EFFECT OF SHADING ON MANGO (*Mangifera indica* L.) SEEDLING STOCKS GROWN IN DIFFERENT POTTING MEDIA

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ABSTRACT

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Shading (80% reduction of full sunlight) did not significantly influence the early growth of mango seedlings (var. Carabao) grown in six potting media preparations. Potting media, however, significantly affected the stem height and diameter, leaf number and size and seedling vigor. Seedlings grown in pure garden soil and those in rice hull charcoal-amended potting media were the least vigorous. Incorporation of undecomposed sawdust to garden soil in equal proportion depressed the early growth of mango seedlings. Interaction effect of shading and potting medium on the early growth of mango seedling was not significant.

KEY WORDS: Mango. Potting media. Seedling stocks. Shading.

INTRODUCTION

Mango (*Mangifera indica* L.) is the third most important fruit crop in the Philippines after banana and pineapple. The country's production of 350,000 t accounts for about 2.5% of the total worldwide production of 15 million t (FAO, 1994).

Like other fruit crops, mango productivity is strongly influenced by the kind and quality of its planting material. The old practice of using seedling trees in establishing mango orchard is already being discouraged because of many problems like delayed bearing period, large tree size and

production of variable quality fruits. The use of asexually propagated planting materials, particularly cleft grafted, is widely practiced at present.

For efficient mass propagation of mango planting materials through cleft grafting, quality scions and rootstocks must be used. As such, a rapid method to produce graftable size seedlings at the shortest time possible becomes imperative. Among the important considerations in growing mango seedling stocks are proper light and potting medium. Seedling stock could be grown under shade to minimize wilting due to rapid transpiration, reduce leaf temperature and leaf damage due to intense light and reduce seedling water requirement. In many other crops, too much shade causes leaf yellowing and etiolation and reduced photosythesis resulting in spindly and invigorous growth (Hartmann and Kester, 1990). In contrast, under intense light, the seedlings may suffer heat damage which is usually manifested by leaf burning or sunscalding. For vigorous growth, seedlings should be grown under optimum light condition.

Another important consideration in growing seedling stocks, particularly those grown in polybags/pots, is the quality of the potting medium. The present practice of using small bags for ease of transport necessitates that the medium must at least supply the seedling nutrient requirements for 5-6 months growing period. Garden soil alone or added with organic matter may be a good potting medium. However, other artificial media aside from garden soil have gained acceptance among nursery operators. This is due to the fact that various other crops could be succesfully grown in media other than pure garden soil like sawdust, rice hull and manures.

This study aimed to evaluate the response of mango seedling stocks (var. Carabao) to shading and potting medium.

MATERIALS AND METHODS

Mango seeds (var. Carabao) were manually dehusked to remove the outer covering, to facilitate germination and avoid production of "bent-stem" seedlings. Selected seeds with more or less uniform size and shape

were sown with the face down, 10 cm apart and 2 cm deep in a seedbed with sandy soil as medium. The medium was kept moist by regular watering.

Black polyethylene bags (0.002 mm thick, 15 cm wide and 20 cm long) with holes at the sides were used in potting the seedlings. The bags were filled with the different media preparations up to 3 cm below the brim. The seedlings were transplanted to the bags after four functional leaves have been produced or about 25 days after germination. The newly potted seedlings were placed under shade for 2 wks. Afterwards, the seedlings were arranged 25 cm x 25 cm between bags following a Split-Plot in Randomized Complete Block Design with three replications. There were 10 sample seedlings per treatment. Shading was designated as the main plot while potting media preparation was the sub-plot. The treatments used were:

Main plot (Shading)

- Unshaded (fully exposed to sunlight)
- Shaded (80% reduction of full sunlight)

Sub-plot (Plotting medium)

- Garden soil [GS] alone
- GS + sawdust [SD] (1:1)
- GS + SD + sand [S] (1:1:1)
- GS + SD + S + rice hull charcoal [RHC] (1:1:1:1)
- GS + S + RHC (1:1:2)
- GS + S + RHC (2:1:2)

The unshaded seedlings were kept in a fully exposed area while the shaded ones were placed under an overhead shade made of dried coconut leaves where light intensity was reduced to about 80% of full light (measured using a light meter; GE Model 214).

Fertilizer solution was prepared by dissolving 1 tbsp. of complete fertilizer (14% N, P, K) per 4 L of water. This was applied to the seedlings

one month after potting. On the second month after potting and every month thereafter until the fifth month, 200 mL urea solution (2 tbsp/4 L water) was applied to the seedlings. Regular weeding, watering and spraying with Malathion and Benlate were done.

Early response of the seedlings to the treatments in terms of stem height and diameter, leaf production and size and general vigor was regularly monitored.

