Effect of Effective Microorganisms an Growth media on the Growth of Potted Taiwan Cherry Seedlings (*Prunus campanulata* Maxim)

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Abstract

2-month old Taiwan cherry seedlings were planted in 5-inch pots filled with 6 growth medium mixes, namely soil, soil + 5% bark compost, soil+ 10% bark compost (BC), perlite + vermiculite + peatmoss (PVP), PVP+25% bark compost and PVP + 50% bark compost. They were divided into 2 groups: 1 group for control and 1 group was treated with EM solution.

The evaluations include plant height, trunk diameter, diameter of tap root, root length, number of branch roots and plant fresh and dry weight in October. In general, treatments with soil-less medium (PVP) control, PVP + middle amount of bark compost without EM application tend to show a better performance, except the results of diameter of tap root and number of branch roots.

The statistic analyses of the data depict that the composition of the growth medium played the most significant role affecting the seedling growth, adding of bark compost the second, while EM played a less insignificant role in most of the observed items in this experiment.

Such results might be caused mainly by an excess supply of water. It is recommended that the implementation of a cultural method have to be properly evaluated prior to its application.

Introduction

Taiwan Cherry (*Prunus campanulata* Maxim) is an important native deciduous tree species spreading in the mountain area of Taiwan. The blossom decorates the landscape and gardens in early spring. Because of its good horticultural properties - compatible, vital. low chilling requiring and early germinating (of seeds), the 1 to 2 year old seedling has been used as rootstock for some of the related species.

Usually the propagation of rootstocks starts with the sowing of seeds in spring time. The germinated seedlings grow through summer and autumn in the open field. During dormant period in winter time, they are dug out bare rootedly. Very often, the young trees don’t grow well, mainly because of the uncontrolled soil conditions. The damage of roots during transplanting may also cause the undesired growth thereafter.

Effective microorganisms have been applied in some countries on numeral crops, i.e. paddy rice, sugar cane and some vegetables in India (Zaccharia, 1995); tamarind, mango and paddy in Laos (Keomanichanh l995); citrus, tomato and soybean in Indonesia (Zaenudin, 1995); paddy rice, seed cotton and maize in Pakistan (Ahmad et al. 1995) etc. to improve the productivity. Other reports regarding plant protection (Jonglaekha et al. 1995; Keomanichanh, 1995) and soil and plant nutrition improvement (Piyadasa et al. 1995) were also concerned.

Knowing the beneficial effect of EM application and in order to produce cherry seedlings of better quality, a trial on a container production system including the use of organic and inorganic mixes as well as the application of effective microorganisms (EM) has been conducted in the growth period of 1996. The potting trial was followed by a field evaluation and nutrient analyses of the plant tissues.

Material and Method

Taiwan cherry seeds were collected in April and May 1995, cold stored and sown on peat moss in February 1996. The seedlings were transplanted in 5 inch pots filled with growth media for different treatments in June 1996.

Field soil and soil less growth medium (peat : vermiculite : perlite = 1:1:1 v/v) were used as basic media. A thoroughly composted bark compost from broad leaves trees served as the source of organic matter. A 1000x of EM stock solution was applied on to the pots monthly to the EM group at a rate of 100 ml/pot until sampling date (140 days from planting). Each treatment included 20 plants.

Table l. Design of the treatments.

Medium	% bark compost v/v	EM (1000x)
Soil	0	0
		+
	5	0
		+
	10	0
		+
PVP	0	0
		+
	25	0
		+
	50	0
		+

Note: EM = effective microorganisms;
PVP = medium mix of peat moss : velmiculite : perlite=1:1:1;
+ = with;
0 = without.

Through whole period, a drip irrigation system was set up to apply water at a rate of 15ml/time and 7 times a day.

Evaluations on plant height, trunk diameter, tap root diameter, root length number of branch root and weight of plant were done in mid October 1996. The soluble sugar and starch contents of plant tissues were measured by means of Anthron and α-amylase method respectively. Kjeldahl-N, and the elements P, K, Ca and Mg were determined by diffusion method, molybdenum blue method and atomic absorption spectrophotometer respectively.

