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Standardization of Potting Media for Nursery Raising Seedlings of Jujube (*Zyzyphus mauritiana* Lamk.)

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Abstract Jujube has taproot system and mortality percentage of the nursery raising seedlings is very high due to root injury caused by the soil medium. To avoid soil conditions an experiment was conducted on standardization of potting mix for healthy nursery raising seedlings of jujube (*Zyzyphus mauritiana* Lamk.). For the purpose seeds were obtained from the fruits of the healthy orchard of jujube and planted in various potting mixtures included canal silt, bagasse farm yard manure and coconut fiber. Ten different combinations of potted media were used to assess the best one for proper and healthy growth of jujube seedling. The maximum water holding capacity (41.34%), air filled porosity (16.47%), EC (1.85 dS/m), germination percentage (86.33%),maximum number of leaves (123.36),maximum number of sprouted shoots (8.14) maximum number of roots (69.11) was observed in T4 where canal silt and bagasse were used at 45% each plus 10% coconut husk. While, potting medium of this treatment was observed acidic in nature had pH value of 6.45. It was further observed that success ratio after transplantation in field was the highest in T4 i.e. up to 92.89%.

Keywords: Jujube, *Zyzyphus mauritiana,*

Introduction

Ber (*Ziziphus mauritiana* Lamk.*)* trees have positive environmental benefits as they provide perennial cover protecting the soil. The strong root system also helps to maintain structure and therefore conserve the soil. Ber can provide food security, due to sustained production of the fruit, irrespective of drought, as the tree is drought and saline tolerant and can grow on poor degraded land (Pareek, 2001). It is king of arid fruits also known as Chinese apple, or Indian plum belongs to the family Rhamnaceae (Buckthorn). Fruit yield varies between 50kg to 200kg per tree depending on the climatic conditions. (Kaarira, 1998) It can also provide additional income to farmers if incorporated into their agricultural system or grown on marginal or unused land.

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(Meena *et al.*, 2003). It has outstanding pharmaceutical properties and is one of the traditional drugs that related with improvement of cardiovascular system, nervous system and as well as relief of insomnia symptoms (Maydell, 1996). Ripened fruits have sweet and sour taste which can expel phlegm, relieve cough and is laxative. (Mukhtar *et al.*, 2004; Abdel-Zaher *et al*., 2005).

Pakistan has a rich collection of ber varieties (more then 35) existing locally which have giant fruit size with massive export potential (Naseem *et al.*, 2013). Botanical studies reveal that like many other fruits (citrus, mango, guava etc.) ber is also cross pollinated fruit that is asexually propagated. Ber seedling are raised and propagated in open field nurseries, then transferred to orchards, but ber has tap root system that is injured when uprooting/transporting the nursery plants to transplant in field. This is a key difficulty for nurserymen to grow healthy ber orchards as most of the plants die due to root damage. According to a research survey report seventy percent ber plants fail in field due to root injury during uprooting and transporting. (Pareek, 2001). Good media management is basic to the production of quality grown ber nursery plants. Optimum water holding capacity, electrical conductivity, pH, better aeration and organic matter of media may help in better seedling stand and plant growth of plants. A number of ber plants may be lost due to root damage while lifting, packaging and transport to the field and transplanting. (Bettineski, 1996).

A good potting mix is fluffy and gives plants better nutrition and anchorage. Roots need air, as well as water, to grow. If the potting mix is too dense or too wet, plant roots will be stunted or even die. Present research trial was carried out to study the physical and chemical characteristics of different media combinations and their influence on the growth and development of grown ber nursery plants. The objective/advantages of this study include: (i) evaluate the best growing media composition to avoid root injury due to tap root system. (ii) polyethylene bags grown ber plants are easy to transport into distant areas because of having an undisturbed root system (iii) to facilitate successful transplantation and survival in the field/orchard. (iv) to assess the actual media nutrient composition required to grow ber seedlings vigorously. (v) to using same place each year as plants were prepared in black color polyethylene bags (vi) weeds and soil borne diseases cannot transferred into new grove sites.

