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Effect of Wetting Agents on Irrigation of Water Repellent Soils

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Wetting agents can be used to increase infiltration rates into hydrophobic (water repellent) soils. A field test was conducted on a soil classified as Tujunga stony sandy loam, which was found to be extremely hydrophobic to learn more about the effectiveness of wetting agents. The area is located near Fontana. The land had been farmed in small grain crops years ago and then was used as a hog ranch, but it has been idle for about eight years.

The test plots were l0-foot-square basins with soil borders. Two wetting agents (designated as products A and P) were used in the study at dilutions of 1 part wetting agent to 650, 1300, 2000, and 4000 parts of water. Water was pumped from a water truck into each basin to a depth of four inches. As the water was being applied to the basin, enough wetting agent was added to the flow stream to produce the desired dilution. Each treatment was replicated three times and six basins were used as checks and received only water.

The water level was checked periodically on marked stakes which were installed in each basin. The initial test was conducted in May. The plots were allowed to dry for more than two months and then untreated water was added to each basin and the infiltration rate checked.

Table 1 shows the time necessary for four inches of water or solution to penetrate and the percentage of decrease in time for infiltration of wetting agent solution basins, as compared to the check plots. On the first run, all wetting agent solutions infiltrated more rapidly than water. Product P showed increasing benefits as the concentration was increased. The second most concentrated solution of product A provided the shortest time for infiltration for that product.

When water was applied during the second test, infiltration was more rapid in each of the treated plots as compared to untreated. Infiltration was more rapid on the second run perhaps because of increased soil moisture. Previous observations have indicated that a hydrophobic soil is less water repellent after once being wet, even though it becomes dry again.

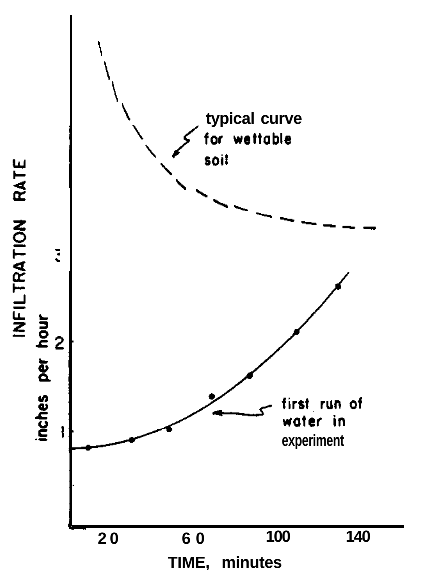
The percentage of decrease in time for four inches of water to penetrate the treated plots, as compared to those untreated, was about the same as when wetting agent solutions were used in the initial test.

TABLE 1. EFFECT OF WETTING AGENTS ON INFILTRATION RATES

Product	Dilution	Time for 4-inch infiltration		Percent decrease in infiltration time compared to check	
		1st run	2nd run*	1st run	2nd run
Water		150	89		
A	1 to 650	123	73	18	18
A	1 to 1300	107	65	29	27
A	1 to 2000	137	67	9	25
A	1 to4000	137	77	9	14
P	1 to 650	88	52	41	42
P	1 to 1300	98	55	35	38
P	1 to2000	107	69	29	28
P	1 to 4000	120	69	20	28

• Water was run on wch plot. Values ore for basins which had received the indicated treatment.

Infiltration rates of water in nonwettable soils as compared with typical curve for wettable soil.



Infiltration rate at various times after water application follows a different pattern for nonwettable soil as compared to wettable soils, according to laboratory studies. The infiltration rate, plotted as a function of time, as well as a curve which is generally accepted as representing infiltration rates with time is presented in the graph. It is usually expected that infiltration rates will start high, and then decrease rather rapidly with

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time, and level out at a fairly constant rate. The infiltration rate on the plots studied was comparatively slow at the beginning, then increased with time after water application. It is assumed that the curve would have leveled off if the experiment had been extended by applying more water.

The information presented in the graph suggests that the relative beneficial effects of using a wetting agent may depend upon the quantity of water being applied. Since the infiltration rate increases with time, it would appear that beneficial effects of a wetting agent would decrease as the time of water application increased. Observation of the data presented in the second table shows this assumption to be true.

The percentage decrease in time for various quantities of water to infiltrate into the treated basins as compared to the untreated is recorded in the second table. The greatest decrease in infiltration time for all treatments was obtained with the use of one-half inch of water and the effectiveness decreased progressively as greater quantities of water were allowed to infiltrate.

