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Effects of petroleum mulch and method of preemergence application of diuron, prometryne, CIPC, and DCPA on cotton weed control, soil moisture, soil temperature, and cotton yield

Kent M. Reasons

To the Graduate Council:

I am submitting herewith a thesis written by Kent M. Reasons entitled "Effects of petroleum mulch and method of preemergence application of diuron, prometryne, CIPC, and DCPA on cotton weed control, soil moisture, soil temperature, and cotton yield." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

Henry Andrews, Major Professor

We have read this thesis and recommend its acceptance:

Edward E.C. Clebsch, Elmer Gray

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

July 30, 1964

To the Graduate Council:

I am submitting herewith a thesis written by Kent M. Reasons entitled "Effects of Petroleum Mulch and Method of Preemergence Application of Diuron, Prometryne, CIPC, and DCPA on Cotton Weed Control, Soil Moisture, Soil Temperature, and Cotton Yield." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

Henry Andrews
Major Professor

We have read this thesis and recommend its acceptance:

Elmer Gray

Edward E. C. Clebsch

Accepted for the Council:

Hilton A. Smith
Dean of the Graduate School

EFFECTS OF PETROLEUM MULCH AND METHOD OF PREEMERGENCE APPLICATION OF DIURON, PROMETRYNE, CIPC, AND DCPA ON COTTON WEED CONTROL, SOIL MOISTURE, SOIL TEMPERATURE, AND COTTON YIELD

A Thesis

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of the Requirements for the Degree

Master of Science

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by

Kent M. Reasons

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CHAPTER I

INTRODUCTION

Mulches are used to stimulate plant vigor and growth by increasing the soil temperature, decreasing soil moisture loss by evaporation, and in many cases controlling weeds. Throughout the ages rocks, stones, dry soil, and almost all forms of naturally occurring plant residues have been used as mulches. Some of the newer mulching materials are black paper, polyethylene plastic, and liquid mulches that are sprayed on the soil surface.

The paper and plastic mulching materials have brought about the greatest changes in the plant's microenvironment. These two materials have a greater water and temperature holding capacity than do any of the older mulching materials.

The greatest disadvantages of paper and plastic are the difficulty of application and the reclaiming of the material at the end of the growing season. Because of this, spray-on agricultural mulches have been developed which can be applied with conventional spray equipment and for which there is no need of reclamation.

Weed control is the greatest problem to be coped with when the liquid mulches are used. They provide better growing conditions for the crop, but at the same time better growing conditions are also provided for the weeds.

In this study a specially formulated water emulsion of petroleum resins, supplied by the ESSO Research and Engineering Company, Linden, New Jersey, was used as a spray-on mulch. The purpose of this study was to determine the effects of the petroleum mulch and methods of preemergence application of herbicides on weed control, soil moisture, soil temperature, and cotton yield.

CHAPTER II

REVIEW OF LITERATURE

The use of organic materials for crop mulching is an old well-known cultural practice. In general all mulching materials possess the same properties of conserving soil moisture, stabilizing soil temperature, stabilizing the soil, controlling weed growth, and increasing yield (1).[1]

I. SOIL MOISTURE

Peters and Russell (32) reported that the greatest amount of moisture loss in a cultivated field can be attributed to evaporation. According to Waggoner et al. (39), evaporation from bare soil depends upon the shelter from the sun and wind and upon the frequency of rainfall. Both white and black polyethylene plastic prevented evaporation from the soil, and thus conserved soil moisture and made it readily available for plant use when moisture was the limiting factor. Harrold and Peters (17, 32) conducted experiments in Illinois using black polyethylene plastic on corn that was grown in weighing lysimeters. The plastic was sealed tightly around the corn plant to prevent any escape or entrance of water. They concluded that 56 per cent of the total evapotranspiration that occurred in the unmulched plots could

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[1]Number in parentheses refers to literature cited.

be attributed to evaporation from the soil surface. When all evaporation was eliminated by the use of polyethylene plastic a good corn (*Zea mays*) crop could be grown without the addition of any summer rainfall (32). Shaw (35) used polyethylene plastic on corn in Iowa and found that water loss under the plastic was only 46 per cent of the total water loss in the uncovered plots. He also concluded that mulches which allow water to penetrate the soil, but do not permit water to escape by evaporation, greatly increased the amount of water available to the crop.

In order to determine the efficiency of water use, Peters *et al*. (31) conducted experiments using clear polyethylene plastic as a mulch on soybeans. Three treatments were used: (1) open surface plots, receiving natural rainfall, (2) plastic covered plots, receiving no rainfall or irrigation water, (3) plastic covered plots receiving no rainfall, with irrigation water added in 1 inch increments. They concluded that the most efficient use of water occurred under the plastic cover when irrigation water was added as needed. They also found that, during a dry season, when the plants were grown on a normal open soil surface, 25 to 50 per cent of the total soil moisture loss was due to evaporation. When the soil was kept wet during the growing season, more than 50 per cent of the total moisture loss was due to evaporation.

Moore (24) used black polyethylene plastic as a mulch in young concord grape vineyards in Virginia. He found that the vines in the mulched plots rooted faster and grew more rapidly than did the unmulched vines. The mulched vines produced grapes 1 year earlier than did the unmulched vines. It was concluded that the conservation of soil moisture was the most important contribution of the mulch to plant growth. It was necessary to provide small holes in the plastic to allow rainfall entry into the soil.

Paper has been an effective mulch in vegetable production, but is costly, too fragile, and deteriorates too quickly to be used economically as a mulch in most cases. Aluminum foil does not deteriorate rapidly, but is still too costly. Emmert (14, 15) evaluated paper, aluminum, and plastic mulches for vegetable production in Kentucky. In these tests Emmert (15) found black polyethylene to be the cheapest and most effective material that had been used on vegetables. He also found that irrigation worked well with polyethylene plastic if slits were provided for water entry into the soil. In these tests, the plots that were completely covered with plastic gave the highest yield. The 3 foot wide strips did not adequately conserve soil moisture. He also concluded that black polyethylene plastic was an exceptionally good mulching material for early grown vegetables. The plastic increased yield, improved the quality of fruit, and conserved moisture when compared to the unmulched plots.

Benoit _et al._ (4) used ground corn cobs, dust, and gravel 2 to 5 millimeters in diameter as mulches applied to a depth of 2 inches, to saturated soil cores in laboratory tests in Iowa. The test was run under several combinations of light intensities and wind velocities. The gravel mulched cores lost 66 per cent as much water by evaporation as the corn cob mulched cores, and 50 per cent as much water as did the dust mulched cores. The water loss for the first 25 days from the unmulched cores was 50 to 100 times greater than from the mulched cores. The upper 6 inches of the unmulched cores dried out almost completely while the upper 6 inches of the gravel mulched cores remained moist. There was little difference in the moisture of the mulched and unmulched cores below the 6 inch depth. From this it was concluded that the greatest amount of water loss by evaporation occurs in the upper 6 inches of the soil.

When petroleum mulch is applied on the soil surface, there are three routes of escape for soil moisture: loss through the film, normal evaporation from the adjacent bare soil, and loss due to lateral movement. Standard Oil (36) conducted several experiments in Arizona with a specially formulated water emulsion of petroleum resins used as a mulch. These tests were carried out on both horticultural and agronomic crops. The rate of moisture loss by these three routes was relatively constant at 25 to 35 per cent of the maximum rate of evaporation from the bare soil. The water saving capacity for four widths of mulch strips was estimated for an average growing season in Tucson, Arizona. The strip widths used were 10, 20, 28, and 64 inches. It was estimated that the 10 inch mulch strip would conserve 0.3 inches of water in a 14 day period and a total of 3.1 inches of water in a 168 day growing season, and the 20 inch strip would conserve 5.4 inches of water in this period of time. The 28 inch strip would conserve 6.5 inches of water during the growing season, and the 64 inch strip would conserve 7.9 inches of water in a full growing season. Therefore it was concluded that in Arizona there would be little value of exceeding a strip width of 28 to 30 inches.

