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EFFECT OF COIRPITH BASED POTTING MIX AND METHODS OF FERTILIZER APPLICATION ON TOMATO

M. BASKAR and A. SARAVANAN
Department of Soil Science and Agricultural Chemistry
Agricultural College and Research Institute
Tamil Nadu Agricultural University
Coimbatore 641 003

ABSTRACT

Pot culture experiment was carried out during 1995-1996 with tomato (CO-3) to study the effect of coirpith based potting mixtures [100% soil, 100% coirpith, 75% coirpith + 25% soil, 50% coirpith + 50% soil and 25% coirpith + 75% soil] and methods of fertilizer application [conventional soil application of N and soil application + fertigation] on physical and chemical properties of the potting medium, yield and uptake of nutrients by tomato. Incorporation of coirpith improved the physical and chemical properties of the potting medium. An yield increase of 6% and 27% were recorded in the treatments of soil + coirpith at 75:25 and 50:50, respectively, over soil alone. Among the two methods of fertilizer applications, fertigation method gave increased yield of tomato to the tune of about 8.72% over conventional soil application method.

KEY WORDS : Potting medium, coirpith, fertiliser application, physico-chemical properties, tomato

Container grown plants require a growing medium with good physical and chemical environment for their growth. An efficient medium must be sufficiently firm and dense to hold the plants, sufficiently retentive of moisture and porous. Depending on the growing nature of plants (epiphytic, semiepiphytic etc) the organic wastes become a constituent in many container media. Considerable research has been done on the use of organic wastes such as saw dust, sludge, datepalm leaves; pecan shells and pine bark in the preparation of potting mixtures. Coirpith is a non-disposable waste product of coir industry. Its use as a soil conditioner in tropical farming is well documented but the work on coirpith utilisation as potting medium is very limited. [Saravanan and Nambisan, 1995].

The soil less culture has low nutrient retention capacity due to heavy leaching by frequent irrigation which warrants standardisation of fertilizer application methods so as to maintain continuous supply of nutrients in a favourable physical and chemical environment throughout the crop growth.

MATERIALS AND METHODS

Bulk soil [*Udic Haplustalf*] was collected from cotton breeding station, Agricultural College and Research Institute, Coimbatore. Coirpith collected from Vedapatti, Coimbatore district was used as a pot mix component. The processed soil and coirpith were mixed as per the details of the treatment (V/V basis) and filled at the rate of 15 l per pot. The experiment was conducted in a factorial Completely Randomized Design replicated six times 3 replications for sampling at vegetative stage and 3 replications for harvest. The treatmental combination includes 2 methods of fertilizer applications on 5 different ratio of potting mixtures.

Methods of fertilizer application

M_1 NPK @ 150:100:50 Kg ha^{-1} of which 50% of N and full dose of P and K were applied as basal and the remaining 50% N was top dressed at 30th DAT.

M_2 NPK @ 150:100:50 kg ha^{-1} of which 50% of N and full dose of P and K were applied as basal and the remaining 50% N was applied through fertigation (application of fertilizers through irrigation water as slurry) at 15 days interval throughout the crop period (up to 90th DAT).

Urea, super phosphate and muriate of potash were used as sources of N, P and K respectively.

Table 1. Physico-chemical properties of the initial potting mixtures

Properties	Unit	T_1	T_2	T_3	T_4	T_5
Mechanical analysis						
Clay	Per cent	28.18				
Silt	Per cent	8.53				
Fine sand	Per cent	25.52				
Coarse Sand	Per cent	36.65				
Textural class		Sandy Clay loam				
Bulk density	g cc^{-1}	1.21	0.08	0.54	0.66	1.05
Particle density	g cc^{-1}	2.12	0.38	1.11	1.33	1.81
Pore space	per cent	44.0	80.0	51.0	50.0	42.0
Maximum water holding capacity	per cent	45.0	863	106	74	52
pH		8.5	6.7	7.5	8.0	8.2
EC	dSm^{-1}	0.550	0.458	0.926	0.586	0.556
CEC	$(mol(p^+)kg^{-1}$	18	59	29	28	26
Total N	Per cent	0.035	0.450	0.280	0.150	0.073
Organic carbon	Per cent	0.49	27.41	11.31	2.70	1.14
Available N	ppm	65.8	102.0	99.0	85.3	78.3
Available P	ppm	7.1	7.9	10.2	9.5	8.9
Available K	ppm	245	800	575	450	375

Potting media

T1	-	Soil + Coirpith - 100:0V/V
T2	-	Soil + Coirpith - 0:100 V/V
T3	-	Soil + Coirpith - 25:75 V/V
T4	-	Soil + Coirpith - 50:50 V/V
T5	-	Soil + Coirpith - 75:25 V/V

Potting mixtures were prepared as per the treatment and initial composite samples were collected from each mixture before the commencement of the pot experiment and were analysed for various physico-chemical properties (Table 1). Physical constants, texture, and chemical properties were analysed as per normal methods. For pH and EC analysis, water and coirpith was taken in the ratio of 50:1 in case of 100% coirpith media and 2:1 (water:potting mix) in case of other media.