While product A did not appear to be as good as product P when compared on four-inch intake, it was as good and possibly better when compared on a one-half-inch intake. Product A, for one-half-inch intake, was more effective at the highest concentration, and decreased in effectiveness as the concentration decreased. This "expected" behavior did not occur for product A when larger quantities of water were allowed to infiltrate.

These data suggest one wetting agent on the market may be superior for one problem or soil type, whereas another product may be superior for another set of conditions. More detailed investigations on the physical-chemical interactions between the wetting agent molecule, soil particle surface, and water are necessary to select a product best suited for the particular case. It would then be necessary to know the molecular structure

TABLE 2. PERCENT DECREASE IN INFILTRATION TIME COMPARED TO CHECK

Treatment		Inches of water infiltrated				
Product	Dilution	1/2	1	2	3	4
		%	%	%	%	%
A	1 to 650	77	65	42	30	18
	1 to 1300	68	56	44	34	27
	1 to 2000	62	50	40	37	25
	1 to 4000	46	35	31	25	14
P	1 to 650	68	65	60	54	42
	1 to 1300	64	62	56	50	38
	1 to 2000	58	50	44	37	28
	1 to 4000	48	41	37	32	28

of each commercial product so that the proper selection could be made.

Water management

Aside from the application of wetting agents, information contained in the diagram provides clues toward better water management on nonwettable soils. Because a soil becomes more water repellent as it becomes drier, it is important that nonwettable soils should not be allowed to become dry before irrigation. "Double bumping" (applying water to cover the field and then stopping the application until several hours later), presently in use in some areas of the state, would appear to be a good practice on hydrophobic soils since the initial application could penetrate during the low infiltration-rate period. When the actual irrigation water is applied, the infiltration rates should be higher.

It should be stated that the results reported here were based only on tests of a very hydrophobic soil which was very dry before the test. The actual percentage of decrease in infiltration time created by wetting agent treatments cannot be assumed to apply to all systems. Conditions under which wetting agents are most likely to be beneficial are on water-repellent soils, when small amounts of water are added each time, and on sloping land, where the water will run off, if not immediately absorbed by the soil.

Turfgrass Youth Educational Programs

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As the population of California continues to rise, the demands for more and better turfgrass areas likewise increase. With a decreasing number of young men studying for careers in this field, the obtaining of qualified personnel for supervisory positions at golf courses, memorial parks, parks departments, school grounds, and other turfgrass areas has become a serious problem.

During the past two years, two programs, aimed at capturing the interest of youngsters and training them for careers in the turfgrass or other plant science fields, have been started by the University of California Agricultural Extension Service in Los Angeles County.

The first of these programs is the new 4-H Turfgrass Project. This 4-H Club project covers a four-year period and provides for year to year progression. The basic sciences of soils, water, and nutrition are taught along with turfgrass culture through a series of "learns" and "do's".

Literature covering the first-year program consists of information on soil texture, soil moisture characteristics, fertilization, measuring of areas, measuring water application, and adjusting and sharpening a lawn mower.

To complete the first year's unit, the youngsters are required to (1) improve and maintain an existing lawn, (2) conduct an experiment demonstrating the effects of fertilization and mowing heights, and (3) measure the amount of water applied from irrigation to determine how

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far the water has infiltrated into the soil. A glass front box is built so that depth and rate of water infiltration into different soil types can be seen.

During the remaining years of the project, the youngsters will plant a new lawn (this may be done the first year if no existing lawn is available) and renovate an existing one, be taught propagation by seed, stolon, and plug, and how to identify and control diseases, insects, and weeds of turfgrass. They will learn about the different turfgrass species and varieties and will grow for display certain numbers of them.

More will be taught through demonstrations about the importance of soil aeration, compaction, deflocculation, layering, profile, and structure. Water quality, salinity, and drainage will also be included.

University research and agricultural extension subject matter specialists have generously contributed to developing this project, with their suggestions, articles, and editing of the information presented. It is anticipated that all of the material for the remaining sections of the project will be completed by early 1963.

Four 4-H boys completed the project during 1962. Each boy's project was inspected twice at his home by a committee from the Southern California Turfgrass Council which is sponsoring the program.

The Southern California Turfgrass Council has established a generous youth educational trust fund. Whoever best completes the first year's work receives an award of $50 which is placed in trust for him towards a college education. The second year winner receives $100, third year $150, and fourth year $200. It is therefore possible for one youngster to win up to $500 to assist him in obtaining an advanced education.

The winner of the first year's award was Scott Campbell of the Malibu 4-H Club. He and another boy who completed the program, with their leaders, were presented to the Council at their November meeting.

