AGGRESIZING — *to eliminate objectionable soil clods*

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The San Joaquin Valley has vast areas of extremely productive soil which are difficult to work into seed beds free of objectionable clods. Several thousand acres of cotton, sugar beets, and vegetables have to be replanted each year, or suffer reduced stands, partly because of cloddy or crusty seed beds. Both the very large as well as the very small, frequently ignored clods can be troublesome. The method described here, called "aggresizing," has been developed to completely eliminate objectionable aggregates of both kinds, and at the same time form excellent seed beds resistant to crusting.

THE IDEA OF STABILIZING SOIL aggregates for crust prevention, improved water penetration, and better aeration is very old. Many methods have been devised for these purposes using various mulches and chemicals. Limited use on some soils has been found for phosphoric acid sprayed as a narrow band over the planted seed. Aggregate stability was increased to a depth of 5mm, was of transitory nature, and affected the fine particles only. A water emulsion of petroleum resins has also been used as a spray over the soil after planting. Both of these products have limited use, affect a very small portion of the soil particles, and are relatively expensive.

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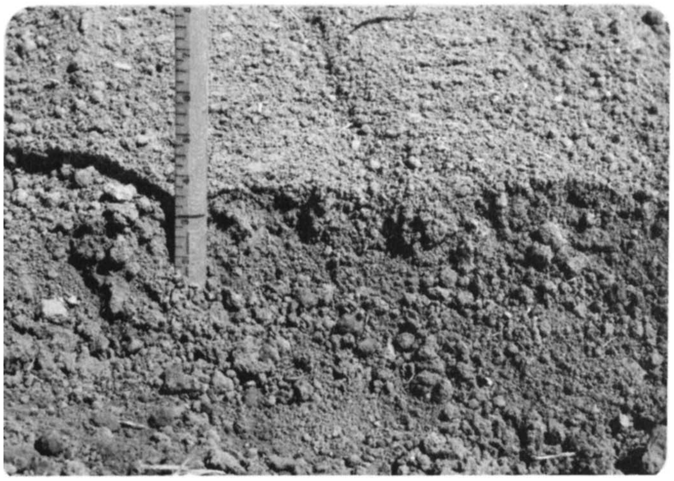
Unlike spraying with phosphoric acid or a petroleum mulch, aggresizing treats the entire bed. It leaves a matrix 3 inches deep of extremely uniform aggregates. The mechanical handling properties of these soils during a planting are so superior to those of regular beds, that the effort would be worthwhile on that basis alone.

Previous experiments growing plants in aggregates of different sizes showed that primary particles ($<$0.5mm) significantly retarded emergence, adversely affected nutrient uptake, and formed serious clods. From this work, the idea was suggested that cultural practices in the field might be controlled to adjust the aggregate blend to a desirable content. This thought was based in part on the belief that the soil in a field at the beginning of a season was more or less composed of "large" clods and that successive operations could be performed reducing the mix until the right size was reached.

Clods and soil crust

Clods and soil crust are two different forms of the same problem. With few exceptions, a clod or crust is formed under three conditions: (1) a critical amount of primary particles; (2) the presence of a suitable bonding agent; and (3) adequate moisture and/or pressure. Dry primary particles have the characteristics of forming clods, or crusts in the absence of, or with very little pressure, merely by becoming wet, with either free or capillary water. Dry primary particles will also flow freely among the interaggregate spaces of large aggregates where they limit air and water movement. When wet, these particles consolidate to form a tight bed much as cement hardens around gravel. Aggregates above 0.5mm usually require pressure, in addition to water, before they form larger clods.

When a lister throws up a bed, it scoops up primary particles from the furrow bottom and leaves them in pockets and layers throughout the body of the bed. Seeds falling in these pockets are affected adversely in germination, nutrient uptake, and seedling growth. Sprinkling and rainfall on beds high in primary particles redistributes and layers the particles and shears more primary particles from the large aggregate—resulting in the twin problems of crust formation and tight seed beds. The boundary between pockets of primary particles and adjacent pockets of larger-sized aggregates restricts water movement. Aggresizing largely eliminates these undesir-



Aggresized bed showing surface and profile to 3-inch depth. Aggregate size distribution in top 2 inches, 15% over 12mm (½ inch), 69% 0.5 to 12 mm, 16% below 0.5mm. Note uniform distribution of aggregates and lack of pockets of any given size.

