

Frontiers

of PLANT SCIENCE

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Crabgrass Control	2
A Slight Case of Rebellion	3
Hybrid Tomato Seed	4
Natural Controls of Insects	5
Insect Problems Worldwide	6
Climate Control—Garden Variety	7



Weather and parasites affect defoliators . . . see page 5

New Materials Control Crabgrass

John F. Ahrens and A. R. Olson

Crabgrass has the dubious honor of being the most troublesome weed in lawn and turf areas. Most lawns are invaded by this pest at one time or another and although some accept it as "something green to fill the spaces," lovers of fine lawns and turf constantly strive to rid themselves of the invader.

Were it not for the light green appearance of crabgrass and its usually poor distribution in lawns, and were it not that the crabgrass dies with the first frost, leaving brown stems and later bare areas, crabgrass might be tolerated as a lawn grass.

Actually two species of crabgrass abound in turf. Both are annuals, developing from seed each year. Small crabgrass, (*Digitaria ischaemum*), the most troublesome of the two in lawns, is characterized by smooth stems and a prostrate, spreading habit, which makes it difficult to cut off with the mower. Large crabgrass (*Digitaria sanguinalis*), has hairy stems and is usually more erect in habit, making it easier to mow and prevent seed set.

The universal question concerning

crabgrass is "How can we get rid of it?" Several cultural practices are known to be effective against invasion of crabgrass. In general, they are based on the idea that crabgrass does not invade dense turf. Management practices that encourage the growth of turf will discourage crabgrass. This includes timely seeding, fertilization and liming, according to need, and mowing at proper heights. Crabgrass seed requires moisture and heat for germination. Encouraged by proper fertilization in the spring, turf grasses become thick enough to shade the soil and retard germination of crabgrass. High mowing (1½ to 2 inches) also strengthens the turf and greatly aids in the shading and retardation of crabgrass. Later in the season, however, lowering the mowing height prevents the crabgrass from going to seed. Watering, if needed, should be applied heavily enough to benefit the turf, not merely the crabgrass which germinates near the surface. During the heat of summer, when the growth of fine turf slows, but crabgrass thrives, fertilization serves the crab-



John F. Ahrens, left, who holds a Ph.D. degree from Iowa State College, began work as a plant physiologist at the Station in 1957. A. R. Olson, assistant forester, is also in charge of landscaping on the Station grounds and assists in experiments there.

grass more than the turf and often increases the infestation.

In recent years, a number of chemicals have been placed on the market for the control of crabgrass. Several of these materials have been tested at experiment stations throughout the Northeast. Because of growing interest and inquiries on these materials, research on turf herbicides was begun in 1960 at The Connecticut Agricultural Experiment Station. Striking results already have been obtained.

Excellent Stands of Crabgrass

To insure uniform stands of crabgrass for experiments, areas of turf were chosen at New Haven on the Station grounds which had been seeded in the spring of the previous year and which had considerable crabgrass previously. Plots were also selected in other areas, at Mt. Carmel and elsewhere, where crabgrass was abundant the year before. In one of these areas a new seeding was established in late April.

Several pre-emergence and post-emergence herbicides were applied in dry powder or liquid formulation, with lawn spreaders or hand sprayers, calibrated for each material and dosage. Liquid applications also were made in some areas with a watering can, a method which yielded poor results because of inadequate distribution.

During the 1960 season, Mother Nature supplied us with weather conditions perfect for the development of crabgrass. Our practice of mowing the treated areas to low heights of ¾ to 1 inch also encouraged the establishment of crabgrass. Excellent uniform stands of crabgrass were obtained in the untreated lawn areas. To evaluate results, visual ratings of the percentage area covered by crabgrass and counts of crabgrass plants were made during the season.

Because of the toxicity to the turf seedlings or failure to control crab-



Garden supply dealers meet at the Station to see crabgrass control plots and hear Dr. Ahrens report.

grass, none of the pre-emergence materials tested was of value in preventing crabgrass invasion on the newly seeded areas. When applied in one or two treatments, neither were the post-emergence herbicides effective in controlling crabgrass in established turf for the full season.