Tokatori et al. (38) used petroleum mulch, clear plastic, and black plastic as mulching materials for vegetable crops in California. Changes in moisture per cent was recorded by taking core samples at the 0 to 2 inch and 2 to 4 inch depths at 3 day intervals. The moisture loss was studied for 1 month periods in July and October. The clear plastic and the black plastic retained more moisture in both July and October than did the petroleum mulch. There was little difference in the moisture per cent of the bare soil and the soil covered with the petroleum mulch. In July, after irrigation was stopped, the bare soil and the petroleum mulch plots dropped from 19 to 6 per cent moisture in 14 days. The plots that were mulched with 12-inch strips of plastic retained 10 per cent moisture over this same 14 day period. Specific data were not presented but Tokatori (38) reported that the petroleum mulch did a much better job of conserving soil moisture in October when the drying conditions were less severe.

Tests were conducted in Texas by Hatchett and Bloodworth (18) using petroleum mulch as a covering for dryland cotton drills. The petroleum mulch was applied at rates of 60, 125, and 170 gallons per acre. Four days after planting and treating, the soil moisture of the plots receiving the high rate of mulch was 17.6 per cent and the soil moisture in the unmulched plots was 13.3 per cent. This difference was significant at the .01 level of probability. This significant difference was maintained for 6 days, but after this period of time there were no differences in any of the treatments. There was no statistical difference at the .01 level of probability between the soil moisture per cents of the mulched and unmulched plots at depths below the seed zone.

II. SOIL TEMPERATURE

Soil and air temperature are most important in the late winter and early spring. The usual effect of a mulch, regardless of the type, is to raise the soil temperature during the winter and early spring and to lower it during the summer (22). Shadbolt et al. (34) found that vegetables would produce higher yields in California if they could be seeded before the normal soil temperatures becomes adequate for germination. He indicated that the soil temperature could be made more favorable for germination of seed by using clear polyethylene plastic as a covering. In this experiment 1.5 mil thick plastic was used, as perforated and unperforated covers. The perforations consisted of holes three-sixteenths of an inch in diameter, spaced 2 by 3 inches throughout the center 18 inches of the film. The covers were raised off the ground to a height of 12 inches. At 12:50 p.m. on February 4, 1960, when the outside temperature was 70° F., the air temperature under the perforated cover was approximately 100° F., and the soil temperature at the 1 inch depth was 82° F. The unperforated cover had an air temperature of 107° F. and a soil temperature of 85° F. The unperforated cover had higher soil and air temperatures, but when the covers were removed the plants did not grow as well as did the plants that had been germinated under the perforated covers. This difference was due to the fact that the plants in the unperforated covers were less cold hardened than the plants that were grown in the perforated covers.

Waggoner _et al_. (39) reported the effects of black plastic, translucent plastic, and aluminum foil mulches on solar radiation. According to Waggoner (39) black plastic absorbs much and reflects little insolation. It can conduct little of this insolation downward because of the underlying air, thus the soil beneath remains cool. The film itself then becomes hot and conducts large amounts of energy back to the atmosphere. The translucent plastic transmits much insolation to the soil beneath. The upward loss of energy from the soil is difficult because the layer of air beneath the film is still and the film absorbs and radiates long wave radiation, thus the energy is conducted into the soil, and it is warmed. The aluminum foil reflects much, absorbs some, and transmits no radiation. Like the black film it can conduct little energy downward, but unlike the black plastic the aluminum remains cool and so does the soil.

Jacks _et al_. (22) used gray paper and black paper as mulches in California. Both of these mulches were applied as perforated and unperforated covers. At the 3 inch depth, the unperforated black paper had a soil temperature 7 degrees warmer than the unmulched plots, while under the perforated black paper the soil temperature was 4 to 5 degrees warmer than the unmulched plots. The gray paper, both perforated and unperforated, had a soil temperature cooler than the unmulched plots.

These workers found that the increase in soil temperature was directly proportional to the increase of the width of the mulch strip.

Harrold *et al*. (17) grew corn in Illinois under black polyethylene plastic and found the soil temperature at the 3.5 inch depth to average 10 degrees warmer than the temperature of the unmulched plots. He attributed this higher soil temperature to: (1) the lack of heat exchange from the soil to the atmosphere due to turbulence, which was eliminated by the plastic cover, (2) loss of heat was further minimized by the poor conductive properties of the air layer between the plastic and the soil, and (3) water droplets from condensation stopped long-wave radiation from the soil to the atmosphere. The air temperature over the plastic covered plots varied greatly, because the heat was being transmitted from the soil back to the air, therefore when solar radiation stopped, the air temperature dropped rapidly.

Clarkson (10) conducted soil temperature studies in North Carolina in 1957, 1958, and 1959 using 4 foot wide strips of 1.5 mil thick polyethylene plastic as a mulch. The soil temperature was recorded at the 1, 3, and 6 inch depths. The maximum soil temperature at these depths ranged from 1 to 5 degrees warmer than did the soil temperatures of the unmulched plots. The minimum temperatures in the mulched plots were higher than the minimum temperature in the unmulched plots. The air temperature at the surface and 2 inches above the plastic mulch was 20 to 25 degrees warmer than the air temperature above the unmulched plots at corresponding heights. Clarkson (10) indicated that the rate of movement, leaching, and utilization of nitrate nitrogen was reduced under the polyethylene mulch. The corn yield in this test indicated that the utilization of applied nitrogen was more efficient where the polyethylene mulch was used.

Standard Oil (21, 36) conducted experiments at Tucson, Arizona, using petroleum mulch as a soil warmer. The petroleum mulch has a soil warming effect because of: (1) greater energy input per unit area due to higher absorptivity for solar radiation, (2) more rapid conduction of heat downward in the wetter mulched soil, and (3) reduced evaporative cooling. In these tests in Arizona the soil temperature of the mulched plots at the 2 inch depth was 98° F. when the soil temperature of the unmulched plots was 80° F. They stated that the effect that a petroleum mulch will have on the soil temperature is dependent on surface absorptivity, mulch width, and the soil surface geometry.

Tokatori et al. (38) compared petroleum mulch, clear plastic, and black plastic as soil warmers. The petroleum mulch was applied in 3, 6, 12, and 24 inch bands to one row plot and soil temperature readings were recorded at the .75, 1.5, 3, 6, and 12 inch depths. The soil temperature was higher under the petroleum mulch than either the clear or black plastic. The clear plastic was superior, as a soil warmer, to the black plastic and was intermediate between the petroleum mulch and the unmulched soil. The greater soil warming capacity of the petroleum mulch, as compared to the plastic, seems to be the mulch-to-soil contact. The petroleum mulch forms a film in intimate contact with the soil, but there is an air space that develops between the plastic and soil which may act as insulation. As the petroleum mulch band width increased up to 6 inches there was a marked increase in soil temperature, but little difference in temperature was recorded for the 6, 12, and 24 inch bands.

Hatchett and Bloodworth (18) used petroleum mulch on cotton in Texas. They reported that all mulched plots had lower minimum soil temperatures than did the unmulched plots. As the mulch rate was increased, the minimum soil temperature increased, and the maximum soil temperature decreased; however, all of these differences were slight.

III. SOIL STABILIZATION

Beale *et al*. (3) conducted experiments with mulch-tillage in the Piedmont of North Carolina. Corn was grown each summer followed by vetch (*Vicia villosa* Roth.) and rye (*Secale cereale* L.). The summer seeded corn plots were prepared with a disc-harrow and the fall seeded vetch and rye were seeded into the stalks with a grain drill.

A moldboard plow was used for preparing the plowed check plot. In the mulch-tillage plots, the average runoff for a 10 year period was 0.56 of an inch per acre, but the average runoff in the plowed plots was 1.52 inches per acre. The degree of soil aggregation was based on the percentage of the fraction composed of soil particles smaller than 0.20 mm. forming aggregates larger than 0.20 mm. The degree of soil aggregation in the mulch-tilled plots was 45 per cent after 4 years but the degree of soil aggregation in the unmulched plots was only 27 per cent after this period of time. The mulch-tilled plot contained 55 per cent more organic matter in the 0 to 6 inch soil layer than did the unmulched plowed plots. The corn yields of the mulched and unmulched plots were approximately equal.

