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Effect of moisture conservation structures and nutrient management on growth of *Melia dubia*

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Abstract: A field experiment was carried out to know the effect of moisture conservation and nutrient management on one year old *Melia dubia* plantation at the Agricultural Research Station (ARS), Malagi in Mundgod Taluk of Uttar Kannada district, during the 2012-2013. The experiments were conducted in split plot design with 16 treatments and three replication. Among all the treatments, ring basin with 150:75:150 N: P_2O_5:K_2O kg/ha recorded significantly higher plant height (5.53 m), collar diameter (3.81 cm) and crown diameter (2.53 m) at 12 months after treatment. The extent of increase in plant height in ring basin with NPK over ring basin with FYM, ring basin with vermin compost was found to be 4.90,5.26 m at 12 MAT. Soil moisture content at 0-30 cm (22.82 %) and 30-60 cm (23.69 %) was significantly higher in ring basin with 150:75:150 N: P_2O_5:K_2O kg/ha over the other treatments.

Keywords: Crown diameter, Moisture conservation, Nutrient management, Plant height

Introduction

Melia dubia is a deciduous tree growing up to 7 to 15 m in height. The leaves are crowded, long-stalked, 30 to 90 cm long and usually bipinnate. There are 2 to 5 pairs of leaflets, ovate to ovate – lanceolate and 4 to 8 cm long. The panicles in the upper axils are shorter than the leaves and many - flowered. The flowers are numerous, violet and white, fragrant, about 8 mm long and borne on the upper axils of the leaves. The petals are hairy. The fruit is drupaceous, ellipsoid, about 1.5 cm long. smooth and shinning and yellowish when ripe. The seed is solitary in each cell, pointed smooth and brown.

It is known to yield useful timber. This tree is occasionally planted for ornament and makes a handsome avenue tree and a shade tree in plantations. It grows rapidly and is used for afforestation purposes. It grows on a variety of soils. However, in deep fertile sandy loam soils it shows optimum growth, whereas in the shallow gravelly soils, it shows stunt growth. The tree is a light demander, the seedling are suppressed under shade. Seedlings tolerate some frost but severe frost kills them. It is susceptible to damage by fires and sapling suffers from browsing.

Natural propagation is mostly through seeds and the germinability is less. It coppices well and produces root suckers when the roots are injured. It pollards well land clusters of new shoots are thrown out from dormant buds on stems and branches. It can be raised either by direct sowing or planting in nursery for raising seedlings or stumps. Direct sowing is recorded to give poorer results than planting of saplings or stumps; the latter is considered the best.

The wood is used for packing cases, cigar boxes, ceiling planks, building purposes, agricultural implements, pencils, match boxes, splints and Catamarans. In Sri Lanka, it is employed for outriggers of boats. It is suitable for musical instruments, tea boxes and ply board. It is a good source of fuel wood (Calorific value 5,043 – 5,176 cal). The wood can be sold for match and veneer industry. The tree with the minimum size of 16 inches girth is saleable at the minimum rate of ₹ 2000/t for match industry and for veneer industry; the market rate is little higher (Anon, 2013).

For conservation and management of water, there are many water conservation techniques that may be adopted based on climatological conditions of the region and socio-economic condition of the people. The technique proved effective in improving the moisture content of the plant root zone. Improper nutrition leading to nutrient imbalance in plants is one of the major factors contributing to low yields in many trees. Nutrient plays an important role in the formation of proteins. The integrated use of organic amendments and inorganic fertilizers can stimulate mineralization and immobilization of soil and improve the overall productivity (Handa *et al.,* 2015)

The main reason for low productivity is high runoff and soil erosion which lead to declining of soil moisture content and fertility of soils. To address these concerns, study was conducted to explore the potential of management practices viz., the soil moisture conservation structures and application of nutrients to improve the productivity.

Material and methods

A field experiment was carried out during 2012-13 to know the effect of moisture conservation and nutrient management on one year old *Melia dubia* at Agricultural Research Station (ARS), Malagi in Mundgod Taluk of Uttar Kannada district. The research station is located in the zone 9 of Karnataka with land slope of 2 per cent.