Three Compounds Effective

With some of the pre-emergence herbicides on established turf, however, excellent results were obtained. Three compounds—dacthal, zytron, and calcium arsenate—all applied in late April or early May in dry powder formulations, controlled better than 95 per cent of the crabgrass for the season.

Dacthal, at 10 lbs. (actual) per acre, controlled 97 per cent of the crabgrass with an average of 0.3 crabgrass plants per square foot remaining in the plots in September.

Comparable figures for zytron, at 20 lbs. (actual) per acre were 99 per cent control and 0.06 plants per square foot, and figures for calcium arsenate at 370 lbs. (actual) per acre were 95 per cent control and 3 plants per square foot.

The untreated areas of turf, with no crabgrass control, had an average of 906 crabgrass plants per square foot remaining in September.

Zytron and dacthal also performed satisfactorily at lower dosages. Both of these materials are promising also because of their relatively low toxicity to humans.

No injury to the turf mixtures containing Kentucky bluegrass, red fescues, and redtop was observed with the above treatments, but with a dosage of calcium arsenate of 555 lbs. (actual) per acre, one and one-half times the dosage required to control crabgrass, slight injury to Kentucky bluegrass was observed early in the season.

Many Questions Unanswered

The results obtained with these materials have stimulated a great deal of public interest as some of the plots were labeled so that visitors could compare results of the treatments. Many questions remain unanswered, however, and further work must be done with these and other herbicides. What will be the effects of these herbicides on the turf over periods of several seasons? Will crabgrass be controlled in the season following treatment? These questions and many others can be answered by a continued program of research. For the present, however, the prospects of controlling an age-old enemy in turf look much brighter than before.

From the Director

Normally, in this column, we discuss nature as it is reflected in the eyes of a scientist. This time we are delighted to present a view of the beauties of nature as seen by one who has the eyes of an artist.

Mrs. Allan F. Kitchel of Greenwich is a distinguished citizen of Connecticut who matches her vision of nature by action to preserve it for all to enjoy. In addition to her many other efforts for society, she has served on the Forestry Advisory Committee to the Experiment Station. She calls her story "A slight case of rebellion."

James E. Horsfall



"All the myriad forms and colors . . . our heritage. . ."

A Slight Case of Rebellion

For the moment let's forget our studies and the lessons we've learned about Conservation. We'll still spell it with a capital "C"—we'll remember of course that we must have water and that life itself depends upon the soil, all interrelated and interdependent. Let's be impractical and heedless—just for the nonce!

Look at the forest, the wilderness, all nature, with the heart. Give emotion full play. "Ah Tree—I love you—just for yourself. Do you serve some utilitarian purpose? Well, that I can overlook. Your beauty thrills me. At the song of the wind in the pines or a far-off call of a thrush, my spirit soars."

Must the tiny brook cascading down the rocky hillside signify a water-supply for a distant city? Oh no—for this we are given sight and hearing: to see the exquisite fern frond trembling above the bank; to hear the song which only water sings. Tune one's heart to the ocean. Breathe deeply at the mountain's top. Be still, in reverence and thanksgiving.

Or touch the bole of a tree. It need not be a "soil builder" nor "water holder." It is just a tree—awe-inspiring giant of the West or friendly white pine of the East. One tree, or a forest, is a soulstirring climax of untold eons.

The mighty tree, the tiny lichen, and all the myriad forms and colors in between, this our heritage to be understood and loved. For we are kin to it—if we choose.

Tomorrow we shall teach Conservation. Today we listen to our hearts.

—*Bulletin of the Garden Club of America. January 1960*

The Search for New Ways To Produce Hybrid Tomato Seed

Carl D. Clayberg

The F₁ hybrids seem firmly established among tomato varieties today, and are familiar to many gardeners. One reason for developing hybrids stems in part from the wide range of environments in which the tomato is grown.

To get maximum yields under these varying conditions breeders have developed a broad spectrum of varieties, each adapted to specific conditions and for specific purposes. Relatively few tomato varieties have had the wide adaptability necessary to make them successful throughout the country. By crossing varieties developed for different environments or different purposes, the breeder may come up with hybrids suitable for either a broader or a different, usually intermediate, use than the parent varieties.