Regular bed showing surface and profile to 3-inch depth. Aggregate size distribution in top 2 inches, over 12 mm (½ inch) 35%, 0.5 to 12mm 43%, below 0.5mm 22%. Note pockets of small and large particles. Thousands of acres of crops are planted to beds such as this each year.

able interfaces and permits freer and faster movement of water in the bed.

All seed beds are a mixture of aggregates or clods of different sizes. A good seed bed is prepared by changing clods of objectionable size to clods of acceptable size. Seed beds containing many clods over two inches (50mm) in diameter are unacceptable for most crops, and many clods of 1 inch (25mm) can cause problems. Small seeded crops are best planted in soil where aggregates do not exceed one-half inch in diameter and an excellent seed bed is one in which three-quarters or more of the aggregates in the top two inches vary between 1 to 12mm (0.4 to 0.5 inches).

Soil particles of less than 0.5mm (called primary particles in this discussion) are undesirable in large quantities, since they are the source of most crusting and objectionable clods. Cultivation —especially with tools that crush and shatter dry clods—is the chief cause of a high primary-particle build-up in the soil. Tractor tires are mostly responsible for the crushing of large particles into primary particles. Table 1 shows that three passes of a tractor wheel in a furrow increased the primary particles content from 15.8% to 36.9%.

The soil was very dry (6% moisture) when the tractor was run down the rows. The mechanical stability of clods in these two fields varied greatly. Note that the loss of clods over 50mm for field 45 with three passes almost entirely accounted for the increase of primary particles. Aggresizing, which is working the soil when wet, actually increases mechanical and water stability. However, creating primary aggregates by crushing when dry (as with the tractor wheel) leaves the primary particles in concentrated pockets, which easily form new clods or a crust when wet.

The critical levels at which primary particles cause serious problems varies with soil type. The two soils in table 1 have critical levels which are quite different.

An aggresized clod has sharp corners and fractures compared to normal tilled soil where the clods have rounded and smooth edges. Aggresized clods in a seed bed appear to have better mechanical and water stability. Studies have shown that the wetter a soil is when it is worked, the greater its water stability will become.

The process of "aggresizing." Note the wet furrow bottoms. Aggresizing can start as soon as the surface clods start to show white by drying which is usually 8 to 10 hours after sprinkling in warm weather. The right moisture for good aggresizing lasts only 4 to 5 hours.

Finished aggresized beds. The nearly perfect geometric shape permits extremely precise planting depth and application of chemicals. The packed furrow bottom permits a rapid transport of water down the furrow.

TABLE 1. EFFECT OF TRACTOR WHEELS ON CLOD REDUCTION AND BUILD-UP OF PRIMARY PARTICLES

Treatment	Percent aggregate size							
	>50mm	25mm	13mm	5mm	2mm	1mm	0.5mm	<0.5
FIELD 40*								
Original	26.9	20.0	14.0	14.5	9.4	3.9	3.2	8.2
1 × Pass	3.3	9.0	29.0	24.9	14.2	5.1	4.0	10.4
3 × Pass	4.9	9.0	19.7	19.8	15.6	7.5	6.7	16.9
FIELD 45†								
Original	23.5	13.9	18.0	13.5	7.7	3.7	4.1	15.8
1 × Pass	-0-	14.4	15.0	18.3	11.9	5.7	6.1	28.5
3 × Pass	-0-	2.2	14.6	18.8	13.3	6.8	7.4	36.9

* Sand 30%, silt 27%, clay 43%.
† Sand 49%, silt 21%, clay 30%.

TABLE 2. EFFECT OF AGGRESIZING AND LILLISTON ON CLOD REDISTRIBUTION

Treatment	Per cent size distribution of aggregate						
	<25mm	12mm	5mm	2mm	1mm	0.5mm	>0.5mm
Original*	30.0	23.1	15.6	10.7	5.4	5.4	10.1
Aggresized 1 ×†	-0-	15.3	24.4	25.1	12.7	10.6	11.9
Aggresized 2 ×	-0-	12.1	24.7	25.9	13.9	11.5	12.0
Aggresized 3 ×	1.4	11.0	24.0	26.4	14.5	11.5	11.3
Lilliston + 1 ×‡	20.7	20.5	18.2	14.2	7.8	7.8	10.9
Lilliston + 1 ×§	-0-	22.4	22.4	18.6	10.7	10.7	15.2

* 30% sand, 27% silt, 43% clay.
† Moisture content was about 18% when aggresizing was done.
‡ Lilliston on wet soil followed by incorporator.
§ Lilliston on wet soil, then dried 1 day and incorporator applied. Samples above are averages of four replications with three sub-samples of each replication.