Separate from the 4-H Turfgrass Project is one started in cooperation with the Los Angeles City Schools. At eleven of the Los Angeles junior and senior high schools, turfgrass variety plots were established. As part of the teaching program connected with these plots, besides the different turfgrass species and varieties being studied, the students learn about propagation methods, fertilization, mowing heights, and irrigation.

As a result of these plots at the Los Angeles city schools, several boys became interested in possibly pursuing a turfgrass career and made plans to enter colleges to study the plant sciences. Some of the boys were in need of employment during the summertime and requests were made to the Farm Advisor for assistance in obtaining jobs in the turfgrass field.

The Southern California Golf Course Superintendents Association was contacted and they agreed to sponsor the program and cooperated in finding summer employment for some of the boys.

Fred Bove (Brentwood Country Club), Dave Mastorleo (Fox Hills Country Club), and Elmer Swanson (Hawthorne Parks Department) each trained one boy during the summer. The superintendents gave warm praise to the boys for their abilities and willingness to work.

In 1963 it is planned that negotiations will be started during March for finding and placing interested young sters. Each student must receive a recommendation from his teacher and principal, and then attend an orientation meeting with a committee composed of the president of the Golf Course Superintendents Association, the supervisor of agricultural education for the Los Angeles City Schools, and the University of California Turfgrass Advisor.

Now that these two programs have been started and were successful for the first year, even if only on a limited scale, enthusiasm has been generated so that each program will grow and become an important means for providing qualified personnel for the turfgrass and related industries.

Any young men who will take part in these programs while in high school, and then receive summer training on the job, should become valuable employees. If they then can be encouraged, and given assistance when needed and deserved, to go on for advanced education in college, highly qualified men for positions of supervision should be the result.

A Comparison of Resin-Fertilizer With Non-Coated Soluble Fertilizers on Bentgrass Putting Green Turf

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A resin-coated 20-10-5 fertilizer* was compared with ammonium phosphate sulfate (16-20-0) and ammonium sulfate (21-0-0) on a bentgrass putting green nursery turf in the coastal area of San Diego, California. The objective was to determine if one or two applications of the resin-coated material would produce turf equal to monthly applications of the non-coated materials over a six-month period.

Rates of actual nitrogen applied were considered to be adequate only for minimum maintenance of most turf and not necessarily adequate for bentgrass golf greens.

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*A product of Archer Daniels Midland Co., Minneapolis Minnesota.

Preliminary soil sampling of the trial area indicated that phosphoric acid and potash were already ample. The irrigation water contained insufficient nitrogen to affect the response of nitrogen treatments in the trial.

Sixteen treatments applied to areas of 50 square feet each were replicated four times in a randomized block design. The trial was on an established Seaside bent-grass putting green nursery on a sandy soil. The area was mowed at a 1/4 inch height three times per week and was uniformly irrigated with about two inches of water per week. Treatment response in the different replications was well matched.

The trial was of six months' duration which included about three months of warm weather and three months of cool weather. The initial fertilizer applications were made on August 11, 1961. The monthly applications were exactly four weeks apart. Data taken every two weeks included fresh clipping weights from five treatments and a color rating of 1 to 5 (best to poorest color) on all treatments. The five treatments reported here, each providing three pounds of actual nitrogen per 1000 square feet per six months, are as follows:

MATERIAL	APPLICATIONS
Heavy Coated 20-10-5	Initial only
Heavy Coated 20-10-5	Initial, again at 3 mo.
Ammonium sulfate	Monthly
Ammonium phosphate sulfate	Monthly
Control	No fertilizer

A serious problem developed during the initial stages of the trial. A large proportion, possibly 50 per cent, of the coated fertilizer was removed by the first few mowings at a 1/4 inch height of cut. Beside actual removal of much of the fertilizer, many remaining capsules were broken by the mower. The net effect of this development was to reduce the amount of fertilizer being applied and to minimize the longevity. The graphs show this to be essentially the case.

Discussion

The data from this trial indicate that there is little relationship between color and fresh clipping yeild except at the lower ratings. When a color rating dropped to 4 or 5 (poor), the clippings also were at a minimum. However, within any rating of 1, 2, or 3 the clipping yields varied greatly. It appeared that some high clipping yields result from nitrogen over-stimulation which exhausts the plants, at the expense of vigor or appearance of the turf. Thus a poor color rating can indicate both over-fertilization as well as under-fertilization.

Yield of clippings is a poor rating measurement. The data indicate that fluctuations of moisture and temperature caused substantial yield variations. From a practical standpoint a healthy turf with reasonably good color and the lowest possible yield would be ideal. Both color ratings and yield are considered in this test of fertilizer performance, with emphasis being placed on the consistency of performance, with least variation of quality, color and yield.

