Some Chemicals for Control of Erosion Caused By Rain

Introduction

The current widespread concern over environmental quality coupled with recently enacted rules and laws intended to protect environmental quality have resulted in the need for effective erosion control measures on highway construction projects.

The California Division of Highways currently uses seeding with rye and/or barley applied with either straw or sometimes wood fiber mulch as its principal method of erosion control. This type of treatment is based on the concept that long-range erosion control can best be accomplished with vegetation. However, on most construction projects, some time elapses between the time of construction of a slope and the time of erosion treatment. On all projects there is a period of time between seeding and the development of a vegetative cover which can resist erosion. The erosion which occurs during these time lapses is unacceptable under current regulations.

A number of commercially available "spray-on" products are represented as being capable of controlling erosion for the time between slope construction and establishment of a satisfactory vegetative cover. This report summarizes a test of the effectiveness of some of these products and includes data on their costs.

The area selected for the test is on a realignment of Road 05-Mon-101 between San Ardo and San Lucas (Contract No. 05-025214). The average annual rainfall for this area is approximately 10½ inches per year, nearly all of which occurs between October and May.

The test plots are located on a southwest facing cut slope with a 2:1 slope design. These plots are between Station 427+00 and Station 430+75 and are 15 feet wide and 40 feet high. The cut is located in the alluvial deposits adjacent to the west side of the Salinas River. The material is unconsolidated fine-grained sand and silt which is highly erodible as shown in Plates 1, 2, and 3. The uniformity of material throughout the test area was checked both for grain size and mineral content. No appreciable differences were found. A distinct difference in appearance of the soil developed after the slope was prepared for treatment. This was caused by the addition of fine material from surface material at the top of the cut as well as from previously undisturbed material in the cut face itself.

All products were prepared and applied by personnel of the Materials and Research Department. The trailer-mounted sprayer pictured in Plates 4 and 5 was used for every application. The tank had a 150-gallon capacity which was more than adequate for the size of the test plots. The inside of the tank was marked at 5-gallon intervals to facilitate the proportioning operations in the field. A continuous and vigorous agitation system is built into the sprayer to assure delivery of a uniform mixture through the spray nozzle. The pump is driven by a 7½ HP Briggs and Stratton 4-cycle engine.

The proportioning, mixing, and spraying operations all went smoothly and without equipment failure. Two problems were experienced with the sprayer, both of which have subsequently been corrected by the manufacturer. The pump size was too small and did not deliver enough pressure at the nozzle, and for some of the materials, the agitation was too vigorous and resulted in a frothy mixture which would not penetrate the soil well. For this project a smaller diameter nozzle was used to maintain pressure, and a chemical antifoaming agent was added to those products which exhibited the foaming property.

Results

Two types of materials were tested on this study, plastics and organics. The plastics tested in this study were Aerospray 52, Curasol AE, Curasol AH, Erode-X, Surfaseal and Terra-Krete. The surface formed by these materials is fragile and will probably not afford protection under extreme conditions. The organic materials tested were Aquatain, Conwed Fiber, Ecology Control, Orzan, Surf-Tite, and Verdyol (Super). Except for Orzan and Conwed Fiber, these materials also formed fragile surfaces and will probably not provide protection under severe conditions. Orzan established a 3-inch thick very hard crust which will support surface traffic without damage and which will tend to resist erosion. Orzan is water soluble and will eventually dissolve and leach away. Conwed Fiber, which was applied at twice the normal application rate (3000 lbs/acre), provided a continuous flexible surface which probably will resist erosion better than any of the other materials tested.

Our observations indicate that the soil is capable of supporting vegetation yet no cover developed on any of our seeded test plots except for the Conwed Fiber. This surprising lack of germination may be due to some effect of the chemical additives tested or to abuse in the method of application or some combination.

Because of low intensity rainfall last spring none of the test plots are eroded. Observations will be made through the next rainy season to determine the relative effectiveness of the materials tested.

Testing

The products included in this study are listed in Table 1 with the name of the vendor who supplied the material, technical assistance for the application, and cost information. Table 2 shows the dilution and application rates recommended by the vendor for this test and also, for comparative purposes, the cost of material per acre for the treatment. The material cost generally does not include shipping and is based on prices in effect during August 1971. The material cost of Aquatain does include delivery any place in the United States and the company would not quote another price. These cost figures do not include the cost of application.

Figure 1 shows the layout of the test plots, provides data on the cut slope characteristics and lists the material applied to each test plot. The control plots shown in Plates 8, 17 and 27 were left untreated as a basis for comparison. Plate 6 shows the test area on the day that the applications were completed. Plate 7 shows the appearance of the test area after the spring rains. No erosion can be seen that compares with the erosion in Plates 1, 2 and 3. The intensity of the spring rains was too low to cause any erosion even in the control plots. Plate 7 shows two features which were the result of failure to properly communicate our requirements to the contractor and Resident Engineer. The toe of all of the test plots was regraded when the contractor prepared the shoulders prior to paving. Although probably not significant in evaluating erosion, it definitely reduced the quantity of water collected on the slope and the distance over which the water had to run on the treated slope. The roller that was used to punch the straw into the rest of the slopes on the job was rolled across the top of all of the test plots and encroached on the sides of the test plots at either end of the test area. This is an extremely serious problem in that it breaks the continuity of the surface allowing water to get under the treatment. Since the rainfalls were gentle no damage resulted but the combination of water collecting basins and breaks in the surface permitted germination of native seeds all across the test area. Few natives germinated elsewhere. Apparently the punched holes acted as catchment for seeds blowing in from outside the top of cut and for rain water and the plants got an early and healthy start.

Each material tested was applied to two test plots except Surfaseal and Conwed Fiber. On one of the test plots the material was applied without seeds and on the other plot the material was applied with seed. The seed mix used was half barley and half rye at a rate of 220 pounds per acre. This mix and application rate were specified in the contract. The single plot to which Conwed Fiber was applied was seeded and the single plot to which Surfaseal was applied was seeded on the lower half.

The viability of the seeds, at least the barley, is demonstrated by the healthy growth on the Conwed Fiber test plot (see Plate 32). The fertility and plant growing capabilities of the soil are

demonstrated by the development of grass from the straw prior to seeding or fertilization. These observations are important because they suggest that the lack of development of vegetation on the test plots may be related to the applied materials.

The materials tested on this project can be divided into two major types, chemical and organic. The chemical sprays are primarily some sort of plastic base which will adhere to the soil surface and form a crust which is supposed to prevent erosion. These plastics are supposedly nontoxic, non water soluble and relatively slow deteriorating. The effective life of any of these materials is not known at this time. The crust of all of these materials is fragile, and can be severely damaged by surface traffic. The chemical sprays used in this study are Aerospray 52, Curasol AE, Curasol AH, Erode-X, Surfaseal and Terra-Krete.

Organic materials used in this study are Aquatain, Conwed Fiber, Ecology Control, Orzan, Surftite, and Verdyol (Super). All of the materials seem to deteriorate in sunshine and/or water to some extent. This deterioration process may contribute nutrients to vegetation, however it also introduces nutrients into adjacent water courses and therefore may be unacceptable as an agent for controlling pollution. All organic materials resulted in a surface crust, which presumably will prevent erosion. Except for Conwed Fiber and Orzan the crusts formed were too fragile to support surface traffic. The Conwed Fiber was somewhat flexible and could be traversed by a man walking carefully. Because of the depth of penetration achieved by Orzan it was possible to walk normally across the surface of the test plot without causing any damage.

Ground squirrels and/or gophers have damaged the crusts on several test plots (see Plates 33 and 34). Probably the rodent damage is totally independent of the type of material and therefore was not considered in the evaluation of performance.

The description and analysis of performance of the tested materials was accomplished by the use of numbered test plots. Which material was applied to which test plot was not revealed until after the visual evaluations were completed. The visual evaluations were made by personnel of the Materials and Research Department and the results are summarized in Table 3. Since no erosion took place the quality evaluations are subjective and based on factors described under remarks.

The project on which this test was performed is not scheduled for completion until mid 1972, so observations of the performance of these test plots will continue through the upcoming rainy season.

The following discussions of each of the materials describes our experience under the test conditions.

Aerospray 52

Aerospray 52 is a white colored viscous alkyd resin which is water dispersible. It exhibits no strong odor and is easy to handle and clean up. The diluted solution was applied to a premoistened surface. After drying Aerospray 52 was colorless and resulted in a hard crust ranging in thickness up to 1/4 inch.

Plates 26 and 30 show the test plots that were treated with Aerospray 52.

After four months of exposure, the Aerospray 52 crust was cracked and softened. The unseeded plot was nearly barren except in the track of the straw roller where some native plants had sprouted. The seeded plot had some scattered barley plants but no rye. The crust on this plot has been damaged both by deer and rodents. The combination of the cracked crust, the deer tracks and the rodent damage are expected to permit erosion to take place on this test plot.

Aquatain

Aquatain is a water soluble liquid concentrate of chemicals andpectin. It has no strong odor and is easy to use but difficult to clean up after because of the green dye that is added to facilitate obtaining a uniform application. The dye stains skin, clothing and equipment and is difficult to remove. On the slope, the color fades from a bright green at the time of application to a light dull green very rapidly in the sunlight. This light green coloration will last at least several months. The slope had to be premoistened before treatment. A thin fragile crust formed on the surface.

Plates 12 and 21 show the test plots that were treated with Aquatain.

After four months of weathering and spring rainfall the crust was no different than that formed on the untreated test plots, although some of the green coloring remained. Both the seeded and unseeded plots remained virtually bare except for the area over which the roller traversed. Some native plants as well as the seeded grasses sprouted in the roller path. Erosion is anticipated on these test plots. The unseeded test plot was damaged by human footprints.

Conwed Fiber

Wood fibers made from white ash and sold by the Conwed Corporation of St. Paul, MN, were tested as part of this project. The application rate used was 3000 lbs. per acre which is twice the normal rate. The violent agitation built into our sprayer was absolutely essential to obtain uniform dispersal of the fibers and to assure a reasonably uniform application. This material has no odor and is easy to use and clean up. The initial mixing is more time consuming than with the liquids because the fiber had to be fed into the mixer gradually to assure mixing and prevent plugging of the pump. The fiber has a light green color that fades very slowly in the sun.

Plate 32 shows the test plot treated with Conwed Fiber.

After four months, this test plot retained the continuous flexible covering of wood fiber. The plot was severely damaged by the straw roller and rodent activity but will probably not erode because of the continuous nature of the fiber cover and the anchoring effect of the sparse but evenly distributed well developed barley.

Curasol AE

Curasol AE is a white viscous polymer dispersion. It was applied to a premoistened slope after dilution and dried to a colorless hard surface. It has a strong odor and although easy to use, was difficult to clean up after. This material is very sticky and unless every drop is washed away very quickly it will form a spot that is difficult to remove. The material also worked into two valves on the sprayer causing them to be difficult to operate and necessitating a thorough cleanout. No other material in this study exhibited this property. The crust formed by this material was brittle and very thin.

Plates 10 and 16 show the appearance of the Curasol AE treated test plots.

Four months of weathering caused the Curasol AE crust to soften but it still maintains its integrity and serious erosion is not anticipated. The only vegetation present on these plots occurs in the roller path and consists primarily of native plants but with some barley and rye on the plot that was seeded.

Curasol AH

Curasol AH resembles Curasol AE in appearance and in difficulty of use and clean up. Its difference appears to be that it dries to a somewhat flexible surface instead of the hard surface formed by the other chemical sprays.

Plates 22 and 28 show the appearance of the test plots treated with Curasol AH.

The Curasol AH crust appears to have been softened by the four months of weathering, however it is still continuous and may afford protection against serious erosion. Vegetation developed on these two test plots only in the roller path and consisted of native plants and barley.

Ecology Control

Ecology Control is a brown powder of unknown composition. It was not totally water soluble and therefore required agitation during application. It had no strong odor and was very easy to use and clean up. It dries to a colorless hard surface.

Plates 11 and 20 show the appearance of the slopes that were treated.

Weathering of the Ecology Control test plots has resulted in a softening of the crust. This crust appears to still be continuous and may provide some protection against serious erosion. The unseeded test plot was nearly barren of vegetation (a few native plants in the roller path) and the seeded plot has a few scattered native plants and barley, primarily in the roller path.

Erode-X

Erode-X is a white viscous concentrate of an unknown plastic material. It must be diluted with water before application. It had no strong odor and was easy to use and clean up. It dries to a colorless hard surface.

Plates 13 and 24 show the test plots treated with Erode-X.

Weathering of the Erode-X treated test plots has resulted in a softening of the crust. This crust is continuous however, and may give some erosion protection. The unseeded test plot is nearly barren and the seeded plot has some native plants and barley which are concentrated in the roller path.

Orzan

Orzan is a dark black extremely viscous solution of chemicals and lignin sulfonate. This material was easy to use and clean up since it is totally and immediately water soluble. It has a rather strong odor that disappears quickly after application. This material exhibited remarkable penetration during application, forming a hard surface up to 3 inches thick. It does cause the surface to appear very dark initially. This darkness does fade with age.

Plates 15 and 23 show the test plots treated with Orzan.

Aging of this material results in an extremely hard thick crust which contains numerous shrinkage cracks. These cracks tend to heal themselves upon saturation of the material and then reform upon drying. The material clearly demonstrated its solubility in water, by developing a crust on the slope below the toe as a result of the light runoff that occurred this spring. These test plots are barren except in the roller path where native plants and some barley in the seeded plot did develop. This material will probably provide satisfactory erosion protection for one season in areas of light rainfall or areas of short duration rainfall.

Surfaseal

Surfaseal is a white viscous plastic of unknown composition. It has no strong odor dries to a hard crust and is easy to clean up. It is somewhat more difficult to use than the other plastics in that the recommended method of application required three passes with intervening time to permit the previous pass to begin setting up. Although easy to do on a small test plot, this could be complicated on a large project and would certainly be more expensive and difficult.

Surfaseal was applied to only one test plot because of a shortage of material. This test plot is shown in Plate 18. The lower half of the plot was seeded.