The experiment was laid out in split plot design with three replication which consisted of four main and four sub treatments. Main treatments were: M_1-conservation pit (0.45 m x 0.30 m x 0.30 m), M_2- Ring basin (0.6 m Radius or 1.2 m Diameter), M_3- Half ring baisn (0.6 m Radius), M_4-Control. Sub treatments; S_1-Farm yard Manure @ 5 ton/ha, S_2- Vermicompost @ 1.25 ton/ha, S_3- NPK 100:50:100 kg/ha and S_4- NPK 150:75:150 kg/ha. For each treatment, six plants were randomly taken for observations. The observations on growth parameters such as plant height, collar and crown diameter were recorded at every three months interval for a period extending to twelve months. The data pertaining to each parameter was analysed statistically using MSTAT C program on computer.

Result and discussion

The findings of the experiment are presented. At the end of the experimental period, there was variation in all the growth parameters among the various treatments(Table 1, 2 and 3). Among the moisture conservation measures, ring basin (M_2) recorded significantly higher growth parameters, at 12 months after treatments *viz.,* 3.88 cm (plant height), 2.59 cm (collar diameter) and 1.63 m (crown diameter). Similarly lowest were recorded in control (M4) 2.29 m (plant height, 1.66 cm (collar diameter) and 1.34 m (crown diameter). In ring basin there was more opportunity for the rainwater to infiltrate around the plant when compared to other moisture conservation methods. Because of higher moisture available in this treatment for longer duration, the plant would have continued to grow even in dry

Table 1. Effect of moisture conservation structures and nutrient management on plant height (m) of *Melia dubia* at different intervals

Treatments	Plant height (m) at different intervals				
Main plot (M)	Initial	3 MAT	6 MAT	9 MAT	12 MAT
Conservation pit (MI)	0.63	0.77	1.66	2.54	3.61
Ring basin (M2)	0.59	1.02	1.85	2.92	3.88
Half ring basin (M3)	0.61	0.95	1.71	2.68	3.75
Control (M4)	0.54	0.59	1.34	1.79	2.29
S.Em±	0.93	0.01	0.01	0.06	0.01
C.D.(P=0.05)	NS	0.03	0.04	0.20	0.04
Sub plots (S)					
Farm yard manure (S1) 5 ton/ha	0.48	0.99	2.06	3.17	4.36
Vermicompost (S2) 1.25 ton/ha	0.63	1.14	2.23	3.36	4.56
NPK (100:50:100) (S1) kg/ha	0.55	1.07	2.14	3.24	4.44
NPK (150:75:150) (S4) kg/ha	0.62	1.26	2.32	3.47	4.69
S.Em ±	0.89	0.01	0.01	0.03	0.01
C.D.(P=0.05)	NS	0.03	0.03	0.11	0.03
Interactions (M x S)					
M1 x S1	0.61	0.91	2.15	3.24	4.65
M1 x S2	0.59	0.01	2.21	3.45	4.87
M1 x S3	0.48	0.98	2.16	3.34	4.74
M1 x S4	0.57	1.23	2.13	3.52	4.99
M2 x S1	0.59	1.25	2.28	3.75	4.90
M2 x S2	0.58	1.39	2.60	3.96	5.26
M2 x S3	0.49	1.31	2.37	3.80	5.02
M2 x S4	0.52	1.51	2.63	4.09	5.53
M3 x S1	0.54	1.14	2.17	3.39	4.87
M3 x S2	0.48	1.33	2.31	3.62	5.03
M3 x S3	0.49	1.25	2.24	3.46	4.96
M3 x S4	0.50	1.37	2.41	3.82	5.12
M4 x S1	0.47	0.65	1.63	2.29	2.99
M4 x S2	0.52	0.83	1.82	2.41	3.07
M4 x S3	0.50	0.72	1.77	2.37	3.02
M4 x S4	0.63	0.95	1.93	2.46	3.12
S.Em ±	0.86	0.02	0.02	0.04	0.02
C.D.(P=0.05)	NS	0.06	0.06	0.12	0.06