The chemical (OM, N, P and K content and pH) and physical (water retention capacity) properties of the different potting media were determined before planting and 5 mos after planting. The water retention capacity (WRC) of the different media preparations was determined by pouring equal volume of water (250 mL) to each bagged medium (without plant) and then collecting and quantifying the amount of water drained after 24 h. Determination was done monthly for 5 mos WRC was computed using the formula:

$$\text{WRC (\%)} = \frac{\text{Volume of water applied - Volume of water drained}}{\text{Volume of water applied}} \times 100$$

RESULTS AND DISCUSSION

Chemical and physical properties of the potting media

Initial chemical analysis of the different potting media showed that all were slightly acidic with pH ranging from 5.9 to 6.9 (Table 1). Garden soil amended with sawdust in equal proportion had relatively lower pH probably due to organic acids released by decomposing sawdust. Those amended with rice hull charcoal had slightly higher pH than pure soil.

Pure garden soil had low OM and P contents but relatively adequate amount of K. Potting media amended with sawdust had higher OM contents that was about 2 to 4 times that of pure garden soil and rice hull

Table 1. Chemical properties of the different potting media used in the experiment before bagging/planting the seedling.

Potting Media	Chemical Properties				
	pH	OM (%)	N (%)	P (ppm)	K (ppm)
GS	6.20	2.64	0.09	7.09	227
GS + SD	5.90	8.96	0.10	7.10	442
GS + SD + S	6.30	8.32	0.10	7.10	405
GS + SD + S + RHC	6.60	6.94	0.11	37.53	544
GS + S + RHC1	6.90	2.84	0.10	70.37	792
GS + S + RHC2	6.65	2.94	0.10	52.85	670

charcoal-amended media. Moreover, these media have twice more K than the pure garden soil. The rice hull charcoal-amended medium had higher P and K contents. Relative to the pure garden soil, these have 5 to 10 times more P and about 2 to 3 times more K. Increasing the proportion of rice hull charcoal in the mixture correspondingly increased the P and K contents of the medium. The different potting media had only very slight variations in their N contents.

Five months after potting, the pH of most potting media except GS + SD placed under both unshaded and shaded conditions, GS + SD + S under unshaded condition and GS under shaded condition, decreased slightly regardless of whether they were placed under shade or in the open (Table 2). The observed pH reduction could be brought about by continuous application of urea. Moreover, this could be partly attributed to the release of organic acids from the decomposing OM (Mabesa and Quisumbing, 1976).

In general, there was a marked reduction in OM and P contents of all potting media regardless of whether they were placed under shaded or unshaded conditions. Their N content, however, increased. Except for the garden soil in both shaded and unshaded conditions and soil + sawdust under unshaded condition which showed slight increase in K content, K

content reduced in all other potting media. This could be due to plant utilization in the case of P and K and decomposition in the case of the OM. The slight increase in N content observed in all potting media including the pure garden soil could be due to mineralization of OM or to the added N from the urea.

WRC was low among the sawdust and rice hull charcoal-amended potting media than the unamended garden soil (Table 3). The porous characteristics of the above-mentioned media could explain the result. Muñoz et al. (1993) reported that additon of sawdust to garden soil increased the porosity of the resulting mixture and Mabesa and Quisumbing (1976) found that large pores in a porous potting medium increased water percolation and infiltration rates, lowering its WRC.

Table 2. Chemical properties of the different potting media used in the experiment 5 mos after bagging/planting of mango seedlings.

Treatment	Chemical Properties				
	pH	OM (%)	N (%)	P (ppm)	K (ppm)
Unshaded Condition					
GS	5.75	2.17	0.11	6.27	282
GS + SD	6.05	6.90	0.15	5.86	520
GS + SD + S	6.75	5.14	0.12	4.23	330
GS + SD + S + RHC	6.05	4.04	0.12	13.14	480
GS + S + RHC1	6.10	2.17	0.10	23.14	520
GS + S + RHC2	6.00	2.52	0.11	19.57	490
Shaded Condition					
GS	6.30	2.32	0.06	4.25	260
GS + SD	6.30	6.85	0.14	5.37	385
GS + SD + S	6.50	6.04	0.15	4.55	345
GS + SD + S + RHC	6.40	5.04	0.17	11.65	415
GS + S + RHC1	6.40	2.82	0.11	15.92	400
GS + S + RHC2	6.35	2.42	0.11	19.01	450

Table 3. Average water holding capacity of the different potting media used in the experiment[1].

Potting Media	Average Water Retention Capacity (%)	
	Open Condition	Shaded Condition
GS	75.99	71.36
GS + SD	66.59	61.02
GS + SD + S	59.39	66.70
GS + SD + S + RHC	62.02	62.81
GS + S + RHC1	63.75	62.98
GS + S + RHC2	65.38	63.85

[1] Average of the values obtained in the 5 sampling periods using bagged medium (without plant).

Seedling growth response

Shading significantly increased the length of the second leaf of mango seedlings (Table 4). Gray et al. (1981) pointed out that plants under shaded conditon generally produced longer and broader leaves as adaptive mechanism under limited light. Except for its effect on leaf length, shading did not have any significant influence on the other seedling growth parameters measured 5 mos after planting.

