COCONUT COIR AS AN ALTERNATIVE TO PEAT MEDIA FOR VEGETABLE TRANSPLANT PRODUCTION

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C.S. Vavrina, K. Armbrester, Mireia Arenas, and M. Pena
University of Florida
Southwest Florida Research and Education Center
P.O. Drawer 5127
Immokalee, FL 33934

Introduction

The vegetable transplant industry in Florida relies entirely on soilless media (predominantly peat moss) as a substrate for plant production (Vavrina and Summerhill, 1992). Soilless media accounts for approximately 9.3% of the total production cost of a vegetable transplant plug (Zimet and Vavrina, 1995). Peat, a non-renewable resource, is harvested in Florida and Canada to supply the Florida industry. Escalating peat costs cannot be easily passed on to the consumer, as the cost per 1,000 plants ($26.00) has remained static over the last 5 years. Growers have been forced to use smaller cells for production thereby increasing the number of plants per greenhouse to reduce production costs. Smaller cell sizes increase space efficiency, but do not necessarily reduce peat use, or improve plant quality (Maynard et al. 1996).

Coir pith is available in large quantities as a by-product of the coconut industry. In the last few years coir dust has been promoted (Pryce, 1990) or considered (Bragg, N. 1991) as a substitute for natural peat in potting media. The particular structure of coconut fibers and their physical and chemical properties, make them suitable for container media purposes (Batra, 1985). In fact the use of coconut fiber in European greenhouse production is well accepted as new technology.

Coir contains equal portions of lignin and cellulose and is rich in potassium and the micronutrients Fe, Mn, Zn, and Cu. Due to the high potassium content of the media a reduction in potassium fertilization has been shown to produce beneficial results (Savithri et al., 1993). However, some studies have shown that it is necessary to increase the nitrogen fertilization for coir grown plants to compensate for N immobilization of the media. Coir has a low Cation Exchange Capapcity (21-30 meq./L) so it does not retain cations or buffer against pH change well (Handreck, 1993).

Coir has a high water holding capacity and has been traditionally used to improve the physical and chemical properties of soils (Savithri and Khan, 1993). When applied to agricultural soils coconut coir can improve moisture retention capacity, and increase available nutrient content, infiltration rate, total porosity, and hydraulic conductivity of that soil (Savithri and Khan, 1993; Abad et al., 1995).

The use of coconut fiber as a growing media for tomato has been investigated. Teo and Tan (1993) found that a mixture of coconut fiber and charcoal dust (2:1; v:v) produced the greatest plant height, number of fruit, total fruit weight per plant and the largest mean weight and fruit diameter. The purpose of this study was to investigate the use of Scotts coconut coir media as an alternative to peat for both tomato and pepper transplants and to follow the growth and development of those transplants in the field through harvest. Special emphasis was placed on the "quality" of the transplants at maturity (6 weeks) just prior to setting in the field.

METHODS

A coconut coir transplant mix (CC) designed by the Scotts Co. (Marysville, OH) was compared to Scotts MetroMix 220 (MM) for use as a vegetable transplant media for soilless media production of tomato and pepper transplants. Each media was placed in half of a 242 cell, Speedling flat (Speedling Inc, Plant City, FL). Each cell of the flat contained 25 cm^3 (0.9 oz) of media. Six replications were set out in a randomized complete block design in the horticulture greenhouse of the Southwest FL Research and Educational Center. Flats were seeded with 'Agriset 761' tomato or 'Boynton Bell' pepper according to trial. Plants were watered as needed and fertilized with 200 ppm N weekly from a commercial 20-20-20 soluble source.

Five weeks after seeding, 10 plants of each crop, from each media and replication were harvested to determine if differences in growth were evident due to media influence. Transplant data included height, top fresh and dry weight, root fresh and dry weight, leaf area, root to shoot ratio, and leaf number.

The remaining transplants were set in the field on an Immokalee fine sand under subsurface seepage irrigation. A standard methyl bromide fumigated (240 lbs/A, broadcast), granular fertilized (220N-78P-300K), plastic mulched (black, 1 mil), 32" wide bed was prepared on January 7, 1996. Holes were punched in a single row, 18" pattern for tomato and 10" by 10" double row pattern for pepper, on 6 ft. centers and transplants were set on January 21, 1996.

Six replications were implemented in a randomized complete block fashion. Data was taken on plant dry matter accumulation at 20, 40 and 60 days after planting (DAP) for tomato (1 plant), and 30, 60 DAP for pepper (1 plant). Tomato yield, fruit number and weight, from 10 plants, was separated into red and green fruit of medium, large, and extra-large size. Pepper yield, from 24 plants, was separated into Fancy, No. 1, and No. 2 grades.

RESULTS & DISCUSSION

TOMATO

Transplant growth. Table 1 shows that tomato plant growth was similar in both the CC substrate and MM. It appears that a slightly larger "all around" plant is produced with the use of CC substrate. This factor warrants further investigation as FL transplant growers often judge plant quality by their ability to control height. Under winter conditions (as here), cool growing temperatures aid in managing plant height. However, during late spring (shipping season) and early fall, a media that promotes plant height (or lushness) will be more difficult to "control".