MAT – Months after treatments

Table 2. Effect of moisture conservation structures and nutrient management on collar diameter (cm) of *Melia dubia* at different intervals

Treatments	Collar diameter (cm) at different intervals				
Main plot (M)	Initial	3 MAT	6 MAT	9 MAT	12 MAT
Conservation pit (MI)	0.53	0.97	1.02	1.47	1.90
Ring basin (M2)	0.57	1014	1.60	1.90	2.59
Half ring basin (M3)	0.42	1.07	1.13	1.62	2.25
Control (M4)	0.56	0.64	0.81	1.23	1.66
S.Em±	0.29	0.04	0.09	0.05	0.13
C.D.(P=0.05)	NS	0.14	0.31	0.17	0.39
Sub plots (S)					
Farm yard manure (S1) 5 ton/ha	0.62	1.11	1.34	1.83	2.58
Vermicompost (S2) 1.25 ton/ha	0.58	1.36	1.57	2.12	2.83
NPK (100:50:100) (S1) kg/ha	0.49	1.20	1.42	1.94	2.66
NPK (150:75:150) (S4) kg/ha	0.57	1.42	1.69	2.39	3.13
S.Em±	0.35	0.02	0.01	0.03	0.01
C.D.(P=0.05)	NS	0.06	0.03	0.09	0.04
Interactions (M x S)					
M1 x S1	0.53	1.04	1.13	1.77	2.33
M1 x S2	0.48	1.45	1.44	2.01	2.58
M1 x S3	0.55	1.16	1.31	1.92	2.47
M1 x S4	0.49	1.52	1.56	2.16	2.71
M2 x S1	0.53	1.42	1.95	2.18	3.15
M2 x S2	0.62	1.61	2.17	2.78	3.63
M2 x S3	0.57	1.54	2.11	2.27	3.24
M2 x S4	0.60	1.50	2.28	2.91	3.81
M3 x S1	0.51	1.31	1.38	1.93	2.63
M3 x S2	0.48	1.46	1.53	2.06	2.87
M3 x S3	0.52	1.32	1.42	1.99	2.76
M3 x S4	0.54	1.63	1.67	2.65	3.52
M4 x S1	0.47	0.69	0.97	1.45	2.06
M4 x S2	0.63	0.91	1.13	1.64	2.22
M4 x S3	0.56	0.79	1.02	1.57	2.15
M4 x S4	0.82	1.03	1.24	1.83	2.42
S.Em±	0.62	0.04	0.02	0.06	0.03
C.D.(P=0.05)	NS	0.12	0.06	0.18	0.09

MAT – Months after treatments

Table 3. Effect of moisture conservation structures and nutrient management on crown diameter (m) of *Melia dubia* at different intervals

Treatments	Crown diameter (m) at different intervals				
Main plot (M)	Initial	3 MAT	6 MAT	9 MAT	12 MAT
Conservation pit (MI)	0.69	0.87	0.99	1.09	1.42
Ring basin (M2)	0.66	0.98	1.10	1.33	1.63
Half ring basin (M3)	0.70	0.89	1.05	1.18	1.51
Control (M4)	0.59	0.71	0.94	0.98	1.34
S.Em±	0.72	0.01	0.01	0.01	0.02
C.D.(P=0.05)	NS	0.03	0.04	0.04	0.08
Sub plots (S)					
Farm yard manure (S1) 5 ton/ha	0.75	0.97	1.20	1.34	1.80
Vermicompost (S2) 1.25 ton/ha	0.65	1.21	1.41	1.58	2.02
NPK (100:50:100) (S1) kg/ha	0.68	1.07	1.33	1.50	1.90
NPK (150:75:150) (S4) kg/ha	0.73	1.26	1.50	1.69	2.16
S.Em±	0.98	0.01	0.01	0.01	0.01
C.D.(P=0.05)	NS	0.03	0.03	0.03	0.04
Interactions (M x S)					
M1 x S1	0.75	1.05	1.17	1.27	1.75
M1 x S2	0.92	1.21	1.38	1.53	1.93
M1 x S3	0.73	1.08	1.32	1.41	1.86
M1 x S4	0.69	1.27	1.44	1.62	2.05
M2 x S1	0.84	1.17	1.23	1.64	1.96
M2 x S2	0.66	1.35	1.56	1.84	2.18
M2 x S3	0.75	1.26	1.49	1.75	2.04
M2 x S4	0.69	1.47	1.62	1.88	2.53
M3 x S1	0.71	0.95	1.25	1.33	1.84
M3 x S2	0.84	1.26	1.43	1.62	2.11
M3 x S3	0.78	1.14	1.35	1.56	1.97
M3 x S4	0.81	1.38	1.55	1.79	2.14
M4 x S1	0.76	0.72	1.16	1.13	1.63
M4 x S2	0.83	1.00	1.27	1.34	1.84
M4 x S3	0.68	0.91	1.21	1.29	1.71
M4 x S4	0.70	1.16	1.39	1.46	1.94
S.Em ±	1.23	0.02	0.01	0.02	0.02
C.D.(P=0.05)	NS	0.07	0.03	0.06	0.07

