IRT-76® POLYETHYLENE MULCH FILM AND GROWTH OF SWEET CORN IN FAIRBANKS, ALASKA

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INTRODUCTION

Cold soils during the short growing season in interior Alaska often limit growth and prevent the maturing of many field-grown warm season crops such as tomatoes, peppers, cucumbers, pumpkins and sweet corn. Clear polyethylene mulch has been recommended for many years as a method of warming soil to promote crop maturity and improve marketable yields (Dinkel, 1966). One significant problem with the use of clear polyethylene mulch is enhanced weed growth beneath the mulch. Weeds compete with the crop for nutrients and water in addition to reducing the soil-warming effects of the mulch. Consequently, herbicides must be used in conjunction with the clear mulch to obtain optimum plant growth. An alternative to clear polyethylene is black polyethylene mulch which suppresses weed growth but does not have the soil-warming and yield-improvement capabilities of clear polyethylene (Matheke et al., l989).

A wavelength selective product called IRT-76®* polyethylene film mulch was developed recently by researchers at the University of New Hampshire cooperating with AEP Industries. Under conditions where the maximum daily temperatures averaged in excess of 70° F (21°C), this green-colored film provided soil warming properties intermediate between black and clear mulch. It also suppressed weeds. IRT-76® mulch suppresses weeds by a dual effect of lowered light intensities and higher temperatures beneath the film. In New Hampshire weeds such as grasses and purslane grew beneath the IRT-76® film but not vigorously enough to compete with the crop (Loy). The degree to which this product could warm soils and suppress weeds at high latitudes in Alaska has not been investigated. The purpose of this research project was to determine if the benefits of soil warming and weed suppression of IRT-76® film could be achieved under subarctic conditions. In addition, this film was compared to the clear polyethylene mulch plus herbicide and black polyethylene mulch crop production systems. Clear polyethylene plus herbicide is the system currently recommended for sweet corn production in the Interior.

METHODS

Bottomland Tanana silt-loam soils located at the Fairbanks Agricultural and Forestry Experiment Station were fertilized on 24 May with 1500 lb/acre (1680 kg/ha) 10-20-20, then tilled and harrowed. The field was divided into four blocks of three rows spaced 5 ft (1.5m) apart within each block and 20 ft (6m) between blocks. Seeds of the sweet corn cultivar, Polar Vee were soaked in water for 24 hours and then hand seeded at the rate of three seeds per hole in holes 12 in (30 cm) apart on 25 May. Each block consisted of three, 3 ft x 48 ft (0.9 x 14.6m) rows composed of four, 12-ft (3.6m) sections of mulch treatments: 1.5 mil clear polyethylene, 1.5 mil black polyethylene, 1.25 mil IRT-76® mulch, and an unmulched control plot. Prior to laying the mulch, the clear polyethylene mulch and control treatments were sprayed with 1.5 lb/acre (1.7 kg/ha) active ingredient of atrazine herbicide. In addition, a single row of Turbo-Tape®** drip irrigation was positioned in the center of each row of all treatments. Plots were fertilized once through the irrigation system with 35 lb/acre (39 kg/ha) 34-0-0 on 1 July. Data including date of 100% seedling emergence, tasseling and silking; plant height; and yield were collected from three 10-ft (3m) plots, one located on each row of the three-row block. Data were analyzed using multivariate repeated measures analysis of variance for a randomized complete block design. Mean separation was achieved using Waller-Duncan K-ratio t-test.

Soil temperatures were measured at a 2-inch (5 cm) soil depth using copper-constantan thermocouples. Three thermocouples were wired in parallel to provide an average temperature signal for each block-mulch combination. Average soil temperatures at hourly intervals were recorded on a Campbell 21X Datalogger.*** Daily and cumulative soil heat units were calculated using 50˚F (10˚C) as the baseline temperature.

RESULTS AND DISCUSSION

Seedlings emerged within a three-day period beginning 29 May on all of the mulch treatments (Table 1). Any differences in seedling emergence among mulch treatments might have been masked by the seed-soaking pretreatment which improves seed germination and subsequent plant development in cold soils (Bennett and Waters, l987). Plants grown through the IRT-76® and clear mulch showed similar patterns of growth in that the days to tasseling and silking differed by no more than one day. Although seedling emergence on the black mulch and unmulched control plots was two days or less later than the other mulch treatments, development of tassels and silk lagged by as much as four days.