Early field growth. Field growth of transplants was similar regardless of substrate used (Table 2). No significant differences were discernable in plant dry weight accumulation 20, 40, or 60 DAP or in fruit number or weight 60 DAP. Plants grown in MM appeared to have a slight advantage in 60 DAP DW and fruit development, but this was not supported statistically.

Yield parameters Red fruit yield at first harvest was influenced by the transplant production media (Table 3). Thirty-four percent of total first harvest yield was red fruit when MM was used as the transplant production media compared to 22% from the CC treatment. First harvest yields are important to growers for two reasons; target market window and generally larger size (i.e. greater value). While a 12% difference in red fruit production may not greatly impact crop economics, it does indicate a difference in rate of maturity. It appeared as if plants grown in MM attained maturity more quickly than those grown in CC. Such speculation was partially supported by the fact that MM "appeared" to have a competitive edge in plant DW accumulation and fruit development 60 DAP as mentioned above. This factor warrants further investigation.

Concerning other aspects of yield, whether propagated in CC or MM yields of green fruit (Table 3), general size distribution of red and green fruit (Tables 4, 5), and average fruit weight (Table 3) were comparable across individual and total harvests. A non-statistical advantage in CC extra-large green fruit development (Table 5) may be explained by maturity also. MM red XL fruit weighed 11.4 lbs, CC red XL yield was 6.9 lbs. Total XL for MM was 34.8 compared to 35.3 for CC. Therefore the apparent increase in XL green yield for CC was simply fruit that had sized but not "colored up", i.e. matured.

PEPPER

Transplant growth. No significant differences in pepper transplant growth were noted between plants grown in CC or MM (Table 6). The tendency for CC to produce a "larger" transplant observed with tomato was reversed with pepper as MM recorded greater mean values for most parameters measured.

Early field growth. Table 7 indicates that once planted in the field, no significant differences in pepper growth 30 or 60 DAP resulted from transplant media treatment. Plants grown in CC had slightly greater individual fruit weight (5.47 g vs. 3.05 g) but this was not significant.

Yield parameters. Tables 8, 9, and 10 reflect the yield of Fancy, No. 1, and No. 2 pepper fruit taken from each individual harvest. These data indicate that compared to MM, transplants grown in CC yield similarly across harvests, in size classifications, weight, and total peppers produced. When observing total fruit volume across all size classification (Table 11) it is interesting to note that individual harvests were almost identical in number and weight.

Pepper are generally harvested 10 - 14 days apart and fruit size diminishes with increasing harvest number. This factor was reflected in pepper average fruit weight by harvest (Table 12); as fruit size diminished so did average fruit weight. Transplant substrate did not impact average fruit weight as both treatments performed essentially the same. This further supports the premise that either media will promote quality yields.

DISCUSSION

This study indicates that Scotts coconut coir substrate can be used as a reliable media for spring production of tomato and pepper transplants in FL. Its use as a media results in transplant parameters that are comparable to those produced using MetroMix 220. Subsequent field establishment and yield characteristics are comparable also.

The water holding ability of the coir material may be a disadvantage in fall tomato production as plant height control is a major concern of growers. Fall temperatures promote over watering and water availability promotes growth. A media with high water holding ability can support longer intervals without irrigation, but conversely can lead to uncontrolled height under "normal" irrigation schedules. Such a consequence would discourage growers unless they "learn" how to use the product. A fall trial is necessary to test this hypothesis.

The delayed maturity of tomatoes grown in coir media should be reviewed further. This point may be academic as delayed maturity was not seen in pepper. However, if real, consideration of coir for tomato production in areas with a restricted market window may not be advisable.

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Table 1. Tomato seedling growth parameters from culture in coconut substrate or Metromix 220, Spring 1996.

Treatment	**Height**	**Top FW**	**Root FW**	**Top DW**	**Root DW**	**R:S**	**Leaves**	**Leaf Area**
	(cm)	(g)	(g)	(g)	(g)	-	#	(cm^2)
Coconut	10.70	1.22	0.46	0.12	0.033	0.28	4.07	27.34
Metromix 220	9.70	1.18	0.43	0.13	0.031	0.24	3.93	26.86
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Tomato seedling dry weight 20, 40, and 60 days after planting (DAP) from culture in coconut substrate or Metromix 220, Spring 1996.

Treatment	**Plant dry weight (g)**			**Fruit 60 DAP**	
	20 DAP	40 DAP	60 DAP	#	(g)
Coconut	1.34	28.55	129.07	19.33	415.32
Metromix 220	1.45	28.45	139.63	23.67	585.72
LSD 0.05	NS	NS	NS	NS	NS

Table 3. Red and green tomato yield and average fruit weight from transplants grown in coconut substrate or Metromix 220, Spring 1996.