MAT - Months after treatments

season. That was the reason for maximum plant height, collar and crown diameter which were recorded in full moon basin method. The technique of soil moisture conservation helps in conserving the runoff water and in turn increased the productivity of lands (Sharanabassappa *et al.,* 2009, Sumbali *et al.,* 2012 and Anju and Koppad, 2013). The other treatments also recorded a significant increase of all growth parameters as compared to control.

Among nutrient management techniques, the application of 150:75:150 N:P_2O_5:K_2O kg/ha (S4) recorded significantly higher plant height (4.69 m), collar diameter (3.13 cm) and crown diameter (2.16 m) and least were recorded in Farm yard manure (S1) at 12 months after treatments. Application of 150:75:150 N: P2 O5: K2 O kg/ha improved the nutrient status of the soil, which might have increased plant height, collar and crown diameter. This has evidence from Manjunath (2003), who reported that application of 2.5 kg FYM with N:P:K (30:15:30 g) per teak plant showed significant increase in height, collar diameter and crown spread compared to control. Lamani *et al.* (2003) reported that application of higher dose of NPK would have increased the plant height and diameter growth of *Acacia auriculiformis* plantation.

In the interaction effect, ring basin in combination with 150:75:150 N:P_2O_5:K_2O kg/ha (M_2 S_4) recorded significantly higher plant height (5.53 m), collar diameter (3.81 cm), and crown diameter (2.53 m) at 12 months after treatments. Minimum plant height (2.99 m), collar diameter (2.06 cm) and crown diameter (1.63 m) were recorded in control with FYM at 12 months after treatments. An increased plant height, collar and crown diameter could be due to higher soil moisture available in ring basin. Higher per cent of available soil moisture during dry season might have favoured the nutrient absorption by plants, which in turn resulted in higher plant height, collar and crown diameter. Interaction treatments influenced growth parameters substantially when compared to individual treatments (Venkatesh *et al.,* 2010). These results are also in line with studies repored by Ashalatha (2011).

The soil moisture content at 0-30 cm and 30-60 cm soil depth from November 2012 to April 2013 were recorded and are given (table 4 and 5). Soil moisture content differed significantly due to moisture conservation methods. Significant higher moisture content was recorded in ring basin (13.05 % and 15.32 % from 0-30cm and 30-60cm depth in April 2013). This might be due to more rain water conservation within the basin during the pre-monsoon and differences between content in conservation measures which was attributed to more consumptive use of water by the plants as reported by Panigrahi *et al.,* (2008)

Maximum moisture content was noticed in the treatment receiving ring basin with 150:75:150 N:P_2O_5:K_2O kg/ha (M_2 S_4) in April 2013, *i.e.,* 13.53 and 14.53 per cent from 0-30 cm and 30-60 cm depth. The conservation structure might have improved the soil moisture content by permitting water to infiltrate into the horizons which directly increased the water level in the soil. It might be due to the increase in soil moisture content probably caused by improvement in organic carbon content of soil due to addition of nutrients as reported by Verma and Chand (2004). From the study,it can be concluded that, the soil moisture content at 0-30 cm (22.82 %) and at 30-60 cm (23.69 %) was significantly higher in ring basin with 150:75:150 (N:P_2O_5:K_2O) kg/ha over other treatments.