The ability to readily combine de-

sirable characteristics in a hybrid holds special significance when heritable disease resistance is considered. Resistance to a number of tomato diseases, such as Fusarium and Verticillium wilts, is controlled by dominant genes. This means that a hybrid between a resistant and a susceptible variety will be resistant.

Disease Resistance Transferred

The breeder normally transfers disease resistance into only the best varieties, because the procedure involves considerable time and effort. These outstanding varieties, we have found, almost always make the best parents of hybrids.

Resistances to a number of different diseases can be transferred at the same time into one of these varieties. Upon crossing this multiple-resistant variety to a selection of different susceptible ones the resulting hybrids will have the desired resistance, but differ from the resistant parent in earliness, fruit size, and other characteristics. These hybrids may meet a specific need which is not sufficient to warrant the separate development of comparable resistant true-breeding varieties.

At this Station we have been generally concerned with ways of simplifying hybrid seed production. In tomatoes one possible method of producing hybrids involves the use of genic male sterility. Since this form of sterility is recessive, the hybrid possesses normal fertility. The male sterility eliminates the need for removing the pollen-producing parts of each flower—a costly and time-consuming procedure with risk of damage to the developing fruit.

Unfortunately the male steriles have several drawbacks from the standpoint of the seedsman who

would use them in hybrid seed production. One of these problems concerns propagation of the male-sterile parent. Incapable of self-fertilization, a male sterile must be perpetuated by cross-breeding fertile and sterile plants. The greatest proportion of male-sterile plants that can be obtained is one-half, and these can only be identified after all have flowered in the field.

We need methods of identifying the male-sterile plants early in the season. We need what geneticists call a "marker gene." If we could find a gene for a vegetative seedling character such as "potato leaf" or "green stem" that is closely linked to a gene for male sterility, we could identify most, if not all, male-sterile plants by examining the population for this "marker gene." Thus, only male-sterile plants would be saved for transplanting to the field. We presently have promising studies underway to locate such useful linkages.

The large producer of hybrid seed needs a technique more simple than a genic male-sterile linkage association. He would like to have a cytoplasmic type of male sterility, as in corn, where all plants grown from a male-sterile plant will be male sterile. With no fertile segregants there is no costly process of separation.

Cytoplasmic male sterility is frequently found in cultivated plants by making wide crosses between them and their wild relatives. In order that this male sterility be economically useful in breeding, one must be able to transfer the cytoplasm—and thus the sterility—from these wild species into the cultivated relative.

Series of Crosses Necessary

The transfer is made by using the cultivated plant repeatedly as the *male* parent in a series of crosses eventually combining its genes with the cytoplasm of the wild plant. Since cytoplasmic male sterility is at present unknown within the cultivated tomato varieties, we attempted to produce it in crosses between the wild and cultivated tomatoes. Unfortunately the distantly related wild tomatoes will cross with the cultivated one only when the latter is used as the *female* parent.

For the past several years we have been studying this failure of the cultivated tomato to function as male parent in crosses with the wild species. By understanding the inheritance of this behavior we may learn ways to overcome it and at last seek cytoplasmic male sterility for use in commercial production of hybrid tomato seed.



Carl D. Clayberg, here pollinating a wild tomato, studies inheritance in this important group of plants. Dr. Clayberg is a graduate of the University of Washington and holds the Ph.D. degree from the University of California.

How Nature Controls Defoliators

Stephen Hitchcock

● Weather, disease, and parasites are among many variables with influence on destructive outbreaks in Connecticut woodland.

From colonial times, periodic outbreaks of insect defoliators of our forests have excited the interest or caused consternation of the landowner. Indeed, the first stirrings of entomological research in America centered about these striking pests. The first entomological paper by an American was written about the canker worm in 1795. In 1797 it was stated that the forest tent caterpillar was "sometimes so plentiful . . . as to strip the oak trees bare." This description of naked oak trees can undoubtedly be recognized by any of those people who lived in areas defoliated by the gypsy moth or the orange-striped oakworm in the past two or three years.

However, the householder does not now have to stand idly by, as he did 100 years ago, while caterpillars devour his trees. Insecticides, properly applied, are perfectly able to control any of the major caterpillar pests of Connecticut forests.

