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ROW COVERS ON VEGETABLES IN NORTH FLORIDA

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Abstract. **The use of row covers to promote earliness and increase total yields of vegetables is becoming an established practice in many cooler production areas of the United States. Use of these materials in the south has not been researched. Trials on row covers were carried out on muskmelons (*Cucumis melo* L.) in the spring of 1984 and 1985, strawberries (*Fragaria x ananassa* Dech.) in the 1983-84 crop season and tomatoes (*Lycopersicon esculentum* Mill.) and peppers (*Capsicum annuum* L.) in the 1985 spring season. Early yield was enhanced with the use of row covers in both muskmelons and strawberries. Total yield, however, was not effected. In tomatoes and peppers, total yields were not affected by treatment when covers were removed 3 weeks after transplanting. The total yield in several tomato row cover treatments was reduced linearly as the time of removal was delayed to 5 weeks. Pepper yield was also reduced when covers were removed after 5 weeks.**

The average date of last frost for north Florida is 15 Mar. Harvest of the major vegetable crops must be completed by 4 July. Market prices drop drastically the week preceeding this holiday for tomato, pepper, watermelon and muskmelon among others. The use of row covers may provide growth enhancement and increased early yields and could increase profits significantly.

Row covers are continuous rolls of synthetic materials, usually polypropylene or polyethylene, used to cover plants with the objective of increasing yields and earliness by increasing soil and air temperatures during cool or cold periods. Dual plastic row covers have been used in California since the late 1950's (2). These are opened for heat ventilation and closed for cold protection. Single piece clear or pigmented opaque plastic with a series of short, cross-wise slits or circular perforations that provide ventilation have been tried and used successfully in northern and midwestern states as tunnels (1,6,7,9). The tunnels are formed by installing the poly covers over wire support hoops. Woven and non-woven materials, being developed by several companies, are also being evaluated as row covers over plants. A few of these have been used in the textile industry as clothing interfacing.

The woven and non-woven row covers are porous and self ventilating. They are light weight and can be applied directly on the plants without the use of the supporting hoops required of tunnels (3,4). These are usually referred to an non supported or "floating" row covers.

Researchers have reported varied results with the use of tunnels and row covers in several vegetables. Generally, early yields are increased significantly but the effects on total yields have been inconsistent (8). The use of tunnels and row covers has only been reported in Florida on muskmelons (5). The purpose of this paper is to report preliminary results on row cover work on tomatoes, peppers, strawberries and muskmelons in north Florida.

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Materials and Methods

Strawberry, muskmelon, tomato and pepper were grown on a Mulat fine sandy (Typic Ochraquults) soil near Gainesville, Florida. The strawberry trial and the first muskmelon trial were conducted in the winter and spring of 1983-1984 while the second muskmelon trial and the tomato and pepper trial were conducted the spring of 1985. Soil and air temperatures were monitored in each of the studies using recording thermographs. Pesticides were applied weekly for insect and disease control at recommended rates.

Strawberries. 'Florida Belle' strawberries were planted 9 Nov. 1984 on 4-ft center polyethylene-mulched beds previously fertilized with 120-70-133, lb./acre N-P-K. Plots were 15-ft long with 8 replications. Treatments consisted of plants covered with a non-woven polypropylene row cover, (cover PP N-W) put down 22 Feb. and removed 16 Mar. or no cover. Plots were harvested once or twice weekly with early and total yields recorded.

Muskmelon. Muskmelon 'Magnum 45' were planted on 20-ft long plots on 6-ft center beds and fertilized at the rate of 120-70-133 lb./acre N-P-K. For the 1984 trial, all the fertilizer was placed in the bed initially and watered with overhead irrigation, while for the 1985 trial, drip irrigation was used.

In 1984 the muskmelons were direct seeded on 16 Mar., in factorial combinations of mulch and no mulch treatments with 5 plant cover treatments. The plant covering treatments were: a) no cover (none), b) clear slitted polyethylene tunnel held up by wirehoops (tunnel, SP), c) non-woven polypropylene held up by wire hoops (tunnel, PP N-W), d) non-woven polypropylene lying loose over the row as a cover (cover, PP N-W), and e) paper hot caps. The covering materials were applied at seeding and removed on 20 Apr. 1984, immediately prior to earliest flowering.

The 1985 treatments were direct seeded on 18 Mar. in factorial combinations of mulch/non-mulch and row covering methods. The row covering methods were a) none; b) tunnel, SP; c) cover, PP N-W; d) clear polyethylene with circular perforations held up with wire hoops (tunnel, CP); e) non-woven polyethylene lying loose on the row (cover, PE N-W); and f) non-woven polyethylene cross laminated lying loose on the row (cover CL N-W). Covers were removed 19 Apr., immediately prior to earliest flowering.

