sive competition between plants and a more succulent, less frost-resistant plant that is incapable of generating new tillers.

(4) If the crop appears to head too early and becomes subject to a number of frosts, it may be mowed or grazed back—preferably before the stems are strongly jointing or elongating. This procedure can backfire however, if there is not enough residual or added fertility and soil moisture to mature the new or second crop of tillers. If the field is clipped, the crop residue should be promptly removed from the field so that the decomposing or dry residue does not impede recovery of the cereal plants. The use of a green-chop machine which leaves a stubble of 6 to 8 inches has proven an effective method of accomplishing this result.

(5) Where crop irrigation is possible, growers with warmer-than-air irrigation water can actually warm a field by irrigating just before and during a forecasted frost.

Severe frost

When a severe frost strikes a cereal field at the very critical heading and flowering period, in most cases it is best to graze or disc the frost-damaged crop and prepare to plant a spring or summer crop such as grain sorghum, corn or millet. When crop salvage seems to be a possibility, the best bet is to high-mow or roll the field—thus improving the access of light to the crown area to stimulate new tillers. This should then be followed by a top dressing of fertilizer and an irrigation. Regardless of what is done the salvage will only be partial.

Rice growers consistently confronted with the cool water temperature problem also have certain management alternatives: (1) In areas where irrigation water is consistently less than 65° F, growers may use warming basins before turning the water into their seeded fields. For highest yields, rice irrigation water in the paddies during most of the day should average from 76° to 78° F. (2) Select a variety, such as Caloro, that is more resistant to the cool water temperature than other California varieties.

C. A. Suneson is Research Agronomist, Crops Research Division, USDA, Agricultural Research Service, stationed on the Davis Campus of the University of California. Milton D. Miller was Extension Agronomist and is now Assistant State Director, Agricultural Extension Service, U.C., Davis.

PLASTIC AND FOR

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V. Q. HALE · J. R. STOCKTON · L. DICKENS

ARTIFICIAL MULCHES have made possible the planting of cold-sensitive crops during seasons of adverse temperature conditions. In many areas of the United States, the use of plastic film in high-return vegetable and fruit crops has become common. These artificial mulches increase soil temperature, permit earlier planting, induce earlier emergence, produce more vigorous seedlings, and hasten maturity.

These trials in the San Joaquin Valley were conducted to determine how the effects of plastic and petroleum-derived mulches differ with soil types, and the effect of these materials on the development and yield of the cotton variety, Acala 4–42.

Three mulch materials—black plastic film, clear plastic film, and petroleum-derived mulch were compared with an unmulched control at the U. S. Cotton Research Station, Shafter, on Hesperia fine sandy loam, and at the University of California West Side Field Station, Five Points, on Panoche clay loam. Tests at Shafter consisted of four replications of four-row plots, 286 ft long, with 40-inch row spacing. At Five Points the rows were 180 ft long with six replications. Rows ran east and west at both locations. All planting and mulching operations were performed between March 11 and 14.

Twenty-inch-wide rolls of plastic film were laid by a machine which rolled the beds, placed the film, and covered about 5 inches on each side with soil to anchor the film. Cotton was machine-planted through the plastic with vermiculite containing fungicide placed over the seeds, and followed with a press wheel. Holes were spaced 8 inches apart with from one to three seeds per hole. The petroleum mulch was sprayed in a 7-inch band at the rate of 100 gallons per acre immediately following planting with a conventional-type planter.

A serious weed problem beneath the film necessitated removal of the clear plastic from plots at Shafter on May 16, and at Five Points on June 5. The seeding rate for the plastic film treatments at both

Planter used with plastic mulches. This planter punches a hole in the plastic and plants the seeds with treated vermiculite.

PETROLEUM MULCHES COTTON

as affected by soil type and location

The effectiveness of plastic and petroleum mulches did not change in tests at two different locations on two different soil types in San Joaquin Valley cotton fields. Higher soil temperatures generated by all of the mulch test treatments resulted in earlier cotton germination and faster development, but ultimate plant sizes were the same. The mulches did not affect cotton quality, but shifted a greater percentage of the yield into the first picking. Although yield increases alone may not return the cost of treatment, reductions in hand labor made possible through precision planting as part of the mulching operation offer some compensation.

locations was approximately 10 lbs per acre, with approximately 25 lbs per acre in the check and petroleum mulch treatments at Shafter. Thirty-five pounds per acre were seeded at Five Points in the check and petroleum mulch plots. Both the check and petroleum mulch plots were thinned in early June. Normal cultivation and irrigation practices were followed. Data were recorded on soil temperatures at 2- to 3-inch depths, seedling stands, soil moisture content, seedling height, seedling fresh weights, fruiting and boll characteristics, and yields. Yields were taken from the two center rows of each plot.