Plants emerging in aggresized beds. Water subbing through the aggresized portion is faster than through non-aggresized beds.

Regular beds planted to vegetable crops showing usual clods. Uniformity of emergence is much higher in aggresized beds.

Most clods covered with free water slake almost instantly into primary particles. The slaking of clods can be observed by watching irrigation water flow down a cloddy furrow. Upon drying, these primary particles form a hard, slick crust which cracks into new clods. Clods enclosed in a mass of other clods, or wet by capillary water do not slake, except slowly, during repeated irrigation.

The process of aggresizing is accomplished by sprinkling the beds and going over them with a power-driven rototiller when they are still wet. Done properly, the rototiller breaks up the large clods while wet and weak in mechanical strength. At the same time larger aggregates are formed out of the primary particles by puddling them. The result is a stabilized, uniform soil matrix 2 to 3 inches deep on top of the bed, with few aggregates over 12mm (one-half inch) in diameter, and a big reduction in primary particles.

The procedure for aggresizing must be followed very closely as described: (1) Have the beds listed up (these tests, dry below PWP). (2) Set up solid set sprinkler and run for 4 to 8 hours using a total of up to 1 inch of water. (3) Conclude sprinkling in the evening and let dry overnight 8 to 10 hours (the length of time depends on drying conditions). (4) As soon as the clods on the surface start showing white because of drying, it is time to run the rototiller. (5) Twice-over may improve the looks, but rarely change the aggregate sizes as compared with once-over.

Furrow irrigations cannot be used because the bottoms of the furrows are left too wet to run the tractor through at the time necessary to work the tops of the beds. Once a clod starts to dry and turn white, its mechanical strength increases very rapidly—in a matter of minutes.

Basic equipment and methods used in these tests included 40 inch beds listed to a rounded peak, a John Deere 4020 Diesel Tractor of 78 drawbar, and 94 PTO HP. The incorporator was a two-bed Massey Harris riding on three sleds in the furrow bottoms. The incorporator teeth were 3 inches long and the trailing housing formed a bed 20 inches flat across the top and with sides 6 inches deep (photo 3). Speed of operation was 2 to 3 MPH.

Aggregate sizes were determined in a nest of standard soil screens of 5, 2, 1, and 0.5mm mesh and larger sizes were screened by use of ½, 1, and 2 inch hardware cloth. Soil samples were collected in soil cans 2½ inches in diameter by 2 inches deep. At random intervals along a bed, the can was pressed open side down to its full depth in the soil. A metal slide was inserted under the opening to retain its content. After oven-drying the soil was screened for aggregate sizes. A solid set sprinkler system was used to wet the field with water applied at 0.18 inch per hour.

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TABLE 3. EFFECT OF AGGRESIZING AT VARIOUS MOISTURE LEVELS ON AGGREGATE SIZE DISTRIBUTION*

Moisture†	Aggregate sizes				
	>5mm	2mm	1mm	0.5mm	<0.5mm
%	%	%	%	%	%
17.6	36.0	25.1	11.3	10.8	16.7
17.5	38.6	20.2	11.2	10.8	19.3
17.5	33.5	20.5	10.7	10.7	24.6
17.4	40.6	18.7	9.6	9.2	21.9
16.5	38.8	22.0	9.8	10.3	19.2
16.2	28.4	21.8	9.5	11.8	28.4
16.2	22.7	17.8	10.7	13.3	35.6
16.1	25.4	20.7	10.3	12.7	31.0
16.1	28.2	18.8	9.4	12.2	31.5
15.0	27.8	20.1	9.1	11.5	31.6
14.9	24.5	19.9	10.2	12.0	33.3
13.8	22.3	19.1	10.0	12.3	36.4
original	46.5	10.4	. . .	11.3	31.8

* From field 45: sand 49%, silt 21%, clay 30%. Field was sprinkled 1 p.m. to 6 p.m. on April 20, for total of 0.9 inches of water and aggresized once at 2 p.m. on April 21.
† The different moisture levels were obtained from edge rows. Samples were oven-dried for per cent moisture and then screened for distribution of sizes. Oven-drying does not alter the aggregate sizes significantly.