Not only have the means of control changed through the years but also the environment within which the insects operate. Trees have gradually reclaimed much of the land which was once pasture and field. This forest is often of scrubby, low quality oak which provides a congenial habitat and a perpetual feast to the caterpillars.

As long as these insects ravage ob-

scure woodlots few owners care or can afford to control them. In the past few years, however, suburban housing developments have pushed into the woods. People have gone to live with the caterpillars. An oak tree which once was only one among many, now has a value as a prized ornamental in someone's yard. Under these circumstances, caterpillar feeding which was once accepted and even expected becomes unwanted under any conditions.

Not only is their feeding unwelcome but even their presence can cause annoyance and discomfort. The great number of caterpillars which can develop in a single woodlot is well nigh unbelievable to someone who has not seen them. Caterpillars swarm over houses, drop from the trees, crawl in doors and windows. In the past three years we know of two cases where it was even necessary to sand a road in midsummer because the many crushed bodies of the orange-striped oakworm made the road too slippery for safety.

Although destructive populations of insects are often associated with an introduced species, only one, the gypsy moth, of the half dozen or so major lepidopterous defoliators of Connecticut is not native to this country. The primary responsibility for the control of these insects, except for the gypsy moth, lies with the individual landowner.

Fortunately, areas of complete defoliation are usually small and appear infrequently. Oak trees, unlike some



Feeding by larvae of the gypsy moth becomes of increasing public concern as more and more people live in or near woodland areas.



Damage to these oak leaves in Essex is the work of the Asiatic oak weevil. Most of the major defoliators of Connecticut woodlands are native species, says Stephen Hitchcock, who is studying woodland and aquatic insects. Dr. Hitchcock, a native of Vermont, has been at the Station for two years.

conifers, can recover even if completely stripped unless they are defoliated for several years running. This rarely occurs.

Research in the past has been concerned, of necessity, in great measure with problems of control and proper timing of sprays. In the process, a considerable fund of information has accumulated about the insects' habits and life histories. Once adequate means of control have been established, it is possible to examine these accumulated facts and to undertake studies which might lead to an understanding of the natural processes which lead to these destructive insect outbreaks.

Natural Controls Highly Variable

Perhaps a means can be found to short circuit the population growth before it reaches destructive proportions. Unfortunately, there are usually a great number of variables, any of which is potentially capable of setting loose the insect hordes. These vary not only between insect species but also from time to time and place to place within a species. Investigating and correlating these is a slow process with many blind alleys and enticing side excursions.

Parasites and predators are usually thought of first when one thinks of "natural control," but other factors must be considered also. Weather, disease, physiology, and genetics may all play a part, both individually and collectively.

The effects of weather on the gypsy moth may serve as an example. It can have a direct effect in that low temperatures of a certain amount and

duration will kill the pest in its overwintering egg mass. Weather can also have an indirect effect in that high humidity favors the development of a disease in the late larval stages. Furthermore, weather can also affect the animals which prey on the gypsy moths. For example, low temperatures restrict the activity of a certain egg parasite so that it is not effective in reducing the number of gypsy moths in Massachusetts but is an important means of gypsy moth population control in Connecticut. Humidity helps to regulate the number of these parasites, too. All these effects must be considered both individually and as they interrelate one to the other, often in complicated and unexpected patterns.

Another example which might be given is the effect of egg parasites on the orange-striped oakworm. Over most of the state a minute parasite exacts an annual toll of about 30 per cent of the eggs of this moth. In an area of Voluntown in 1959, however, another small egg parasite teamed up with it and about 75 per cent of the eggs were destroyed. One would naturally expect that this would mean only that there would be 25 per cent as many larvae as there had been eggs. However, in actuality the oakworm population was almost entirely wiped out. Investigation showed why.

Oakworms Practice Togetherness

Unlike the gypsy moth, the orange-striped oakworm is gregarious in its early instars. The young from each egg mass stay together and feed and move as a unit. Each young larva spins a small amount of silk over the leaf surface and this helps it maintain a footing. In aggregate a colony will cover the leaf with silk. Furthermore, the young larva has great difficulty in biting an unbroken leaf margin in order to feed, but with many larvae chewing on the leaf margin there is always a broken margin on which to start.