Four months of weathering resulted in a thin soft crust on the Surfaseal test plot. The crust on this test plot may provide some protection against erosion. No seeds developed on the test plot but some barley did sprout on the untreated area below the toe. Vegetation, both native plants and barley, sprouted in the roller path. Since no barley was sprayed on the upper portion of the slope, the source of seed is not known.

Surftite

Surftite is a golden brown powder composed of lignin sulfonate. The odor is similar to that of Orzan but not as strong. The material is very easy to use and clean up. Surftite causes a dark brown discoloration of the slope which fades with age. Although the primary constituent is similar to that of Orzan, this material did <u>not</u> exhibit the penetrating qualities of Orzan.

Plates 25 and 31 show the appearance of the test plots treated with surftite.

Weathering of these test plots has resulted in softening of the crust, which is thin and cracked. Probably this material will leach away rapidly at the start of the next rainy season and the plot will erode. Vegetation grew only in the roller path.

Most of the plants are natives, but good barley developed on the seeded plot.

Terra-Krete

Terra-Krete is a light green slightly viscous solution of chemicals in a latex base. This material exhibits no strong odor and is easy to use and clean up. It dries to a colorless hard surface.

Plates 14 and 19 show the appearance of the Terra-Krete treated test plots.

Four months of weathering greatly weakened the crust of this material, however it is still continous and may provide some erosion protection. The unseeded test plot is barren except for some natives in the roller path. The seeded plot developed some barley and the only rye that reached maturity.

Verdyol (Super)

Verdyol is a brown granular appearing powder that is not entirely water soluble. The composition of this material is unknown, but it is organic and it has a slight odor similar to some kinds of fertilizer. Verdyol is very easy to use and clean up. It leaves a colorless crust on the surface.

Plates 9 and 29 show the Verdyol treated test slopes.

Weathering for four months resulted in a weak crust on both test plots, which probably will not aid in controlling erosion. On the unseeded plot some native plants sprouted, primarily on the roller path. On the seeded plot a very few seeds germinated but some of these were rye grass, which was unusual.

Product Name	Vendor	Telephone
Aerospray 52	Gene Thouvenell P.O. Box 283 Upland, CA 91786	714-985-5775
Aquatain	Don Keller 1440 S. Allec St. Anaheim, CA 92805	714-635-4770
Conwed Fiber	Richard Carlyon 751 N. Edwards Dr. Carson City, Nev. 89701	702-882-2055
Curasol AE	Gordon Christensen P.O. Box 975 Placerville, CA 95667	916-622-6030
Curasol AH	Same as Curasol AE	
Ecology Control	Jack Hatton 5275 Craner Ave. No. Hollywood, CA 91601	213-985-2807
Erode-X	Walt Stanley 946 E. Tunnell St. Santa Maria, CA 93454	805-925-3244
Orzan	Joe Otnes Suite 621 Leatherby Bldg. 1400 No. Harbor Blvd. Fullerton, CA 92632	213-694-2149
Surfaseal	Same as Surftite	
Surftite	Ed Graf 1680 Bryant St. Daly City, CA 94015	415-992-5520
Terra-Krete	Tom James 12740 Matteson Ave. Los Angeles, CA 90066	213-397-1384
Verdyol (Super)	Same as Ecology Control	

Table I. Products Tested

Product	Dilution Rate gals/lbs:gals H_2O	Application Rate gals. Mixture per Acre	Material Cost Per Acre
Aerospray 52	1:15.5	5991	$1092.00
Aquatain	1:5.5	1416	550.00
Conwed Fiber	1#:3	10,890	365.00
Curasol AE	1:40	5953	403.92
Curasol AH	1:40	5953	451.44
Ecology Control	1#:16.5	3630	261.60
Erode-X	1:9	2904	2821.00
Orzan	1:1	7260	328.50
Surfaseal	1:10	2396	1050.00
Surftite	1#:1	3630	584.00
Terra-Krete	1:50	7405	637.50
Verdyol (Super)	1#:37.5	5445	348.00

Table 2. Product Technical Data

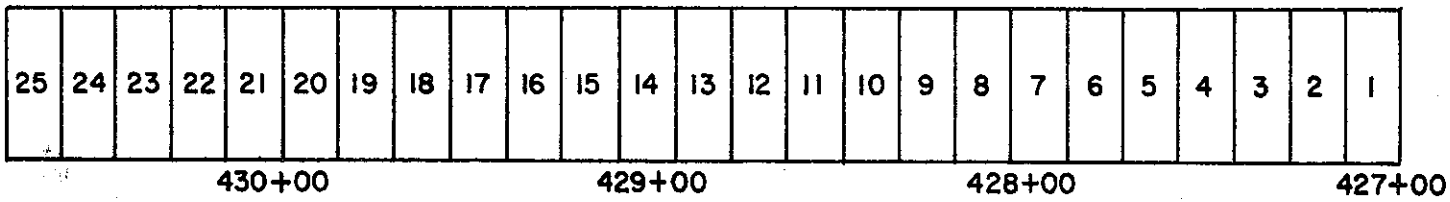
Product Name	Quality*	Observations
Aerospray 52	M	Softened Cracked Crust, some vegetation
Aquatain	U	No significant crust, no vegetation
Conwed Fiber	S	Good but flexible crust, fair barley development
Curasol AE	M	Softened crust, no vegetation
Curasol AH	M	Softened crust, no vegetation
Ecology Control	M	Weak crust, no vegetation
Erode-X	M	Softened crust, no vegetation
Orzan	S	Hard crust, no vegetation
Surfaseal	M	Softened crust, no vegetation
Surftite	M	Softened crust, no vegetation
Terra-Krete 2	M	Weak crust, some vegetation
Verdyol (Super)	M	Weak crust, no vegetation

Table 3. Summary of Results

*S - Satisfactory
M - Marginal
U - Unsatisfactory

FIGURE I

RAIN EROSION TEST PLOTS



1. Control
*2. Verdyol
3. Curasol AE
*4. Ecology Control
5. Aquatain
*6. Erode-X
7. Terra-Krete
8. Orzan
*9. Curasol AE
10. Control
*11. Surfaseal (lower half)
*12. Terra-Krete
13. Ecology Control
*14. Aquatain
15. Curasol AH
*16. Orzan
17. Erode-X
*18. Surftite
19. Aerospray 52
20. Control
*21. Curasol AH
22. Verdyol
*23. Aerospray 52
24. Surftite
*25. Conwed Fiber

N 43 W

1 inch = 50 feet

Slope Angle 2:1

*Seeded

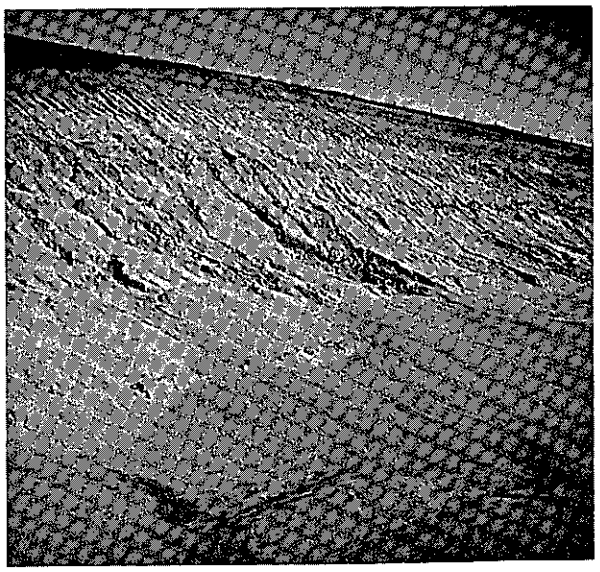


Plate 1

Plate 2

Plate 3

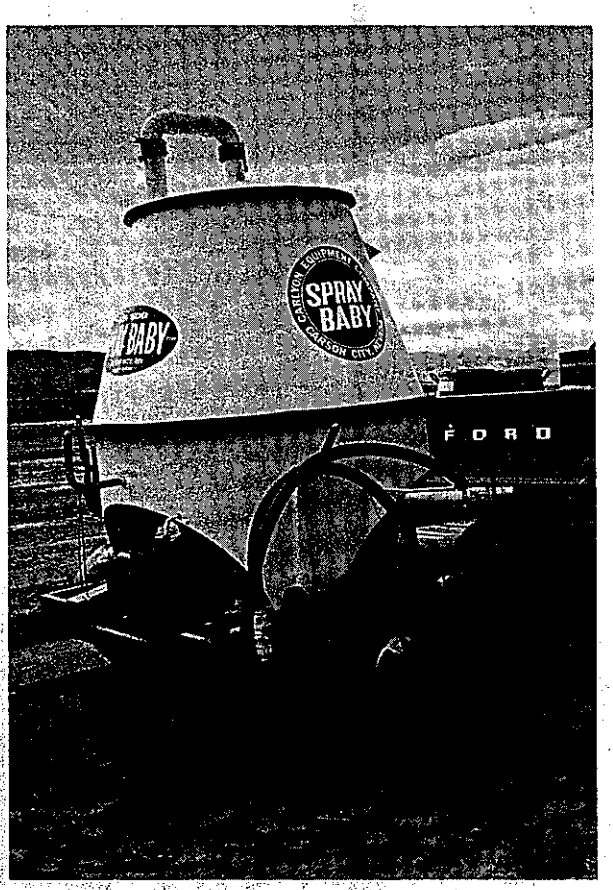


Plate 4

Rental spray rig used to apply all products included in this test.