Materials and methods

Media preparation and seed sowing

Silt, coconut fiber, bagasse and farm yard manure in different combinations were used to grow ber seedlings at fruit plant nursery of Horticultural Research Institute, AARI Faisalabad Punjab Pakistan. Ber stones were harvested from full ripened healthy ber fruits and were sown in black color polyethylene bags (15x15 inch). Stones were also soaked in water for 24 hours to enhance germination percentage, and then placed at about 2cm depth in polythene bags. The germinated seedlings were kept under close observation and watering was done at proper intervals. Pot media and plant growth analysis were performed. Plants were also propagated through T-grafting at pencil thickness and then transplanted (after one year) in orchard to check their survival percentage. Experiment was carried out in randomized complete block design (RCBD). Each treatment consisting of 10 plants replicated five times. Data was analyzed statistically and treatments were compared by using Least Significant Difference (LSD) test at 5% probability level.

Potting media analysis

Analytical methods of Oregon state university (Gessert, 1976) were followed to determine physical characteristics of potting media combinations. Air filled porosity and water holding capacity were calculated by the formula: Air filled porosity % = cups of drained water/ total volume of the pot (cups). Water holding capacity % = percent porosity - percent air space. Electrical conductivity (EC) of the saturation extract was measured by using corning conductivity meter (220pH/EC meter). About 250 g of soil was saturated with distilled water, paste was allowed to stand for an hour and pH was recorded by Oreon research digital pH/milivolt meter with glass electrode using buffers of pH 4.0 and 9.0 for standardizing the instrument.

Plant growth analysis

The data for plant growth characteristics were recorded since sowing to orchard transplantation. Germination percentage was recorded weekly. Mortality percentage in each media composition was also recorded. Stem diameter (mm) was measured by screw gauge from the centre of seedling. Numbers of mature leaves were counted on each seedling. Number of sprouted scion shoots were counted after grafting at field transplanting stage. Number of

roots was counted at orchard transplantation stage. Survival percentage in field was noted after two to three months

Results and discussions

Pot media analysis

Good potting mix should hold enough water to prevent the plant from becoming stressed at the chosen irrigation frequency. It must not hold too much water as it can reduce the air filled porosity. (Thompson *et al.*, 2001).

Appropriate water holding capacity avoids water wastage, nutrient leaching and runoff. Media with total water holding capacities greater than 35% are the most satisfactory for general nursery cropping. (Krucker, 2003). Maximum water holding capacity (41.34%) was found in T4 (silt 45%: coconut fiber 10%: bagasse 45%: farm yard manure 0%), followed by T7 (39.50%) (silt 0% coconut fiber 0%: bagasse 100%: farm yard manure 0%) while minimum water holding capacity (12.39%) was depicted in T9 (silt 0%: coconut fiber 100%: bagasse 0%: farm yard manure 0%) (Table 2). These results were also supported by Gouin (1995) who studied many other horticulture fruits at nursery stages in which coconut fiber was used along with silt in various combinations to improve water holding capacity.

Results for Air filled porosity was found best (16.47%) in T2 (silt 50%: coconut fiber 5%: bagasse 45%: farm yard manure 0%) followed (14.46%) by T7 (silt 0%: coconut fiber 0%: bagasse 100%: farm yard manure 0%). Minimum (6.65%) air filled porosity was found in T8 (Silt 100%: Coconut fiber 0%: Bagasse 0%: Farm Yard Manure 0%) (Table 2). Symptoms of low aeration like less vigorous growth, smaller leaves dark green or chlorotic leaves were observed in T8 (silt 100%: coconut fiber 0%: bagasse 0%: farm yard manure 0%). The higher values of total porosity mean the less compactness and increased aeration, which results in better root growth and penetration of ber plants into the soil. These findings were supported by the results of De-Boodt (1971) and Paul and Lee (1976) who reported that aeration was improved in silt and sand with the addition of organic amendments.

Good media combinations must be low in soluble salts and have an acceptable pH range. (Raviv, 1998). Measuring pH is essential part of designing and maintaining the quality of potting mixes. It is of utmost important as it effect on the availability of plant nutrients. The effect of pH on nutrient availability is most important when supply of nutrient is poor. Lowest pH (6.27) was observed in T6 (silt 25%: coconut fiber 10%: bagasse 65%: farm yard manure 0%) while highest pH (7.02) was shown by T1 (silt 60%: coconut fiber 5%: bagasse 35%: farm yard manure 0%) and T7 (silt 0%: coconut fiber

0%: bagasse 100%: farm yard manure 0%).(Table 2) Other combinations of media had pH value within the range of to 6.43 to 6.68. More or less similar findings were reported by Ouyang *et al.* (1984).The results were supported by Fitzpatrick *et al.* (1998) who suggested that the media pH value for container grown plants should range from 5.5 to 6.5.