Table 4. Effect of moisture conservation structures and nutrient management on soil moisture content (%) at 0-30 cm depth in Melia dubia plantation in different months

Treatments	November	December	January	February	March	April
Main plot (M)						
Conservation pit (MI)	16.38	15.48	14.32	13.85	12.18	11.75
Ring basin (M2)	18.59	17.62	16.43	15.26	14.19	13.05
Half ring basin (M3)	17.14	16.54	15.37	14.18	13.27	12.37
Control (M4)	14.68	13.18	12.59	11.39	10.49	9.53
S.Em±	0.76	0.65	0.14	0.16	0.21	0.13
C.D.(P=0.05)	NS	NS	0.48	0.48	0.63	0.39
Sub plots (S)						
Farm yard manure (S1) 5 ton/ha	17.39	16.42	15.19	14.65	13.86	12.18
Vermicompost (S2) 1.25 ton/ha	17.73	16.79	15.26	14.83	13.92	12.74
NPK (100:50:100) (S1) kg/ha	16.25	15.49	14.82	13.71	12.36	11.35
NPK (150:75:150) S4) kg/ha	18.53	17.12	16.32	15.16	14.47	13.75
S.Em ±	0.582	0.75	0.05	0.06	0.15	0.15
C.D.(P=0.05)	NS	NS	0.15	0.22	0.45	0.43
Interactions (M x S)						
M1 x S1	15.93	15.69	14.17	13.04	11.97	11.39
M1 x S2	16.18	15.52	14.43	13.49	12.29	11.65
M1 x S3	16.08	15.46	14.25	13.13	12.18	11.46
M1 x S4	16.35	15.74	14.68	13.75	12.37	11.82
M2 x S1	18.19	17.35	16.02	15.18	14.11	13.09
M2 x S2	18.49	17.34	16.23	15.52	14.35	13.45
M2 x S3	18.26	17.47	16.19	15.35	14.26	13.29
M2 x S4	18.54	17.73	16.31	15.77	14.49	13.53
M3 x S1	16.95	16.31	15.28	14.25	12.45	10.97
M3 x S2	17.05	16.59	15.61	14.49	13.05	11.92
M3 x S3	17.00	16.45	15.47	14.32	12.98	11.05
M3 x S4	17.13	16.73	15.75	14.57	13.15	12.83
M4 x S1	14.65	13.49	12.21	11.32	10.28	9.32
M4 x S2	14.83	13.75	12.65	11.52	10.43	9.47
M4 x S3	14.74	13.52	12.32	11.45	10.35	9.25
M4 x S4	14.98	13.98	12.87	11.64	10.57	9.59
S.Em ±	0.92	0.29	0.14	0.28	0.30	0.31
C.D.(P=0.05)	NS	NS	0.42	0.81	0.60	0.91

MAT – Months after Treatments

Table 5. Effect of moisture conservation structures and nutrients on soil moisture content (%) at 30-60 cm depth in Melia dubia plantation in different months.

Treatments	November	December	January	February	March	April
Main plot (M)						
Conservation pit (MI)	17.63	16.79	15.38	14.59	13.50	12.69
Ring basin (M2)	20.00	19.76	18.58	17.31	16.47	15.32
Half ring basin (M3)	19.73	18.54	17.48	16.23	15.65	14.53
Control (M4)	17.10	15.50	14.74	13.58	11.60	10.03
S.Em±	1.00	0.13	0.14	0.15	0.11	0.10
C.D.(P=0.05)	NS	0.39	0.48	0.47	0.33	0.29
Sub plots (S)						
Farm yard manure (S1) 5 ton/ha	18.23	17.29	16.21	15.63	14.11	13.43
Vermicompost (S2) 1.25 ton/ha	18.49	17.37	16.35	15.86	14.34	13.65
NPK (100:50:100) (S3) kg/ha	17.48	16.39	15.48	14.22	13.43	12.54
NPK (150:75:150) S4) kg/ha	19.76	18.49	17.84	16.55	15.63	14.89
S.Em ±	0.62	0.09	0.36	0.22	0.19	0.14
C.D.(P=0.05)	NS	0.27	1.08	0.67	0.57	0.42
Interactions (M x S)						
M1 x S1	15.99	15.85	14.76	13.73	12.45	12.94
M1 x S2	17.18	16.53	15.98	14.69	13.91	12.96
M1 x S3	16.83	15.80	14.98	13.74	12.69	11.85

Contd.....