Chepil (7, 8, 9) used cut-back asphalt and asphalt in water emulsions as soil stabilizers in Kansas. The two materials were applied as a fine spray at rates up to 400 gallons per acre on a basis of undiluted material. The film was initially completely effective at holding the soil. This effectiveness lasted only about 2 weeks on clay soils, and for 2 months on sandy and loam soils. The film was generally porous and took in rain water well. The germination of wheat (*Tritium*), grass, and legumes was unaffected by the asphalt film. When the asphalt was mixed with the soil, a higher degree of aggregation was produced for about 2 years (7), but after this period, the soil progressively became more granular and more erodible by wind. The mulched soil continued to have more water stable aggregates and was more permeable to water than the unmulched soil. Chepil (9) concluded that the asphalt would be an effective soil stabilizer only as long as its sticky properties were maintained.

Standard Oil (36) used petroleum mulch for sand dune stabilization in North Africa. One hectare of dune was treated, with broadcast application, and planted with *Acacia* and *Eucalyptus* seedlings in February of 1961. After a period of 8 months the dune had remained stable, and the tree seedlings had reached a height of 6 feet with more abundant foilage and root growth than the seedlings in the conventionally stabilized plots. The rate of seedling growth in the mulched plots was somewhat better than the seedling growth in the adjacent areas where conventional stabilization had been applied. This extra growth was probably due to the increased thermal absorption by the black surface.

IV. WEED CONTROL

Davis (13) used mulching paper for burley tobacco (Nicotiana tabaccum) production for 2 years in Tennessee. Weed control equal to that produced by cultivation was obtained with the mulching paper, but there was no increase in yield or acre value of the mulched crop over the conventionally cultivated crop. He concluded that the cost of the paper and the labor involved in applying it was greater than the cost of conventional culture.

Parks *et al*. (30) in 1960, used black polyethylene plastic and black paper as a mulch for burley and dark fire tobacco in Tennessee, and found that they would adequately control weeds and therefore eliminate the need for all hoeing and cultivation operations. Parks (30) like Davis (13) concluded that the cost of the mulching material and its cost of application was greater than the cost of hoeing and conventional cultivation. Since the yield was not increased, he concluded that mulching of tobacco was not profitable.

Standard Oil (36) found that a petroleum mulch produces a crop response by increasing soil temperatures in the seed zone and by conserving soil moisture, but these factors also encourage the growth of weeds. Due to the fact that weed growth is also stimulated, it is necessary to incorporate some type of weed control with the application of the petroleum mulch. Standard Oil (36) reported the results of the weed control programs in New York and Oklahoma, in 1960, where the petroleum mulch and various herbicides were used together. In these tests several herbicides were mixed with the petroleum mulch and applied preemergence. The petroleum mulch-herbicide combinations were compared with the conventional aqueous preemergence applications of the herbicides. Both of these tests indicated that the mulch-herbicide formulations gave weed control that was comparable to the conventional herbicide treatment.

Tests were conducted at the Main Experiment Station in Knoxville and the West Tennessee Experiment Station in Jackson, Tennessee in 1962 by Andrews (2) to determine the effect of petroleum mulch and method of preemergence application of herbicides on cotton. Four herbicides, 3-(3,4 dichlorophenyl)-1,1-dimethylurea (diuron), 2,4-bis(isopropylamino)-6-methylmercapto-S-trizine (prometryne), 2,3,5,6-tetrachloro-terephothalic acid (DCPA), and isopropyl-N-(3-chlorophenyl) carbamate (CIPC) were used. This test was conducted under dry growing conditions, and weed competition was not severe. He found that weed control was slightly better when the mulch was used in conjunction with the herbicides than when the herbicides were used alone. There was a greater weed population in the plots where the mulch alone was applied than in the untreated plots.

Wiggans _et_ _al_. (41) found that petroleum mulch alone greatly increased the germination of vegetables and grasses in Oklahoma. When petroleum mulch was used alone there was excessive weed growth, but when herbicides were incorporated with the mulch the amount of weed growth was greatly decreased.

Orsenigo (26, 27) and Orsenigo et al. (28, 29) have screened petroleum mulch-herbicide combination on several crops in Florida. Orsenigo (26) found that when the petroleum mulch was applied over 3-amino-2,5-dichlorobenzoic acid (amiben) and 2-chloro-N,N diallyll-acetamide (CDAA), the toxicity of both materials to sugarcane, (Saccharum officinarum L.) was decreased. When the petroleum mulch was applied over 2,6-dinitro, N, N-di-n-propyl-a,a,a-trifluro-p-toluidine (trifluralin), the toxicity of the material was decreased on sugarcane, and the percentage of grass control was increased by the addition of the mulch.

Orsenigo (27) also found that 12 pounds active ingredient per acre of CIPC gave adequate control of crabgrass (Digitaria sanguinalis L.) and goosegrass (Eleusine indica L.), when 600 gallons per acre (gpa) of petroleum mulch was applied over the herbicide in broadcast application. Orsenigo et al. (28) used herbicides formulated in the mulch and applied them as preemergence sprays. The same herbicides were applied preemergence to summer squash (Curcurbita pepo), sweet corn, cucumber (Cucumis sativus) and snapbean (Phaseolous vulgaris) with the mulch being applied over the herbicides. Ratings were recorded for stand, tolerance, and yield. All herbicides were found to be variable when applied either in the mulch or under the mulch.

Several herbicides were put into the petroleum mulch and used as a preemergence spray in tomatoes (Lycopersicum esculentum) by

Orsenigo et al. (29) in Florida. The mulch-herbicide formulations were applied at the rates of 200 and 600 gpa. The tomato stand and tolerance were rated as acceptable to good for all herbicides in the 600 gpa rate, with the exception of CDAA at 4 pounds per acre. Acceptable grass control was obtained for 6 weeks with N,N-dimethyl-2,2-diphenyllacetamide (diphenamid), 2-chloroallyl di-ethyldithiolcarbamate (CDEC), and CDAA when the mulch was applied at a rate of 200 gpa. CDAA and CDEC also gave 6 weeks control of grass species when applied at 4 pounds per acre in 600 gpa of mulch. Acceptable broadleaf control was obtained for 6 weeks with CDAA, CDEC, DCPA, and amiben when they were applied in 200 gpa of mulch (28). The most common response of a large number of herbicides was a slight reduction of their toxicity to both crops and weeds (26). Abramitis and Miller (1) used petroleum mulch combined with amiben, DCPA, and 0-(2,4 dechlorophenyl)-0- methyl isopropylphosphoramid-otthioate (DMPA) and found that the weed control was comparable to that obtained when the herbicides were applied alone as aqueous sprays.

V. CROP YIELD

Many investigators (2, 11, 12, 13, 19, 30, 38) have used plastic, paper, and petroleum mulches to determine if an economical yield increase could be obtained in various crops. Parks et al. (30) used both plastic and paper mulches in tobacco production and concluded that the uses of these mulches were not economical in Tennessee. Davis (13) reported that the use of paper mulch on burley tobacco gave no increase in yield or acre value over conventional cultural practices in Tennessee.

Darby *et al*. (12) found petroleum and plastic resin sprays as mulches to be promising for vegetable production in Florida. They reported that petroleum mulch applied at the rate of 600 gpa greatly increased the germination, survival, and growth of tomatoes, lettuce (*Lactuca sativa*), beans, collards (*Brassica oleracea*) and cucumbers. In the plots that were mulched, there was no fruit rot with any of the crops, but there was fruit rot in the unmulched plots, therefore the acre value of the crops were increased due to higher quality. Clarkson and Frazier (11) used polyethylene plastic and paper mulches for cantaloupe (*Cucumis melo*) production in Oregon. The yield of early seeded cantaloupes grown in the mulched plots was increased over the yield of cantaloupes grown in the unmulched plots. The plastic mulched plots also yielded a higher per cent of marketable fruits than did either the paper mulched or check plots.