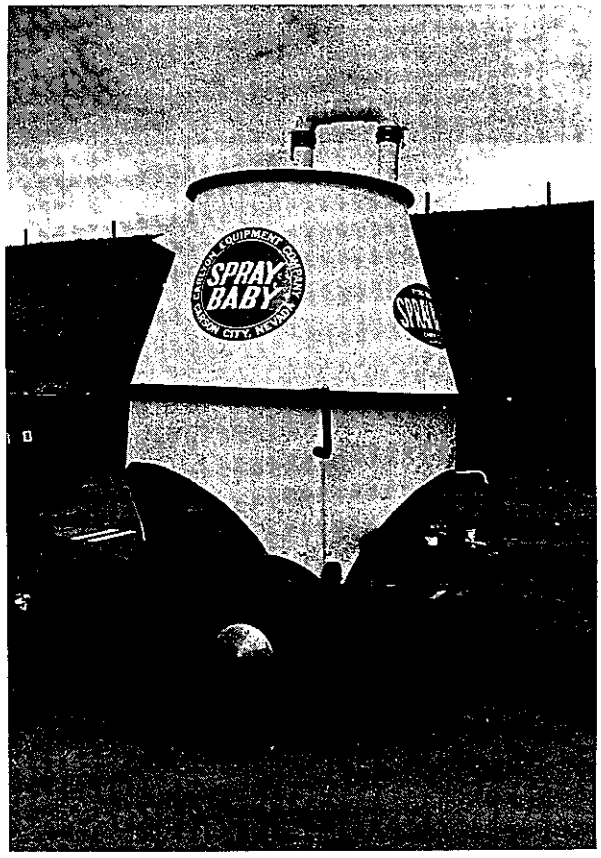


Plate 5

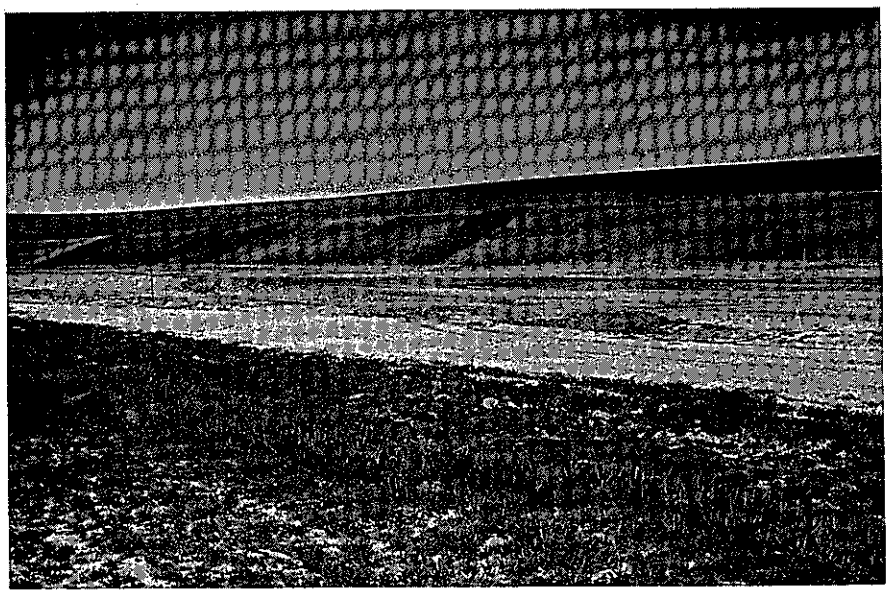


Plate 6 - View of Test Area on 2-24-71

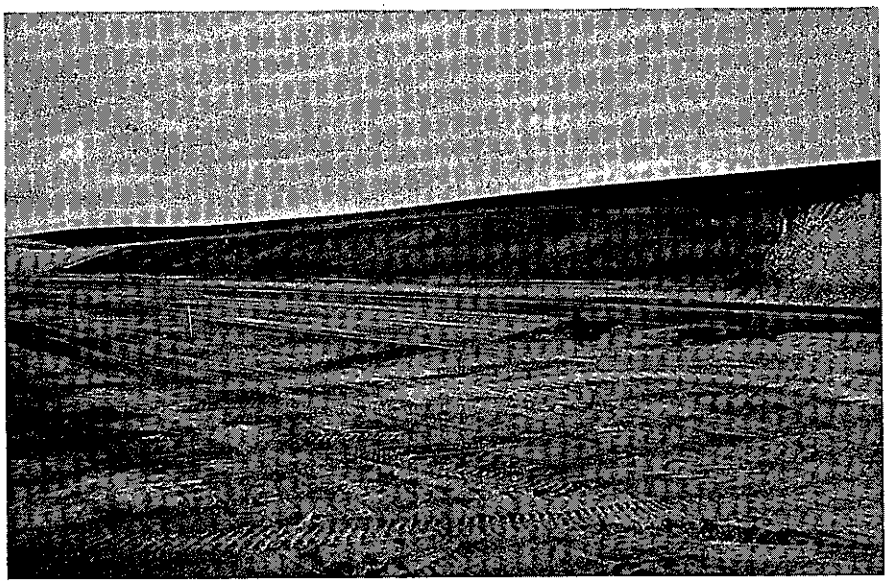
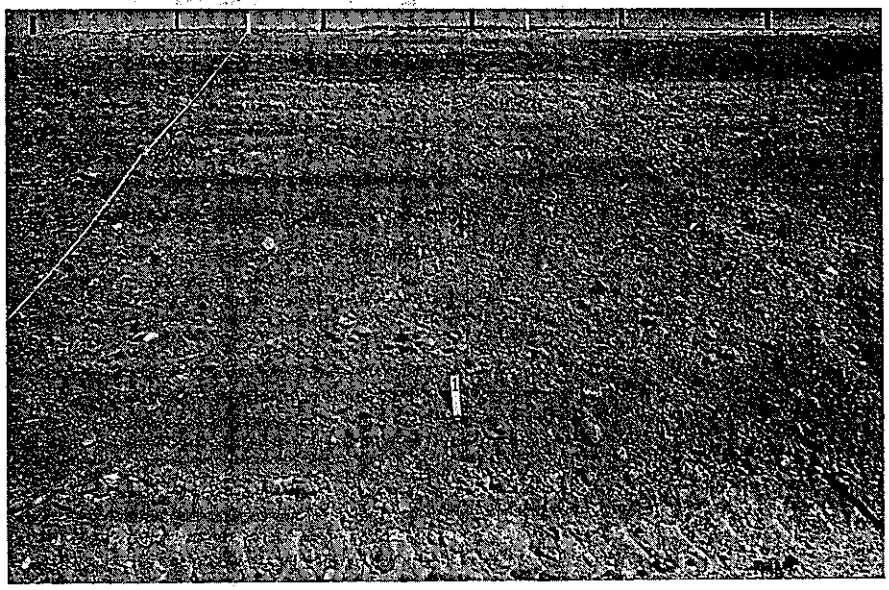
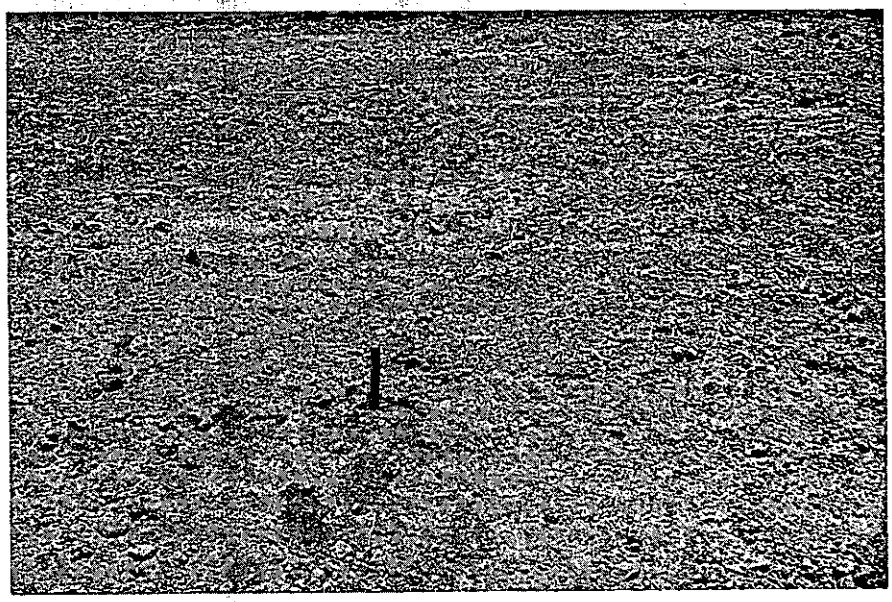