Result and Discussion

Table 2, 3 and 4 depict the statistic analyses of the tree growth. Table 1 depicts that all of the observation items of tree growth are significantly different among treatments. Plant height has been enhanced mostly by PVP control, followed by PVP-25% bark compost (BC)+EM and PVP+25% BC.

Trunk diameter has been enhanced again by PVP control mostly, and then by PVP+25% BC+EM, PVP+EM, PVP+25% BC.

Length of tap roots have been positively influenced by PVP control followed by PVP+25% BC+EM.

Length of branch roots have been influenced by PVP+25% BC mostly.

Tap root diameter has been enhanced by PVP+25% BC, then followed by PVP+25% BC, then followed by PVP+25% BC+EM and PVP+EM application.

Number of roots has been affected by soil+5% BC+EM and PVP control significantly.

Table 2. Effects of soil, PVP bark compost and EM on the growth of Taiwan cherry seedlings.

Treatment			plant	trunk	root length (cm)		tap root	No. of
Medium	BC (%)	EM (1000x)	Height (cm)	Dia. (cm)	tap root	branch root	Dia. (mm)	roots
Soil	0	0	36.1de	4.46de	32.0bcde	22.3bcd	5.83c	5.7b
		+	32.5ef	4.29de	18.2def	15.2cd	6.03bc	4.0b
	5	0	34.2ef	4.10e	24.5cdef	14.0cd	5.25c	5.3b
		+	35.2ef	4.25de	11.6f	17.7cd	5.78c	11.0a
	10	0	31.3ef	4.05e	14.9ef	24.0cd	5.02c	4.0b
		+	30.3f	3.84e	15.8ef	11.8d	5.10c	5.3b
PVP	0	0	65.9a	6.10a	57.0a	34.7b	5.56c	11.0a
		+	49.0b	5.54abc	40.8abc	24.0bcd	6.87abc	6.3b
	25	0	49.1b	5.37bc	43.2ab	56.4a	8.02a	6.7b
		+	40.7cd	5.57ab	48.3ab	25.5bcd	7.67ab	6.3b
	50	0	42.6c	4.88cd	23.9cdef	17.7cd	6.13bc	5.3b
		+	40.8cd	5.16bc	34.8bcd	34.5b	6.70abc	5.7b
LSD	5%		4.5	0.6	16.0	11.8	1.61	3.1
	1%		6.0	0.8	21.6	15.9	2.18	4.2

BC = bark compost;
EM = effective microorganisms;
+= with;
0=without.
Numerals in same column with same letter have no significant difference in 5% Duncan's Multiple range test.

Table 3 compares the percentages of difference and interaction among 3 main factors. Basic media and bark compost are the main factors affecting Taiwan cherry growth. EM only have significant effect in plant height and branch roots length. There is very significant effect of interaction among 3 factors on plant height and root length and slight effect of interaction on branch root length.

Table 3. Percentage of difference (Fo) of main effects and interactions of EM, bark compost and basic media on the growth of Taiwan cherry seedlings.

		Plant Height (cm)	Trunk Diameter (mm)	Root Diameter (mm)	Root length (cm)		No. of roots
					Tap root	Branch root	
Main effect	EM	0.0***	73.3	23.3	17.8	0.1***	78.2
	BC	0.0***	0.0***	69.0	0.3**	9.1	14.0
	BM	0.0***	0.0***	0.0***	0.0***	0.0***	89.1
Interaction	EM x BC	0.05***	31.0	68.9	41.3	3.0*	0.1
	EM x BM	0.0***	60.1	70.8	19.5	51.6	1.2
	BC x BM	0.0***	47.0	4.9*	21.8	0.4**	0.4
	EM x BC	2.3*	13.3	43.9	43.9	0.0***	16.6

EM = effective microorganisms;

BC = bark compost;

BM = basic media;

*, **, *** mean 5%, 1%, 0.1% significant difference by Duncan's multiple Range Test respectively.

Table 4 shows the influence of 3 factors on plant growth. EM applications decreased the plant height and the length of branch roots significantly, and affected less on root diameter and tap root length while increased root diameter and number of root slightly. Except plant height, there is no significant difference between 0 and medium bark compost treatments. The effect of PVP on seedlings growth is more significant than soil.

Table 4. Comparison of the effect among EM, bark compost, basic media (soil and PVP) on the .growth of Taiwan cherry seedlings.

