MIRACLE CHEMICALS - CAN THEY AID SALINITY?

by

D.R. Cameron, D.W.L. Read and D.G. Warder

INTRODUCTION

Soil conditioners generally include synthetic chemicals having the ability to stabilize soil aggregates and improve soil structure or tilth. Some of the more common experimental chemicals are:

Krilium - Na salt of hydrolyzed polyacrylonitrite
PAM - polyacrylamide (hydrophylic polymer)
PVA - polyvinyl alcohol (high molecular weight polymer)
PVAc - polyvinyl acetate emulsions
Bitumen emulsions (like asphalt)
HPAN - hydrolyzed polyacrilonite
IBMA - isobutylene maleic acid
VAMA - modified vinyl acetate maleic acid

Experimental results (SSSA Special Publ. #7, 1975) have shown that the above soil conditioners can increase soil aggregation, soil stability, and water infiltration rates. However, because of expense ($1000 to $3000/ha), their use has been limited to bank stabilization on highways and lanscape care in environmental and tourist areas.

Soil amendments include any material which directly or indirectly improves soil conditions when used, e.g., limestone, gypsum, peat moss, straw, cinders, manure, even fertilizers. It would appear that soil conditioners are a special class of soil amendments, however, the distinction is generally not clear.

There are many chemicals on the market today that are reported to improve soil conditions (drainage, salinity, fertility) and crop yields. Some of these compounds and their functions are listed in Table 1. Their uses vary and include improving soil physical conditions, activating soil microorganisms, supplying essential trace elements and other nutrients, and supplying growth hormones (Johnson 1975). Bulletins prepared by the vendors of these products usually contain testimonials as to their usefulness. However, there is very little published scientific literature on any of these products. Some of the products listed in Table 1 are no longer manufactured.

Table 1. Compounds sold as soil conditioners or soil amendments

Product	Manufacturer	Active ingredients	Reported uses
Soil Inoculant	Bionomic Res. Corp., Chicago	trace elements and micro-organisms	N-fixation, respiration, better growth

Table 1. Compounds sold as soil conditioners or soil amendments (Cont.)

Product	Manufacturer	Active ingredients	Reported uses
Nature Aid Soil Aid-S (SAS10) Soil Aid-T.F. SATF10) Plant Aid S.S.O	Anti-Pollution Products, Calgary	saponin from yucca	SAT10 for lawns, SAS10 for crop, opens soil to air and water, counter-acts stress
Amway All-Purpose Spray Adjuvant	Amway Corp., Ada, Mich.	surfactant mixture	moisture penetration alkali control, wetting problems in hardpan areas
Soil Life "300"	The Larutan Corp., Anaheim, Cal.	ferment and polyoxyethylene ester and alkyl aryl poly	breaks up compacted soils, increases moisture retention, biocatalytic
Agri-SC	Agri-Inter-national, Omaha, Neb.	ammonium lauryl sulfonate ($C_{12}H_{23}O_4NH$)	drainage of wet spots
Eskomit	Europe?	microorganisms	convert fibres to humus, nourishment for N-bacteria
Humates	World Wide Farm Markets Inc., Minot, N.D.	humus	water retention, ion exchange, soil percolation, earthworms
Culbac	Direct Inter. Buyers Assoc., Salt Lake, Utah	seaweed (essentials for microorganisms)	foliar spray, seed coating
Maxicrop	Maxicorp, New Westminster, B.C.	seaweed, trace elements	foliar spray
Sumargo Red Earth	Hugh-Mer Sales Ltd.	volcanic ash, (minerals, trace elements)	improves germination, growth, yield
Medina	Medina Agric. Prod. Co., Hands, Texas	essentials for microorganism metabolism from blue-green algae	break down residues, loosen soils
Plen-T-4	Trico Products, Storm Lake, Iowa	lactic acid, kelp, molasses, whey, trace minerals	foliar spray for improving plant growth

Table 1. Compounds sold as soil conditioners or soil amendments (Cont.)