Plate 7 - View of Test Area on 4-5-71

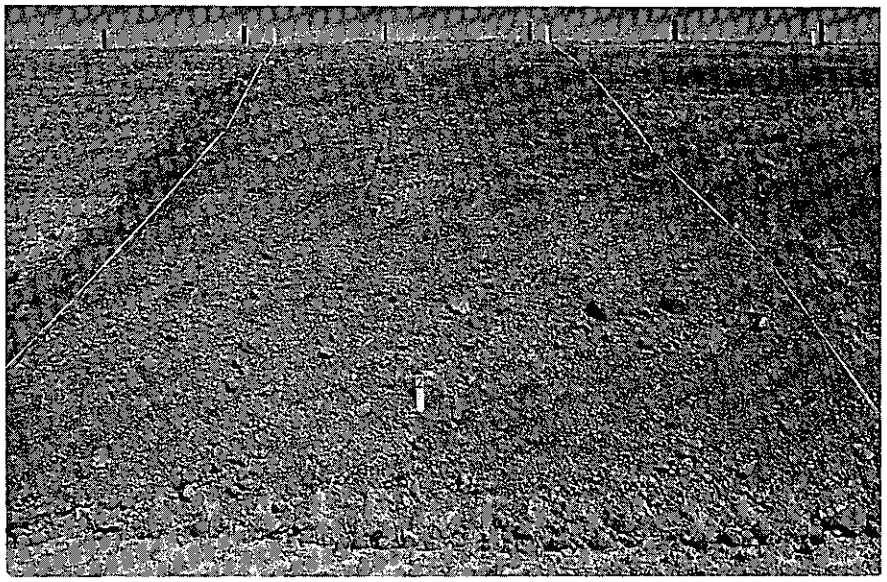


Control 2-24-71

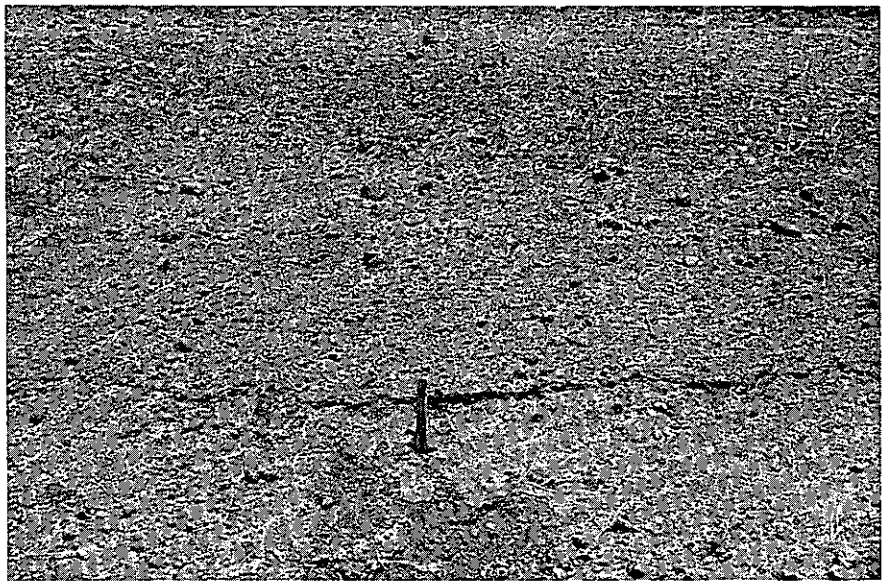


Control 7-22-71

Plate 8

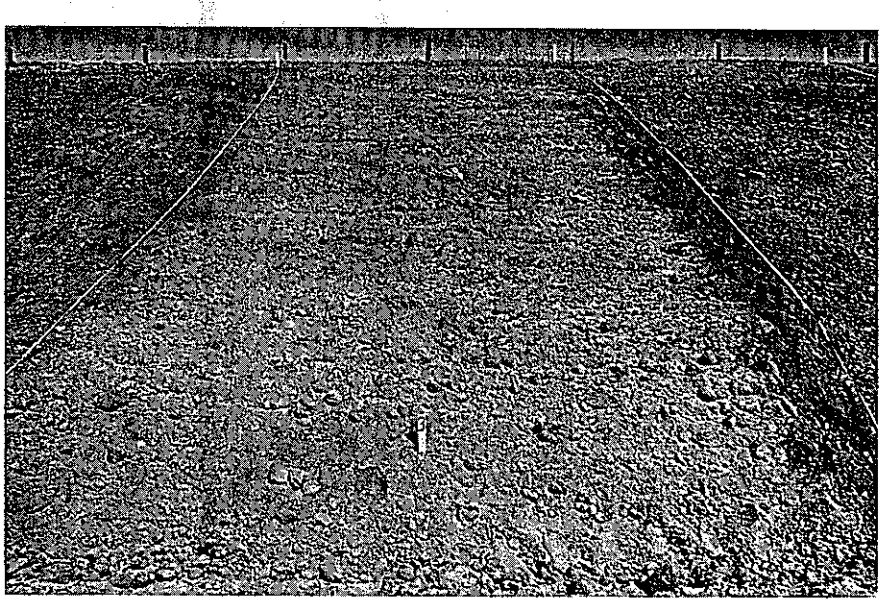


Verdyol Super - Seeded 2-24-71

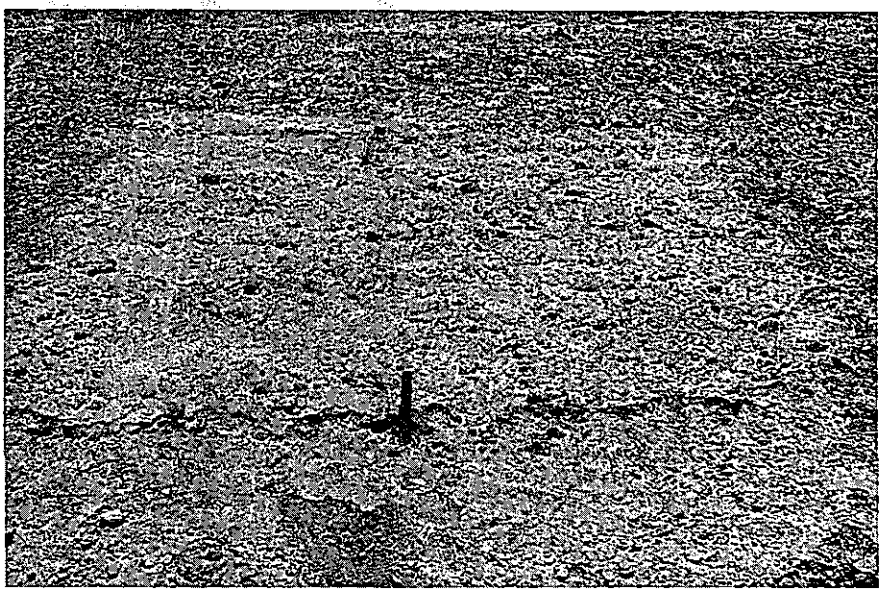


Verdyol Super - Seeded 7-22-71

Plate 9

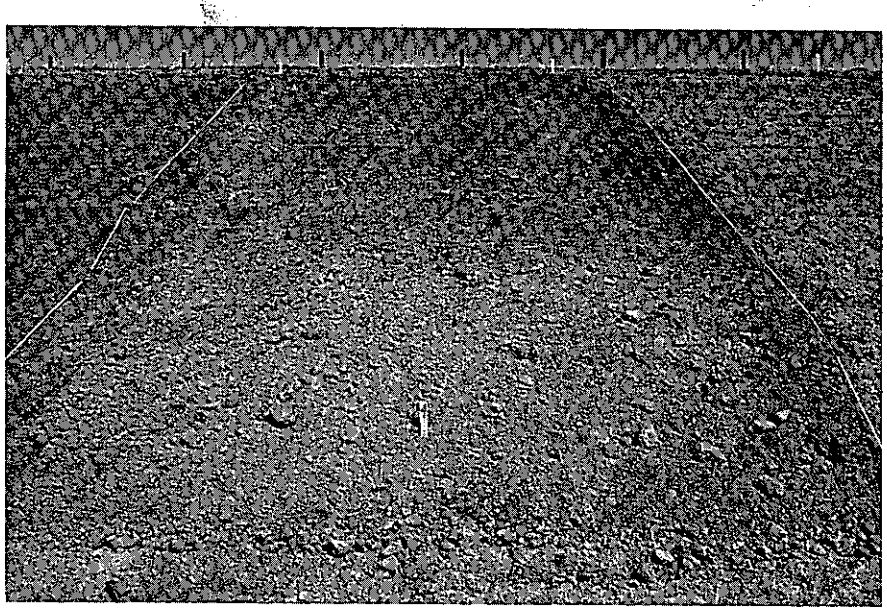


Curasol AE 2-24-71

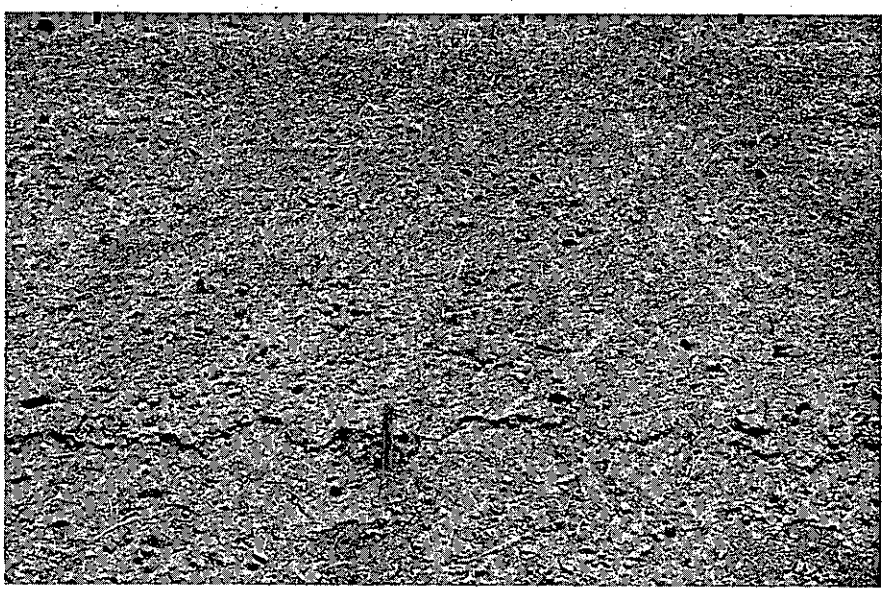


Curasol AE 7-22-71

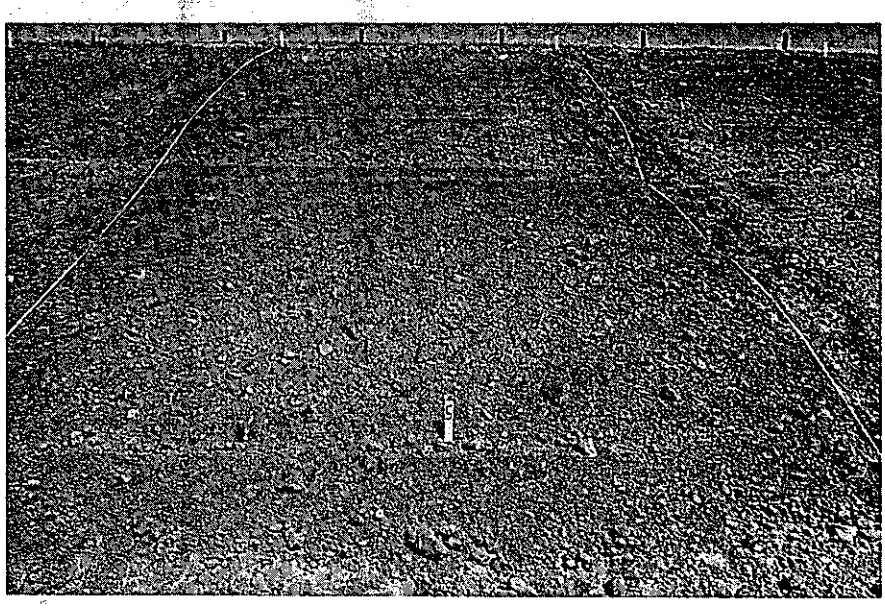
Plate 10



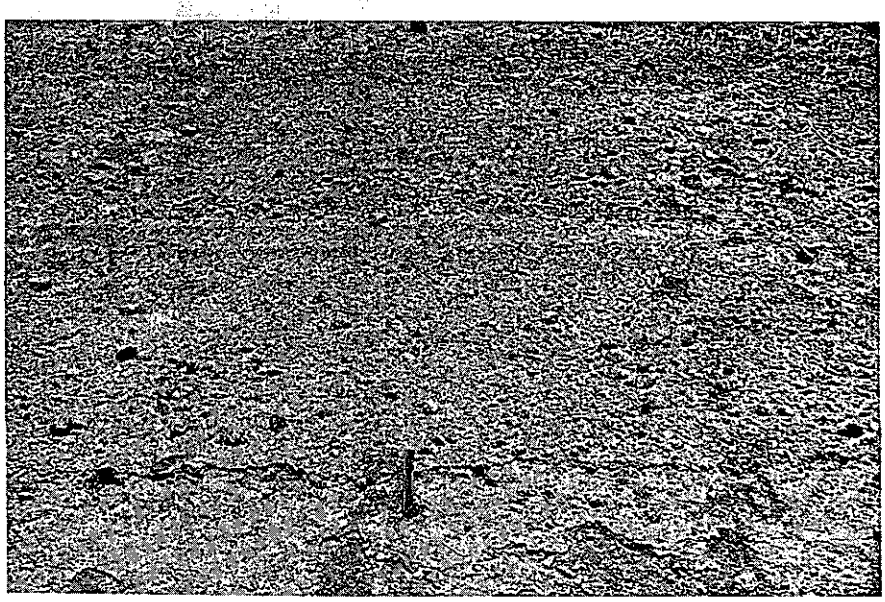
Ecology Control - Seeded 2-24-71



Ecology Control - Seeded 7-22-71

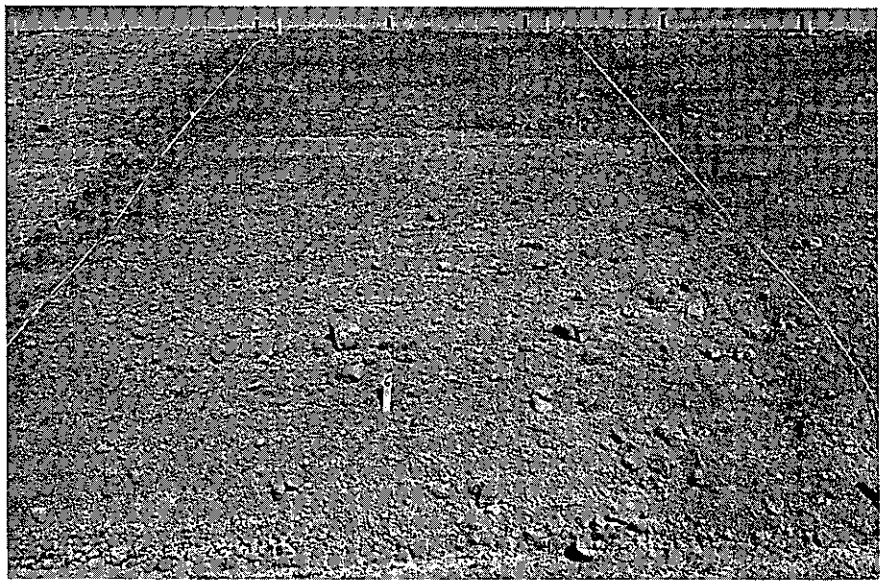


Aquatain 2-24-71

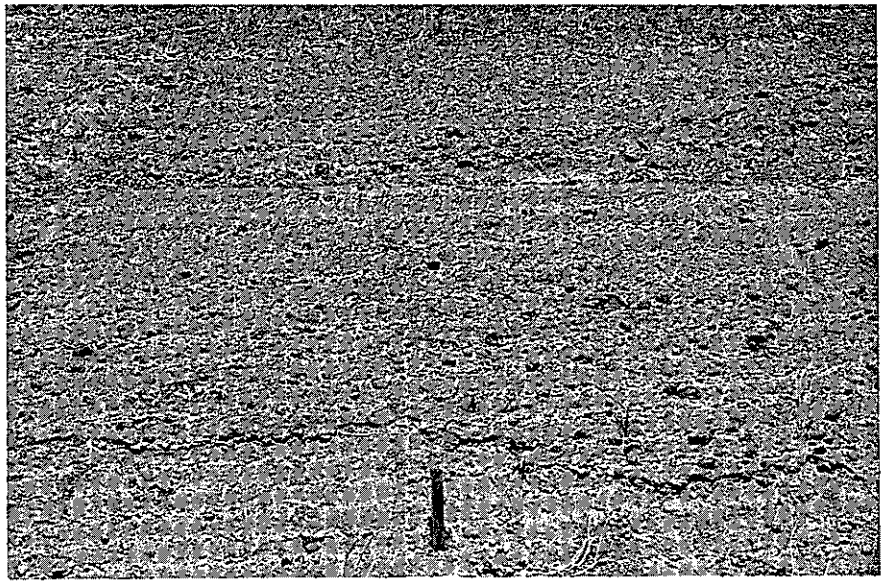