In the graphs, four like treatments of three pounds of actual nitrogen per 1000 square feet per 6 months are compared with the unfertilized control. The degree of consistency is measured by the variation of each treatment from its own average. On evaluating the graphs, one must keep in mind the position of the average level of each treatment in relation to the other treatments.

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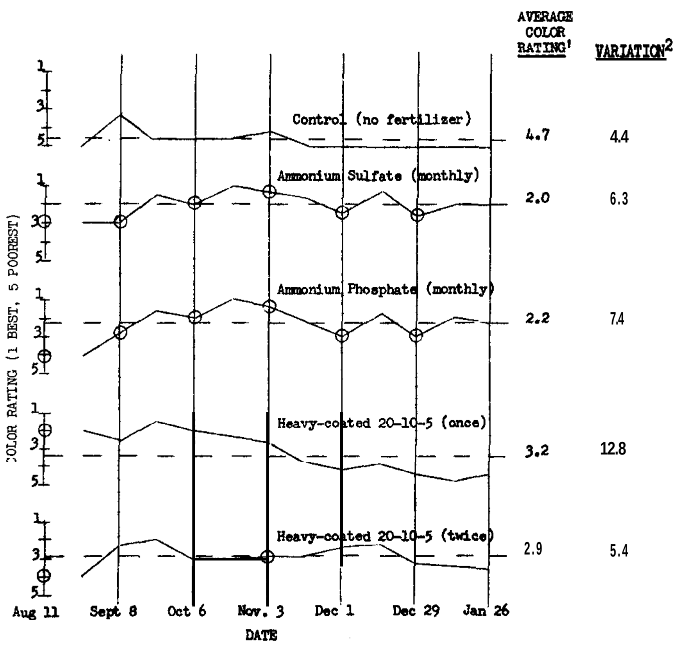
color ratings - 3 pound NITROGEN TREATMENTS VERSUS CONTROL
AVERAGES AND VARIATION FROM EACH TREATMENTS'S OWN AVERAGE

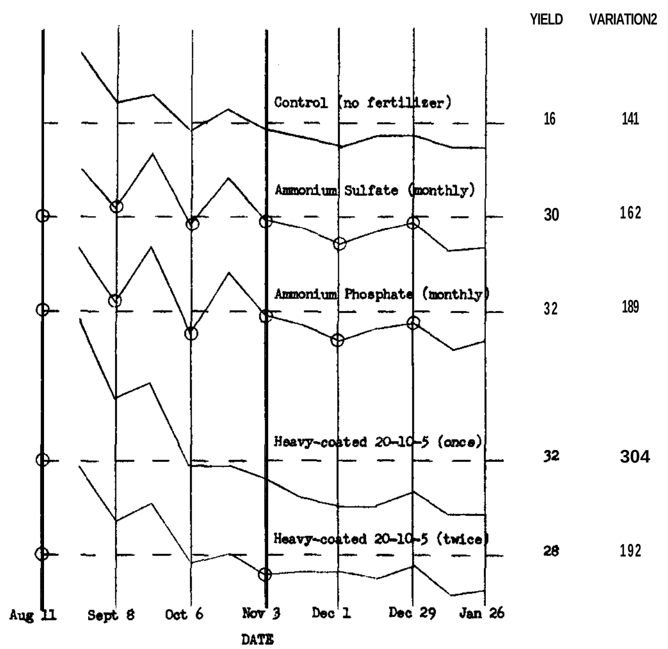


O Fertilizer application made

1 Simple average of 12 color ratings, lowest average is best

2 Sum of plus and minus ratings above and below treatment average

CLIPPING YIELD (GRAMS - 3 POUND NITROGEN TREATMENTS VERSUS CONTROL
AVERAGES ANDVARIATION FROM EACH TREATMENT'S OWN AVERAGE



O Fertilizer application made

1 Grams, average per clipping

2 Sum of plus and minus readings above and below treatment average

The check or control shows this treatment to have the least variation but a color rating of 4.7 indicates very poor color. Density and growth were also very poor. In comparing the four fertilizer treatments, all had virtually the same yield for the six-month period. Ammonium sulfate applied monthly, had the least total variation of yield. Fully as important as total variation is the pattern in which the variation occurs. This pattern is best depicted by the graphs themselves. It is very evident in the first three months (warm period) of the yield charts that the uncoated fertilizers produced an up and down or erratic growth pattern. The pattern of the coated fertilizer was much steadier. The decline could easily be due to partial removal of the material by mowing, as cited earlier.

Evaluating the treatments on color rating, the coated fertilizer applied twice in six months had the least variation of color but a slightly poorer color rating than either ammonium sulfate or ammonium phosphate sulfate applied monthly.