Potting media, however, significantly influenced most of the seedling growth parameters (Table 4). Seedlings grown in GS+S+RHC were the tallest although they were statistically similar to seedlings grown in GS and in GS+SD, GS+SD+S and GS+SD+S+RHC.

Stem diameter of the seedlings was likewise affected by the potting media (Table 4). Those grown in GS+S+RHC1 had the biggest stem diameter although they did not differ significantly withstem diameter of seedlings grown in GS, GS+SD+S+RHC and GS+S+RHC2. Those grown in GS+SD+RHC1 produced the most number of leaves while those grown in GS+SD+S had the least. Except in GS+S+RHC1, the number of leaves produced by the seedlings planted in other potting media were statistically the same.

Table 4. Horticultural characteristics of 5-mo-old mango seedlings (var. Carabao) as affected by shading and potting media preparation.[1]

Treatment	Plant height (cm)	Girth dia. (cm)	No. of leaves	1st leaf Length (cm)	1st leaf Width (cm)	2nd leaf Length (cm)	2nd leaf Width (cm)	Vigor Rating[2]
Shading (a)								
Open	344.23	5.99	10.43	11.25	3.41	11.25	3.41	1.79
Shaded	347.67	6.07	9.15	11.79	3.54	11.79	3.54	1.81
Potting Medium (b)								
GS	362.70ab	6.05ab	9.8b	13.06	3.56ab	13.06	3.56ab	1.7b
GS + SD	339.35b	5.85bc	9.3b	10.83	3.28ab	10.83	3.28ab	1.9a
GS + SD + S	302.90b	5.60c	8.9b	10.27	3.14b	10.27	3.14b	2.4a
GS + SD + S + RHC	335.65b	6.15ab	10.0b	12.02	3.80a	12.02	3.80a	1.7b
GS + S + RHC1	387.35a	6.30a	11.4a	11.60	3.58ab	11.60	3.58ab	1.5b
GS + S + RHC2	347.70ab	6.15ab	9.5b	11.34	3.51ab	11.34	3.51ab	1.8b
CV(a), %	7.80	7.01	10.88	14.15	7.78	3.67	7.26	3.71
CV(b), %	8.63	4.49	8.23	13.14	9.88	6.51	6.57	20.95

[1] Means in a column followed by a common letter are not significantly different at 0.5 level according to Duncan's Multiple Range Test (DMRT).

[2] Rating scale:

1 - Most vigorous; plot with most of the seedlings having healthy appearance.

2 - Moderately vigorous; plot with some seedlings showing less healthy appearance.

3 - Least vigorous; plot with most of the seedlings generally less vigorous in appearance.

For the size of the first and second leaf, seedlings grown in media amended with rice hull charcoal generally produced bigger leaves while those grown in sawdust-amended media, the smallest. Statistical analysis however revealed no significant difference in leaf size between the seedlings grown in rice hull charcoal- and sawdust-amended media.

In terms of the general vigor of the seedlings which reflects overall growth performance, seedlings grown in rice hull charcoal-amended media and those in pure garden soil were the most vigorous while those in sawdust-amended media, particularly those without rice hull charcoal, were the

least vigorous. In fact, their growth was inferior compared to that of seedlings grown in garden soil.

It is interesting to note that despite the relatively high P, K and OM of the rice hull charcoal-amended potting media and their good physical characteristics (highly porous), they failed to bringsignificant improvement on the early growth of mango seedlings. This result could be attributed to the effect of regular fertilizer application which may have masked the influence of the rice hull charcoal on the growth of the seedlings. Mango trees are generally known to respond to N through increased vegetative growth (Bondad, 1987; Valmayor, 1977). Even then, considering its significant P and K contribution, rice hull charcoal could still be considered a promising amendment to garden soil especially those with low P and K contents. Moreover, utilization of rice hull charcoal as potting media component is a practical solution to the problem of disposal.

The result may indicate that the undesirable effect of incorporating undecomposed sawdust to garden soil, and the release of products of decomposition toxic or inhibitory to the growth of mango seedlings could perhaps explain the unfavorable growth response of the seedlings to sawdust incorporation. Bartholomew (1965) reported that N immobilization would likely occur during decomposition of organic mulches high in carbon but deficient in N, and that in severe condition may cause marked injury to crops. Growth inhibition in potato due to bagasse incorporation in the soil was reported by Taja and Van Der Zaag (1986) in their mulching experiment. Although the result of the final analysis of the different potting media revealed that sawdust-amended media had higher P, K and N contents than pure garden soil, these nutrients were probably released only after the sawdust was decomposed and after the seedlings had already suffered deficiency of the above-mentioned nutrients. Although N fertilization was employed, the amount of added N was perhaps too low to correct the problem.

No significant interaction effect of shading and potting medium on the early growth of mango seedlings was noted.

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