Aquatain 7-22-71

Plate 12

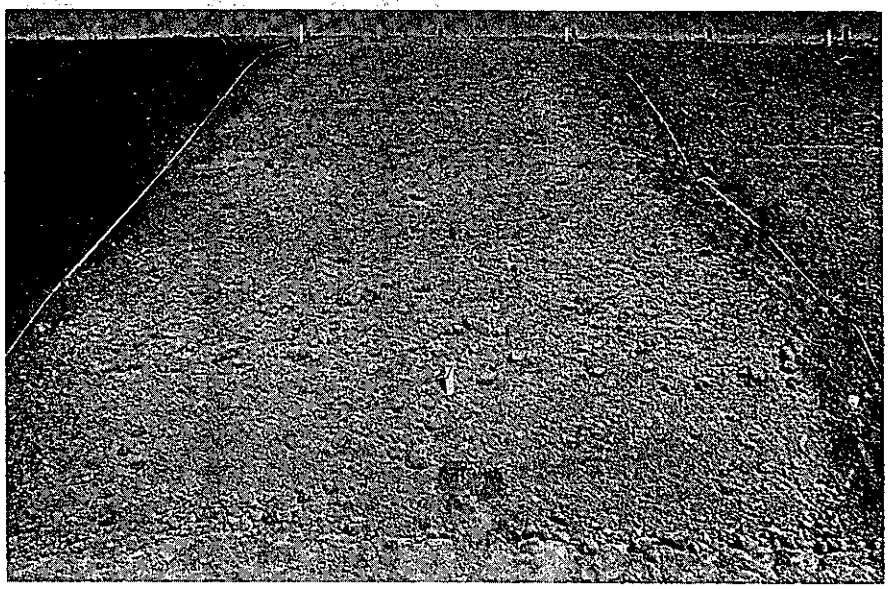


Erode-X - Seeded 2-24-71

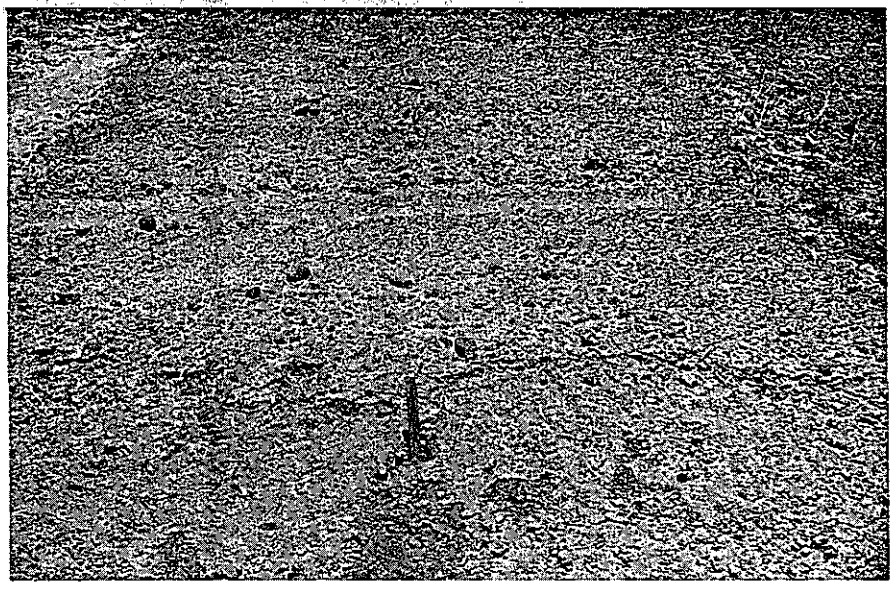


Erode-X - Seeded 7-22-71

Plate 13

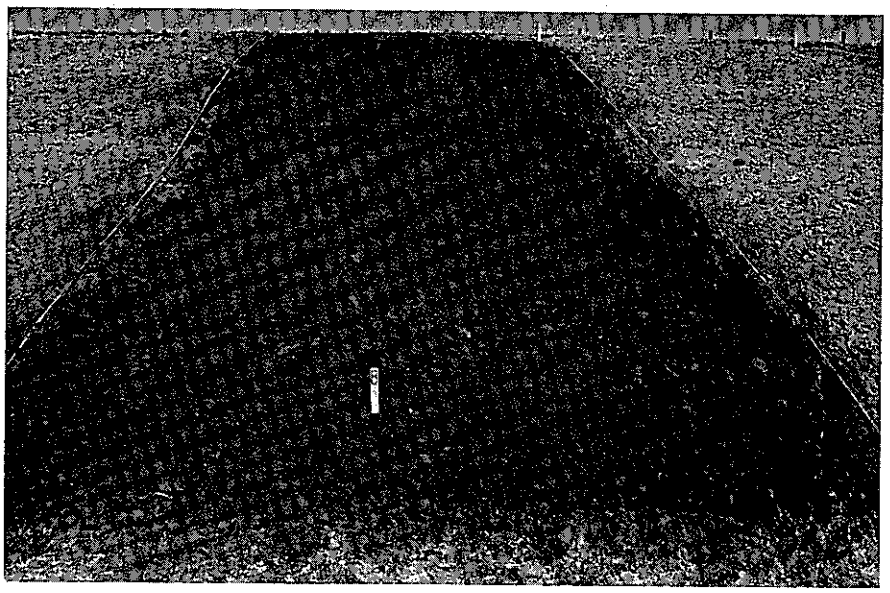


Terra-Krete 2-24-71

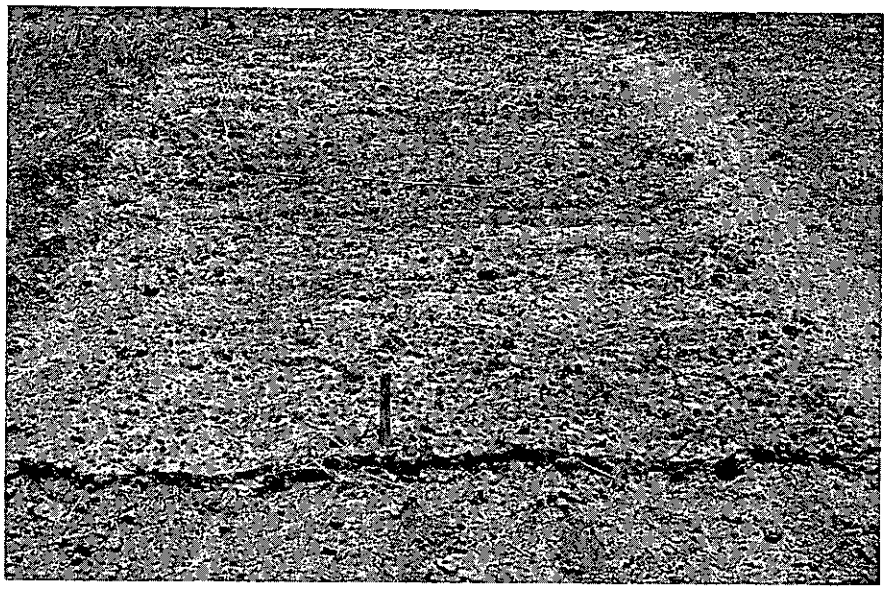


Terra-Krete 7-22-71

Plate 14

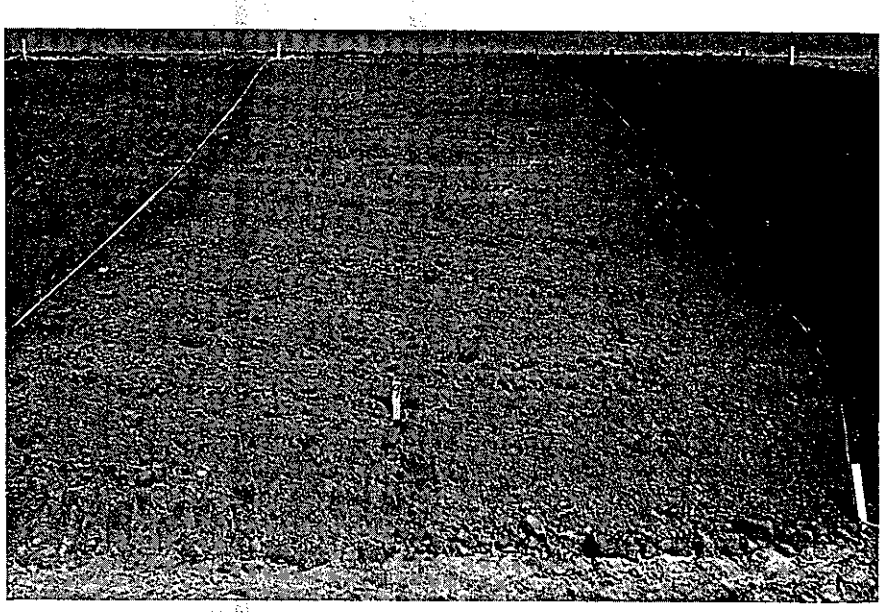


Orzan 2-24-71

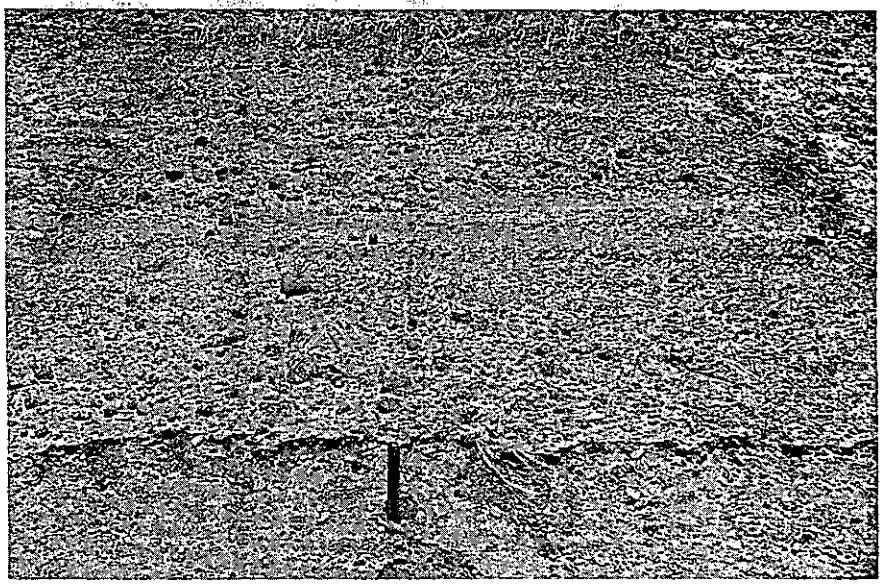


Orzan 7-22-71

Plate 15

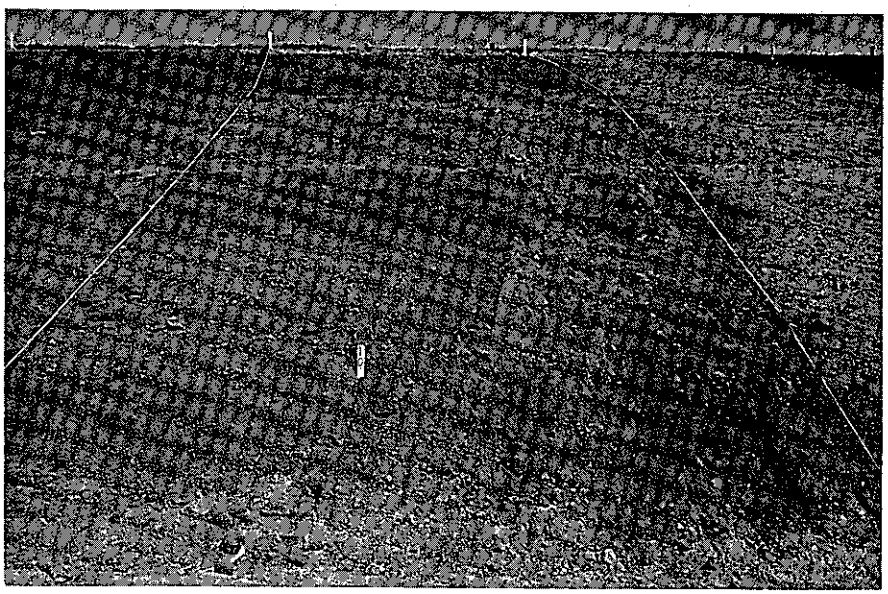


Curasol AE - Seeded 2-24-71



Curasol AE - Seeded 7-22-71

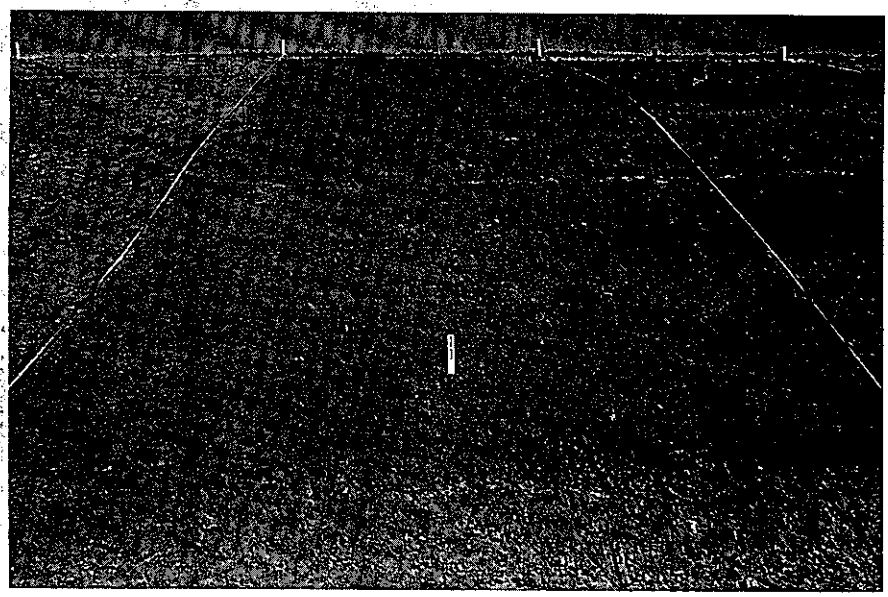
Plate 16



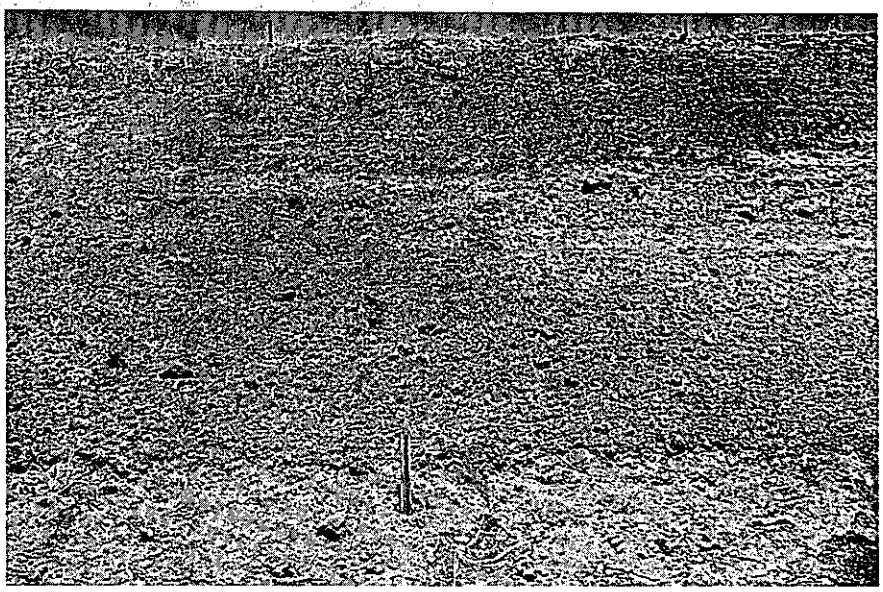
Control 2-24-71

Control 7-22-71

Plate 17