Weather affected all treatments, including the unfertilized control, in similar manner. Both color and yield were considerably less in cool weather, essentially the last three months. The effect of a brief warm spell during December demonstrates this principle on the graphs.

Summary

Results from this trial show that regular monthly applications of a soluble nitrogen fertilizer such as 21-0-0 or 16-20-0 at a rate of 1/2 pound of actual nitrogen per 1000 square feet per month give very satisfactory turf performance. Keeping in'mind that the coated fertilizer in this trial was jeapardized by partly being removed and some injured by close mowing, it appears that one application, at the same nitrogen rate as above, applied every three to four months will give equally satisfactory performance. Coated fertilizer lasting six months from one application appears within the realm of possibility with the right membrane coating, method of application, type of plant being grown, and other factors.

Subsequent demonstrations on putting greens have shown that the coated fertilizer applied following an aerification, is not susceptible to removal by close mowing.

A Seaside Bentgrass golf green in regular play near the coast in San Diego was fertilized with the heavy-coated 20-10-5 fertilizer, broomed into aerfication holes and top dressed with sand in mid-November 1961. The rate was about four pounds of nitrogen per 1000 square feet. It was not necessary to fertilize again until March 15, 1962. Color and texture of the turf were excellent. During this four-month period a serious dollar-spot fungus problem existed on all other greens of the golf course, and control was imperfect despite constant fungicide application. The green which received the coated fertilizer showed no fungus symptoms and was never treated with fungicides. Apparently the coated fertilizer maintained constant adequate fertilization and constant vigor enabling the turf to resist disease.

Chemical Brush Control

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Brush near the rural home is a fire hazard in California. However, many of the native shrubs may become attractive ornamentals when competition from other shrubs is eliminated. Their natural adaptation to the site is also an important consideration in landscaping. Scattered shrubs do not present the same fire hazard that exists with dense stands of brush.

Shrubs may be either thinned out or eliminated from woodland areas with chemicals. Poison oak, frequently found beneath live oak trees, should be removed. In some cases it is also desirable to reduce the number of trees to allow those remaining to become larger and more attractive. The chemical pruning of low-hanging branches on live oak trees also helps to control fire since these branches carry fire to the rest of the tree. Normal removal of dry plant residues from beneath the trees also increases the fire protection.

Reducing the quantity of dry grass helps to control the spread of fire. One satisfactory method for dry grass reduction is to use horses or other livestock to graze off the grass. For landscaping purposes, bushes that are least attractive to livestock can be selected. These include: manzanitas, madrone, sugar bush, laurel sumac, buckeye, redbud, and some of the Ceanothus. However, many other shrubs are also satisfactory if the stocking rate is not too heavy and after the bushes have become fairly large. Year-around use of stock is the easiest method of maintaining these areas (with light use in winter months). The livestock will help control brush regrowth, thereby reducing the amount of spraying necessary.

When stocking is undesirable or impossible, the quantity of grass on the ground should be reduced chemically. Most native shrubs and trees (in unirrigated areas) appear to tolerate low dosages of the soil sterilant, simazine. An application of simazine in the winter beneath the shrubs and trees would protect them against fire (4 pounds per acre is suggested). Some types of brush seedlings are not killed by this treatment, however, and some spraying with 2,4-D and 2,4,5-T (brush killer) will also be necessary. If the treated areas are not mechanically disturbed, and seeds brought near the surface where they can germinate, chemical treatments will be more effective.

Herbicides

The low volatile esters of 2,4-D and 2,4,5-T are com-

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monly prepared as mixtures called brush killers. Similar mixtures of the oil-soluble amines are now available. Since the amine mixtures are essentially non-volatile, they would be safer to use when sensitive plants are close at hand. The esters, like these oil-soluble amines, are soluble in oil and emulsifiable in water. The number of pounds of actual chemical per gallon of material varies, but the esters usually contain 4 pounds of actual 2,4-D and 2,4,5-T in each gallon. Water-soluble amines of 2,4-D normally come in preparations containing 4 pounds of actual 2,4-D in each gallon.

Ammate (mmonium sulfamate) is a water-soluble inorganic salt.

Amitrole (amino triazole) is a water-soluble chemical that is commonly used for controlling poison oak.

Several soil fumigants that can be used for controlling woody plants include ethylene dibromide, DD, Telone and SMD (Vapam or VPM).

Fenuron can be obtained in 25 per cent pellets for application to the soil.