Tomato and Pepper. 'Sunny' tomatoes and 'Early Calwonder' peppers were transplanted on 20-ft-long plots and 6-ft-center polyethylene-mulched beds. The tomatoes were fertilized with a total of 240-157-300 N-P-K and pepper with 180-105-200/acre N-P-K. Both crops were watered using drip irrigation and 2/3 of the N and K was applied with the irrigation water during the growing period. Both

Table 1. Protection method effects on strawberry yield.

Protection method	Yield (flats/acre) Week 1	Week 2	Week 3
None	28 b[y]	33 a	210 a
Cover	119 a	31 a	82 b

[z]Mean separation in columns by Duncan's Multiple Range Test, 5% level.

Table 2. Interaction of method and bed cover effects on muskmelon yield.

Protection method	Yield (cwt/acre) Early Open	Early Mulch	Total mean
	1984		
None	1	17 b	279
Tunnel, SP	41	130 a	327
Tunnel, PP-NW	17	111 a	294
Cover, PP-NW	8	111 a	325
Hot Caps	11	20 b	276
	1985		
Tunnel, SP	19	167 a	589
Tunnel, CP	29	192 a	505
Cover, PP-NW	7	162 a	601
Cover, PE-NW	3	155 a	482
Cover, CL-NW	7	148 a	552
None	1	55 b	453

Mean separation in columns by Duncan's Multiple Range Test, 5% level.

Table 3. Protection method and removal date effects on marketable tomato yields.

Protection method	Yield (25 lb.-boxes/acre) Weeks covered 3	4	5	F[y]
Tunnel, SP	1168	612 bcd	512 b	L**
Tunnel, CL	912	464 d	332 c	L**
Tunnel, OP	1192	636 bcd	416 c	L**
Cover, PP-NW	928	628 bcd	316 c	L**
Cover, PE-NW-1	1036	924 ab	800 b	NS
Cover, PE-NW-2	1136	556 cd	268 c	L**
Cover, CL-NW	1256	1228 a	1304 a	NS
Cover, W	1260	1228 a	1116 a	NS
None	1064	868 bc	1240 a	NS

[z]Mean separation in columns by Duncan's Multiple Range Test, 5% level.
[y]Linear (L) effects were significant at the 1% level or not significant (NS).

experiments were factorial combinations of 9 methods of plant cover treatments along with 3 removal dates of each cover (3, 4, and 5 weeks after installation). The plant covering treatments were a) tunnel, SP; b) tunnel, CP; c) tunnel made of opaque white polyethylene with slitted perforations (tunnel, OP); d) cover PP-NW; e) cover PE-NW-1 (0.6 oz/yd weight); f) cover PE-NW-2 (0.75 oz./yd weight); g) cover CL-NW; h) cover of a wide weave woven material lying loosely over the row (cover W); and i) none. Both crops were transplanted 3 Apr. Tomatoes were staked and tied after the last cover removal date.

Results and Discussion

Strawberries. A heavy freeze occurred 29 Feb. and 1 Mar. 1984 with an ambient air low temperature of 24°F. With both the row cover and no cover, all open flowers and fruit were killed. Fruit development after the freeze was more rapid with the covered than uncovered plants. Fruit yield at the first harvest was significantly greater from the covered than uncovered plants (Table 1). During the second week of harvest, fruit yields were similar with both treatments. At the third week of harvest, however, fruit yield was significantly greater with the non-covered than the covered treatments. Yields for the rest of the season were similar and the total yield was not significantly influenced by row cover treatments.

Muskmelon. Plant growth was observed to be more rapid when muskmelons were grown on polyethylene mulch during both years. Total yields for both years were significantly higher with the treatments grown on mulch as compared to open culture.

In both years, protection method significantly interacted with bed cover (mulch/non-mulch) in their effects on early muskmelon yield. Protection method effects were similar when plants were grown without mulch (Table 2). When plants were grown on mulch, early yields were significantly greater when plants were covered with tunnels or covers. Yields with hot caps (1984) were similar to those obtained with no protection and significantly less than with covers and tunnel. During both years, early yields were similar with tunnels and covers. Total yields were not influenced by protection treatments in either year. The use of covers or tunnels did not increase yields but only increased earliness.