Soil electrical conductivity is an indirect measurement that correlates very well with several medium‘s physical and chemical properties. It correlates with crop productivity, including soil texture, cation exchange capacity (CEC), drainage conditions, organic matter level, salinity, and subsoil characteristics. Droughty areas typically have distinct textural differences from those with excess water; these can be identified using EC. The results indicate that maximum EC value (1.85 dSm2), (1.82 dSm2) and (1.81 dSm2) was in T4 (silt 45%: coconut fiber 10%: bagasse 45%: farm yard manure 0%), T6 (Silt 25%: Coconut fiber 10%: Bagasse 65%: Farm Yard Manure 0%) and T8 (silt 100%: coconut fiber 0%: bagasse 0%: farm yard manure 0%) respectively. Minimum EC value depicted in T9 (0.95 dSm2) (silt 0%: coconut fiber 100%: bagasse 0%: farm yard manure 0%) (Table 2). High levels of electric conductivity showed reduced plant growth (Poole *et al.*, 1981) They recommended that EC values should range between 0.63 to 1.56 dSm-2 for media used for container grown plants and EC values > 3.5 dSm-2 can have adverse effects on seedling growth.

Plant growth analysis

The data for plant growth characteristics were recorded and analyzed up to transplanting of seedlings. Viability of ber seed is variable depending on source and growth conditions (Pareek, 2001). The seeds started germination in about two days. Maximum germination percentage (86.33%) was observed in T4 (silt 45%: coconut fiber 10%: bagasse 45%: farm yard manure 0%) followed by T3 i.e. 76% (silt 40%: coconut fiber 5%: bagasse 55%: farm yard manure 0%). Minimum germination (50.33%) was recorded in T10 (silt 50%: coconut fiber 0%: bagasse 0%: farm yard manure 50%) that is might be due to absence of coconut fiber and bagasse in potting medium. (Table 3). That is might be due to high in salts in coir which hindering and delaying germination. Coconut fiber contains N, P, and K that is reduced and available to plants slowly at lateral growth stages. It was depicted that coconut fiber and bagasse in proper portion may improve germination rate.

Minimum mortality percentage (15%) was found in seedlings grown in T4(silt 40%: coconut fiber 5% bagasse 55%:farm yard manure 0%) while maximum mortality (67.33%) was in silt 0%+ coconut fiber 100%+ bagasse 0%+ farm yard manure 0%.(Table 3) It shows that coconut fiber alone is not suitable to grow ber nursery. These findings are in accordance with Wilson and

Stoffella (2003). Similar results were also reported for other perennials plants such as Mexican heather (Wilson *et al.,* 2001).

Plants were also grafted after one year growth through T-grafting and stem diameter was noted. Maximum stem diameter (9.11mm) was observed in T4 (silt 45%: coconut fiber 10%: bagasse 45%: farm yard manure 0%) while minimum scion (5.32mm) diameter was noted in T10 (silt 50%: coconut fiber 0%: bagasse 0%: farm yard manure 50%). (Table 3). Saleem *et al.* (1995) demonstrated that the growth rate, plant height, vegetative growth and root fresh weight of sour orange were increased in media containing sand + peat (1:4). Similarly Ma *et al.* (2000) reported maximum plant growth and stem diameter of citrus seedlings in media containing peat + Sand (1:4), however, Anvari *et al.* (1994) observed maximum stem diameter of plants in media containing sand and manure. Similarly, Wilson *et al.* (2001) observed that plants grown in different types of medium were slightly reduced in size (number of leaves/plants) compared to plants grown in peat based medium.

Number of sprouted scion shoots were also noted after one year of grafting at time of transplanting and maximum number of scion shoots (8.14) were recorded in T4 (silt 45%: coconut fiber 10%: bagasse 45%: farm yard manure 0%) while minimum (3.14,2.88,2.52) in T10 (silt 50%: coconut fiber 0%: bagasse 0%: farm yard manure 50%),T9 (silt 0%: coconut fiber 100%: bagasse 0%: farm yard manure 0%),T8 (Silt 100%: coconut fiber 0%: bagasse 0%: farm yard manure 0%).(Table 3).

Maximum number of leaves (123.36) were counted in T4 (silt 45%: coconut fiber 10%: bagasse 45%: farm yard manure 0%) while minimum number of leaves (69,66,65) were counted in T9(silt 0%: coconut fiber 100%: bagasse 0%: farm yard manure 0%),T10(silt 50%: coconut fiber 0%: bagasse 0%: farm yard manure 50%), T8(silt 100%: coconut fiber 0%: bagasse 0%: farm yard manure 0%) respectively. These findings are in accordance with Wilson and Stoffella (2003) who observed that the plant growth in compost based medium was different in terms of number of leaves.