Folior sprays

Woody plants may be sprayed during the growing season after some leaves have become fully enlarged on all of the bushes. Spraying may be continued as long as plants are growing. When growth stops due to the exhaustion of soil moisture in the root zone, woody plants are less sensitive to sprays. Sprays should cover the entire plant, including the lower leaves and the stems. Some woody plants require as many as 3 annual applications to completely kill them.

If a fire has occurred, conditions are excellent for initiating a spray program because: (1) the sprays can be kept close to the ground, which reduces the danger of drift onto sensitive plants; (2) less foliage present means less spray is required to treat a bush or a given area; and (3) the fire-damaged plants are more susceptible to 2,4-D, 2,4,5-T and amitrole.

The plants may be sprayed with brush killer(2,4-D plus 2,4,5-T) or Ammate. Brush killer is used at the rate of one-half pound of actual chemical to 12.5 gallons of water. Ammate is generally used at the rate of 9 pounds of chemical to 12 gallons of water, with one-half ounce of sticker-spreader added.

Amitrole is especially valuable for killing poison oak and sometimes blackberries. It is more selective than either brush killer or Ammate. Use one-half pound of actual amitrole (1 pound of commercial 50 per cent) to 10 gallons of water and add one-half ounce of sticker-spreader. A greater concentration increases the effectiveness but decreases selectivity.

The backpack mist blower is useful for applying sprays where drift problems are not important and for treating larger areas, especially where sensitive crops are relatively far away.

Brush killer is mixed with diesel fuel and sprayed or poured all around the first foot of the stems, using about 3 fluid ounces for each inch of stem diameter. Stems larger than 2 inches in diameter should be chopped through the bark near the base to facilitate penetration. Although the esters are superior to the oil-soluble amines, the latter should be used when fumes from esters might damage other plants. Applications in the winter or spring give best results.

Cut-surface treatment

The cut-surface method is effective, but it is of limited usefulness near the home where dead trees would be unsightly. Cuts should be made near the ground with a heavy hatchet or axe, through the bark, well into the wood and continuous around the tree. Cuts should be filled with undiluted water-soluble 2,4-D amine. If Ammate is used, cuts must be larger to hold an appreciable quantity of the dry salt. Applications made in the winter and spring give the best results.

Injury to near-by trees of the same species is not common but has been observed. This injury may occur because of root grafts which allow the chemical to pass from one plant to the next.

Stump control

Stumps may be sprayed with the basal spray mixtures already described. Tops and sides of stumps should be covered thoroughly with the spray as well as all sprouts that might be present. Effectiveness is increased by cutting into larger stumps near the base. Control is best when stumps are treated immediately after cutting.

Freshly cut stumps may be treated with 2,4-D water-soluble amine applied liberally to the tops of the stumps, and especially to the sapwood. Winter is the best season for making this treatment. Control is much more effective when the stumps are cut close to the ground. A similar chemical, water-soluble 2,4,5-T amine, is slightly more effective than the 2,4-D amine for controlling sprouting on some stumps but it is more expensive. Ammate crystals placed on top of the stumps can also be used to control sprouting.

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Soil applications

Fumigants are useful for killing woody plants when the number to be treated is limited. One-half cup of soil fumigant is poured or injected into holes 6 inches deep and spaced about 6 inches apart around the base of the bush or tree. Killing is most rapid during the period of active growth. Tests have demonstrated the effectiveness of fumigants against poison oak, blue oak, live oak, walnut, and the St. George Rupestris grape root-stock. Roots are normally killed about 10 inches from the point of application but occasionally roots have been killed as far as 30 inches away. The killing action of fumigants is similar to pruning.

Fenuron pellets have only a limited usefulness near the home. Applications should be made at the very base of the stems from November through January. The dosage required to effect control is variable, depending upon soil type and plant species. One ounce may be enough to kill a small bush but a large clump of live oak may require as much as a pound. Fenuron may wash off and kill grass. It will induce chlorosis on shrubs or trees having roots beneath the point of treatment and injury may result. Application is quite easy and in many cases no retreatment is needed. Chemical costs are probably greater than for the other chemicals discussed.

Precautions

Both 2,4-D and 2,4,5-T can damage surrounding plants due to drifting of the spray. Considerable care is necessary in making applications. A use permit from the County Agricultural Commissioner is required to purchase more than one-half pound of actual chemical within a 24-hour period. The spray equipment used in applying these materials is difficult to clean with certainty; therefore, it is safer not to use such equipment for applying insecticides or other chemicals that might be used on plants. Ammate is quite corrosive, so spray equipment should be washed immediately after use. Fumigants should be kept off the skin and not spilled onto the shoes.