Product	Manufacturer	Active ingredients	Reported uses
Marinure	Conklin	seaweed (cytokinins, auxins, and gibberellins, plant growth hormones) minerals, trace elements, fish emulsion	foliar spray for improving growth
Symbex (Symcoat) (Symspray)	Agro-K Corp., Minneapolis	bacteria, yeasts, and enzymes	break down of crop residues to humus inoculant, seed treatment, spray
Crop+ Soil+	Cytozyme Labs, Salt Lake, Utah	Cytokinin	foliar and soil incorporation, stimulate yields
WEX	Conklin Prod. Int., Regina, Sask.	wetting agent	moisture penetration
Triacontanol	Alfa-Grow Inc., Warehouse Point, Conn.	triacontanol	foliar spray
Tyfo	National Res. & Chem. Co. Hawthorne, Cal.	trace elements	foliar spray
K-Mag	Duval Sales Corp.	Mg, K, S and trace elements	
Vel-Donna	Alberta	N, P, K, trace elements	fertilizer
Agriserum		microorganisms, some nutrients	organic assistant for growing healthier plants
Grozyme	Calgary		for soil fertility problems
Super-Gro Bio-Act		organic soil amendments	
Nachurs	Alberta	liquid fertilizer mixtures	crop yield increases

Effect on Soil Permeability

A study was set up at the Swift Current Research Station to examine the effect of various commercial products sold as soil conditioners on

the movement of water through soils. Soil samples were taken from saline and nonsaline soils, air-dried, and crushed and sieved. The commercial chemicals were added to the soils at the recommended rates, but no real differences were apparent, so the chemicals were added at 5 times the recommended rates.

After the chemicals were added, the soils were saturated. A constant head flow device was used to add water to the soil. Flow rates were measured every 10 minutes for approximately 6 hours. This usually permitted up to 4 pore volumes of water to move through the soil. The data were used to calculate hydraulic conductivities (cm/hr).

Seven soil chemicals which were reported to affect soil water movement were used in this study. A description of these chemicals and their recommended application rates are given in Table 2.

Table 2. Description of chemical compounds used in permeability study

Compound	Application rate	Chemical description
Amway All-Purpose Spray Adjuvant	wet ground with 1 pint/100 gallons water	not really given, low-sudsing, nonionic surfactant, biodegradable. Probably similar to Soil Life and Brij. Emulsifier and dispersing agent.
Soil Life "300"	1 gal./4000 sq.ft. (clay soils); 1 gal./10,000 sq.ft.(sandy soils)	ferment solution (water in ferment 84%); polyoxyethylene ester 4%, alkyl aryl poly...(label smudged) 8% - mainly used as emulsifiers, dispersing agents, wetting agents - similar to Myrj, Polysorbate 80, Tween, Altot, Brij.
Agri-SC	4 oz/acre mixed with 1 to 20 gal. water	ammonium lauryl sulfonate ($C_{12}H_{23}O_4NH$) 48% by weight - used as wetting agent, detergent, lowers surface tension of aqueous solutions
Soil Aid-S	1 gal./acre with 10 gals. water	steroid saponin - 10% by weight, saponins are amorphous glycosides found in certain plants (yucca) characterized by their ability to form emulsions and soapy lathers
Krilium	5 lb/50 sq.ft.	sodium salt of hydrolyzed polyacrylonitrite
Brij-35	Not known. Assume 1.5 gal. (30% solution) per acre	wetting agent used in laboratories for cleaning glassware. Not sold as a soil conditioner but contains similar ingredients as Soil Life

One of the main problems with running the flow experiments was controlling soil bulk density. As soil bulk density increases, flow rate decreases. In order to remove the effect of bulk density from the experiment, an analysis of covariance was run on each of the experiments. The adjusted treatment means are shown in Table 3.