Plants on the unmulched and black mulch plots were shorter than the clear and IRT-76® mulches throughout the growing season (Figure 1). Plant height was similar for the clear and IRT-76® plots except in the first two weeks of July when plants grown through the clear mulch were significantly taller. Differences in height between clear and IRT-76® mulch were not significant by the end of the season.

Yield of mature, edible ears for the IRT-76® and clear mulch treatments was significantly greater than the black and unmulched treatments. (Table 1, Figure 2) Yield differences between the clear mulch and the IRT-76® were not significant. The yield for the IRT-76® mulch ranged from 54.6-57.6 lb per 10-ft (3m) row, whereas for the clear mulch, yields ranged from 56.7 lb to 63.7 lb per 10-ft (3m) row. However, corn growing through the clear mulch had significantly more ripe ears early in the season (7 and 9 August) than the other mulch treatments (Figure 3). Yields on the IRT-76® mulch lagged behind the clear mulch until 11 August (Figure 3). Both the clear and IRT-76® mulch had a longer ripening period than the black mulch and unmulched plots in which peak yields occurred on 17 August .

No weeds grew beneath the IRT-76® mulch. Instead, 20-25% of the soil surface was covered with algae. The IRT-76® mulch raised soil temperatures at the 2-in (5 cm) depth nearly as much as the clear polyethylene mulch (Figure 4). Cumulative soil heat units were significantly less beneath the black mulch and the unmulched control.

Although this study has been conducted for only one growing season, the results indicate that the IRT-76® mulch provides the benefits of soil warming and controls weeds under subarctic conditions. Growth and yield characteristics of corn grown through IRT-76® mulch were similar to plants grown with clear polyethylene mulch. There was no significant difference in total yield between the IRT-76® and clear mulch plots, although there was a delay in maturity and harvest on the IRT-76® plots.

During most seasons, 'Polar Vee' sweet corn grown on unmulched bottomland soils at the Agricultural and Forestry Experiment Station does not produce mature ears. The 1990 growing season was favorable for corn production, and even the unmulched plots yielded mature sweet corn. The IRT-76® mulch may not perform as well as clear polyethylene during less favorable growing seasons, therefore this study will be repeated for at least two more years. We encourage commercial growers and home gardeners to test wavelength selective mulches like IRT 76® and share their experiences with us. With

Mulch Treatment	Days after seeding			Yield
	Seedling emergence*	Tasseling*	Silk*	(lb per 10-ft row)
Clear plus herbicide	4	42	52	59.2a**
IRT-76	4	42	51	55.3a
Black	5	43	54	45.6b
Unmulched plus herbicide	6	45	55	28.0c

* days to development on all plants
** values followed by letters are significantly different (Waller-Duncan K-ratio t-test, p=.05)

Table 1. *Dates of seedling emergence, tasseling and silking; and yield of sweet corn grown through four mulch treatments.*

grower and gardener assistance, we can determine the worth of wavelength selective mulchs under a wide variety of conditions at many locations in Alaska.

* AEP Industries, Moonachie, New Jersey donated the ITR-76® mulch film used in this project.

** T-Systems International, Inc., San Diego, CA.

*** Campbell Scientific, Inc., Logan, UT.

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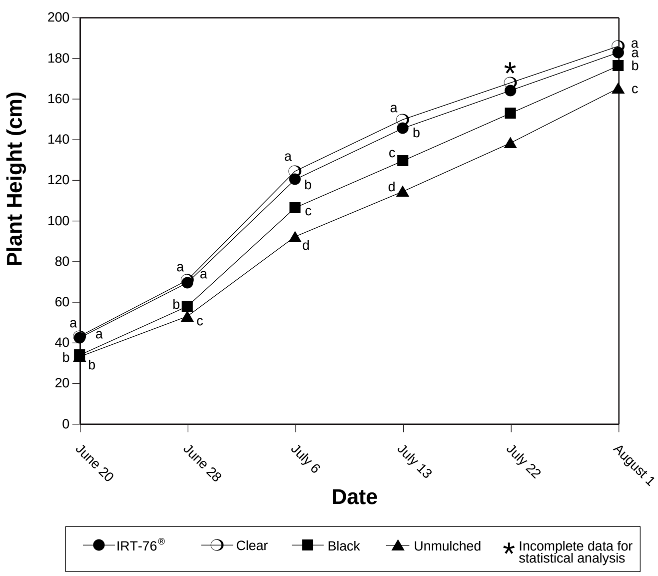

Figure 1. Sweet corn growth using various mulches.

