Early Muskmelon Production with Wavelength-selective and Clear Plastic Mulches

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Summary. Black, clear, and wavelength-selective IRT 76 plastic mulches with or without clear, slitted, hooped rowcovers were evaluated for early muskmelon production in 1991 and 1992. Clear and IRT 76 plastic mulches tripled early yield, compared with bare ground, 130 and 45 cwt/acre, respectively. Highest yields both years were from the combination of rowcover with either clear plastic or IRT 76 mulch-181 cwt/acre in 1991 and 379 cwt/acre in 1992. Yield from clear plastic was superior to that from IRT 76 by 41 cwt/acre in 1991, but not in 1992. The minimum soil temperature for IRT 76 compared with clear plastic was +0.5°F and -2°F for 1991 and 1992, respectively. Crop rotation and herbicides were used to provide adequate weed control both years. The best cost-effective early muskmelon production system tested involved clear plastic, rowcovers, and trickle irrigation.

The advantages of plastic film mulches for early muskmelon production have been well-documented by researchers and put into practice by growers (Carolus and Downs, 1958; Schales and Sheldrake, Jr., 1966; Taber, 1990). Of the many benefits, the increase in soil temperature during a cool spring is probably the most important, as a higher minimum soil temperature favors continued root growth. Throughout central

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Iowa, early muskmelon yield from transplants with clear plastic mulch on sandy loam soils has been double that of black plastic and four times the production from bare soil (Taber, 1990). Transplanting usually occurs the first week of May. Not all northern areas of the country find an advantage of clear plastic over black plastic mulch, probably because of lower solar radiation, a later planting date, and a need for improved weed control.

New wavelength-selective plastic mulches have been developed that combine the properties of the black and the clear mulch (Loy and Wells, 1990). These new films transmit solar near-infrared radiation that warms the soil but blocks a portion of the photosynthetic radiation, thus limiting weed growth (Loy, 1991). Of those on the market, IRT 76 transmits the most radiation and results in a soil temperature increase, compared with bare ground, almost equivalent to that from clear plastic (Loy, 1991).

Muskmelons will make rapid vegetative growth in response to increasing soil temperature and will tolerate high soil and air temperatures. The combination of clear plastic mulch and rowcovers has given consistently high early muskmelon yields in Iowa (Taber, 1990). My objective was to determine if wavelength-selective IRT 76 is as effective as clear mulch for early muskmelon production where herbicides satisfactorily control weed growth.

The experiment was conducted at the Horticulture Research Station in central Iowa on a sandy loam soil. The previous crop was rye, and strips were left surrounding the plot area to serve as a windbreak. A spring broadcast application of 60N 104P 200K (lb/acre) was preplant-incorporated with a rotovator. To suppress weed growth, Prefar 4E (bensulide) at 5 qt/acre and Alanap 2E (naptalam) at 6 qt/acre were incorporated lightly with a cultipacker just before laying the 4-ft wide films on 6-ft row centers. Mechanical cultivation was used as needed for row middles. Weed control was adequate in all treatments throughout the growing season. Trickle irrigation tubing was buried 2 inches deep and 6 inches off row center as the mulch was laid. Soil moisture was maintained at 20 to 30 chars, as monitored by tensiometers placed at 8-inch depths.

Three-week-old Gold Star muskmelon seedlings, raised in 72-cell packs

(cell size $1.5 \times 2\frac{5}{16}$ inches) in the greenhouse were transplanted to the field on 8 May 1991 and 6 May 1992 in a randomized, complete-block design with four replications. Treatments consisted of a single-row plot, 30 ft long, with in-row hill spacing of 2 ft with two plants per hill. The mulch treatments were: 1) bare ground, 2) black plastic (photodegradable, short formulation, Plastigone Technologies, Miami, Fla.), 3) clear plastic (photodegradable, short formulation, Plastigone Technologies), 4) IRT 76 (AEP Industries, South Hackensack, N.J.), 5) clear plastic+ rowcover, and 6) IRT 76 + rowcover. All films were linear, low-density polyethylene materials, 1 to 1.25 mil thick. The rowcover used with the clear plastic and the IRT 76 was a slitted, clear material (Ken Bar, Reading, Mass.) placed over wire hoops, spaced every 5 ft in the row on the day of transplanting. The height of the rowcovers over the plastic mulch was 14 inches, and the rowcover was pulled tight to prevent sagging between hoops. The rowcovers were removed on 7 June 1991 and 5 June 1992 when the runners filled the area under the rowcover and initial flowers were at anthesis. Soil temperatures were measured for all treatments in three blocks with copper-constantan thermocouples placed 4 inches to the side of the transplant and 4 inches deep. Three thermocouples were wired in parallel according to the procedure of Culick et al. (1982) to give one average output reading for each plot. Temperatures were monitored with a CR-10 data logger (Campbell Scientific,

Logan, Utah) with a scan rate of 5 min and averaged hourly.

Early Yield was determined as fruit harvested from 15 to 24 July 1991 and from 29 July to 7 Aug. 1992. Fruit harvest ended 29 Aug. 1991 and 25 Aug. 1992 for 6 and 4 weeks of harvest, respectively. Cull fruit were small, <3 lb, misshapen, or poorly netted.