Carob Tree Growth Stimulated with Gibberellin

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Slow stem elongation and the excessive time required for production of a salable plant have been problems with a number of nursery plants including the carob tree ***(Ceratonia siliqua).*** Aqueous spray applications of potassium gibberellate concentrations made at specific intervals, over a 20-week-treatment period, offer the possibility of producing salable plants more rapidly than would be possible under ordinary nursery management practices.

Two-month-old carob seedlings were planted in 1-gallon cans and treatments were begun out of doors in mid-October. Eight separate randomized treatments of five plants per replicate were used, as listed in the table. The foliage of each plant received approximately 5 ml of solution at each time of application.

Observations were made weekly on total stem elongation. At the end of 20 weeks, the treatments were discontinued and rhe plants were allowed to grow for an additional 10 weeks to determine their post-treatment response. At this time, total elongation, number of nodes, and number of leaflets were recorded.

Table

The table shows that shoot elongation was generally proportional to the concentration of gibberellin applied. Also the number of leaflets produced and number of nodes produced were significantly greater in most gibberellin treatments.

Graph

The graph shows that the 50-1T/M treatment (50 milligrams per liter applied one time per month) or the 25-2 T/M treatment produced almost a linear elongation with time which exceeded the other treatments. The 10-lT/W treatment (l0mg/l applied one time weekly) approached these concentrations at 20 weeks, but fell off rapidly when treatment ceased. Such frequent treatments caused the plants to become weak and spindly, and eventually to die back prior to the 30-week observation. This caused lateral branching and reduced the total height, producing more variability within the treatment. Of 25 plants treated with 10-1T/W, 15 were definitely abnormal and 3 were

