - inch rows on June 16, 1980 on the Hagerstown silt loam soil. The variable treatments were applied with a hand sprayer after planting. The plots were irrigated with approximately two inches of water to test the effect of the conditioners on water penetration and seedling emergence.

Twenty-four hours after irrigation, soil samples were collected from each plot to measure soil water retention in the surface soil. The values for the treatment and " check " ranged from 18.1 to 21.2 percent moisture and were not significantly different.

After soybean emergence, 39 -inch sub-plots were selected at random and the number of plants per sub-plot was counted and averaged. Again, soil conditioners had no effect under the conditions of this experiment. Yields of 40 to 45 bushels per acre were obtained on all plots with no significant effect from treatments.

Results summarized. From the experimental data collected and results of other studies reported in the literature, it may be assumed that these liquid soil conditioners can give positive results on poorly drained soils with aeration porosities of less than 10 percent measured under a water tension of 16 to 20 inches.

Since poorly drained soils are not prevalent on cropped areas of farms in central Pennsylvania, positive results should not be expected under field conditions. Letey reported in 1975, " I have been unable to find documented evidence of beneficial effects of nonionic surfactants when applied to naturally wettable soils." Our data leads to the same conclusion for the anionic surfactants. They are expected to be beneficial on water- repellent soils and thatch residues on turf. Surfactants have specific properties for solving specific problems. They are not general-purpose chemicals.

The project is supported in part by Fair Funds administered by the Pennsylvania Department of Agriculture.