Maximum number of roots including tap, secondary and tertiary roots (69.11) were observed in T4 (Silt 45%: Coconut fiber 10%: Bagasse 45%: Farm Yard Manure 0%) followed by T3 (59.77) while minimum number of roots were counted in T8(Silt 100%: Coconut fiber 0%: Bagasse 0%: Farm Yard Manure 0%), T9(Silt 0%: Coconut fiber 100%: Bagasse 0%: Farm Yard Manure 0%) and T10(Silt 50%: Coconut fiber 0%: Bagasse 0%: Farm Yard Manure 50%), i.e. 36.22, 34.25 and 35.00 respectively. Similar results were also reported for other perennials plants such as Mexican heather (Wilson *et al.,* 2001).

Ber plants were transplanted in field after one year of grafting to check their survival percentage. Results were highly satisfactory, maximum success survival (92.89%) was shown by T4 (Silt 45%: Coconut fiber 10%: Bagasse 45%: Farm Yard Manure 0%). While minimum success was shown by T8 (Silt 100%: Coconut fiber 0%: Bagasse 0%: Farm Yard Manure 0%),T9 (Silt 0%: Coconut fiber 100%: Bagasse 0%: Farm Yard Manure 0%) and T10 (Silt 50%: Coconut fiber 0%: Bagasse 0%: Farm Yard Manure 50%).

Table 1. Potting media combinations (w/w)

Treatments	Silt%	Coconut Fiber %	Bagasse %	Farm Yard Manure %
T1	60	5	35	0
T2	50	5	45	0
T3	40	5	55	0
T4	45	10	45	0
T5	35	10	55	0
T6	25	10	65	0
T7	0	0	100	0
T8	100	0	0	0
T9	0	100	0	0
T10	50	0	0	50

Table 2. physical and chemical characteristics of potting medium

Treatment	Water holding capacity %	Air filled porosity %	pH	EC dS/m
T1	36.92 c	11.54c	7.02a	1.23d
T2	35.76 cd	9.51d	6.68b	1.49c
T3	35.02 d	11.53c	6.65bc	1.75ab
T4	41.34 a	16.47a	6.45cd	1.85a
T5	30.35 e	14.46b	6.63bc	1.48c
T6	35.11d	9.69d	6.27d	1.82a
T7	39.50 b	14.33b	7.02a	1.72ab
T8	28.37 f	6.65e	6.62bc	1.81a
T9	12.39 g	14.02b	6.60bc	0.95e
T10	31.35 e	12.31c	6.43cd	1.60bc

Table 3. Effect of potting media on growth of ber (*Zyzyiphus mauritiana Lamk.*) plants

Treatments	Germination %	Mortality %	Stem girth at the time of grafting (mm)	Number of sprouted scion shoots	Number of leaves	Number of roots	Survival % in field
T1	65.33d	34.33e	7.71b	5.11c	94.03b	54.77c	64.41c
T2	58.66e	42.00d	6.52de	4.90cd	93.22b	54.85c	72.49c
T3	76.00b	15.00h	7.02bcd	5.97b	92.64b	59.77b	83.00b
T4	86.33a	26.00g	9.11a	8.14a	123.36a	69.11a	92.89a
T5	69.66c	31.33f	7.28bc	4.25de	82.00de	53.44c	66.48c
T6	66.33d	35.33e	7.48bc	4.00e	84.09cd	48.33d	67.37c
T7	42.00g	59.00b	6.35de	4.18de	83.67cd	38.77e	53.96d
T8	70.67c	31.00f	6.95cd	2.52f	65e	36.22ef	40.33e
T9	32.00e	67.33a	6.10e	2.88f	69e	34.25f	37.33e
T10	50.33f	50.00c	5.32f	3.14f	66e	35.00f	33.02e

Conclusion

It is concluded from the results that T4(silt 45%+ coconut fiber 10%+bagasse 45%+farm yard manure 0%) showed better growth and development in various media combinations. That is might be due to addition of all four potting mixtures in medium in suitable proportions. This combination also maintains a good balance between holding moisture and draining well. Such plants in field with over 90% survival since there is little stress or root damage during lifting, transport and planting. The roots of the plants do not coil and therefore retain the drought hardy character and vigor almost similar to plants raised *in situ.*

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