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Soil Wetting Agents

H.D. Sunderman
Research Soil Scientist

Low water infiltration rate of soil often is responsible for excessive runoff, resulting in low irrigation and rainfall efficiencies. Excessive runoff causes the erosion hazard to increase and leaves less water on the field for crop production. Tillage, particularly deep chiseling, can increase water infiltration rate but this practice may have a high energy requirement and the benefits are often short-lived. The necessity to conserve fuel and reduce production costs has renewed interest in alternatives to tillage for increasing water infiltration rate. Soil wetting agents and other non-traditional soil amendments are being examined for their usefulness as such alternatives. There are those who extol their use as a cure for nearly every malady associated with crop production. Still others categorically condemn them as useless.

The dominant factor dictating effectiveness of a soil wetting agent in increasing water infiltration rate is whether or not the soil is water repellent. Normally, soils are naturally wettable and will not need wetting agents but, in some situations, they become water repellent. Varying degrees of water repellency have been observed at various depths in the soil profile after forest fires, and in grasslands, turf, citrus groves, golf greens, mine spoils, and forest litter. Surprisingly, coarse-textured soils seem to be affected more often than fine-textured soils. However, this condition has been observed infrequently in Kansas.

AGRICULTURAL EXPERIMENT STATION
Kansas State University, Manhattan
John O. Dunbar, Director

Table 1. Companies entered, products tested, and application factors for a soil wetting agent study at the Colby Branch Experiment Station, 1977-1980.

Company/Product	Placement	Date of application	Rate,[a] qt./acre
Amway Corporation:			
All Purpose Spray	Band over	6/17/77, 6/21/78	0.5
Adjuvant	Water furrow	6/17/77, 6/21/78	1.0
Circle-7 Corporation:			
Sol-Ez	Broadcast	5/11/77	0.25
Conklin Company:			
Wex	Broadcast	5/5/77, 5/16/78, 5/18/79	1.0
Wex	PP incorporate	5/2/80	40.0
ML2-248[b]	Broadcast	5/5/77	8.0
Saturall	Broadcast	5/16/78, 5/18/79	16.0
Saturall	PP incorporate	5/2/80	40.0
Recess Industries:			
Formula 7040	Band over	5/5/77, 5/15/78	1.0
Formula 7052X	Seed furrow	5/5/77, 5/15/78, 5/18/79	32.0
Shaklee Corporation:			
Basic H	Broadcast	5/16/78[c], 5/18/79, 5/18/80	1.0

[a] Except for Sol-Ez (one gallon of solution applied with a mist applicator), all materials were applied in 20 gallons of solution per acre using a conventional field sprayer.

[b] Experimental.

[c] Separate testing site used this year.

Research at other locations in the country has shown that soil wetting agents were useful in crop production when the soil was water repellent but had either no effect or an adverse effect on normal, wettable soils.

Procedure

The effectiveness of several commercially available products was studied at the Colby Branch Experiment Station during the period from 1977 through 1980. Not all products were tested every year nor were the same data collected each year.

The site used was a typical upland Keith silt loam under furrow irrigation. Application rates, placement, and timing were those stipulated by the participating companies for their respective products. Companies participating, products tested, and rates used are shown in Table 1. The Shaklee Corporation declined an invitation to participate the first year (1977) and decided to enter too late the second year to be included with the other products in the primary site. Otherwise, with the exception of Basic H in 1978, all other materials all years were tested in the same crop production system (corn). All conditions of the experiment were those considered best for site and crop, except irrigation, which was designed to be slightly stressful. This provided the best opportunity for wetting agents to demonstrate their effect on plant-water relations and grain yield.

Table 2. Corn plant populations (June 2) and leaf nutrient concentrations (June 22) from a soil wetting agent study at the Colby Branch Experiment Station, 1977.

Treatment	Plant pop.[a]	Leaf nutrient concentrations[b]								
		N	P	K	Ca	Mg	Zn	Fe	Mn	Cu
	1000/A	. . . . . . %		. . . . ppm						
Control	26.2	3.[illegible]	0.30	3.23	3347	2454	31.2	230	79	15.0
Adjuvant, 1 pt/A	25.2	3.16	0.30	3.16	3311	2530	30.1	210	78	14.8
Adjuvant, 1 qt/A	24.7	3.14	0.29	3.14	3898	2443	32.5	229	83	13.2
Formula 7040	24.6	3.15	0.29	3.18	3353	2515	29.5	230	80	16.4
Formula 7052X	26.5	3.20	0.29	3.16	3537	2464	30.0	228	80	15.2
Wex	26.4	3.10	0.30	3.13	3562	2461	32.5	235	80	14.3
ML2-248	26.5	3.18	0.29	3.13	3926	2309	32.1	242	79	16.8
Sol-Ez	26.7	3.23	0.30	3.21	3599	2520	33.8	252	82	15.1
$LSD_{.05}$	1.6	NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] Mean of 6 observations [b] Most recently matured leaf

Table 4. Total infiltration amounts during irrigations in a soil wetting agent study at the Colby Branch Experiment Station during the 1977 growing season.