Treatment		Plant Height (cm)	Trunk Diameter (mm)	Root Diameter (mm)	Root length (cm)		No. of roots
					Tap root	Branch root	
EM	+	38.8b	4.82a	5.97a	28.2a	21.5b	6.38a
	0	43.2a	4.78a	6.36a	32.6a	28.2a	6.22a
BC	0	45.9a	5.10a	6.08ab	37.0a	24.1ab	6.67a
	m	39.8b	4.82a	6.68a	31.8a	28.4a	7.25a
	h	36.2c	4.48b	5.74b	22.4b	22.0b	5.00b
BM	Soil	33.2a	4.17b	5.50b	19.5a	17.5b	5.78a
	PVP	48.0b	5.44a	6.83a	41.3b	32.1a	6.83a

EM = effective microorganisms;

BC = bark compost;

BM = basic media;

+ = with;

0 = without;

m = middle content;

high = high content.

Numerals in same item with same letter have no significant difference by 5% Duncan's Multiple range test.

Table 5, 6 and 7 depict the statistic analyses of the fresh and dry weight of the tree.

Table 5 depicts the effects of growth mixes on fresh and dry weight of shoots and roots of cherry seedlings. Combination of PVP+25% bark compost with or without EM application seems to have positive effects on the increase of plant dry weight. The effects of PVP control and PVP+EM drop in the second order.

Table 6 depicts the results of a statistical analyses of the percentage differences of main effects and interactions among EM application, bark compost and PVP medium on the weight of cherry seedlings. The results show the order of affecting parameters, which should be PVP > bark compost > EM.

Table 5. Effects of soil, PVP, bark compost and EM on fresh and dry weight of Taiwan cherry seedlings.

Treatment			Shoot wt. (g)		Root wt. (g)		Total	
Medium	BC (%)	EM	Fresh	Dry	Fresh	Dry	Fresh	Dry
Soil	0	0	12.58bc	4.41b	8.87def	2.71bc	21.45bc	7.11bcd
		+	10.70bc	3.99b	5.84def	1.86c	16.54c	5.83cd
	5	0	10.90bc	4.41b	6.07def	2.43bc	16.97c	6.84bcd
		+	7.46c	3.07b	4.21ef	1.31c	11.67c	4.39cd
	10	0	8.15c	3.17b	4.18ef	1.48c	12.33c	4.65cd
		+	4.99c	2.18b	2.64f	0.98c	7.62c	3.16d
PVP	0	0	18.38ab	7.54ab	16.27ab	4.53b	34.65ab	12.23ab
		+	18.87ab	7.58ab	13.48bc	4.29b	32.36ab	11.86ab
	25	0	26.21b	10.46a	20.90a	7.05a	47.13a	17.52a
		+	26.28a	10.01a	16.29ab	4.71b	42.58b	14.72a
	50	0	13.16bc	4.15b	9.12cde	2.69bc	22.27bc	6.83bcd
		+	10.54bc	4.25b	11.99bcd	3.03bc	22.52bc	7.28bcd
LSD	5%		8.83	3.61	5.73	2.11	13.75	5.38
	1%		11.97	4.89	7.76	2.86	18.62	7.29

Note: same as Table 2.

Table 6. Percentage of difference (F_o) of main effects and interactions among EM, bark compost and basic media on the weight of Taiwan cherry seedlings.

		Shoot wt. (g)		Root wt. (g)		Total wt.	
		Fresh	Dry	Fresh	Dry	Fresh	Dry
Main effect	EM	32.5	47.9	12.0	10.3	20.0	23.5
	BC	0.2**	0.2**	0.3**	0.5**	0.1**	0.1**
	PVP	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***
Interaction	EM x BC	87.7	92.2	31.5	27.1	9.22	68.1
	EM x BM	54.5	57.5	78.0	83.1	61.4	68.0
	BC x BM	2.3*	2.9*	5.6	8.6	2.3	2.8*
	EM x BC x BM	94.1	98.3	44.3	51.9	95.1	90.8

EM = effective microorganisms;

BC = bark compost;

BM = basic media

*, **, *** mean 5%, 1%, 0.1%, significant different by Duncan’s multiple Range Test, respectively.