Thirty days old seedlings of tomato were transplated at the rate of three seedlings per pot. Recommended package of practices were adopted and yield of fresh fruits was recorded. Potting mixture samples were collected up to a depth of 15 cm at two growth phases of tomato *viz.,* flowering and at harvest stage and analysed for physico-chemical properties (Tables 2, 3). The plant samples were collected at harvest stage and analysed for uptake computation (Table 4).

RESULTS AND DISCUSSION

Changes in physical properties

Bulk density is one of the most commonly used indices for the evaluation of soil physical conditions. By the inclusion of coirpith in the potting medium, the bulk density was decreased which would favour good physical properties like improved pore space and water holding capacity. The bulk density was significantly reduced from 1.21 g cc^{-1} (100% soil) to 0.54 g cc^{-1} (75% coirpith + 25% soil) by the incorporation of coirpith in the potting medium. Similarly, the other physical parameters *viz.,* per cent pore space, maximum water holding capacity were also improved by the addition of coirpith in the potting medium (Table 1). Increase in water holding capacity and pore space by the addition of coirpith to the soil was reported by many workers (Ramaswamy and Sree Ramulu, 1983; Saravanan and Nambisan, 1995). The pore space was slightly decreased from flowering stage to harvest stage which might be due to compaction of the potting medium. Though the water holding capacity was increased from flowering to harvest stage due to decomposition of coirpith, the increase was spectacular only in the media which consisted of 100% coirpith (Table 2).

Table 2. Effect of treatments on physical properties of the potting medium

Treatments		Flowering stage				Harvest stage			
		Bulk density ($g\ cc^{-1}$)	Particle density ($g\ cc^{-1}$)	Pore space (%)	Water holding capacity (%)	Bulk density ($g\ cc^{-1}$)	Particle density ($g\ cc^{-1}$)	Pore space (%)	Water holding capacity (%)
M1	T_1	1.31	2.19	44.2	48	1.35	2.20	43.7	48
	T_2	0.10	0.39	74.6	675	0.14	0.45	71.1	711
	T_3	0.57	1.28	55.1	107	0.59	1.38	56.8	114
	T_4	0.77	1.56	53.3	72	0.87	1.63	50.3	75
	T_5	0.71	1.93	51.1	57	1.11	2.00	48.0	57
	Mean	0.69	1.46	55.7	192	0.81	1.53	54.4	201
M2	T_1	1.34	2.21	44.3	47	1.34	2.21	43.1	48
	T_2	0.11	0.36	74.1	664	0.25	0.50	70.5	720
	T_3	0.57	1.27	55.5	107	0.61	1.35	52.2	114
	T_4	0.27	1.58	53.3	71	0.89	1.65	50.4	75
	T_5	1.08	1.96	51.0	56	1.11	1.94	48.5	57
	Mean	0.77	1.48	55.8	189	0.83	1.53	53.1	203
CD (P=0.05)					0.05	NS	0.92	5	
	S					NS	NS	NS	NS
	T					0.073	0.22	1.47	8
	SxM					NS	NS	NS	NS
	SxT					NS	NS	NS	11
	MxT					NS	NS	NS	NS
	SxMxT					NS	NS	NS	NS

Treatment details as in the text

Changes in chemical properties

The improvement in the CEC, available nutrients and organic carbon content of the potting medium due to addition of graded doses of coirpith in the process of potting mixture preparations were attributed to the high CEC, organic carbon and nutrient contents of coirpith. Coirpith incorporation in the potting medium considerably reduced the pH which could be attributed to acidic nature of the coirpith. The pH of the medium was significantly increased from flowering to harvest stage. The pH of the media which consisted of 25% soil + 75% coirpith, significantly increased with the advancement of growth, where as in all other media the pH changes were not appreciable.

The increase in EC of the medium as observed in the present study under fertigation of N at harvest stage might be due to the high EC irrigation water generated by dissolved fertilizers. Papadopoulous (1987) and Haroon (1991) also reported similar increase in EC under fertigation of N. But at flowering stage, conventional method recorded slightly, higher EC than fertigation. This may be ascribed to the application of full dose of fertilizers before flowering under conventional method. The media which contains coirpith recorded higher EC than 100% soil medium. The possible reason could be that the coirpith had high water soluble salts resulted from water used for retting. The EC of all the potting media except with 100% coirpith increased from flowering stage to harvest observed in the study may be due to fertilizer addition and dissolution of soluble salts from the components of coirpith. But with 100% coirpith medium, EC was decreased probably due to heavy leaching as a result of its high pore space. Among the coirpith containing media, media containing 75% coirpith and 50% coirpith had higher EC than 25% coirpith media. The effect of coirpith in influencing the organic carbon as observed in the present study was well documented (Duraisamy, 1992). Increasing proportions of coirpith addition to soil in the preparation of potting mixtures increased the N content of the media. The supplementation of N through decomposition products of the added organics could have resulted in the build up of total N. The conventional method of fertilizer application recorded high available N at flowering stage. This might be due to application of full dose of N prior to flowering stage. But at harvest stage, fertigation registered slightly higher available N possibly due