Treatment	Total infiltration for irrigation made				
	July 5[a]	July 19			Aug. 1[b]
	F w TT[c]	F w/o TT	F w TT	Mean	F w TT
	. . . .	inches	. . . .		
Control	1.55	3.37	1.71	2.54	0.68
Adjuvant, 1 pt/A	1.68	3.50	1.76	2.63	0.75
Adjuvant, 1 qt/A	1.65	3.36	1.83	2.59	0.68
Formula 7040	1.64	3.44	1.59	2.51	0.73
Formula 7052X	1.35	3.31	1.58	2.45	0.64
Wex	1.62	3.45	1.63	2.54	0.70
ML2-248	1.54	3.52	1.66	2.59	0.71
Sol-Ez	1.70	3.60	1.82	2.71	0.91
Infiltration mean	1.59	3.44	1.70	2.57	0.73
Application mean	3.55	4.00	4.00	4.00	2.07
$LSD_{.05}$: Rep	0.30		0.17		0.14
Material	N.S.		N.S.		N.S.
Traffic	——		0.11		——
M X T	——		N.S.		——
Coef. of varability, %	10.7	Material = 8.5 Traffic = 7.2			17.3

[a] Rain-shortened irrigation, values based on 16.2-hour irrigation.
[b] Rain-shortened irrigation, values based on 9.5-hour irrigation.
[c] F w/o TT = furrows without tire traffic; f w TT = furrows with tire traffic.

Results

No data were obtained to substantiate claims that wetting agents increase plant populations (Table 2), nutrient uptake (Tables 2 and 3), or water infiltration (Tables 4 and 5). The significant (P = .05) increase in plant potassium (K) concentration associated with Sol-Ez (Table 3) was attributed to the consistency of the data and was not considered sufficient to merit application for this effect alone.

Except for a one-year-in-three apparent response to Basic H, grain yield was not positively influenced by any of the products tested (Table 6). Yield decreases tended to be associated with exceptionally high rates of some products. As noted earlier, the 1978 test on Basic H was at a site adjacent to the primary study. Yields for both the treated and untreated plots that year for that site were abnormally and unexplainably low so there may have been unobserved contributing factors. The yield response to Basic H in 1978 was not duplicated by results in the remaining two years of the study.

Table 3. Leaf nutrient concentrations at silking in 1978.

Treatment	Concentration in leaf[a]		
	N	P	K
Control	2.52	0.22	2.41
Adjuvant, pt/A	2.53	0.22	2.45
Adjuvant, qt/A	2.49	0.21	2.44
Formula 7040	2.50	0.21	2.37
Formula 7052X	2.49	0.21	2.40
Wex	2.53	0.22	2.38
Saturall	2.56	0.22	2.42
Sol-Ez	2.60	0.21	2.52
$LSD_{.05}$	NS	NS	0.08

[a] Leaf opposite and below ear.

Table 5. Total infiltration (furrows with tire traffic) during four summer irrigations in 1978.

Treatment	Total infiltration, inches			
	July 4[a]	July 12[b]	July 19[c]	Aug. 30[d]
Control	4.4	3.0	2.4	3.6
Adjuvant, pt/A	3.6	2.3	2.0	3.1
Adjuvant, qt/A	3.3	2.2	2.2	3.1
Formula 7040	3.5	2.4	2.1	3.3
Formula 7052X	3.2	2.0	1.9	2.8
Wex	3.6	2.4	2.1	3.3
Saturall	3.5	2.2	2.0	3.1
Sol-Ez	3.8	2.4	2.4	3.5
Infiltration mean	3.6	2.4	2.1	3.2
Application mean	4.8	6.0	4.7	6.2
$LSD_{.05}$	NS	NS	NS	NS

[a] Values based on 21-hour irrigation.
[b] Values based on 19.7-hour irrigation.
[c] Values based on 15.5-hour irrigation.
[d] Values based on 19.2-hour irrigation.