Hatchett and Bloodworth (18) reported that the yield of cotton was not increased in Texas when petroleum mulch was applied at planting. Andrews (2) also reported no significant difference in cotton yield in Tennessee when petroleum mulch was used.

CHAPTER III

MATERIALS AND METHODS

The objectives of this experiment were to determine the effects of petroleum mulch and methods of preemergence herbicide application of diuron, CIPC, DCPA, and prometryne on weed control, soil moisture, soil temperature, and cotton yield. This experiment was conducted at the West Tennessee Experiment Station at Jackson, Tennessee, during the 1963 growing season.

The plots were located on a Memphis silt loam soil. Dixie King cotton was planted on three dates, April 15, May 1, and May 15, with a hill drop planter at a spacing of 16 inches. The different planting dates were used so that a greater range of soil moistures and soil temperatures could be incorporated in the study. Each hill contained 6 to 9 seeds. The petroleum mulch was applied at the rate of 200 gpa, to 36 inch rows, in a 12 inch band over the row with a tractor mounted sprayer.

In order to minimize land use, the experiment was divided into two separate parts, one for the environmental study and the other for a yield study. These two fields were located within 100 yards of each other.

I. ENVIRONMENTAL STUDY

The environmental study was a split-split plot design with three replications. The split plots were two rows wide and 60 feet long, and were further divided into three 20 feet long split-split plots. These subplots were used for the different methods of placement of the herbicides. The three placements methods were incorporated in the mulch, under the mulch, and without the mulch. Diuron, CIPC, DCPA, and prometryne or prometone were applied at each of these placements. The herbicides were applied in a 12 inch band over the row, at one-half the recommended rate, at the recommended rate, and one and one-half times the recommended rate. The herbicides and rates of applications are given in Table I.

The original study called for the use of diuron, CIPC, DCPA, and prometryne. When the herbicides were mixed with the mulch, the manufacturer mixed 2-methoxy-4,6-bis (isopropylamino) s triazine (prometone) instead of prometryne with the mulch. Therefore, prometone was used throughout the study when the herbicide was being applied in the mulch, but when the herbicide was applied under the mulch and alone prometryne was used. This was discovered after the main test had been planted and another small test was conducted using prometryne and prometone at 1, 2, and 3 pounds mixed with the mulch and alone. This test was planted on July 17.

Soil Temperature Recordings

The soil temperature data were collected daily from recording maximum-minimum soil thermometers by personnel of the Mid-South Agriculture Weather Project. Two thermometers were placed in each of the three replications; one of the thermometers was in the row of a mulched

TABLE I

HERBICIDES AND RATES OF APPLICATION USED IN 1963 FIELD EXPERIMENTS WITH PETROLEUM MULCH FOR COTTON PRODUCTION, WEST TENNESSEE EXPERIMENT STATION, JACKSON, TENNESSEE, 1963

Herbicide	Rate, lbs. ai per acre		
	0.5X	1.0X	1.5X
Diuron	0.5	1.0	1.5
CIPC	4.0	8.0	12.0
DCPA	4.0	8.0	12.0
Prometryne or Prometone*	1.0	2.0	3.0

*Prometone was erroneously applied instead of prometryne when the herbicides were mixed in the mulch.

plot and the other in the row of an unmulched plot. Both were placed 1 inch below the soil surface.

Soil Moisture

The soil moisture data were taken at 2 week intervals by gravimetric sampling with a tube sampler. The samples were taken at the 2 inch depth from the mulched and unmulched plots. Two composite samples were taken from each of the three replications. The composite samples were then dried and weighed to determine the per cent moisture.

Weed Control Ratings

Weed control ratings were made at 2 week intervals, and the ratings of the three replications were averaged to give a mean rating for each treatment. The ratings were made on a 0 to 10 basis, 0 being no control and 10 being complete control. The weed control ratings were made separately for the three methods of herbicide placement, as well as the mulch-alone and no treatment plots.

II. YIELD STUDY

The yield study was a randomized complete block design with six replications. The plots were three rows wide and 60 feet long. Forty feet of the center row was harvested for yield determinations. Yields were statistically analyzed by the analysis of variance, and the means were compared by Duncan's Multiple Range Test. Diuron, at 1 pound active ingredient per acre, and prometone or prometryne at 2 pounds active ingredient per acre, were incorporated in the mulch and applied without the mulch as a preemergence spray.

The yield study received no hoeing and only the middles were cultivated. All the weeds in the rows that were not controlled by the herbicides were allowed to grow the entire season.

A 300 boll composite sample was taken from each herbicide treatment, and the sample was analyzed for lint percentage and the lint was then analyzed for length, strength and fineness of fiber.

Rainfall data for April through September were taken from the records of the climatological station at the West Tennessee Experiment Station, Jackson, Tennessee.

CHAPTER IV

RESULTS AND DISCUSSION

A progress report of this study was presented at the Southern Weed Conference in January of 1964 (33).

I. ENVIRONMENTAL STUDY

Data were collected in this part of the study on weed control, soil moisture, and soil temperature. General observations were made on the rate of cotton germination and emergence.

Weed Control

Weed control ratings for the three methods of herbicide placement and the three planting dates of cotton are given in Tables II, III, and IV.

Weed control ratings were made only one time on the April 15 planting (Table II). At the time of application of the mulch and herbicide the soil was dry and remained dry for several days after application. For this reason inadequate weed control was obtained in this planting of cotton.

When the herbicides were applied either in the mulch or under the mulch, there was almost no weed control, but when the herbicides were applied alone, in an aqueous spray, adequate weed control was obtained with the higher rates.

TABLE II

AVERAGE WEED CONTROL RATINGS FOR FOUR HERBICIDES APPLIED AT THREE RATES IN, UNDER, AND WITHOUT PETROLEUM MULCH, COTTON PLANTED APRIL 15, 1963, WEST TENNESSEE EXPERIMENT STATION
0 = NO CONTROL AND 10 = COMPLETE CONTROL

Herbicide	Rate ai lb/A	Placement of herbicide	Weed control 5/17
Diuron	0.5	In	6.6
		Under	7.3
		Without	8.3
Diuron	1.0	In	7.0
		Under	7.0
		Without	8.6
Diuron	1.5	In	5.0
		Under	6.3
		Without	7.1
CIPC	4.0	In	2.0
		Under	2.6
		Without	4.3
CIPC	8.0	In	4.3
		Under	5.6
		Without	6.0
CIPC	12.0	In	7.0
		Under	6.0
		Without	7.6
Prometryne	1.0	In	5.3
		Under	6.3
		Without	7.3
Prometryne	2.0	In	8.0
		Under	8.3
		Without	8.3
Prometryne	3.0	In	8.3
		Under	8.6
		Without	9.0
DCPA	4.0	In	0.6
		Under	2.0
		Without	4.0
DCPA	8.0	In	1.3
		Under	3.3
		Without	4.6
DCPA	12.0	In	2.0
		Under	3.0
		Without	3.6

TABLE III

AVERAGE WEED CONTROL RATINGS FOR FOUR HERBICIDES APPLIED AT THREE RATES IN, UNDER, AND WITHOUT PETROLEUM MULCH, COTTON PLANTED MAY 1, 1963, WEST TENNESSEE EXPERIMENT STATION
0 = NO CONTROL AND 10 = COMPLETE CONTROL

Herbicide	Rate ai lb/A	Placement of herbicide	Weed Control 5/17	6/5	6/20	7/19	8/6	8/23
Diuron	0.5	In	5.6	0.6	2.0	0.6	0.0	0.3
		Under	6.6	1.3	2.6	1.6	0.6	1.3
		Without	8.6	6.3	6.3	6.0	6.6	6.0
Diuron	1.0	In	5.6	0.6	1.3	2.3	2.0	0.6
		Under	7.6	4.0	1.3	5.3	4.3	3.0
		Without	8.0	8.6	8.0	9.0	8.6	9.0
Diuron	1.5	In	6.6	2.6	2.6	2.6	1.3	0.6
		Under	7.0	3.3	3.3	4.0	3.3	3.0
		Without	9.3	8.3	8.3	9.0	8.3	9.0
CIPC	4.0	In	6.0	3.0	2.3	0.6	1.0	1.3
		Under	8.3	7.0	5.3	6.3	6.6	6.3
		Without	9.6	9.3	8.3	8.0	9.0	8.3
CIPC	8.0	In	7.3	5.3	4.6	3.3	2.6	3.0
		Under	8.0	7.0	6.6	6.3	6.0	6.6
		Without	10.0	9.3	8.3	9.0	9.0	9.0
CIPC	12.0	In	7.6	6.3	5.3	5.3	4.6	4.6
		Under	8.0	5.6	5.3	6.3	6.3	6.0
		Without	10.0	8.6	7.3	7.6	9.0	8.6