Treatment	Red + Green fruit weight (lbs) Harvest				Average fruit weight (lbs) Harvest			
	1	2	3	4	1	2	3	4
Coconut	9.02	10.82	11.33	31.17	32.00	29.25	20.95	82.20
Metromix 220	13.80	12.27	11.72	37.79	26.27	26.83	22.83	75.93
LSD 0.05	2.57	NS	NS	NS	NS	NS	NS	NS

Treatment	Red + Green fruit weight (lbs) Harvest				Average fruit weight (lbs) Harvest			
	1	2	3	4	1	2	3	4
Coconut	41.02	40.07	32.28	113.37	0.51	0.41	0.37	0.43
Metromix 220	40.07	39.10	34.55	113.72	0.52	0.42	0.38	0.44
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS

Table 4. Medium, large and extra-large tomato fruit sizes from transplants grown in coconut substrate or Metromix 220, Spring 1996.

Treatment	Medium size weight (lbs) Harvest				Large size weight (lbs) Harvest				Extra-large size weight (lbs) Harvest			
	1	2	3	Total	1	2	3	Total	1	2	3	Total
Coco.	2.722	8.33	10.42	21.47	2.98	7.77	9.30	20.05	35.32	23.97	12.57	71.86
Metro. 220	2.10	9.87	9.87	21.84	3.17	6.60	10.58	20.35	34.80	22.63	14.10	71.53
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Green tomatoes extra-large weight from transplants grown in coconut substrate or Metromix 220, Spring 1996.

Treatment	Green XL weight (lbs) Harvest			
	1	2	3	Total
Coconut	28.43	17.48	8.43	54.30
Metromix 220	23.40	15.03	9.67	48.10
LSD 0.05	NS	NS	NS	NS

Table 6. Pepper seedling growth parameters from culture in coconut substrate or Metromix 220, Spring 1996.

Treatment	Height (cm)	Top FW (g)	Root FW (g)	Top DW (g)	Root DW (g)	R:S -	Leaves #	Leaf Area (cm^2)
Coconut	8.58	0.98	0.44	0.095	0.034	0.37	4.13	20.51
Metromix 220	8.58	1.04	0.49	0.105	0.037	0.35	4.40	22.77
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS

Table 7. Pepper seedling dry weight 30 and 60 days after planting (DAP) and fruit number and weight 60 DAP, Spring 1996.

Treatment	**Plant dry weight (g)**		**Fruit 60 DAP**	
	30 DAP	60 DAP	#	(g)
Coconut	0.93	15.62	3.33	18.23
Metromix 220	0.90	16.94	2.83	8.64
LSD 0.05	NS	NS	NS	NS

Table 8. Fancy fruit yield of pepper from transplants grown in coconut substrate or Metromix 220, Spring 1996.

Treatment	**Fancy fruit (#)** Harvest					**Fancy fruit weight (lbs)** Harvest				
	1	2	3	4	Total	1	2	3	4	Total
Coconut	7.00	2.50	0.00	0.00	9.50	3.92	1.28	0.00	0.00	5.20
Metromix 220	8.33	1.17	0.17	0.00	9.67	4.60	0.55	0.12	0.00	5.27
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 9. No. 1 fruit yield of pepper from transplants grown in coconut substrate or Metromix 220, Spring 1996.

Treatment	**No. 1 fruit number**					**No. 1 fruit weight (lbs)**				
	Harvest					Harvest				
	1	2	3	4	Total	1	2	3	4	Total
Coconut	16.33	12.68	6.17	5.83	41.01	6.22	4.17	2.42	2.00	14.81
Metromix 220	14.17	13.33	7.17	4.17	38.84	5.48	4.63	2.60	1.40	14.11
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 10. No. 2 fruit yield of pepper from transplants grown in coconut substrate or Metromix 220, Spring 1996.

Treatment	**No. 2 fruit number**					**No. 2 fruit weight (lbs)**				
	Harvest					Harvest				
	1	2	3	4	Total	1	2	3	4	Total
Coconut	0.83	8.67	15.83	2.67	28.00	0.13	2.30	4.22	0.50	7.15
Metromix 220	0.67	6.83	14.50	2.33	24.33	0.23	1.92	3.92	0.40	6.47
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 11. Total fruit yield from transplants grown in coconut substrate or Metromix 220, Spring 1996.

Treatment	**No. 2 fruit number**					**No. 2 fruit weight (lbs)**				
	Harvest					Harvest				
	1	2	3	4	Total	1	2	3	4	Total
Coconut	24.00	23.83	22.00	8.50	78.33	10.27	7.75	6.63	2.50	27.15
Metromix 220	23.33	21.33	21.83	6.50	72.99	10.32	7.10	6.63	1.80	25.85
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 12. Average pepper fruit weight, Spring 1996.

Treatment	**Average fruit weight (lbs)**				
	Harvest				
	1	2	3	4	Overall
Coconut	0.42	0.33	0.30	0.30	0.35
Metromix 220	0.43	0.33	0.31	0.28	0.35
LSD 0.05	NS	NS	NS	NS	NS