Use of a plastic mulch increased ($P < 0.01$) early muskmelon yield both years (Table 1). Without a rowcover, the clear and IRT 76 mulches performed comparably and tripled early yield compared with bare ground (from 45 to 130 cwt/acre, averaged for the 2 years). However, the highest early yield was achieved from the rowcover in combination with either the clear or IRT 76 mulch. The slitted rowcover advantage ($P < 0.01$) was 72 cwt in 1991 and 227 cwt in 1992. Also, first harvest was advanced 2 days both years by use of the rowcover compared with no rowcover. Although the trend was for clear plastic to outperform IRT 76 mulch, it was only significant in the 1991 growing season, largely as the result of the use of a rowcover. There was no difference in marketable fruit size or cull yields either year.

The 40-year average May temperature is 61F and rainfall is 4.5 inches. May 1991 was a warm, wet spring with ambient air temperature 2F and rainfall 3.4 inches above average. May 1992 was cool and dry, with temperature 1F and rainfall 3.4 inches below average. The average May daily solar radiation was 15.4 and 19.1 MJ/m² for 1991 and 1992, respectively. Also, minimum air temperature was at or

Table 1. Effect of plastic mulch type and slitted, hooped, clear plastic rowcovers on early and total marketable muskmelon yield, 1991 and 1992.

Mulch treatment	Marketable yield* (cwt/acre)			
	Early		Total	
	1991	1992	1991	1992
None	40	50	399	237
Black plastic (BP)	78	113	475	351
Clear plastic (CP)	118	175	427	334
IRT 76 (IRT)	100	128	421	326
CP + slit rowcover (RC)	213	390	442	453
IRT + slit RC	149	367	402	450
Comparison ^y				
None vs. rest	*	**	NS	*
RC vs. no RC	**	**	NS	*
IRT vs. BP	NS	NS	NS	NS
IRT vs. CP	*	NS	NS	NS

*Early yields harvested during the first 10 days; total yield for 45 days in 1991 and 27 days in 1992.

^yContrasts calculated by partitioning the treatment effects using SAS general linear models procedure.

***, NS Contrasts significant at $P = 0.05$, 0.01, or not significant, respectively.

Table 2. Average minimum soil temperatures and plant survival for mulch and rowcover treatments.

Mulch treatment	Minimum soil temp (°F) ^a		Plants/plot ^b (%), 1992
	1991	1992	
None	60	55	64
Black plastic (BP)	63	57	86
Clear plastic (CP)	62	59	93
IRT 76 (IRT)	65	58	79
CP + slit rowcover (RC)	67	62	100
IRT + slit RC	65	59	86
Comparison ^c			
None vs. rest	**	**	**
RC vs. no RC	**	**	*
IRT vs. BP	*	NS	NS
IRT vs. CP	NS	*	NS

^aAveraged over 9 May to 7 June 1991 and 7 May to 5 June 1992.^bContrasts calculated by partitioning the treatment effects using SAS general linear models procedure.^c*, **, NS Contrasts significant at P = 0.05, 0.01, or not significant, respectively.

slightly below 32F on three May dates in 1992. This was reflected in soil temperatures, as the minimum soil temperature for 1992 was 5 to 7F below the 1991 values (Table 2). As Loy (1991) and Loy and Wells (1990) noted, IRT 76 raised soil temperature more than black plastic, but less than clear plastic mulch. For 1991, the IRT 76 treatment minimum soil temperature was +2F vs. black, but IRT 76 was equal to clear with both at 65F; in 1992 the IRT 76 values were +1F compared with black and 2.5F compared with clear. The higher soil temperature under clear plastic may be the result of higher daily solar radiation in 1992 than in 1991. Even though the clear plastic had a significantly higher minimum soil temperature, early yield was not significantly enhanced (Table 1). This may be related to the cool growing season, which delayed harvest by 10 to 14 days. Vegetative de-

velopment and fruit enlargement was slow, with marketable fruit size of 3.6 lb in 1992 compared to a more-normal 4.9 lb in 1991. Rowcovers significantly ($P < 0.01$) increased minimum soil temperature +2.5F, compared with no cover, both years.

Plant survival was a critical factor in 1992 (Table 2). The harsh, cold winds severely reduced plant population. The use of a plastic mulch increased plant survival from 64% to 86%, and a rowcover increased it to 98%. There was no difference in plant stand in 1991, when all treatments averaged 96%.

The difference in plant population between rowcover and no rowcover for 1992 resulted in a 122 cwt/acre higher total marketable yield with the rowcover treatment. Total marketable yields from rowcover plots in 1992 were similar to 1991 (451 and 412 cwt/acre, respectively), but there

were only 4 weeks of harvest in 1992 compared to 6 weeks in 1991.

Rowcovers and clear plastic mulch are recommended for a consistent year-to-year muskmelon earliness advantage in the northern Great Plains. Trickle irrigation must be used with this system to supply water to the rapidly developing small transplants. Although yields from IRT 76 were comparable to clear plastic, its extra cost is not justified as long as weed control is adequate.

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