TABLE III (continued)

Herbicide	Rate ai lb/A	Placement of herbicide	Weed Control 5/17	6/5	6/20	7/19	8/6	8/23
Prometryne	1.0	In	7.0	2.6	1.3	1.3	0.3	0.0
		Under	9.3	6.6	5.0	6.0	4.3	5.6
		Without	10.0	9.3	8.3	8.6	9.0	8.6
Prometryne	2.0	In	7.0	4.3	2.6	4.3	2.3	1.6
		Under	10.0	8.0	6.3	7.6	6.3	7.6
		Without	10.0	9.0	8.6	8.6	8.6	8.6
Prometryne	3.0	In	8.6	6.0	5.0	5.6	1.3	4.0
		Under	10.0	8.6	8.0	8.3	6.0	8.6
		Without	10.0	9.0	9.0	8.6	8.6	8.6
DCPA	4.0	In	5.6	1.6	2.0	1.0	0.6	0.0
		Under	6.0	2.0	2.3	2.6	2.6	3.6
		Without	8.0	9.0	8.6	8.3	8.6	9.0
DCPA	8.0	In	5.6	1.6	2.3	0.6	0.6	0.6
		Under	6.3	2.6	3.6	3.6	3.3	3.3
		Without	9.6	9.0	9.0	9.0	8.6	9.0
DCPA	12.0	In	6.6	3.3	2.3	1.0	1.6	2.0
		Under	6.3	3.6	3.3	2.0	2.6	5.3
		Without	10.0	9.0	8.3	8.3	9.0	9.0

TABLE IV

AVERAGE WEED CONTROL RATINGS FOR FOUR HERBICIDES APPLIED AT THREE RATES IN, UNDER, AND WITHOUT PETROLEUM MULCH, COTTON PLANTED MAY 15, 1963, WEST TENNESSEE EXPERIMENT STATION
0 = NO CONTROL AND 10 = COMPLETE CONTROL

Herbicide	Rate ai lb/A	Placement of herbicide	Weed Control				
			6/5	6/20	7/19	8/6	8/23
Diuron	0.5	In	7.3	6.3	5.3	6.6	6.6
		Under	9.3	8.3	7.6	8.6	8.0
		Without	9.6	8.6	8.6	9.0	8.3
Diuron	1.0	In	6.6	5.3	7.6	7.0	7.6
		Under	9.6	8.6	8.6	8.6	8.6
		Without	10.0	9.3	8.6	9.0	8.6
Diuron	1.5	In	6.3	5.0	5.6	5.6	6.0
		Under	8.6	7.3	7.3	7.0	7.0
		Without	10.0	7.3	8.0	7.6	8.6
CIPC	4.0	In	8.0	5.6	6.6	5.6	6.6
		Under	9.0	7.3	7.6	7.3	8.0
		Without	9.6	7.6	8.3	7.0	7.6
CIPC	8.0	In	8.6	7.3	5.3	5.6	7.0
		Under	9.3	9.0	7.3	7.6	7.6
		Without	10.0	9.0	7.6	8.6	8.0
CIPC	12.0	In	8.6	7.0	6.3	6.6	7.0
		Under	9.3	9.0	8.3	8.6	8.6
		Without	10.0	9.0	9.0	8.3	8.3

TABLE IV (continued)

Herbicide	Rate ai lb/A	Placement of herbicide	Weed Control 6/5	6/20	7/19	8/6	8/23
Prometryne	1.0	In	6.0	5.3	5.6	5.6	6.0
		Under	8.6	7.3	8.6	8.6	8.6
		Without	10.0	8.3	9.0	8.6	9.0
Prometryne	2.0	In	8.3	7.3	5.3	5.3	6.6
		Under	9.3	9.0	7.6	8.6	8.6
		Without	9.6	9.3	9.0	9.0	9.0
Prometryne	3.0	In	9.6	7.6	6.0	7.0	7.0
		Under	10.0	9.6	8.3	8.3	9.0
		Without	10.0	9.6	8.3	9.0	9.0
DCPA	4.0	In	7.0	5.3	4.0	5.3	6.0
		Under	7.3	7.3	7.6	8.3	7.3
		Without	8.6	8.6	8.6	8.6	8.6
DCPA	8.0	In	9.0	7.0	6.6	5.6	7.0
		Under	8.3	7.3	8.6	7.6	7.6
		Without	8.6	9.0	8.0	8.6	9.0
DCPA	12.0	In	8.3	7.6	6.0	5.6	6.0
		Under	8.6	7.6	8.0	7.6	8.0
		Without	9.6	9.0	8.6	8.3	8.6

There seemed to be an adequate supply of soil moisture (Table V) when the May 1 planting was made, and satisfactory weed control was obtained with all herbicides at all rates when they were applied alone as preemergence sprays (Table III). When the herbicides were mixed with the mulch unsatisfactory weed control was obtained, with the exception of the 12 pound rate of CIPC and the 3 pound rate of prometone. These were the only two rates of these herbicides that gave adequate weed control when they were incorporated in the mulch. When the herbicides were applied under the mulch, better weed control was obtained than when the mulch-herbicide mixture was used, but this treatment did not give weed control that was equal to the herbicide alone treatments.

Diuron alone at the 1 pound rate gave adequate weed control, but when this rate of diuron was mixed with the mulch or applied under the mulch, weed control was inadequate. Figure 1 shows 1 pound of diuron in the mulch, Figure 2 shows 1 pound of diuron under the mulch, and Figure 3 shows 1 pound of diuron alone. DCPA, used alone, gave about the same degree of weed control as did CIPC, but did not do as well as did CIPC when it was used in conjunction with the petroleum mulch.

The May 15 planting (Table IV) of cotton received the same herbicide and mulch treatments as did the April 15 and May 1 plantings, but weed control was better in this planting than in either of the other plantings. The reason for this is probably that this land area did not have as great a weed population as did the other areas, and since it was drier at this time, there was less moisture (Table V) for

TABLE V

RAINFALL DATA FOR WEST TENNESSEE EXPERIMENT STATION
JACKSON, TENNESSEE, 1963

Days	April	May	June	July	August	September
1						
2						
3				.32		
4						.06
5						
6	.17	.35		.37		.03
7	.17					
8				.61		
9						
10						
11						
12						
13						.46
14			.04	.98		
15						
16			1.60			
17	.10		.02	.07		
18						
19						
20	.42		.20			
21			.26			
22						
23		.01				
24				.18		
25	.25	.42				
26		2.70				
27		.90	.41	.17	.13	.03
28	.73	.35	.11	.46		
29	1.63	.05			1.03	.41
30	.69			.30	.01	
31				.10		
Total	4.16	4.78	2.64	3.56	1.17	0.99

Figure 1. Weed control obtained with 1 pound of diuron mixed in the mulch.

Figure 2. Weed control obtained with 1 pound of diuron applied under the mulch.

Figure 3. Weed control obtained with 1 pound of diuron used alone.

the weed germination. All of the herbicide rates and placements gave better control than in the two previous plantings. Table IV shows that the herbicide-mulch combinations continued to give weed control that was inferior to the herbicide alone treatments.

When it was discovered that prometone had been mixed with the mulch instead of prometryne, a small experiment using prometone and prometryne was initiated. Table VI contains the average weed control and cotton injury ratings obtained by these two materials. Prometone used alone at the 1 pound rate gave an average cotton injury rating of 8.0, but prometone at the 3 pound rate gave an average cotton injury rating of 2.6 when it was mixed with the mulch. Prometone alone at the 3 pound rate gave a complete kill of all cotton and weeds. Prometryne alone gave complete weed control at all rates and no cotton injury even at the high rates. Figure 4 shows the reduction of toxicity of prometone when it was applied in the mulch.