Tomatoes. Plant growth appeared similar with all treatments. Yield was influenced by an interaction between protection method and length of time the tomato plants were covered. Total yield for the tomatoes covered 3 weeks were similar with all treatments (Table 3). When tomatoes were covered 4 and 5 weeks, however, significant differences occurred among treatments. Yields were reduced linearly with an increase in time covers were on the tomato plants

Table 4. Main effect of pepper yields by removal date.

Removal date (week)	Yield (boxes/acre) Small	Medium	Large	Total
3	204 a	78 a	30 a	312 a
4	195 a	84 a	21 ab	300 a
5	156 b	57 b	12 b	228 b

[z]Mean separation in columns by Duncan's Multiple Range Test, 5% level.

Table 5. Protection method and harvest date effects on marketable pepper yields.

Protection method	Yield (boxes/acre) Harvest 1	2	3	F[z]
Tunnel, SP	76	65	135	Q*
Tunnel, CL	20	51	109	L**
Tunnel, OP	100	78	160	Q**
Cover, PP-NW	26	49	123	L**
Cover, PE-NW-1	45	62	132	L**
Cover, PE-NW-2	36	71	161	L**
Cover, CL-NW	125	65	116	Q**
Cover, W	99	93	115	NS
None	234	49	90	Q**
LSD (.05)	35	34	34	

[z]Linear (L) or Quadratic (Q) effects were significant at the 1% (**) or 5% (*) level or not significant (NS).

with the 3 tunnel treatments, the polypropylene cover, and the heavier polyester cover. Fruit yields were not influenced by time the covers were in place with the wide weave, non-woven and woven cover, and the lighter polyester cover.

A possible explanation for this response may be the effect of treatment on heat build-up and/or retention under the covers. The covers with the wider weave did not reduce yields as did the more heat retentive heavier materials and the tunnels.

Peppers. As with tomatoes, plant growth was similar with all treatments. Yields were significantly influenced by cover removal date (Table 4). Removing the covers and tunnels 5 weeks after application significantly reduced yields. This was consistent among all fruit size categories. The use of covers also delayed harvest (Table 5). Yields with the non-covered check were significantly higher than with all covered treatments at the first harvest. The larger harvests were delayed with the clear tunnels and the poly non-woven covers. Here as in tomatoes, temperature differences under the covers appeared to be implicated in yield reactions.

Row covers can increase early yields in strawberries and muskmelons when used in north Florida under cool conditions. Total yields may not be increased by the use of tunnels or covers. When used under warmer conditions total yield can be reduced by leaving the row covers on extended periods of time in tomatoes and peppers. Yield can also be delayed in peppers.

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LIQUID FERTILIZATION OF SQUASH AND MUSKMELON GROWN AS A SECOND CROP FOLLOWING TOMATOES

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Abstract. **Squash (*Cucurbita pepo* L. cv. Seneca Zucchini) and muskmelon (*Cucumis melo* L. FL85-2M) transplants were established as a second crop in the Spring of 1985 following a Fall 1984 tomato crop. Soil tests prior to planting indicated low residual fertility. Liquid fertilizer was applied with an injection wheel at 0, 75-13-62, 150-27-125, or 225-40-187 lb. N-P-K/7500 linear bed feet (lbf). Seven beds, 30 inches wide and 9 inches high, were formed on 4.5-ft centers between irrigation furrows 40.5 ft apart. The fertilizer was applied 100% preplant; 50% preplant and 50% at midgrowth; or 33% preplant, 33% at midgrowth, and 33% just prior to first harvest. Fruit yield increased with fertilizer rate and was higher with split applications as compared to a single preplant application. Early yields were highest with the 150-27-125 applied in 2 applications. Later, yields were higher with the 225-40-187 applied in 2 or 3 applications.**

Utilization of residual fertilizers and polyethylene mulch by a second crop of vegetables following the main vegetable crop would be desirable for economical and environmental reasons. Several studies have been conducted in Florida on the use of mulch and residual nutrients by a second vegetable crop (2,3,4,8). Much of the effort in the earlier studies emphasized the quantity of fertilizers necessary for optimum yields by the second crop and the placement of dry fertilizers in relation to the plant row (2,4). Application of liquid fertilizers by the IFAS tractor-mounted squarebar applicator also was studied (8). Dry fertilizers were applied by hand in a hole punched through the mulch (4), or by a modified automatic plug-mix planter(8). Placement of dry fertilizers by hand is a labor intensive, expensive process.The modified plug mixer gave good performance, but could be used only for pre-plant fertilizer application. Liquid fertilizers, applied by the

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