Table 3. Average hydraulic conductivity (cm/hr for each of the soil conditioner treatments. (Treatment means have been adjusted for bulk density effects)

	Soils			
	Gull Lake Saline Silty loam	Swinton Nonsaline Silty loam	Hatton Nonsaline Sandy loam	Hatton Saline Sandy loam
Control	6.91	2.03	2.70	1.37
Amway	4.90	2.06	2.39	1.26
Soil Life	5.82	1.88	2.34	1.38
Agri-SC	5.11	1.96	2.37	1.49
Soil Aid	4.86	1.82	2.35	1.17
Krilium	3.08	1.24	1.46	0.79
Brij	5.25	1.91	2.37	1.13

There were no significant differences ($P = 0.05$) between the Gull Lake saline soil treatments. The Swinton soils results represent only one replication and no statistical conclusion can be drawn from the data. The analysis of covariance on the Hatton saline and nonsaline soils showed no significant differences between the control and any of the treatments except Krilium. All the other treatments were also significantly different than Krilium. Krilium significantly reduced the flow rate.

The effect of the miracle chemicals on flow rate was disappointing. Except for the lower flow rate by Krilium, none of the other miracle chemicals seemed to alter the flow rate of water through either saline or nonsaline soils. Some of the claims made by vendors of these products cannot be verified under the laboratory conditions of this study.

Field Tests

Several test locations were set up within 50 km of Swift Current where Agri-SC and Amway chemicals were applied to moderately saline areas. The results for two of these sites are shown in Table 4. In Spring 1979 on the Gull Lake site there appeared to be a decrease in the salt content in the surface 30 cm and a buildup in the 30-61 cm depth of the treated plots. This would indicate that the chemical treatments have aided in the removal of salts from the surface 30 cm. However, in July there appeared to be no differences. At another site 10 km southwest of Swift Current, the Amway treatment showed lower salt contents throughout the profile. However, this lower salt content was not significantly different from the other treatments in the surface 0-61 cm.

Table 4. Effect of Agri-SC and Amway All-Purpose Adjuvant on salt content (mmho/cm) of moderately saline areas

Gull Lake Site

Depth (cm)	Sept. 25 1978	June 27, 1979			July 30, 1979		
	Start	Check	Agri-SC	Amway	Check	Agri-SC	Amway
0 - 30	2.2	2.6	1.6	1.7	1.9	2.2	1.9
30 - 61	4.0	5.7	6.9	6.9	3.0	2.9	2.9
61 - 91	3.1	4.4	5.3	5.2	2.0	2.0	1.5
91 - 122	3.1	4.4	5.8	9.0	1.4	1.7	2.4

Site 10 km SW of Swift Current

Sept. 20 1978	July 27, 1979		
Start	Check	Agri-SC	Amway
1.0	2.3	2.6	1.7
0.5	3.2	3.5	2.5
1.4	2.7	2.1	1.7
1.7	2.4	2.3	1.9

The interpretation of field results is difficult. It is difficult to find a uniform salinity site and the interpretation of results in the light of spatial variability is sometimes confusing. Time of year and weather conditions can make differences. For example, should spring results be compared to fall results? Spring salt concentrations appear to be higher than fall results according to Table 4.

On the whole field results do not usually show pronounced differences. However, there are occasions where the results have indicated that these chemicals appear to be useful. Our data base is not extensive enough to label these positive findings as chance events. Thus, according to our very limited field studies, it would seem that some of these chemicals might work in specific (but undefined) circumstances.

Lethbridge Experiment

Bole and Dubetz (1978) conducted an experiment at the Lethbridge Research Station which included the addition of different soil-plant conditioner-hormones to wheat crops. The wheat was grown outside in lysimeters subjected to a high and low water stress. The yield results are summarized in Table 5.