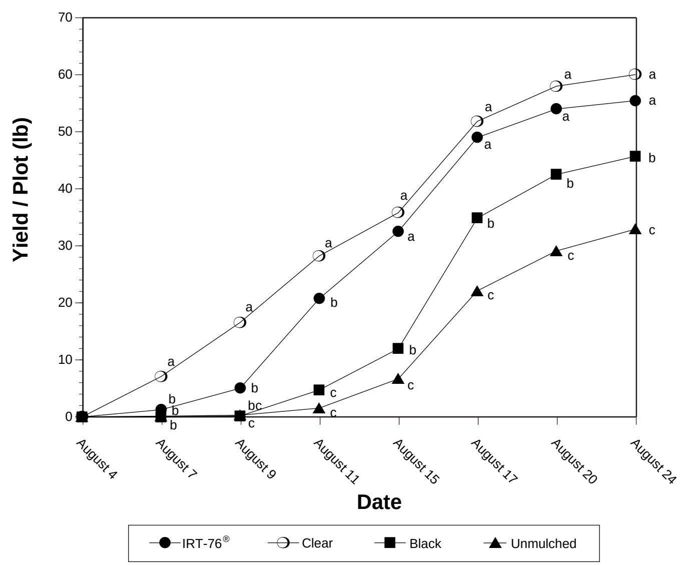

Figure 2. Cumulative sweet corn yeild using various mulches.

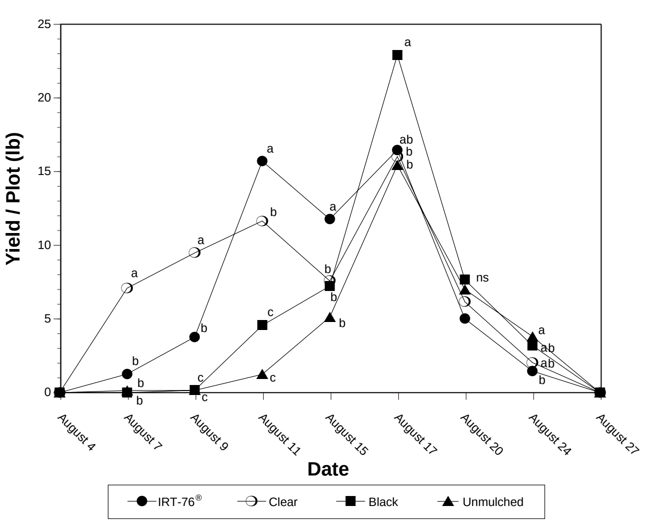

Figure 3. Timing of sweet corn yield using various mulches.

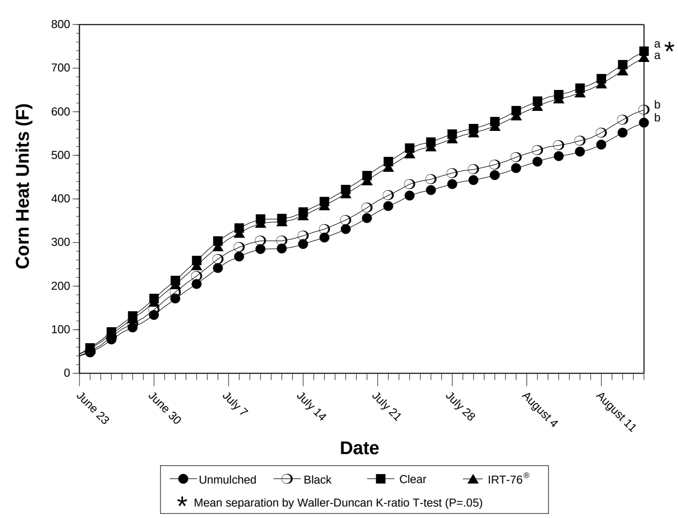

Figure 4. Cumulative heat units at a 2" soil depth beneath four mulch treatments.

Note on all figures: Points identified by different letters are significantly different (Waller-Duncan K-ratio t-test, P = 0.5)