Table 7 shows the influence of 3 factors on the weight of the seedlings, There was a slight negative effect of EM application but was not significant. The weight of the seedlings treated with medium content of bark compost was slightly heavier than 0 bark compost treatment, yet no significant difference between these two treatments could be seen. Plant growth in high content of bark compost treatment had the least weight. Medium is the main factor affecting the result of this experiment. There is a very significant difference (lower than 0.1%) between PVP and soil medium influencing plant weight.

Table 7. Comparison among the effects of EM, bark compost and basic media on the weight of Taiwan cherry plant and seedlings.

Treatment		Shoot weight (g)		Root weight (g)		Total weight (g)	
		Fresh	Dry	Fresh	Dry	Fresh	Dry
EM		13.1	5.2	9.1	2.8	22.2a	7.9
	0	14.9	5.7	10.9	3.5	25.8a	9.2
BC	0	15.1a	5.9a	11.1a	3.4a	26.4a	9.2a
	m	17.7a	7.0a	11.8a	3.9a	29.6a	10.9a
	h	9.2b	3.4b	7.0b	2.0b	16.2b	5.5b
BM	Soil	9.1b	3.5b	5.3b	1.8b	14.4b	5.3b
	PVP	18.9a	7.3a	14.7a	4.4a	33.6a	11.7a

EM = effective microorganisms;
BC = bark compost;
BM = basic media;
+ = with;
0 = without;
m = middle content;
h = high content.
Numerals in same item with same letter have no significant difference by 5% Duncan's Multiple range test.

Table 8, 9 and 10 depict the statistic analyses in the carbohydrates contents of the seedling.
Table 8 depicts the effects of the treatments on the carbohydrates contents of cheery seedlings. There are highly significant differences (lower than 1%) in 80% ethanol soluble sugar contents in shoots and roots, and significant difference (lower than 5%) in starch content of roots, but no difference in starch and total carbohydrates content of shoot (Table 8) among all of the treatments. Table 9 shows the comparison of the percentage of difference among 3 main factors on carbohydrates content of the trees. Medium is the most important factors in this experiment. There is very highly significant difference(lower then 0.1%) in sugar and total carbohydrate contents of roots, and significant difference in sugar content of shoots and starch content of root. Bark compost also have some influence in sugar content of shoots and starch content of roots, and has highly significant difference in total carbohydrate contents of roots among treatments. These two factors have some interaction in sugar contents of shoots and roots and total carbohydrate contents of roots. EM shows very little influence on carbohydrate contents of the seedlings (Table 9). In general, growing seedlings in soil, high bark compost dosage and EM application, resulted in higher carbohydrate contents than in other media (Table 10).

Table 8. Effects of soil, PVP, bark compost and EM applications on carbohydrates contents of Taiwan cherry seedling.

Treatment			Shoot (% of dry wt.)			Root (% of dry wt.)		
Medium	BC (%)	EM	s.s	Starch	Total	s.s	Starch	Total
PVP	0	+	3.20c	4.38	7.57	2.05bcd	4.52abc	6.57b
		0	3.64bc	3.74	7.38	2.07bcd	2.94c	5.01c
	5	+	2.89c	3.79	6.57	1.56cd	4.47abc	6.08bc
		0	3.12c	4.33	7.45	1.45c	3.37bc	4.82c
	10	+	2.68c	3.94	6.62	1.90bcd	4.20abc	6.09bc
		0	2.77c	3.81	6.53	1.93bcd	4.96abc	6.88a
Soil	0	+	2.76c	4.44	6.87	2.12bcd	4.62abc	6.74b
		0	2.92c	3.95	7.15	3.45a	3.64bc	6.59b
	25	+	3.04c	4.89	7.93	3.07ab	5.27ab	8.34a
		0	3.52c	4.19	7.72	3.62a	5.38ab	9.00a
	50	+	4.66ab	3.76	8.41	3.44a	6.00a	9.44a
		0	4.95a	3.44	8.39	2.78abc	5.95a	8.73a
LSD	5%		1.07	ns	ns	1.09	1.93	1.13
	1%		1.50	ns	ns	1.53	ns	1.59

EM = effective microorganisms;

BC = bark compost;

s.s = 80% ethanol soluble sugar;

PVP = growth mix of peat moss : vermiculite : perlite = 1 :1:1.