Only the 1.5X rate of CIPC (12 lb./A) in the mulch and prometone (3 lb./A) in the mulch gave weed control that was comparable to the herbicide alone treatment. These same two herbicides, at the same rates, gave the greatest amount of weed control when they were applied under the mulch. None of the herbicide-mulch treatments gave weed control that was equal to the herbicide alone treatments. The reason for the herbicide-mulch combinations not giving adequate weed control is not known. But since the petroleum mulch film is impermeable to water, it is theorized that there is a possible physical immobilization of the herbicides and they are not leached into the soil zone of the

TABLE VI

AVERAGE WEED CONTROL AND COTTON INJURY RATINGS WITH PROMETRYNE AND PROMETONE APPLIED IN AND WITHOUT PETROLEUM MULCH WEST TENNESSEE EXPERIMENT STATION, JACKSON, 1963 0 = NO CONTROL AND 10 = COMPLETE CONTROL

Herbicide	Rate ai lb/A	Placement of herbicide	Weed control 8/6	Cotton injury 8/6
Prometryne	1.0	In	7.0	0.0
		Without	10.0	0.0
Prometone	1.0	In	8.3	0.0
		Without	10.0	8.0
Prometryne	2.0	In	8.0	0.0
		Without	10.0	1.6
Prometone	2.0	In	7.3	1.6
		Without	10.0	10.0
Prometryne	3.0	In	8.0	0.0
		Without	10.0	3.1
Prometone	3.0	In	8.0	2.6
		Without	10.0	10.0

Figure 4. Weed control and cotton injury resulting from 3 pounds of prometone mixed with the mulch (background) and applied alone (foreground).

germinating weed seed. A second theory is that the herbicides may be chemically bound to the mulch since both are saturated organic compounds.

Soil Moisture

Soil moisture (Figure 5) was determined at the 2 inch depth from the mulched and unmulched plots on different dates during the growing season. Soil moisture samples were taken only one time from the April 15 planting before it was plowed, the remainder of the samples were taken from the May 1 planting. When the sample was taken from the April 15 planting on May 25, the mulched plot had 1 per cent more moisture than did the unmulched plot.

The soil contained 22 per cent moisture when the mulch was applied to the cotton planted on May 1. After nine days without rain, the mulched plots had 19.0 per cent soil moisture and the unmulched plots had 18.8 per cent soil moisture. The soil moisture differences of the mulched and unmulched plots never varied more than this during the remaining sampling period. On May 16, the unmulched plots had a soil moisture percentage that was 0.2 per cent higher than the mulched plots. Therefore there seems to be no value in using petroleum mulch, applied at 200 gpa in a 12 inch band over 36 inch rows for soil moisture conservation in Tennessee cotton production.

Soil Temperature

The soil temperature data were recorded in the April 15 planting from April 18 to May 5, and then the instruments were moved to the May 1

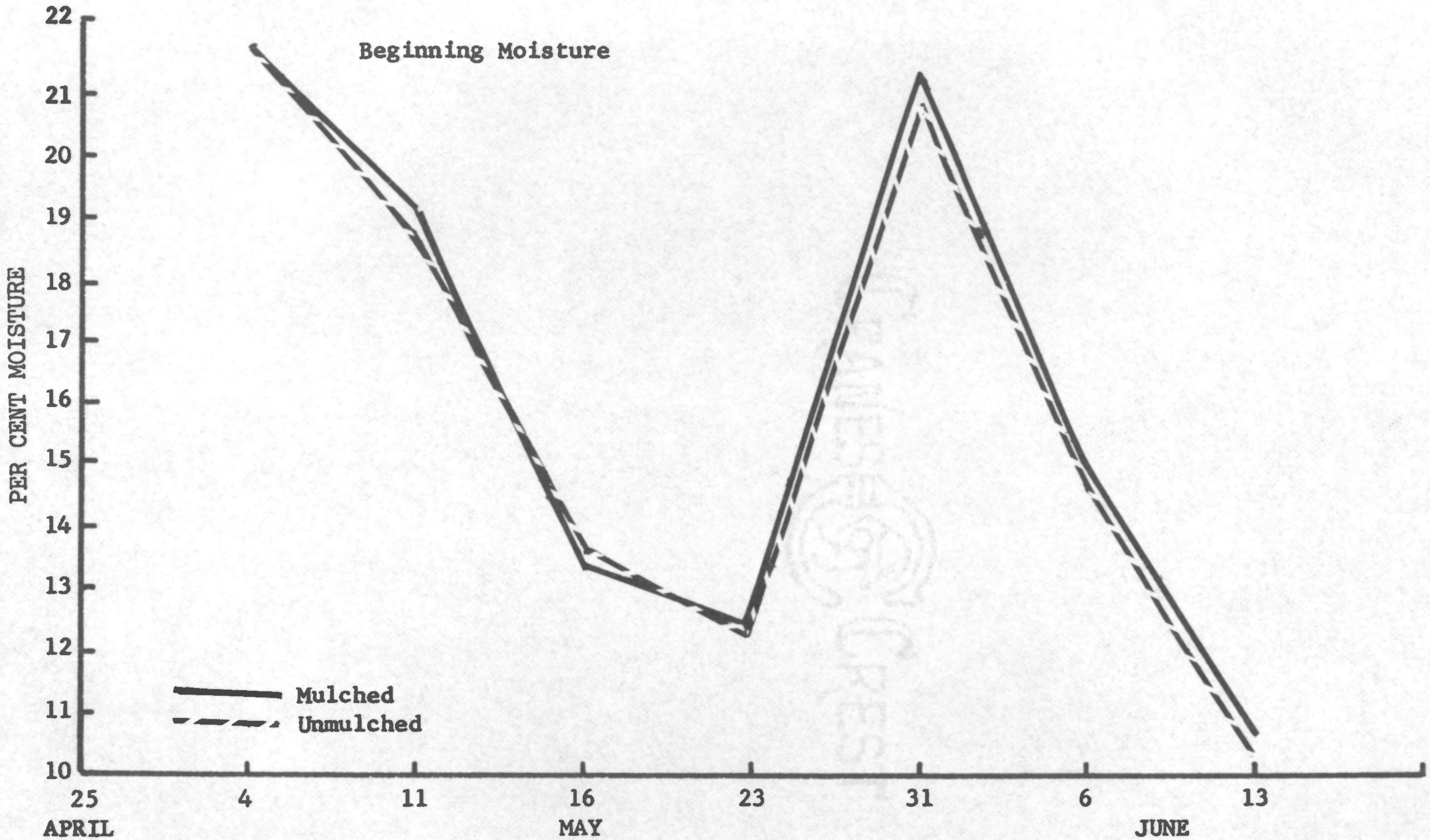

Figure 5. Per cent soil moisture at the 2 inch depth in mulched and unmulched plots, West Tennessee Experiment Station, 1963.

planting. A three day average of the maximum soil temperatures 1 inch below the mulched and unmulched plots and the maximum air temperatures 3 inches above bare soil are given in Figure 6. The minimum temperatures at the same measurements are shown in Figure 7.

In the April 15 planting the maximum temperatures (Figure 6) below the mulched soil averaged 3 to 5 degrees warmer than the maximum temperatures below the unmulched soil. These warmer temperatures persisted for about 15 days after planting. From April 21 to April 24 the maximum air temperature dropped from 88 to 71° F., and the maximum soil temperature of the unmulched soil dropped from 85 to 75° F., but the maximum soil temperature of the mulched plots dropped from 87 to 80° F. During this 15 day period the minimum temperature of the mulched soil remained about 2 degrees warmer than the minimum temperature of the unmulched soil.