FOAM SPRAYS OF INCREASE GROWTH EFFECTS ON OLEAND

HENRY HIELD

THE PLANT GROWTH REGULATOR, succinic acid 2,2-dimethylthydrazide (SADH) is registered for use on certain crop plants under the name Alar and for ornamental plants under the name B-Nine. B-Nine is used to reduce stem elongation of chrysanthemums, hydrangeas and bedding petunias, marigolds and zinnias. This chemical is effective in reducing the growth of oleander, but the cost of the required concentration is generally prohibitive for field plantings.

The greatest entry of growth regulators is frequently during the initial wetting from the spray treatment. These trials were conducted to determine if Alar growth retardation could be increased through the use of foam carriers to increase the wetting time. Alar concentrations are given as active ingredient of the 85% WP. Statistical evaluations were at the 1% confidence level.

Foams

The foaming agents tested were commercial products or ones where future marketing was anticipated. Preliminary screening for phytotoxicity indicated that

Oleander plant to right just after application of a foam treatment.

GROWTH RETARDATION OF POTTED OLEANDER PLANTS FROM VARIOUS ALAR APPLICATIONS

TABLE 1

Treatment	Growth (cm) Days after treatment	
	24	42
0.85% Alar	7.2 bc	19.4 abc
0.85% Alar & 1% Foamex	3.4 c	11.5 def
0.85% Alar and 1% Jet X	2.1 d	7.4 efg
0.85% Alar & 1% Rockwood	4.0 bc	12.3 cde
1% Foamex	11.8 a	26.3 a
1% Jet X	12.3 a	25.7 a
1% Rockwood	11.4 a	23.0 ab
0.85% Alar & 1% UN1-1081	9.0 a	17.8 bcd
1% UN1-1081	8.4 ab	20.3 ab
No Treatment	11.8 a	24.0 ab
F Value	10.4	20.9

TABLE 2

Treatment	Growth (cm) Days after treatment	
	29	44
0.5% Alar	8.9 ab	12.9 a
0.5% Alar & 0.5% Foamex	3.6 c	6.3 bc
1% Alar	6.1 bc	9.3 ab
1% Alar & 0.5% Foamex	4.1 c	6.1 c
No Treatment	10.0 a	11.4 ab
F Value	14.8	7.0

TABLE 3

Treatment	Growth (cm) Days after treatment		Drying Time (minutes)
	38	56	
0.5% Alar	26.2 bc	42.0 abcde	8
0.5% Alar & .75% CD 587 not foamed	20.9 cde	36.4 bcdef	9
0.5% Alar & .75% CD 587 foamed	13.2 f	26.0 fg	197
0.5% Alar & 1% Jet X not foamed	31.1ab	52.0 a	15
0.5% Alar & 1% Jet X foamed	17.2 def	32.4 cdefg	191
0.5% Alar & 1% UN1 1108	26.4 bc	41.1 abcde	13
1% Alar	23.4 bcd	38.6 bcdef	8
1% Alar & .75% CD 587 not foamed	15.5 def	29.4 efg	8
1% Alar & .75% CD 587 foamed	9.5 f	21.2 g	208
1% Alar & 1% Jet X not foamed	22.3 cd	43.2 abcd	10
1% Alar & 1% Jet X foamed	14.1 ef	30.5 def	202
1% Alar & 1% UN1 1108	21.3 cde	31.0 defg	11
.75% CD 587 foamed	35.2 a	52.3 a	185
1% Jet X foamed	38.1 a	52.1 a	180
1% UNI 1108	30.6 ab	45.7 ab	15
No Treatment	36.8 a	—	
F value	21.4	10.5	

TABLE 4

Treatment	Growth (cm) Days after treatment		Drying time (minutes)
	37	58	
0.5% Alar	22.1 abcd	38.4 abc	30
0.5% Alar & 1% Fomark not foamed	17.6 cdef	39.7 abc	56
0.5% Alar & 1% Fomark foamed	10.4 ef	21.0 d	140
0.5% Alar & 0.5% Fomark foamed	11.5 ef	24.3 d	125
1% Alar	16.8 cdef	38.5 abc	30
1% Alar & 1% Fomark not foamed	13.0 def	26.0 cd	50
1% Alar & 1% Fomark foamed	7.7 f	16.0 d	145
1% Alar & 0.5% Fomark foamed	7.7 f	15.4 d	128
1% Alar & 1% Regulaid	15.2 def	28.7 bcd	59
1% Fomark foamed	20.5 bcde	33.1 bcd	150
0.5% Fomark foamed	32.1 ab	46.1 ab	130
1% Regulaid	28.5 ab	52.5 a	60
No Treatment	32.9 a	45.5 ab	—
F Value	9.2	7.7	