M1 x S4	17.54	16.87	15.92	14.83	13.28	12.65
M2 x S1	19.59	18.36	17.29	16.75	15.68	14.15
M2 x S2	20.96	19.63	18.59	17.84	16.30	15.63
M2 x S3	18.26	17.47	16.19	15.35	14.26	13.29
M2 x S4	19.63	18.78	17.56	16.74	15.49	14.53
M3 x S1	18.59	17.38	16.98	15.76	14.43	13.45
M3 x S2	18.50	17.73	16.93	15.37	14.64	13.07
M3 x S3	18.49	17.64	16.58	15.30	14.93	13.32
M3 x S4	18.53	17.89	16.63	15.58	14.34	13.59
M4 x S1	16.63	15.52	14.65	13.73	12.39	11.26
M4 x S2	16.85	15.69	14.43	13.93	12.45	11.79
M4 x S3	16.58	15.17	14.36	13.54	12.43	11.48
M4 x S4	16.69	15.53	14.94	13.66	12.39	11.91
S.Em ±	0.21	0.18	0.05	0.06	0.14	0.09
C.D.(P=0.05)	NS	0.54	0.15	0.18	0.42	0.25

MAT – Months after Treatments

Rererences

Anju, S. V. and Koppad, A. G., 2013, Influence of in situ soil moisture conservation measures on growth and productivity of *Acacia aurculiformis. Karnataka J. Agric. Sci.,* 26(1): 170-171.

Anonymous, 2009, *Melia dubia*, DOI : http/google.com/Melia dubia/ accessed on 7. 11.2013.

Ashalatha, A., 2011, Development of suitable *Melia dubia* based agroforestry system for higher productivity and carbon sequestration. *M.Sc.(Forestry) Thesis* submitted to TNAU, Coimbatore.

Handa, A.K., Dhyani, S. K. and Uma, 2015, Three decades of agroforestry research in India: Retrospection for way forward. *Agric. Res. Jr.,* 52(3):1-10

Lamani, V. K., Patil, S.K., Manjunath, G. O. and Kannur, S. S., 2003, Influence of fertilizers on initial growth of *Acacia auriculiformis.*; *My Forest,* 39(1): 93-97.

Manjunath, A., 2003, Tree crop interaction studies in Teak based agroforestry system in upland paddy area. *M.Sc. Thesis*. University of Agricultural Sciences, Dharwad.

Panigrahi, P., Srivastava, A. K., Huchche, A. D. and Shyam, S., 2008, Improving productivity in acid lime (Citrus aurantifolia Swingle) through adaptation of rainwater conservation practice in vertisols. *Indian J. Soil Cons.,* 36(2): 109-111.

Sharanabasappa, B.N., Channabasappa, K.S. and Naik, G. V., 2009, Effect of moisture and integrated nutrient management on two year old Teak plantation. *My Forest,* 45(2): 191-197.

Sumbali, S., Koppad, A.G. and Gurav, M., 2012, Effect of soil moisture conservation structures and application of manures and fertilizers on growth of *Acacia auriculiformis Int. J. Env. Sci.,* 1(3): 178-185.

Venkatesh, L. Lakshmipathaiah, O. R. and Panduranga, 2010, Effect of moisture and integrated nutrient management on volume teak *Mysore J. Agric. Sci.,* 44(1): 59-63.

Verma, M.L. and Charaqn, S., 2004, Effect of biofertilizer on soil moisture, nutrient status and fruit productivity under organic cultivation of apple in Himachal Pradesh. *Indian J. Soil. Cons*., 37(3) : 201-205.