On May 3 the recording thermometers were moved from the April 15 planting to the May 1 planting. This was 2 days after the mulch had been applied. For the first 15 to 20 days after the mulch application the maximum soil temperature in the mulched plots was 6 to 8 degrees warmer than the maximum soil temperature in the unmulched plots, and the minimum soil temperatures were 2 to 3 degrees warmer in the mulched plots. After this period of time both maximum and minimum soil temperature in the mulched and unmulched plots were about the same. After June 27 both the maximum and minimum soil temperatures in the unmulched plots were greater than the maximum and minimum temperatures in the mulched plots. The reason for the unmulched plots having a higher

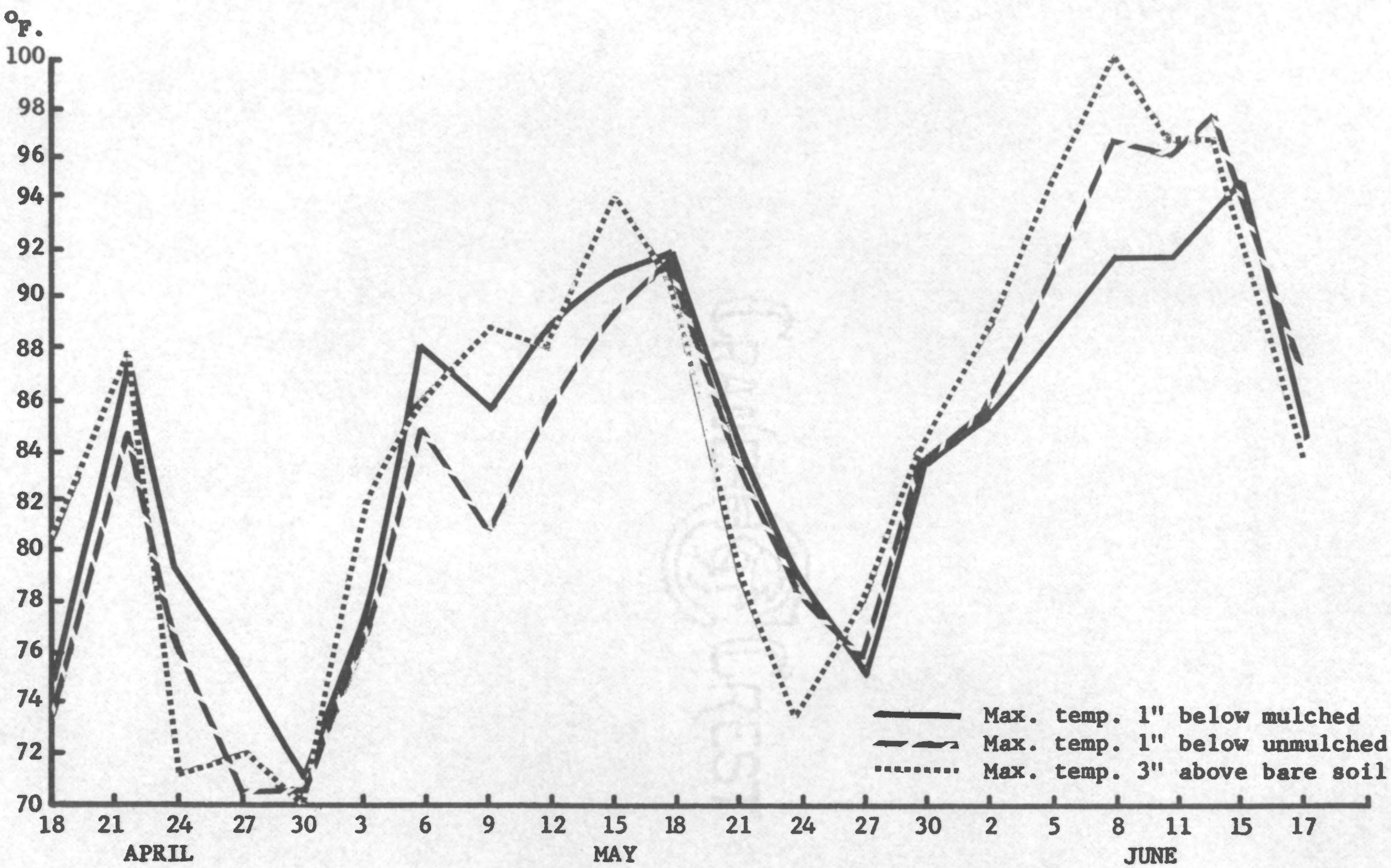

Figure 6. Three day averages of maximum soil temperatures 1 inch below the soil surface in mulched and unmulched plots, and maximum air temperatures 3 inches above bare soil, West Tennessee Experiment Station, 1963.

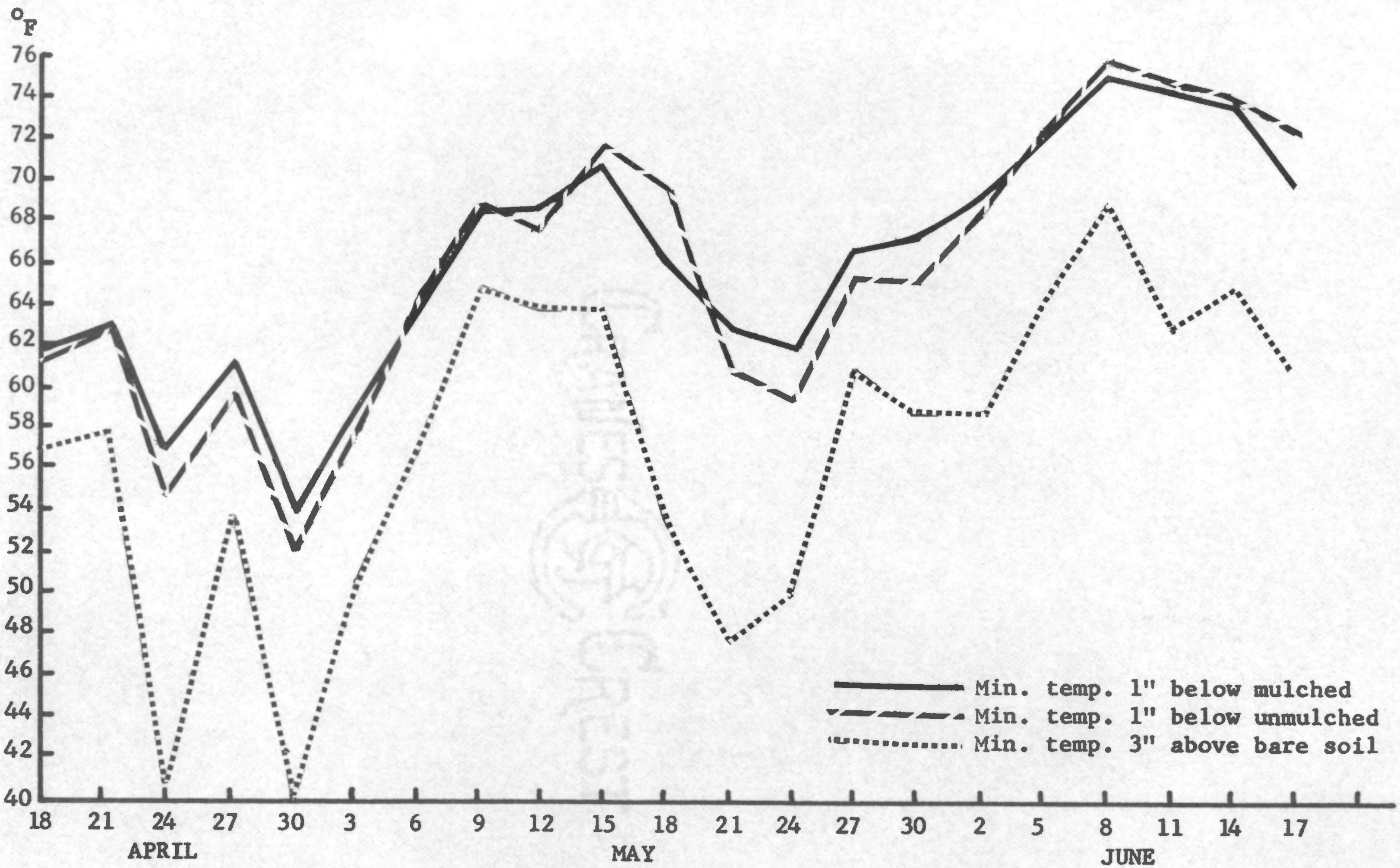

Figure 7. Three day averages of minimum soil temperatures 1 inch below the soil surface in mulched and unmulched plots, and minimum air temperatures 3 inches above bare soil, West Tennessee Experiment Station, 1963.

soil temperature than the mulched plots, in the latter part of the growing season, was probably due to the extensive shading of the soil by uncontrolled weeds in the mulched plots.