The researchers concluded that no significant differences in yields of grain or straw or in any of the yield components were obtained from any of the soil supplements or the chelated micronutrient product. The soil supplements did not aid the plants to tolerate the 8-bar stress.

Table 5. Effect of various soil supplements and water stress on yield of wheat (from Bole and Dubetz, 1978)

Product	Grain yield (gm/plant)	
	Unstressed	Stressed
Control	2.03	1.65
Crop+	2.04	1.57
Soil+	1.93	1.60
SSO	2.00	1.61
Medina	1.94	1.58
WEX	1.99	1.55
Triocontanol	2.02	1.58
Tyfo	1.93	1.57

Scott Results (C.H. Keys)

Keys (1972-75) ran a series of field trials using the Soil-Aid-S (SAS) compound that contains 10% steroid saponins. The wheat seed was treated so as to provide the recommended amounts of SAS per acre (i.e., 0.3 oz of active ingredient per 80 lbs of seed was equivalent to 4 oz of SAS soln./acre). All treatments were fertilized and sprayed normally. Foliar applications of SAS were at a rate of 128 oz of product or 12.8 oz of active material per acre.

The results from four years of study at Scott and Laverna, Saskatchewan, are summarized in Table 6. Keys noted that crop variation within treatments was evident; thus, differences due to treatment were not visually apparent. However, yield results indicated response to the treatment.

Table 6. Effect of Soil Aid-S (SAS) on wheat yields under dryland conditions

Year	Yields (bu/ac) for seed and foliar treatments of SAS				
	Check yield	4 oz and/ or seed treatment	12.5 oz/acre foliar treatment	Seed + foliar treatment	6 oz seed + foliar
1972	20.0	24.5	22.1	27.5	-
1973	23.0	25.4	25.4	24.8	-
1974	35.1	24.8	28.8	33.9	39.9
1975	40.3	49.0	-	-	-
	29.6	30.7	25.4	28.7	39.9
Check yields		29.6	26.3	26.3	35.1
Average cost of SAS = 65¢/acre					

Seed treatment with SAS gave an average of one bu/acre increase over the check, foliar treatment gave a one bu/acre loss in yield, and the combination showed a 2.4 bu/acre increase. The results seem to be encouraging.

CONCLUSION

The question asked at the onset of this paper was "Can these miracle chemicals aid salinity?" Often the promotional material on these products states that they can aid "alkali" or other problem soils. We know that 20 to 30 tons/acre of manure on saline soils gives only temporary improvement (Johnson 1976). It is questionable whether a few ounces or pounds of other materials will be as effective.

The laboratory flow rate (hydraulic conductivity) tests do not show any major differences in the ability of treated soils to percolate water at saturation. Most of the field tests on saline areas do not show any noticeable differences. However, there are one or two observations where the field results did show a difference. Why the product seems to work in these few cases and not in others is not known, but it does serve as a basis for positive testimonials.

Lethbridge results show no advantages in the use of these products for increasing yields. On the other hand, the Scott data show that seed treatment with SAS seems to have a positive effect on yield.

It is almost impossible to thoroughly test all these products under all field conditions. It is difficult to disprove their usefulness. Most of them are not harmful. By the same token, most of them are unlikely to show any significant or economical benefit.

REFERENCES

BATES, D. 1979. It's rip-off time again. Country Guide, March.

BOLE, J.B. and S. Dubetz. 1978. Effects of various soil supplements and water stress on the yield and yield components of wheat. Can. J. Soil Sci. 58: 321-323.

JOHNSON, W.E. 1976. Soil improving amendments - benefit or loot. Western Producer, May 27.

JOHNSON, W.E. 1975. Beware of fertilizer medicine men. Saskatchewan Agriculture.

KEYS, C.H. 1972-75. Field trials of steroid saponin growth regulators. Summarized notes on yield results.

SSSA. Special Publication No. 7. 1975. Soil Conditioners. Soil Sci. Soc. Amer., Madison, Wisc.