Numerals in same column with same letter have no significant difference by 5% Duncan's Multiple range test.

Table 9. Percentage difference (F_o) of main effects and interactions of EM, bark compost and basic media on carbohydrates contents of Taiwan cherry.

Factor		Shoot (% of dry wt.)			Root (% of dry wt.)		
		s.s	Starch	Total	s.s	Starch	Total
Main effect	EM	18.4	72.5	97.4	57.7	21.6	10.5
	BC	3.8*	36.8	88.1	65.8	3.2*	0.0***
	BM	1.2*	72.5	10.1	0.0***	1.2*	0.0***
Interaction	EM x BC	88.4	82.0	84.3	28.8	22.3	26.1
	EM x BM	94.0	51.4	65.8	49.9	64.9	17.3
	BC x BM	0.1***	63.7	11.1	3.6*	44.8	0.2**
	EM x BC x BM	83.3	66.1	82.3	23.4	52.0	1.3*

EM = effective microorganisms;

BC = bark compost;

BM = basic media;

ss.=80% ethanol soluble sugar:

*,**, *** mean 5%, 1%, 0.1% significant difference by Duncan's multiple Range Test

respectively.

Table 10. Comparison among the effects of EM, bark compost and basic media on carbohydrates contents of Taiwan cherry seedlings.

Treatment		Shoot (% of dry wt.)			Root (% of dry wt.)		
		s.s	Starch	Total	s.s	Starch	Total
EM	+	3.20a	4.20	7.40	2.36	4.84	7.20
	0	3.49a	3.91	7.40	2.46	4.37	6.83
BC	0	3.12b	4.13	7.24	2.29	3.93b	6.23c
	m	3.14b	4.30	7.42	2.42	4.62ab	7.06b
	h	3.76a	3.74	7.49	2.51	5.28a	7.78a
BM	Soil	3.64a	4.11	7.75	3.00a	5.14b	8.14b
	PVP	3.05b	4.00	7.05	1.82b	4.08a	5.91a

The same as Table 7

Table 1l, 12, 13, 14 and 15 depict the statistic analyses of the macro-nutrients contents of the seedlings.

Among most of the treatments, there are significant differences in macro-nutrients contents in shoots and roots, except calcium in shoots and phosphorus in roots (Table 11 and 12).

Table 11. Effects of soil, PVP bark compost and EM application on mineral nutrients contents in the shoots of Taiwan cherry seedlings.

Treatment			% of dry weight				
Medium	BC	EM	N	P	K	Ca	Mg
PVP	0	+	1.43d	0.295ab	2.18cd	0.91c	0.167cd
		0	2.20ab	0.299ab	2.54bc	1.39bc	0.235ab
	m	+	1.54cd	0.267abc	3.46a	1.36ab	0.183c
		0	1.59cd	0.242bc	2.71b	1.32abc	0.199bc
	h	+	2.02abc	0.243bc	2.55bc	1.67a	0.253a
		0	1.79bcd	0.217bc	2.23bc	1.42ab	0.200bc
Soil	0	+	2.37a	0.351a	3.75a	1.11bc	0.165cd
		0	2.02bc	0.304ab	3.58a	1.30abc	0.195bc
	m	+	1.82bcd	0.240bc	2.44bcd	1.03bc	0.155cd
		0	1.80bcd	0.235bc	2.67bc	1.29abc	0.198bc
	h	+	1.97abcd	0.291ab	1.95c	1.10bc	0.126d
		0	1.51cd	0.183c	2.63bc	1.17bc	0.191bc
LSD	5%		0.49	0.079	0.47	ns	0.041
	1%		ns	ns	0.65	ns	0.058

EM = effective microorganisms;

BC = bark compost;

+ = with;

0 = without;

m = middle content;

h = high content.

PVP = medium mix of peat moss : vermiculite : pearlite = 1:1:1.

Numerals in same item with same letter have no significant difference by 5% Duncan's Multiple range test.

Table 12. Effects of soil, PVP bark compost and EM application on mineral nutrients contents in the roots of Taiwan cherry seedlings.