Since there was no apparent effect on grain moisture at harvest (Table 6), no evidence was found to substantiate claims that any of the products tested accelerate grain drydown.

Conclusions

Soil texture is probably the reason for low water infiltration rate in most cases. In fine-textured soils, the pore diameter is simply too small or soil structure is too poor to permit rapid water movement. Cultural practices that conserve good tilth and aggregation help a great deal in maintaining the best possible infiltration rates. Conversely, practices that degrade tilth and aggregation (like working a too-wet soil) magnify the problem. Unless the soil is also water repellent, wetting agents probably will not improve water infiltration into soils with traffic or tillage pans or those with "gumbo" characteristics. Because the water infiltration rate of a fine-textured soil is inherently lower than that of a coarse-textured soil, there's less opportunity for improving infiltration rate into a fine-textured, water-repellent soil.

Good advice to those unsure about their need for soil wetting agents includes the following:

1. Test the soil for water repellency. If a drop of water quickly flattens and moves into the soil, then it is likely that a soil wetting agent would be a needless expense. If the drop beads up and doesn't move rapidly into the soil, water repellency should be suspected and a soil wetting agent might be useful. As the degree of repellency increases, the drop will appear to stand more and more upright and will take longer to move into the soil. If the repellency is only a surface feature, the drop will move quickly into the soil once the repellency is broken.

2. Don't be misled by sales gimmicks and testimonials about the effectiveness of a product. A knowledgeable and reputable salesperson should be aware of the conditions under which the product will work and won't promote its use where it is likely to fail. Even be skeptical of data offered as proof of a product's effectiveness. Non-ionic and anionic surfactants, as a group, generally destroy water repellency, so you should ask if a wetting agent is also needed.

3. Don't invest more in an unproven product than you can afford to lose. Treat small areas and compare yields with adjacent untreated areas. Comparison of results from different fields or different years is essentially worthless. If the product proves effective and the need for a wetting agent is confirmed, compare labels for cost per unit of active ingredient. A wetting agent may cost more per pint, but because of higher concentration of active ingredient, may result lower treatment cost.

Table 6. Corn grain yields and grain moisture contents from an irrigated soil wetting agent/amendment study, 1977-80.

	1977[a]	1978	1979	1980
	Grain yield, bu/acre[b]			
Control	66	197	146	18.
Adjuvant, 1 pt/A	63	171	——	——
Adjuvant, 1 qt/A	64	184	——	——
Basic H	—	138[c]	154	184
Formula 7040	64	181	——	——
Formula 7052X	68	190	152	——
ML2-248	67	——	——	——
Saturall	—	180	153	165
Sol-Ez	62	188	——	——
Wex	65	183	153	183
$LSD_{.05}$	NS	NS	NS	15
	Grain moisture content, %			
Control	14.0	21.6	17.9	18.2
Adjuvant, 1 pt/A	14.0	21.0	——	——
Adjuvant, 1 qt/A	14.1	21.6	——	——
Basic H	——	15.1[c]	19.1	17.8
Formula 7040	13.8	21.8	——	——
Formula 7052X	13.9	22.0	19.7	——
ML2-248	14.4	——	——	——
Saturall	——	21.7	19.6	15.5
Sol-Ez	14.1	20.9	——	——
Wex	13.9	21.4	19.1	15.9
$LSD_{.05}$	NS	NS	NS	NS

[a] Hail damage August 1.
[b] Adjusted to 15.5% moisture and 56 lbs/bu; mean of at least six observations except in 1980 three observations.
[c] Not in same field as others in 1978; control = 126 bu/A, $LSD_{.05}$ = 10 bu/A; and 15.3% moisture, $LSD_{.05}$ = NS.

4. When considering the addition of a wetting agent to a pesticide, read the label carefully. Amending a pesticide in a non-labeled manner is a violation of the law and will probably void any warranty, while transferring liability to the user. If the pesticide's performance is enhanced by a wetting agent, this information should be included on the label. Also, the label will indicate if the formulation already contains a wetting agent.

Summary

While research has shown soil wetting agents to be useful additions to water-repellent soils, the infrequent occurrence of that type of soil in Kansas limits their use. It appears that such products are being promoted aggressively where their use is, at best, ques-

tionable. In such areas, their use represents an unnecessary expense for producers.

Note: When trade names are used in Kansas State University publications, no endorsement of them or criticism of similar products not named is intended.

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Agricultural Experiment Station, Manhattan 66506

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