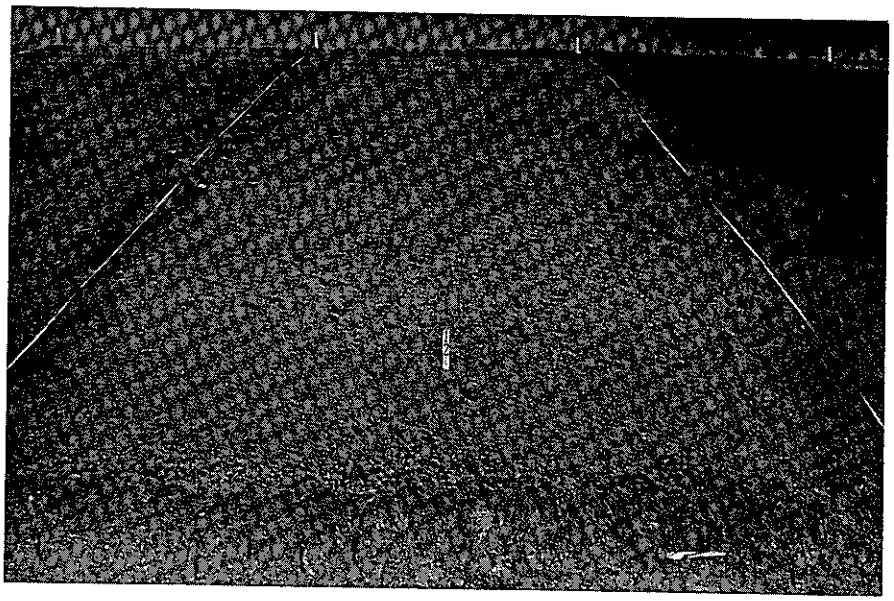


Surfaseal - Bottom half seeded 2-24-71

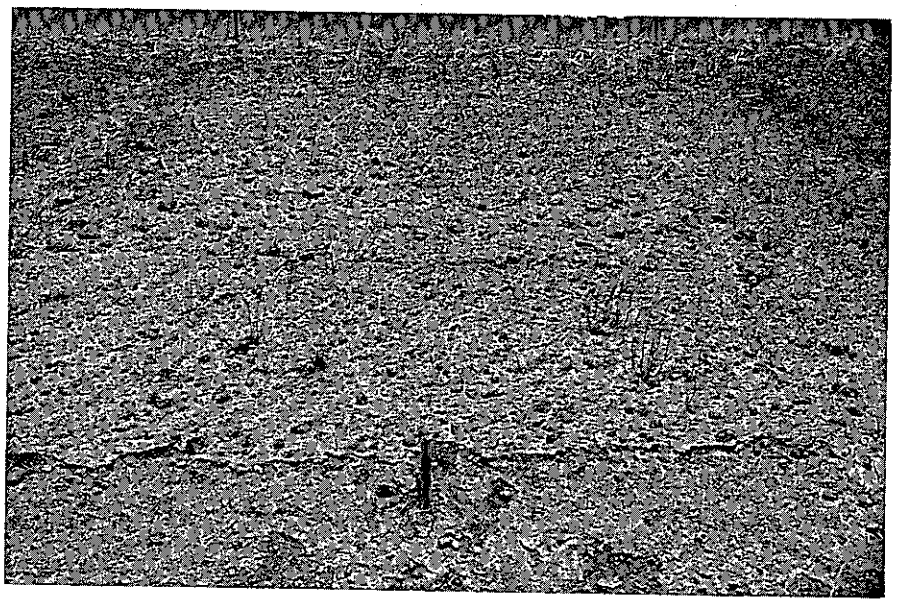


Surfaseal - Bottom half seeded 7-22-71

Plate 18

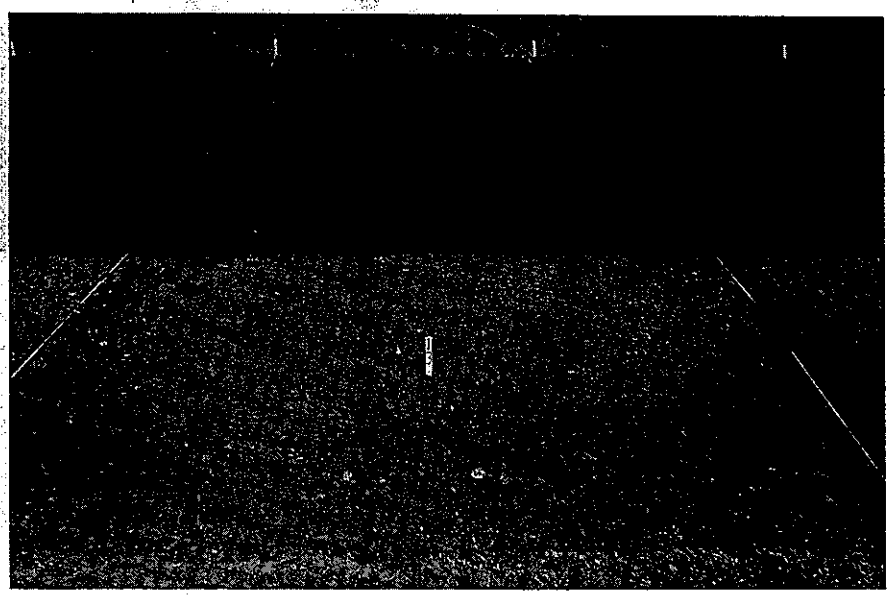


Terra-Krete - Seeded 2-24-71

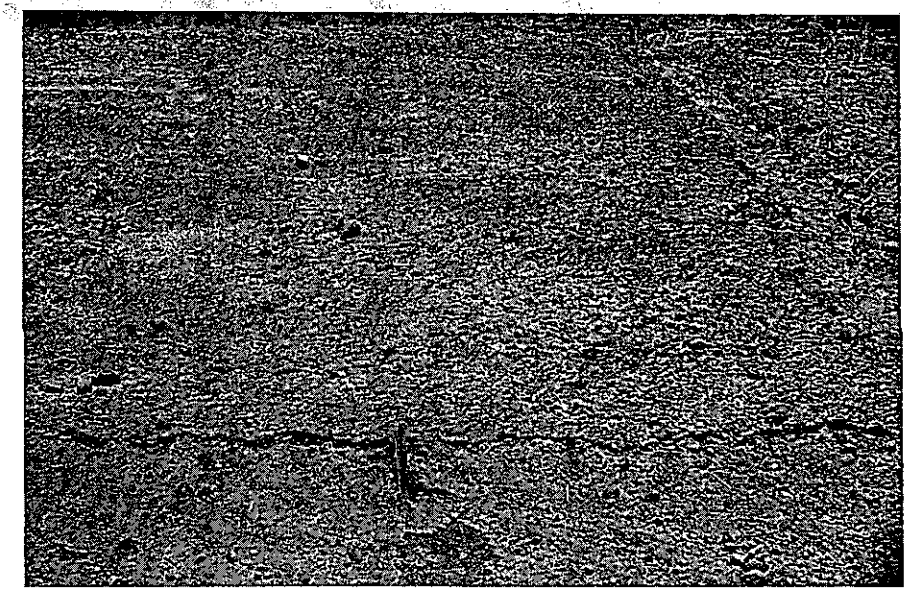


Terra-Krete - Seeded 7-22-71

Plate 19

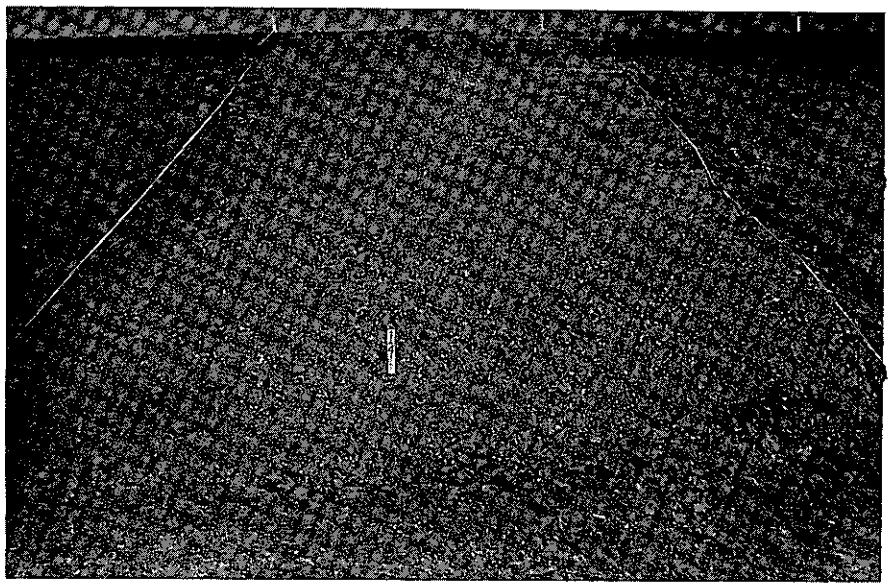


Ecology Control 2-24-71

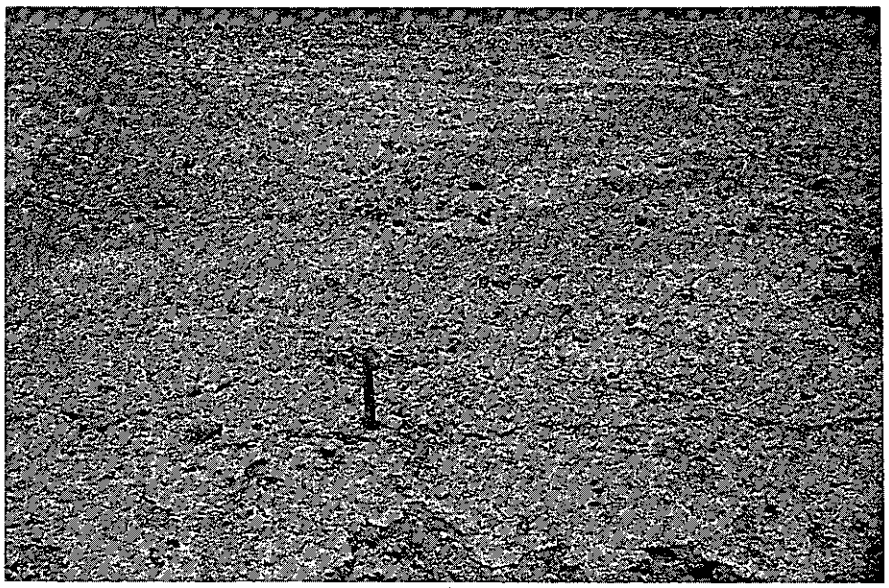


Ecology Control 7-22-71

Plate 20

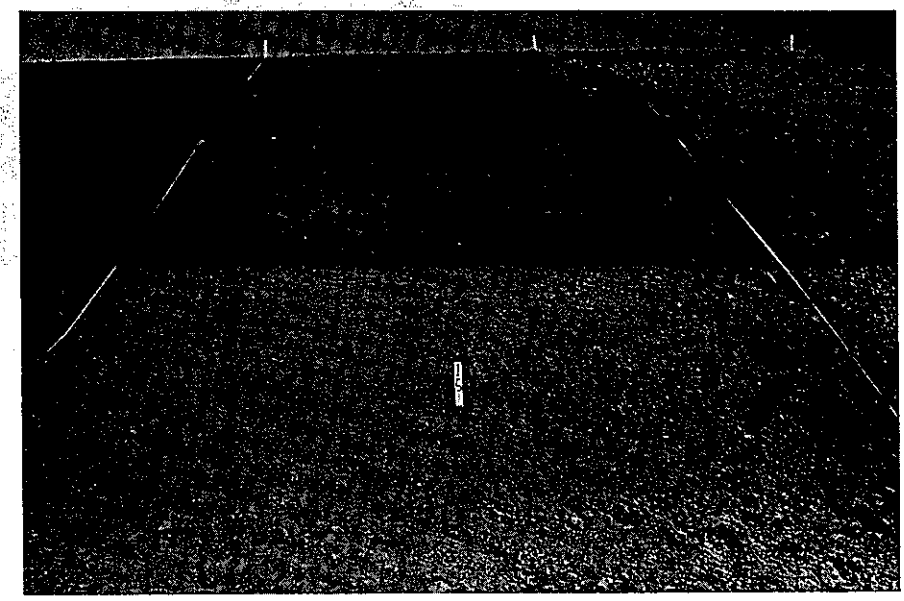


Aquatain - Seeded 2-24-71

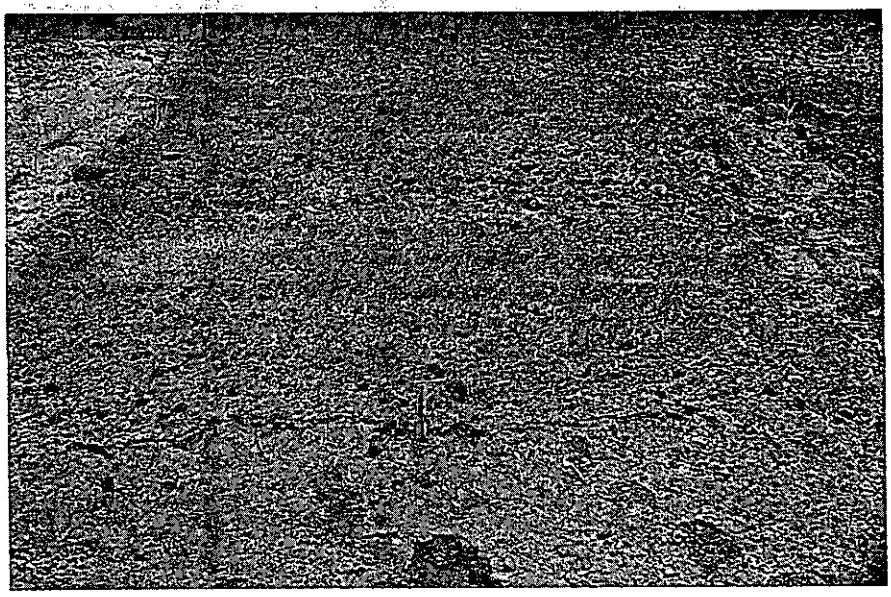


Aquatain - Seeded 7-22-71

Plate 21

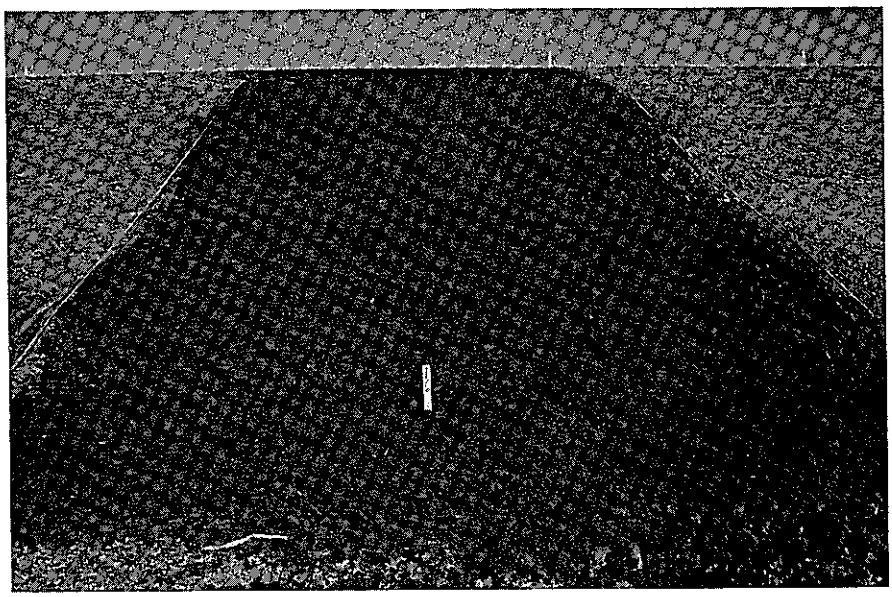


Curasol AH 2-24-71

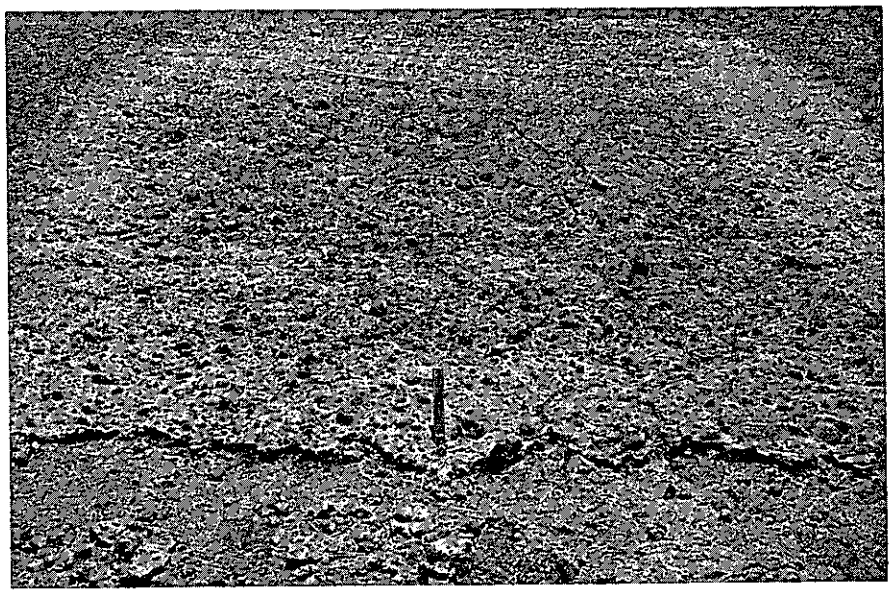