Table 4. Effect of treatments on root volume yield and nutrient uptake of tomato

Treatments		Root volume (ml pot^{-1})	Fruit yield (g pot^{-1})	Dry matter Production (g pot^{-1})	N-uptake (mg pot^{-1})	P-uptake (mg pot^{-1})	K-uptake (mg pot^{-1})
M_1	T_1	8.9	409	65.2	1089	101	1789
	T_2	48.0	377	57.6	1001	84	1879
	T_3	43.0	421	70.1	1301	108	2455
	T_4	31.0	495	75.7	1707	141	2577
	T_5	22.7	646	87.6	2032	137	2821
	Mean	30.7	470	71.2	1426	114	2294
M_2	T_1	11.5	435	70.6	1463	95	1872
	T_2	50.0	412	66.8	1124	97	1992
	T_3	45.0	452	76.6	1565	123	2595
	T_4	33.7	549	83.9	1853	128	2604
	T_5	24.7	707	94.3	2145	156	3087
	Mean	33.0	511	78.4	1630	120	2430
Mean	T_1	10.2	422	67.9	1276	98	1806
	T_2	49.0	395	62.2	1063	91	1036
	T_3	44.0	437	73.4	1433	116	2525
	T_4	32.4	522	79.8	1780	135	2591
	T_5	23.7	678	9.0	2089	147	2713
	Mean	31.9	491	74.8	1528	117	2362
CD (P=0.05)	M	0.6	6	0.6	30	4.6	56
	T	0.7	8	0.7	39	5.9	72
	MxT	NS	14	1.2	68	10.3	123

Treatment details as in the text

to application of N upto 90th DAT and frequent application of N also could have increased the mineralisation of coirpith. The decrease in available N in potting medium containing higher proportions of coirpith at flowering stage might be due to very high uptake of N at flowering stage by tomato and might be due to initial wider C/N ratio. A rapid turn over of available N at post harvest stage with potting medium, containing higher proportions of coirpith (100%, 75% and 50% coirpith) could be attributed to the slow and steady release of nutrients. The favourable influence of coirpith on soil available N is already known.

At flowering stage, fertigation treatment registered high value for available P which might be due to positive interaction of fertigation of N on P availability (Haroon, 1991). But at harvest stage, fertigation gave low value. This might be attributed to high uptake of P due to high dry matter production under fertigation treatment. Incorporation of coirpith in the potting medium improved the available P in the soil at all the growth stages of tomato. This might be attributed to the release of CO_2 and organic acids during the decomposition of coirpith rendering less soluble P into more soluble P. The availability of P was high at flowering stage and declined at harvest stage and this might be due to crop uptake.

The fertigation treatment registered lower available K than soil application of N. This may be ascribed to high uptake by tomato in the fertigation treatment. The media which consisted of high proportion of coirpith registered high available K which might be due to high K content of coirpith (Savithri and Hameed Khan, 1994). The decrease in available K at post harvest stage may be ascribed to the increased uptake of K as the advancement of crop growth.

Yield and nutrient uptake

Incorporation of coirpith in the potting medium significantly increased the yield and nutrient uptake of tomato (Table 4). The increase in nutrient availability, CEC, moisture retention and pore space of the potting medium have contributed to the increase in tomato yield. The improvement in root distribution pattern by the addition of coirpith also confirmed the reasoning. The highest yield (657 g pot^{-1}) was obtained for the potting medium consisted of 75% soil + 25% coirpith followed by

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	Mean	31.9	491	74.8	1528	117	2362
CD							
(P=0.05)	M	0.6	6	0.6	30	4.6	56
	T	0.7	8	0.7	39	5.9	72
	MxT	NS	14	1.2	68	10.3	123

Treatment details as in the text

50% soil + 50% coirpith (506 g pot^{-1}) which might be due to favourable physiochemical properties of the respective potting medium. The potting medium consisted of either 100% soil or 100% coirpith did not support tomato growth in terms of yield. This could be quite expected that under 100% coirpith medium though CEC and pore space were high, the other properties of the medium were not sufficient to support to crop. Fertigation method was highly efficient method in increasing the tomato yield to the tune of about 8.72% over conventional method of fertilizer application which might be due to the increased nutrient use efficiency. (Haroon, 1991). This might also be ascribed to the continuous and steady supply of the available nutrients particularly the N throughout the crop growth. The pattern of nutrient uptake by tomato followed similar trend as that of the yield and this might be explained by the variation in the yield for different treatments.

It can be concluded that mixing of soil and coirpith in the ratio of 25:75 and application of 50% of recommended N through fertigation were proved to be more effective than other treatments.

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