The parasites, therefore, had lowered the population of certain colonies below the critical level at which they could survive. Experiments in the laboratory showed that this was indeed so and that these small egg parasites could have an effect beyond what a mere count of their number showed.

Recent advances in the use of disease pathogens and sterility techniques give hope that eventually we may have means not only to anticipate outbreaks but also to control them without resorting to those insecticides which sometimes have undesirable side effects.

World Authorities Meet in Vienna To Discuss Research on Insects

Neely Turner

Science has always been international and entomology is no exception. No country has a monopoly on discovery of new knowledge. In the beginning the exchange of information between entomologists was by correspondence. And since these were very few in each country, the correspondence on common problems soon became international. The exchange of correspondence led to exchange of visits by individuals and to the organization of national and international groups of scientists. It was these organizations that developed the system of publication of results of research for the free use of all who are interested.

The First International Congress of Entomology was held in Brussels in 1910, with 19 countries represented, and with four delegates from the United States. The 11th Congress in Vienna this summer attracted about 1500 entomologists from all over the world, including about 120 from the United States and four from the Connecticut Agricultural Experiment Station.

What is it that induced R. L. Beard, J. B. Kring, Neely Turner and Robert Wallis to travel from New Haven to Vienna to participate in this Congress? It wasn't a "free junket." Two of us obtained travel grants from the National Science Foundation that covered round trip transportation by the least expensive means and part of the cost of room and meals. The other two grants were less than half of the minimum cost. We paid the rest out of our pockets.

It wasn't just a holiday, because sessions of the Congress started at 8:00 a.m. and sometimes lasted until 6:30 p.m. And it wasn't the cold facts included in the scientific papers, because these can be read two years hence in the comfort of an easy chair.

The most important stimulus to go was the experience of attending the 10th Congress in Montreal in 1956. We discovered that these Congresses provided the opportunity to meet and discuss mutual problems with some of the best entomologists in the world. Attendance of outstanding sci-

entists is assured by invitations to participate issued by the sponsors. Incidentally, three of the four staff members from the Station were so invited. Moreover, the Austrian sponsors hoped for a good attendance from this side of the Atlantic because the location made it certain that there would be a large attendance from eastern Europe.

It is characteristic of these Congresses to create an atmosphere conducive to informal discussions. In such surroundings even the most reserved entomologists can be met without the formality of introduction by a mutual acquaintance. Each of us was able to discuss his problems with several world authorities, whether it was biological control, the gypsy moth, development of resistance to insecticides, mosquitoes, aphids, wireworms, or the effects of insecticides on wildlife.

Appreciate Connecticut Research

We found that our contributions towards solution of these problems are substantial, and that our work is received with respect. This has been confirmed by correspondence received from abroad since returning from the Congress. This interest reassures us that our type of work is sound.

The summaries of this knowledge on these problems led to a reappraisal of what we have been doing, and the first faint stirrings of the necessity for new hypotheses and new experiments. Furthermore, some new light was shed on every serious problem. It is the essence of productive research to consider these new facts as we are seeking more new knowledge.



Neely Turner has been on the Station staff for 30 years. He is State Entomologist and Vice Director.

CLIMATE CONTROL

(Garden Variety)

Paul E. Waggoner

The summaries made it plain that no country can necessarily depend on entomologists of other countries for solution of serious local problems. We must therefore increase our own ingenuity in solving our own problems.

The second major reason for travel to Vienna was the opportunity to visit research laboratories in Europe. Among us we made visits to 35 institutions and laboratories in nine countries (including one Communist state). We saw evidences of strong support of research in entomology in most places—adequate buildings, good equipment and competent scientists. Our reception was friendly and the staff members showed us their excellent work in as much detail as we required.

There were also dividends not strictly scientific. The English-speaking scientists were honored by reading of papers in English by Danish, Dutch and Italian entomologists. Most of them are just as fluent in some other European language as in English.

In discussion of problems with other scientists, the only hindrance was lack of a common language. There were no other barriers as for instance between communist and non-communist countries. The conversations were either scientific or social and never political or economic. This was indeed a meeting of scientists facing the problems of insects and their control and not arguing with each other.