Curasol AH 7-22-71

Plate 22

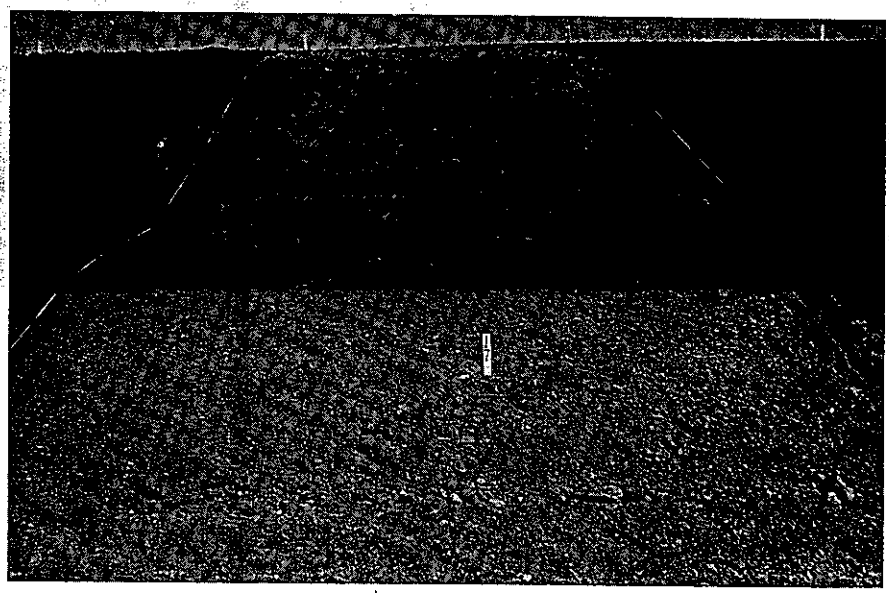


Orzan - Seeded 2-24-71

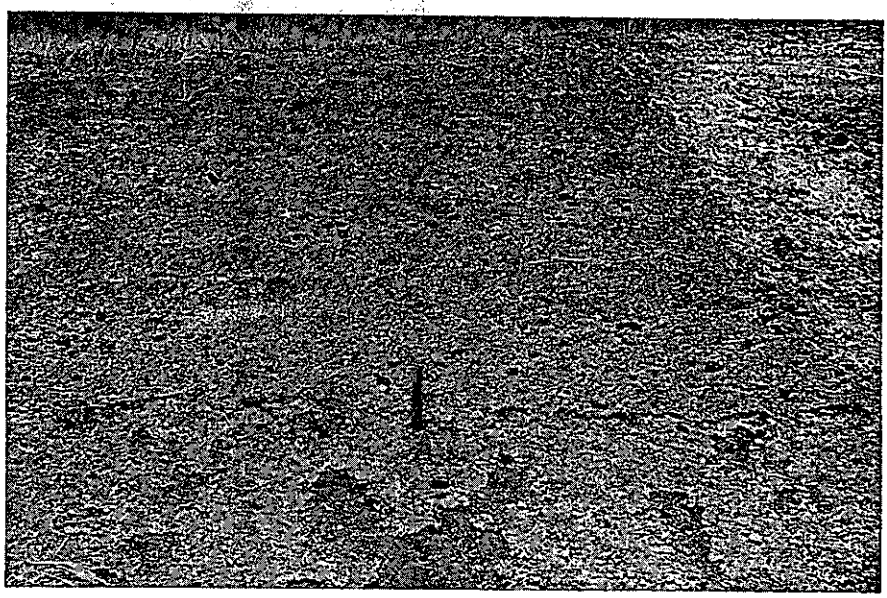


Orzan - Seeded 7-22-71

Plate 23

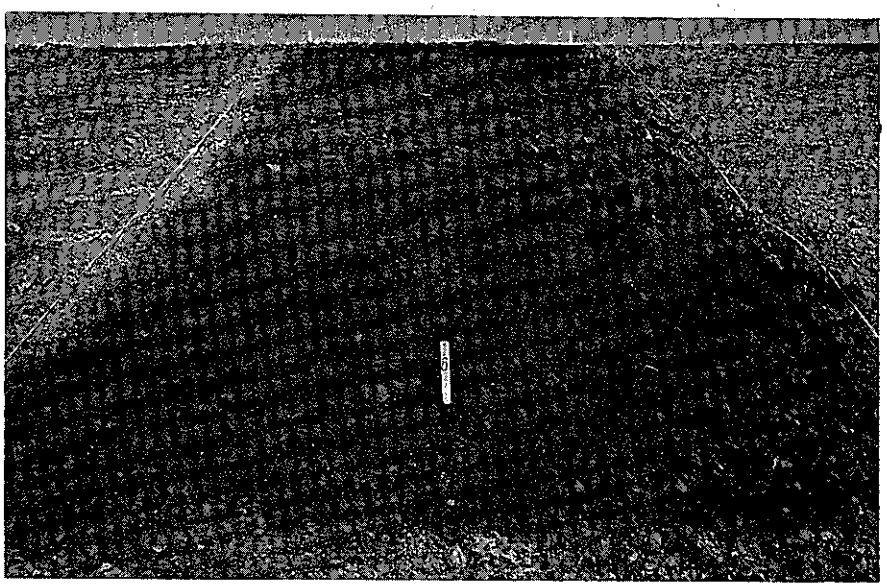


Erode-X 2-24-71

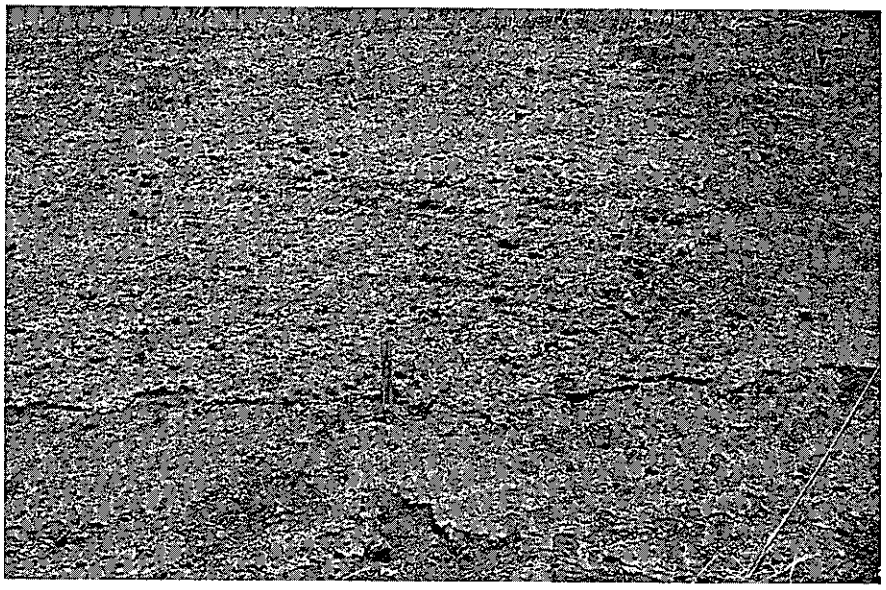


Erode-X 7-22-71

Plate 24

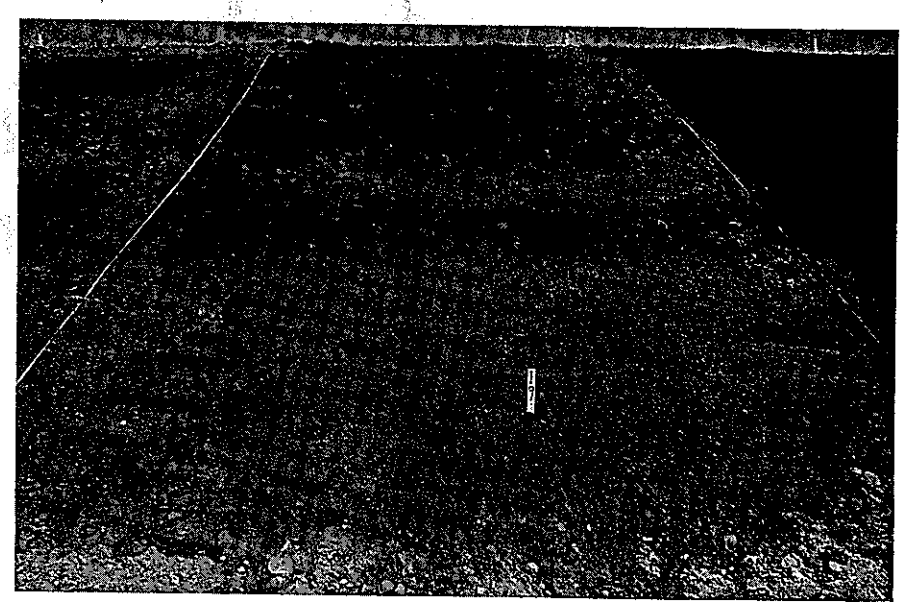


Surftite - Seeded 2-24-71

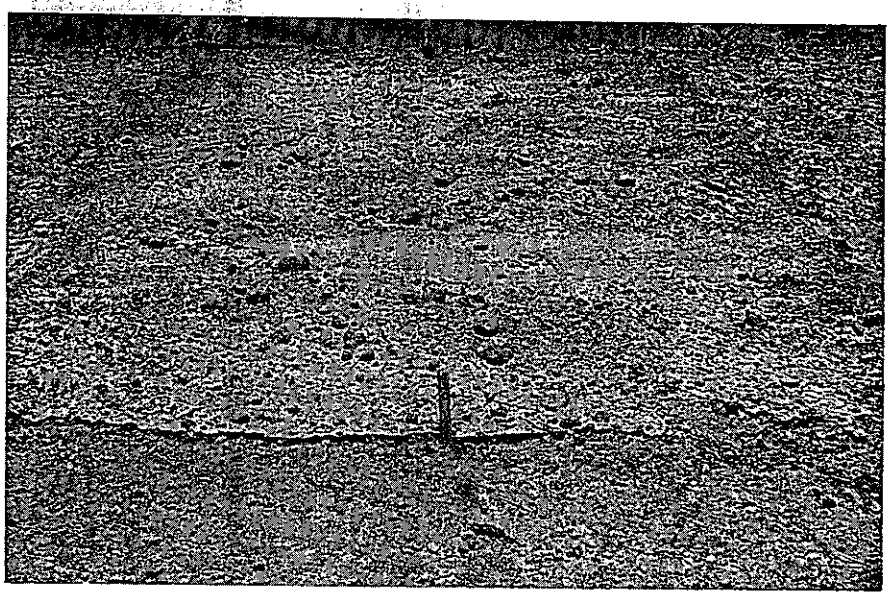


Surftite - Seeded 7-22-71

Plate 25

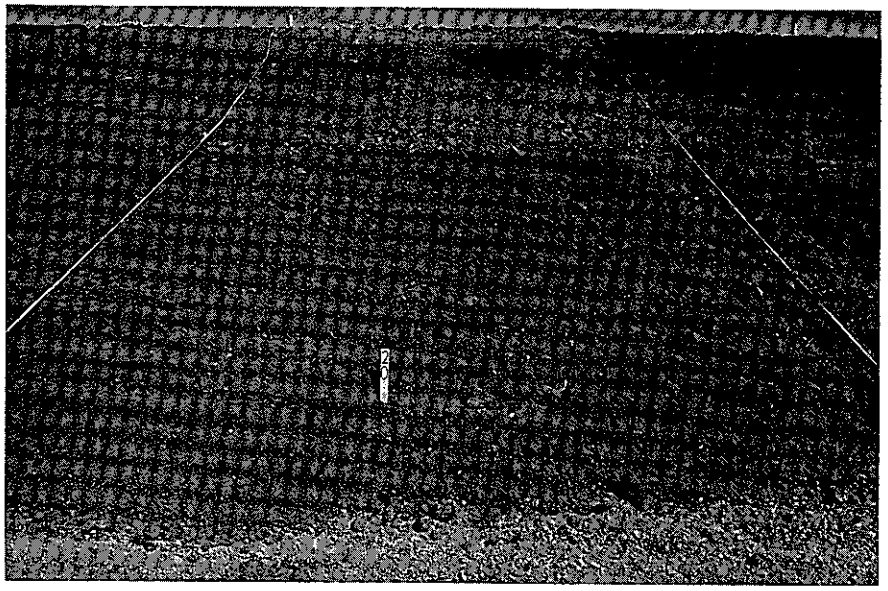


Aerospray 52 2-24-71



Aerospray 52 7-22-71

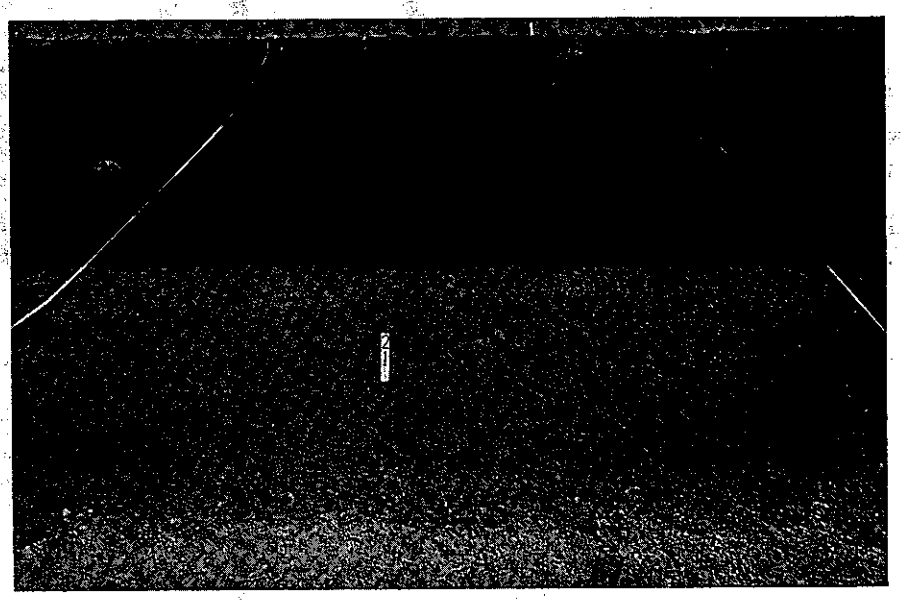
Plate 26



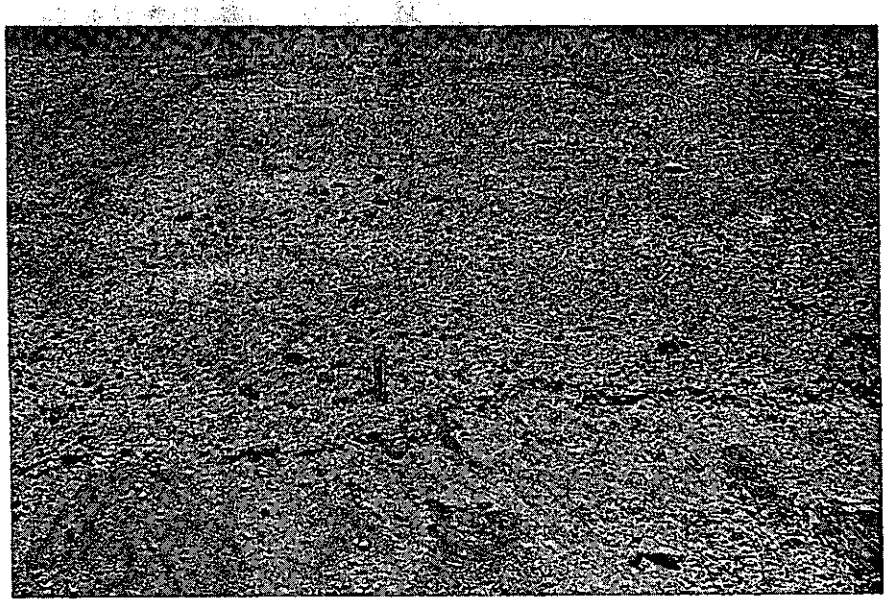
Control 2-24-71

Control 7-22-71

Plate 27