Treatment			% of dry weight				
Medium	BC	EM	N	P	K	Ca	Mg
PVP	0	+	1.46bcd	0.314ab	1.11bc	0.36e	0.097bc
		0	1.93abc	0.312ab	1.31bc	0.49de	0.113abc
	m	+	1.58bcd	0.307ab	1.29bc	0.52de	0.090bc
		0	1.14d	0.262ab	1.49ab	0.55de	0.090bc
	h	+	1.98abc	0.318ab	1.61ab	1.12a	0.143a
		0	2.03ab	0.288ab	1.38bc	0.80bc	0.118abc
Soil	0	+	2.38a	0.272ab	1.94a	0.49de	0.122ab
		0	1.95abc	0.321ab	1.45b	0.69cd	0.116ab
	m	+	1.98abc	0.279ab	1.31bc	0.65cd	0.093bc
		0	1.83bcd	0.265ab	1.40bc	0.59cde	0.094bc
	h	+	1.62bcd	0.367a	0.92c	0.96ab	0.085c
		0	1.44d	0.225b	1.29bc	0.74bcd	0.115abc
LSD	5%		0.53	ns	0.45	0.23	0.03
	1%		ns	ns	ns	0.32	ns

Same as Table 11.

Bark compost is the most important factor affecting mineral content in the plant tissues. There was a significant influence on nitrogen and phosphorus contents in shoots, and calcium and magnesium contents in roots. PVP significantly affect calcium and magnesium content in shoots. EM affects only magnesium content in shoot. Bark compost, PVP and soil show high interactions in potassium and magnesium contents in shoots, and nitrogen, potassium and magnesium contents in roots (Table 13).

Table 13. Comparison among the effects of EM, bark compost and basic media on macro-nutrients contents of Taiwan cherry seedlings.

Treatment		Shoot					Root				
		N	P	K	Ca	Mg	N	P	K	Ca	Mg
EM	+	1.84	0.281	2.89	1.20	0.175b	2.02	0.309	1.36	0.68	0.105
	0	1.82	0.252	2.72	1.32	0.203a	1.72	0.278	1.39	0.64	0.108
BC	0	2.00a	0.312a	3.01	1.18	0.190	2.21a	0.304	1.45	0.51b	0.112a
	m	1.69b	0.246b	2.82	1.25	0.184	1.62b	0.278	1.36	0.58b	0.092b
	h	1.80ab	0.242b	2.59	1.35	0.192	1.76ab	0.300	1.30	0.90a	0.115a
BM	Soil	1.81	0.272	2.84	1.18b	0.172b	2.05	0.288	1.37	0.64	0.108
	PVP	1.84	0.262	2.78	1.34a	0.206a	1.69	0.300	1.38	0.68	0.104

EM = effective microorganisms;
BC = bark compost;
BM = basic media:
+ = with;
0 = without;
m = middle content;
h = high content.
Numerals in same item with same letter have no significant difference by 5% Duncan's Multiple range test.

Table 14 and 15 show the analyses of the influences of 3 factors on mineral nutrient contents of the seedlings. The seedlings with better growth contain lower nitrogen and calcium, and higher potassium in shoots and roots, and higher magnesium in shoots. Bark compost tends to have positive effect on calcium and negative on phosphorus and potassium contents. Some of the better grown seedlings contained less macro-nutrients, expect potassium, could be explained, that a diluting of absorbed elements occurred during seedling growth.

Table 14. Percentage differences (F_o) of main effects and interactions of BM, bark compost and EM on macro-nutrients content in shoots of Taiwan cherry seedling.

Factor		N	P	K	Ca	Mg
Main effect	EM	78.1	9.1	36.8	11.9	0.3**
	BC	3.6	0.5**	18.7	21.7	63.2
	BM	8.4	45.5	74.0	4.4*	0.1***
Interaction	EM x BC	9.9	62.3	58.5	13.5	12.0
	EM x BM	1.5*	40.9	3.8*	38.7	3.6*
	BC x BM	9.9	44.3	0.1**	9.5	3.0*
	EM x BC x BM	7.8	58.8	3.7*	18.5	0.5**

EM = effective microorganisms;

BC = bark compost;

BM = basic media;

*, **, *** mean 5%, 1%, 0.1% significant difference by Duncan’s multiple Range Test respectively.