The total effect of the trip can be summarized easily. We both contributed and received new knowledge about insects. We made an acquaintance with entomologists of many foreign lands, and we know that the exchange of information with them will continue. We feel that our own work has been productive and stands the close scrutiny of our fellow entomologists. And we have been stimulated to seek new approaches to solve our own problems.

New Publications

The publications listed below are now available to those who apply for single copies to Publications, The Connecticut Agricultural Experiment Station, Box 1106, New Haven 4, Connecticut.

Entomology

- B 632 Mosquitoes in Connecticut
- C 213 Insects in Houses
- C 214 Cankerworms

Reports on Inspection

- B 629 Food and Drug Products, 1957
- B 633 Commercial Feeding Stuffs, 1959

Our plants, unlike ourselves, are usually left outdoors where, like Robert Louis Stevenson's cow, they are "blown by all the winds that pass and wet by all the showers." Among the changing combinations of wind, sun, and rain that pass over our plants, they will not often find an environment that just exactly suits their needs for most rapid growth and development.

Therefore, we want a device that will change the climate near the plant, hastening the appearance of flower and fruit and increasing their yield. Energy from fuel or electricity can be added to this "microclimate," as in a greenhouse. But the cost of this energy may exceed the benefit of earliness, and we will still want an economical device for changing the microclimate.

Because climate basically is created at the very place we want a change in climate—the boundary between air, plant, and soil—we have an excellent opportunity to change the microclimate by changing this boundary.

The incoming radiation from sun and sky strikes the plants and soil. Some of this energy passes back into the sky as reflected short-wave or emitted long-wave radiation. Some is consumed in the evaporation of water from leaves or soil. Some, we hope, is fixed through photosynthesis. Then the remainder of the energy heats the air and soil.

If the surface is changed, the disposition of energy among these accounts is changed, and the plants will find themselves in a different climate, better or worse for growth and development. Mulching is commonly used to change the surface.

The special name "mulch" was given to this practice hundreds of years ago. The English word is prob-

ably derived from the German vernacular *molsch*, meaning soft and rotten. Thus, the ancient mulch must have been a litter of straw and leaves that gardeners found kept the soil cool and moist. With the advent of cheap paper and, more recently, plastic film these too were spread upon the soil and called mulch.

Soil Climate Manipulated

By learning how this variety of materials changed the distribution of energy at the surface, we prepared to design mulches for the control of weather in the garden, creating a range of soil climates and varying the activity—for good or ill—of roots and their pests.

Black and translucent polyethylene films, paper, hay, and aluminum foil were each spread over plots of soil at the Lockwood Farm and compared with bare soil. We observed the incoming and outgoing streams of radiation of all wavelengths. We measured the evaporation of moisture at the surface and the storage or loss of heat from the soil. We estimated the exchange of sensible heat from surface to air.

Black film absorbs most radiation from the sun and sky, becomes hot itself, loses much heat to the daytime air, and—because it is underlain at most places by a thin layer of air—retards the gain and loss of soil heat.

Translucent film, unlike the opaque black, transmits most radiation from the sun to the soil. But the emission and exchange of energy from the warm soil to the atmosphere is restricted by the film and the deposit of water upon it. Consequently, the soil is somewhat warmer at night and a great deal warmer during the day if it is covered with translucent film.

The divergent dispositions of energy caused by these unlike coverings during clear weather are shown on page 8 in Figure 1, and the consequent courses of temperature 1.2 inches beneath the soil surface are diagrammed in Figure 2. During cloudy weather the differences are less.

Paper reflects much solar radiation, while readily emitting long-wave radiation. Thus it retards the gains of heat by the soil more and retards the losses less.



Dr. Waggoner heads research in soils and climatology. Station Bulletin 634, available in December, will give details of research on plastic mulching.