Cotton Germination and Emergence

Figure 8 shows mulched and unmulched plots 10 days after planting. The mulched cotton came up quicker and more uniformly than did the unmulched cotton. Ten days after planting, the cotton in the mulched plots was about 1 inch taller than the cotton in the unmulched plots. The mulched cotton had a darker green color and fewer incidence of seedling diseases than did unmulched cotton. The mulched cotton maintained this more vigorous appearance for about 15 to 20 days, but by the end of this period, the unmulched cotton's growth was equal to the growth of the mulched cotton.

There were no appreciable differences in the soil moisture content of the mulched and unmulched plots, therefore soil moisture was not the factor that produced the greater amount of cotton growth in the mulched plots. It appears that the 6 to 8 degrees warmer soil temperature in the mulched plots was responsible for the earlier emergence and the greater early growth of the mulched cotton. The mulched cotton did not retain this early growth advantage, because of the greater amount of weed competition in the mulched plots.

II. YIELD STUDY

The treatments used in the yield study were diuron in the mulch, prometone in the mulch, diuron alone, and prometryne alone. The yield

Figure 8. Emergence and early vigor of unmulched cotton (left) and mulched cotton (right). Both mulched and unmulched plots were treated with 1 pound of diuron.

study was planted on the same three dates as the environmental study. The yields and statistical analysis for the four herbicide-mulch treatments and the three cotton planting dates are given in Table VII. The diuron and prometryne alone treatments produced yields that were significantly greater, at the 0.05 level of probability, than the diuron in the mulch and prometone in the mulch treatments. There was no significant difference, at the 0.05 level of probability, between yields of the diuron alone treatment and prometryne alone treatment in the May 1 and May 15 plantings. There was a significant difference between the yield of the diuron alone treatment and the yield of the prometryne alone treatment in the April 15 planting.

In the April 15 planting there was no significant difference between prometryne alone and prometone in the mulch, but prometone in the mulch gave a significantly greater yield than did diuron in the mulch. In the second planting of the yield test the two herbicide alone treatments were equal to each other and the two mulch-herbicide treatments were also equal to each other, but the herbicide alone treatments were significantly greater than the mulch-herbicide treatments.

In the May 15 planting, there were no significant differences between the two herbicide alone treatments, nor were there any significant differences between the two mulch-herbicide treatments. Prometone in the mulch was equal to prometryne alone, but diuron alone and prometryne alone produced significantly greater cotton yields than did the diuron in the mulch treatment (Table VII).

TABLE VII

COTTON YIELDS IN POUNDS OF LINT PER ACRE FOR THREE PLANTING DATES, USING HERBICIDES WITHOUT AND HERBICIDES IN PETROLEUM MULCH FOR WEED CONTROL, WEST TENNESSEE EXPERIMENT STATION, JACKSON, TENNESSEE, 1963

	Planting Dates					
	April 15		May 1		May 15	
Herbicide	Yield in lbs. lint per acre	Statistical significance*	Yield in lbs. lint per acre	Statistical significance*	Yield in lbs. lint per acre	Statistical significance*
Diuron without mulch	841	a	667	a	714	a
Prometryne without mulch	388	b	595	a	708	a b
Prometone in mulch	377	b	177	b	555	b c
Diuron in mulch	65	c	171	b	528	c

*Mean followed by letter "a" is significantly different at 0.05 from those means not having "a"; those followed by "b" are significantly different from those not having "b", etc.

There was no herbicide or mulch injury in either the herbicide alone or the mulch-herbicide treatments. The differences in the yield of the herbicide alone treated plots and the mulch-herbicide treated plots were due to weed competition. The mulch-herbicide treatments gave inadequate weed control and the herbicide alone treatments gave almost complete weed control for the entire growing season. Figure 9 shows cotton treated with 1 pound of diuron alone and 1 pound of diuron in the mulch.

Fiber data, shown in Table VIII, were collected for the four mulch-herbicide and herbicide alone treatments for the three planting dates. There appears to be no effect by petroleum mulch on the length, strength or fineness of the cotton fiber.

Figure 9. Severe weed competition in the mulched cotton and no weed competition in the unmulched plots, both plots were treated with diuron at the rate of 1 pound per acre. Photographed August 8, 1963, West Tennessee Experiment Station.

TABLE VIII

AVERAGE LENGTH, STRENGTH, AND FINENESS OF COTTON FIBER FROM THREE PLANTINGS OF MULCHED AND UNMULCHED COTTON, WEST TENNESSEE EXPERIMENT STATION, 1963

Treatment	Upper half mean length in inches	Stelometer measurement of strength		Fineness, micronaire reading
		T_1	E_1	
April 15 planting				
Diuron without mulch	1.01	1.59	5.7	4.25
Diuron in mulch	1.06	1.77	6.9	4.03
Prometryne without mulch	1.04	1.68	6.0	4.08
Prometone in mulch	1.10	1.77	6.7	3.88
May 1 planting				
Diuron without mulch	.98	1.59	6.0	4.48
Diuron in mulch	1.05	1.78	6.0	3.98
Prometryne without mulch	1.05	1.65	5.4	4.40
Prometone in mulch	1.06	1.71	7.3	3.78
May 15 planting				
Diuron without mulch	1.03	1.85	6.2	4.33
Diuron in mulch	1.00	1.77	7.5	4.33
Prometryne without mulch	1.05	1.73	6.0	4.53
Prometone in mulch	1.02	1.81	7.3	4.45

CHAPTER V

SUMMARY AND CONCLUSIONS

The objectives of this experiment were to determine the effects of a specially formulated water emulsion of petroleum resins and methods of preemergence herbicide application of diuron, CIPC, DCPA, and prometyne on weed control, soil moisture, soil temperature, planting date, and cotton yield.

Dixie King cotton was planted on a Memphis silt loam soil, on April 15, May 1, and May 15, at the West Tennessee Experiment Station at Jackson, Tennessee in 1963. Each of the three planting dates received herbicide treatments of diuron, CIPC, DCPA, and prometryne or prometone. The herbicides were applied at three placement methods with relation to the mulch. These placement methods were in the mulch, under the mulch, and without the mulch and the three rates of application were: (1) one-half the recommended rate, (2) at the recommended rate, (3) and one and one-half the recommended rate. The mulch and the herbicides were applied in 12 inch bands over 36 inch rows.

Weed control ratings showed that when the herbicides were mixed with the mulch or applied under the mulch almost no weed control was obtained, but when the herbicides were used alone excellent weed control was obtained. Even prometone, a soil sterilant, did not cause cotton injury nor did it produce adequate weed control when erroneously mixed with the mulch.

There were essentially no differences in the soil moisture of the mulched and unmulched plots, but the mulched plots did have a maximum soil temperature that was 6 to 8 degrees higher than that of the unmulched plots for 15 days after planting. The mulched cotton emerged quicker and grew faster in the early part of the season, but this early vigor was soon offset by the severe weed competition in the mulched plots. Due to the fact that there was inadequate weed control in the mulched plots, the yields of the unmulched herbicide alone plots were significantly greater, at the 0.05 level of probability, than the yields of the mulched plots. There appeared to be no ill effects from the petroleum mulch on the length, strength and fineness of the cotton fiber.

The results of this study showed that there might be an advantage to using petroleum mulch in cotton production to increase the soil temperatures of early planted cotton fields; but until methods are developed so that weed control can be obtained by the use of herbicides with the mulch, it does not appear that the use of petroleum mulch would be practical for cotton production in Tennessee.

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LITERATURE CITED

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