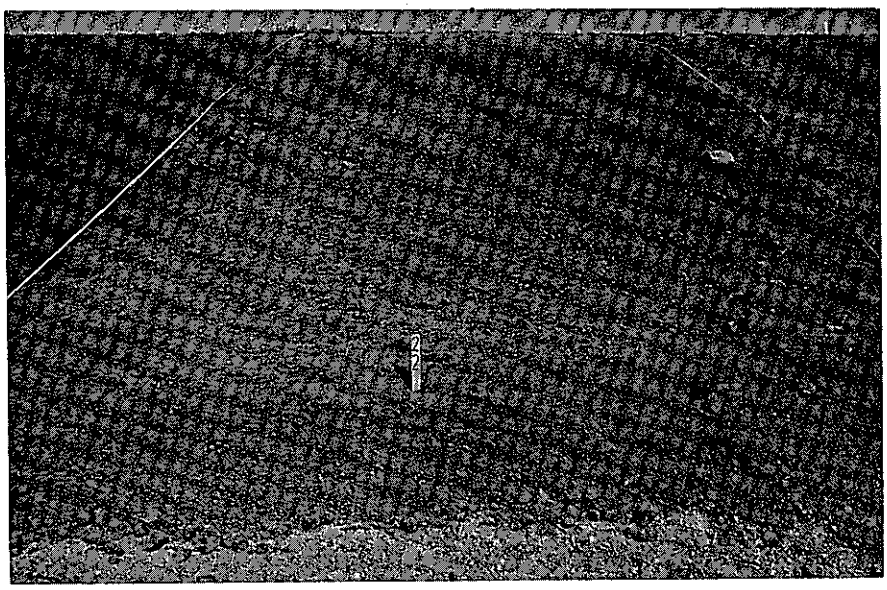


Curasol AH - Seeded 2-24-71

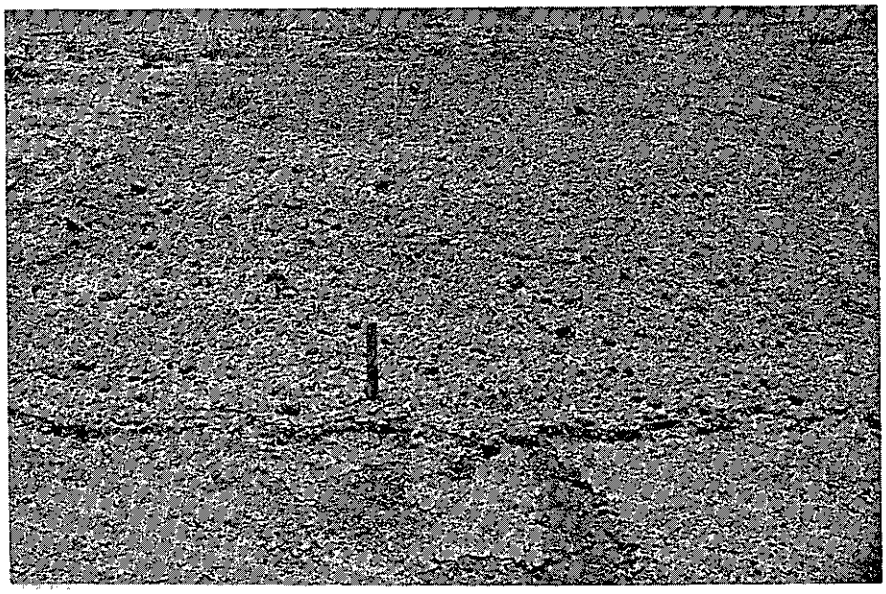


Curasol AH - Seeded 7-22-71

Plate 28

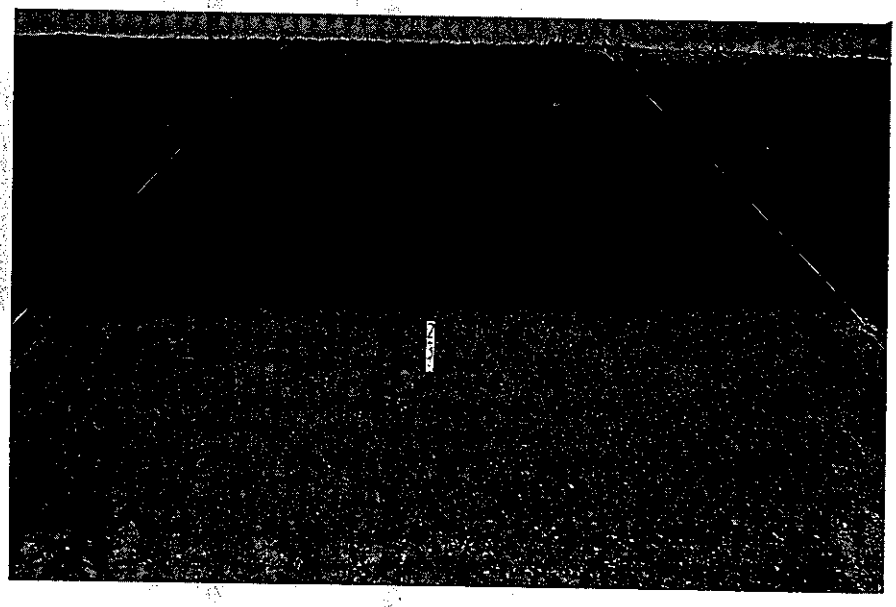


Verdyol Super 2-24-71



Verdyol Super 7-22-71

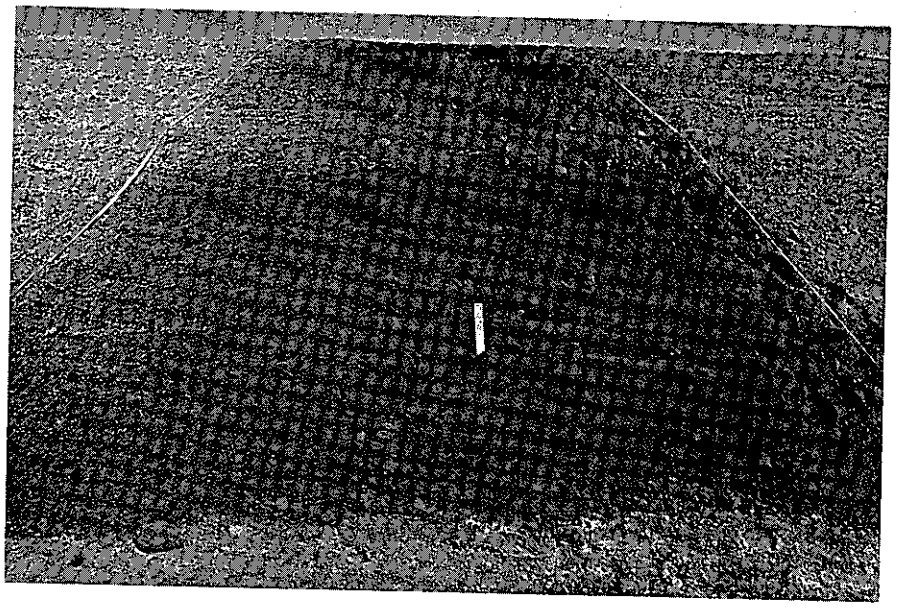
Plate 29



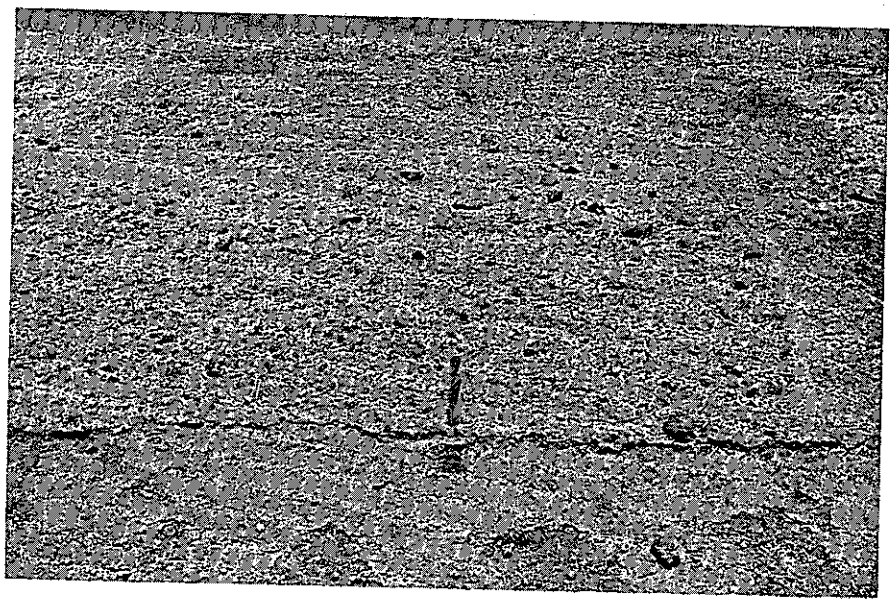
Aerospray 52 - Seeded 2-24-71

Aerospray 52 - Seeded 7-22-71

Plate 30

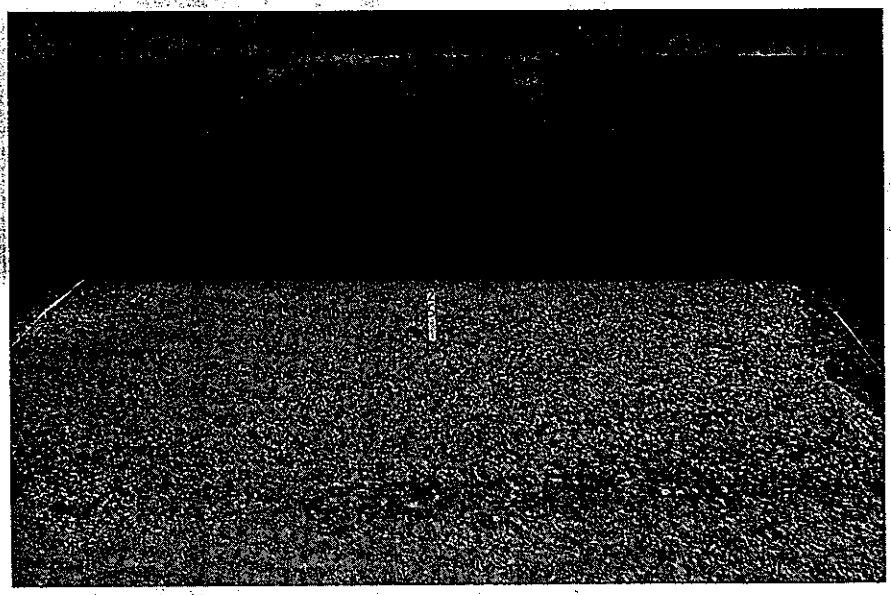


Surftite 2-24-71

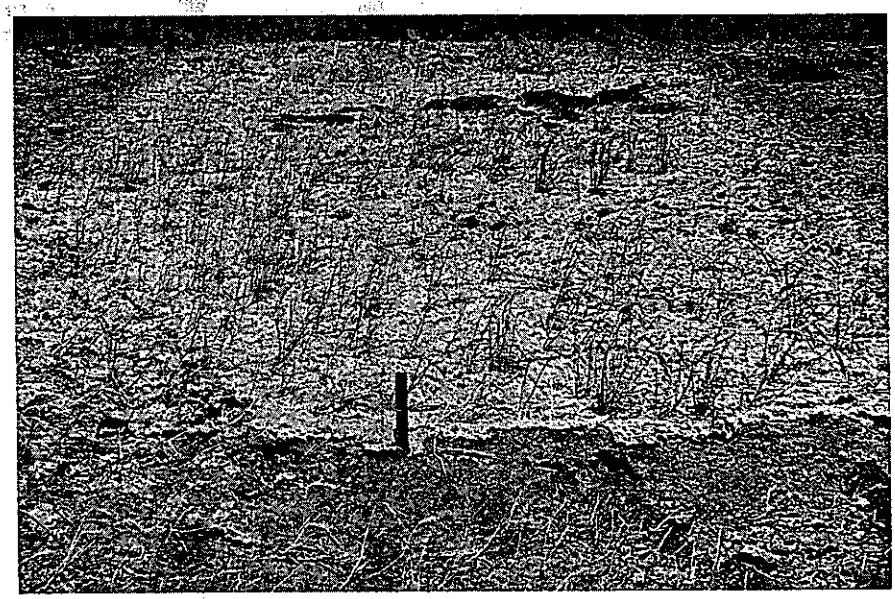


Surftite 7-22-71

Plate 31



Conwed Fiber - Seeded 2-24-71



Conwed Fiber - Seeded 7-22-71

Plate 32

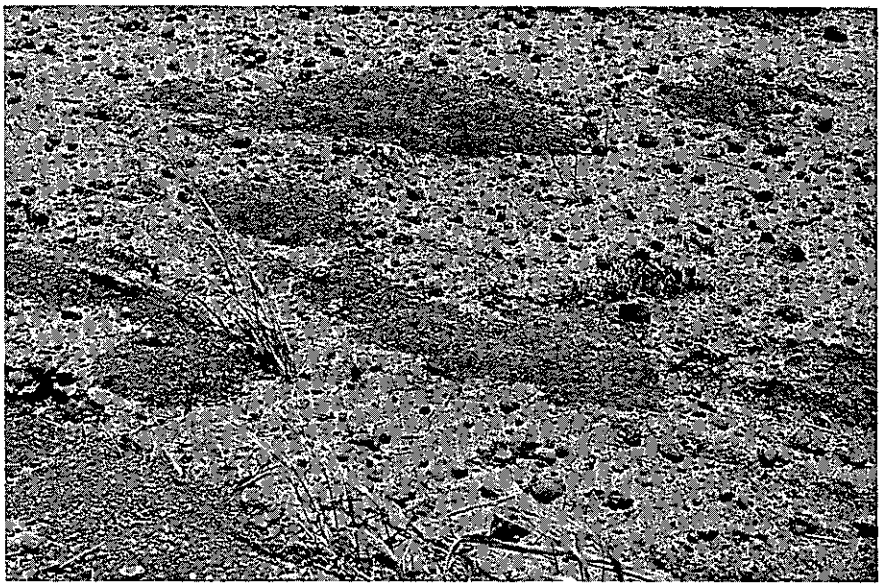


Plate 33 - Rodent Damage

Plate 34 - Rodent Damage