Table 15. Percentage differences (F_o) of main effects and interactions among BM, bark compost and EM on macro-nutrients contents in roots of Taiwan cherry seedlings.

Factor		N	P	K	Ca	Mg
Main effect	EM	15.4	10.8	74.5	35.5	65.6
	BC	7.7	45.7	37.0	0.0***	1.1*
	BM	8.9	51.4	88.6	28.6	45.1
Interaction	EM x BC	62.1	7.8	34.7	0.5**	95.2
	EM x BM	12.1	78.6	77.5	77.1	33.0
	BC x BM	2.5*	97.5	0.4**	5.6	1.9*
	EM x BC x BM	7.9	16.4	3.2*	63.9	4.5*

Same as in Table 14

In this experiment, the soil less growth medium composed of peat moss, vermiculite and perlite, either used alone or mixed with middle amount of bark compost, performed the best while bark compost at a higher rate performed negatively on the growth of cherry seedlings. EM application didn’t show significant effect on the growth of cherry seedlings under given growth condition as it might be expected.

It might be explained the following way. During early to mid-summer 1996, the climate was hot and dry. A drip irrigation system was set to apply 105-110ml(12 to 13mm) water for each pot per day. This amount of water was correct at the beginning, but was excess for later on when the hot days were passing by.

The plants received excess water were practically water logged for quite a long time. It might cause the anaerobic condition in the growth medium. Besides, too much water might also leach out the nitrogen in the medium and caused N-deficiency in the root regime. Especially in the treatment of high bark compost it might cause an accumulation of ammonium ion in the soil. These conditions tend to retard the growth of plants, especially the roots (Stolzy,. 1974, Compbell, 1978, Mengel and Kirkby, 1982).

Besides, too much decomposted bark compost reversed the positive effect of medium - through worsening the aeration, increasing carbon dioxide content (Compbell, 1978), competing soil nitrogen (Mengel and Kirkby, 1982., Wilding, 1985), and releasing toxic substances (butyric acid for an example) under poor drainage conditions (Compbell, 1978).

Finally, it could be concluded that, when a positive result of EM application is being expected, an optimal growth condition should be considered prior to planting.

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Reference

Ahmad, R., T. Hussain, G. Jilani, S. A. Shalid, S. N. Akhtar and M. A. Abbas. 1995. Use of effective microorganisms for sustainable crop production in Pakistan. Proc. of Second Conference of Effective Microorganisms. p. 15-27.

Campbell, C. A. 1978, Soil organic carbon, nitrogen and fertility. In “Soil Organic Matter” edt by Schnitzer, M. and S. U. Khan. p. 199-213.

Higa, T. 1995. Effective Microorganisms and their role in Kyusei nature farming and sustainable agriculture. Proc. of Second Conference of Effective Microorganisms. p. 1-6.

Jonglaekha, N., W. Pumsatit and S. Mekamol. 1995. The use of EM for control of root rot of strawberry. Proc. of Second Conference of Effective Microorganisms. p. 28-30.

Keomanichanh, K. 1995. Effect of EM application on fruit trees and paddy rice. Proc. of Second Conference of Effective Microorganisms. p. 87-89

Mengel, K. and E. A. Kirkby. 1982. Principles of Plant Nutrition. International Patash Institute. p. 99.

Piyadasa, E. R., K. B. Attanayake and A. D. A. Ratnayake. 1995. The role of Effective Microorganisms in releasing nutrients from organic matter, Proc. of Second Conference on Effective Microorganisms. p. 7-13.

Stolzy, L. H. 1974. Soil atmosphere, In 'The Plant Root and Its Environment. edt by Carson, E. W. Univ. Press of Virginia. p. 335-361.

Wilding, R. E. and T. R. Garland. 1985. Microbial development on soil shale wastes: Influence on geochemistry. In “Soil Reclamation Processes” edt by Tate III, R. L, and D. A. Klein. Marcel Dekker. Inc. p, 123-125

Zachria, P. P, 1995, Studies on the application of Effective Microorganisms (EM) in paddy, sugarcane and vegetables in India. Proc. of Second Conference on Effective Microorganisms. p. 31-41.

Zaenudin, S , 1995, Effective Microorganisms (EM4) technology in Indonesia. Proc. of Second Conference of Effective Microorganisms. p.80-81.