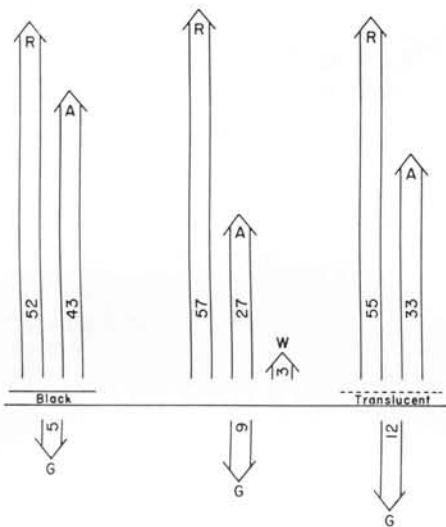


Figure 1. The disposition of 100 units of incoming radiation by bare and film-covered surfaces on a clear noon. R is outgoing radiation, A is sensible heat lost to the air, W is evaporation, and G is the heat stored in the ground.

Hay insulates the soil, damping the midday rise and the nighttime fall of the soil temperature.

Aluminum foil reflects much incoming radiation and emits less long-wave radiation, retarding both the gain and loss of heat by the soil.

If a translucent film markedly warms the soil and an opaque one does not, one expects that a film, intermediate in translucency or ability to transmit radiation to the soil, would produce an intermediate warming. Besides it might discourage the weeds that grow so luxuriantly beneath the translucent film. In fact, we found that a green film did both warm the soil and retard weed growth, verifying the prediction and suggesting an important, practical soil covering for the control of the climate in the ground.

Plastic films provide an economical means of changing soil temperature, and, of course, they stop the direct loss of moisture from the soil surface, a loss that is important when a large portion of the field is unshaded by leaves and is exposed to the sun.

Whether plants would find these

Effect of mulches on soil temperature and strawberry yield

Bare	Black film	Translucent film	Green film	Hay
	Midday soil temperature at 1 inch depth			
87° F.	91	98	95	79
	Number of blossoms on 6 plants, May 9			
9	14	41	26	3
	Yield of berries on 6 plants by June 2			
0.6 oz.	1.9	4.7	2.9	0
	Yield of berries on 6 plants for the entire season			
11.7 oz.	14.6	13.5	15.6	14.0

changes good or bad remained for us to test in the field. Effects of these changes may not be directly upon the plants: they don't grow alone but together with their pests. Therefore, Dr. P. M. Miller, of the Department of Plant Pathology, and I tested the changed climates of the mulches upon the strawberry, a perennial plant whose early fruit are esteemed and whose roots are plagued by pests.

The springtime soil temperatures beneath the mulches that were placed about the strawberry plants were changed in the expected way, as shown in the accompanying Table. The number of blossoms that had appeared by May 9 was greater where the plastic mulches warmed the soil. The yield of berries on the early date of June 2 was also increased by the warmer soil climates. Eventually the plants mulched with the intermediate,

green film, produced the highest yield for the entire season.

Although weeds had to be pulled repeatedly from beneath the clear film, they presented no problem beneath the green.

The plastic mulches do have disadvantages. In the spring weeds grow luxuriantly beneath the translucent film, and in the summer this film disintegrates in the ultraviolet rays of the sun. On the other hand, the black film may last longer than one wants, ending its career blown into the neighbor's fence.

All of the films evidently encourage the attacks of the fungus *Rhizoctonia*, which parasitizes the strawberry roots. Nevertheless, the gardener will find these mulches an intriguing new tool, permitting him to modify the climate beneath his plants and so hasten the appearance of flower and fruit.

In Station Bulletin 634, available in December, we present in greater detail our research on plastic mulches.

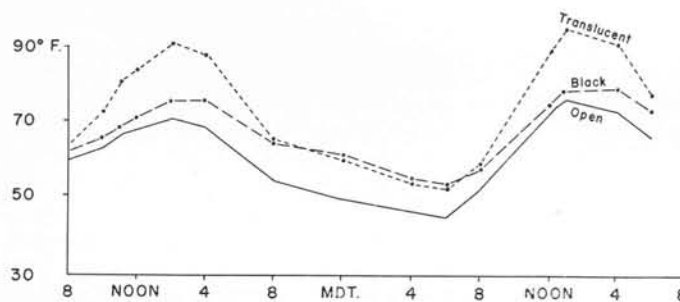


Figure 2. The temperature of the soil beneath bare and film-covered surfaces during clear weather.

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AGRICULTURAL EXPERIMENT STATION
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James E. Horsfield
Director

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