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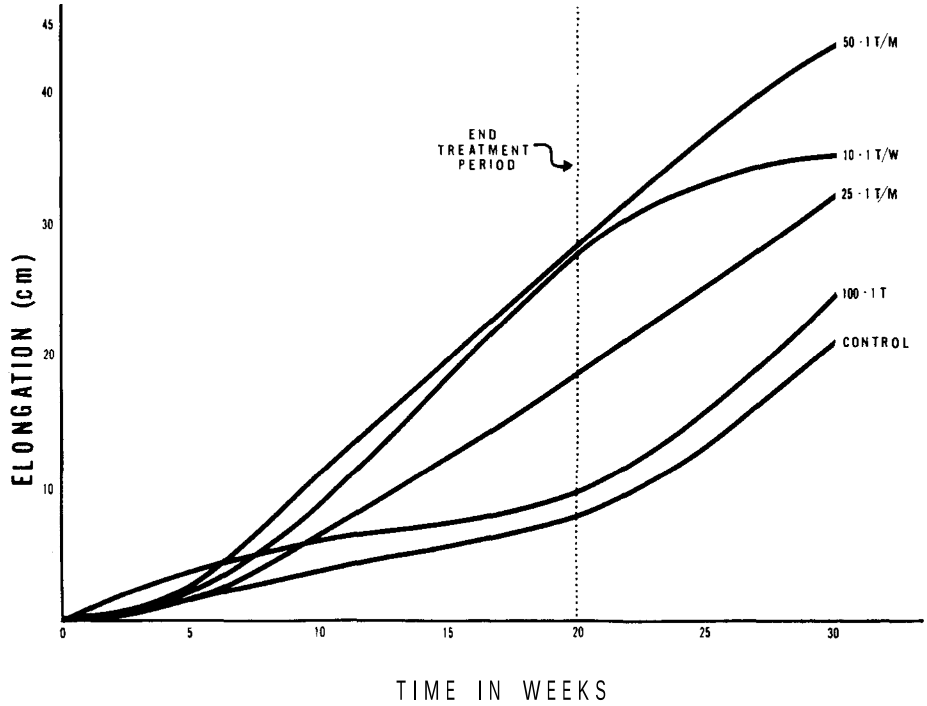
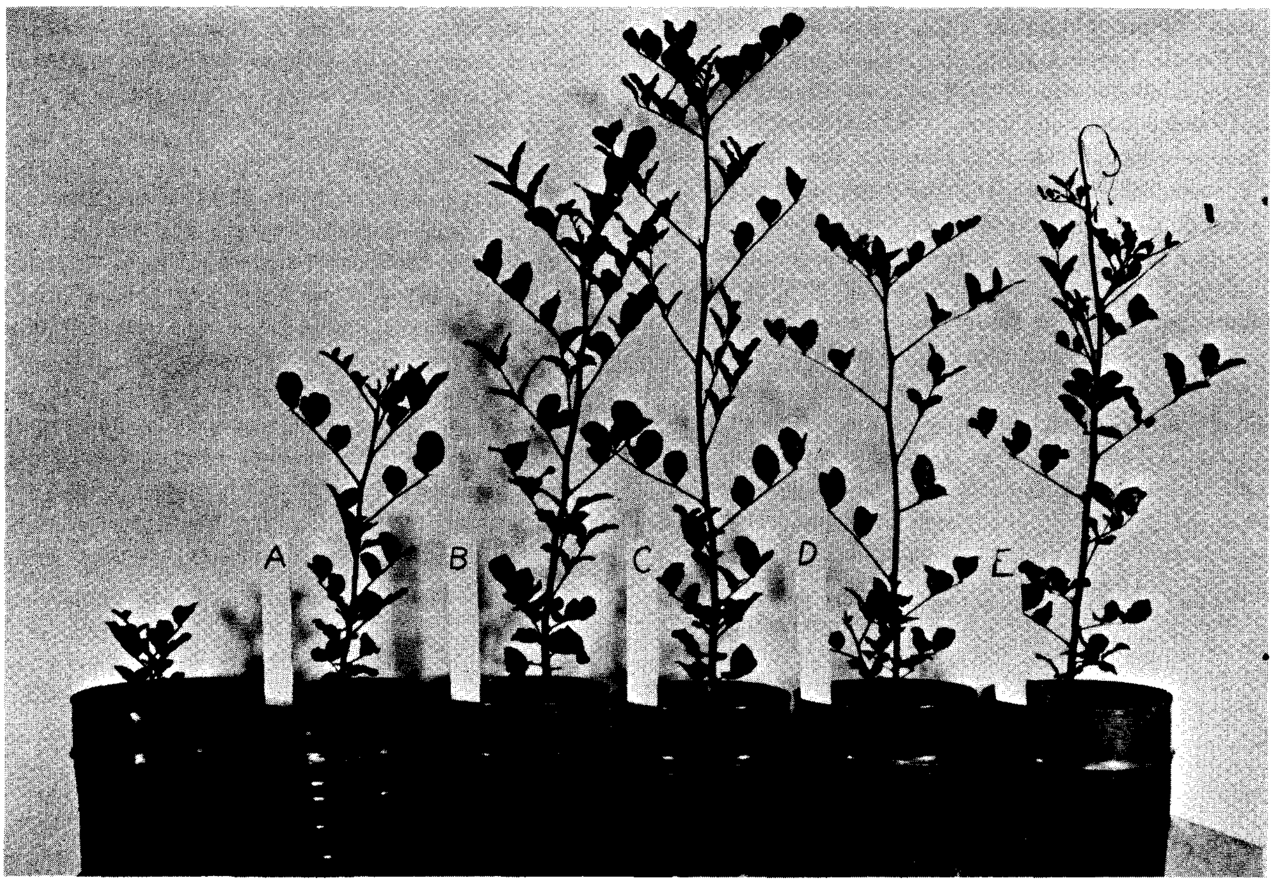
Treatment	Total concen-tration	Treatment symbol	No. of leaflets	No. of nodes	Increase in Ht. (cm) at 20 wks.	Increase in Ht. (cm) at 30 wks.
100 mg/l-one time only..	100 mg/1	100.1T	50.88	16.04	9.64	25.08
50 mg/l-one time only	50 mg/l	50.1T	46.48	15.80	8.08	21.44
50 mg/l-one time/month..	250 mg/l	50-l T,'M	61.84**	18.48**	27.92*'	43.68**
25 mg/l-two times/month..	250 mg/l	25.2T/M	57.32*	18.16**	28.60**	42.92**
25 mg/l-one time/month..	125 mg/l	25.IT/M	55.40*	17.20"	I820**	32.36**
10 mg/l-two times/month..	100 mg/l	10.2T/M	59.60**	18.52**	19.a4**	36.08**
10 mg/l-one time/week..	200 mg/l	IO-IT,'W	51.50	16.95	28.27**	3e.55**
Control	0	Control	43.76	15.08	7.88	21.12

* Significant at 5% level.
** Significant at 1% level.

dead at the 30-week observation period. Note that the slope of the curve approaches a constant after the treatment period (except for the 10-lT/W treatment). Preliminary results with ***Brunfelsia calycina,*** var. Macrantha ***(B. lindeniana)*** indicated that it was also responsive to similar concentrations of potassium gibberellate. Further testing may reveal similar results for other slow-growing species.



Graph illustrates shoot elongation over 30 week period with four gibberellin treatments compared to control. Table details significance of treatments.



Representative plants at the 30 week observation date. No label-Control, A – 100-1 T, B – 25-1 T/M, C – 25-2T/M, D-10-2T/M, E-10-1T/W.