Plant emergence

Plant emergence in all treatments was earlier at Shafter than at Five Points because of the earlier high soil temperatures in the sandy soil. However, the mulches had a marked effect on emergence at both locations (table 1). Earliest emergence was with the clear plastic treatment and latest in the check, with the black plastic and petroleum mulch treatments showing emergence at about the same time.

The danger of frost damage caused by too-early emergence was recognized as a problem with the use of mulches. Some damage was noted at Five Points late in March, but no plants were killed. The earlier emergence with continued influence of higher soil temperatures produced differences in plant size (table 2), which were apparent as late as July. The plants which started earlier also grew faster, but by harvest time, plant heights were the same.

The mulches had no effect on soil moisture distribution, but all of the mulches caused increases in maximum soil temperature. Clear plastic caused a greater increase in soil temperature to a 6-inch depth than did the other mulches. The black plastic appeared to absorb instead of transmit solar heat to the soil. Temperature differences at the 2- to 3-inch depth became more pronounced as the days became warmer until the plants became large enough to provide shade. The mulches had no effect on minimum nighttime temperatures nor on the times of day that maximum and minimum temperatures were achieved.

Date of flowering was in the same order as date of emergence, but whether this was dependent on the date of emergence, or the continuing effect of the mulches, was not determined. The mulch treatments did not significantly affect the number of flowers or bolls, boll retention, lint percentage or boll size. The plastic mulches increased yields at both locations, and the petroleum mulch increased the yield at Shafter, but not at Five Points (table 3).

Production costs

In view of the increased production costs with the use of mulches, there is some question as to whether the yield increases are great enough to return a

Plastic film after the cotton planting operation.

profit. However, rapid emergence and better stands of cotton result from the use of mulches, particularly when early planting dates are used. The increased soil temperatures and crust prevention aspects also assist in obtaining and maintaining good stands of cotton and might allow lower seeding rates that would not require thinning. Petroleum mulch is the easiest and least costly to apply, with no cost for removal. The plastic film requires special equipment for placement and removal as well as special planting equipment, but part of these extra costs is compensated by reduced hand labor resulting from precision planting. An average of 10% more of the cotton crop was ready for early harvest when mulches were used—indicating that a financial gain could be expected from improvements in grade and staple of lint.

Verle Q. Hale is Assistant Agronomist, Department of Agronomy; John R. Stockton is Associate Specialist, and Lamar Dickens is Laboratory Technician, Department of Irrigation, University of California, Davis. *Film and equipment were provided by Spencer Chemical Company, Kansas City, Missouri. Humble Oil and Refining Company, Houston, Texas, provided the petroleum mulch.*

TABLE 1, INFLUENCE OF ARTIFICIAL MULCHES ON COTTON SEEDLING EMERGENCE

Date Mo/Day	Treatment							
	Check Shafter	Check Five Points	Clear plastic Shafter	Clear plastic Five Points	Black plastic Shafter	Black plastic Five Points	Petroleum mulch Shafter	Petroleum mulch Five Points
	Number of seedlings/0.001 acre							
3/25	0	0	16	8	5	0	13	0
3/27	0	0	20	14	13	3	29	0
4/2	4	0	21	20	19	11	41	10
4/8	25	0	22	33*	20	20	39	17
4/15		3		33		24		43
4/29		11		33		24		62

* This figure represents the maximum stand. There were 19 holes in the measured 0.001 acre with 1 or 2 seeds per hole. The check and petroleum mulch plots were later thinned to about the same stand.

TABLE 2, INFLUENCE OF ARTIFICIAL MULCHES ON COTTON PLANT HEIGHT AND WEIGHT*

Treatment	Fresh weight		Height
	Shafter	Five Points	Five Points
	gm/plant		inches
Check	2.8	2.1	3.7
Black plastic	4.2	4.9	5.7
Clear plastic	5.1	8.7	7.1
Petroleum mulch	4.0	2.4	4.7

* Observations were made May 15 at Shafter and May 20 at Five Points. Each figure is the average for 20 plants.

TABLE 3, INFLUENCE OF ARTIFICIAL MULCHES ON YIELD AND EARLINESS OF COTTON

Treatment	Yield		First pick	
	Shafter	Five Points	Shafter	Five Points
	lbs seed cotton/acre		%*	%
Check	2570	3425	62	67
Black plastic	2930	3982	75	76
Clear plastic	2840	3954	76	77
Petroleum mulch	2870	3683	75	68
L.S.D. (5%)	246	489		

* Percentage of total yield that was in first picking.

Emergence of cotton seedlings through petroleum derived mulch.

Emergence of cotton seedlings through plastic film.