International Journal of Environmental Sciences

(A peer reviewed International Journal)

Effect of Soil Moisture Conservation Structures and Application of Manures and Fertilizers on Growth of *Acacia auriculiformis*

International Journal of Environmental Sciences, Vol. 1 No. 3. pp. 178-185. 2277-1948. 2012

ISSN *2277 – 1948*

Article type *Full Length Research Article*

Submission date *28 June 2012*

Acceptance date *10 July 2012*

Publication date *15 July 2012*

Article URL *http://www.crdeep.com/category/ijes*

Authors *Santosh Sumbali,[1*] A. G. Koppad, [2] and Maruti Gurav [3]*

CRDEEP Head Office:315/10, Kaulagarh Road, Rajendranagar, Indra Vihar, Dehradun, 248001, Uttrakhand, India.

International Journal of Environmental Sciences Vol. 1 No. 3. 2012. Pp. 178-185

Full Length Research Paper

Effect of Soil Moisture Conservation Structures and Application of Manures and Fertilizers on Growth of *Acacia auriculiformis*

Santosh Sumbali,[ii*] A. G. Koppad, [2] and Maruti Gurav [3]

[1] *Research Scholar, Department of Natural Resource Management., College of Forestry, Sirsi- 581401.*
[2] *Associate Professor Department of Natural Resource Management, College of Forestry, Sirsi. 581401*
[3] *Research Scholar, Department of Natural Resource Management, College of Forestry, Ponnampet–571216*

****Corresponding Author: Santosh Sumbali***

Abstract
Moisture and nutrients are basic resources for the growth and productivity of trees. Conservation of moisture, application of manures and fertilizers helps in improving growth and productivity of trees. This experiment was conducted to investigate the effect of soil moisture conservation structures and nutrients on growth performance of *Acacia auriculiformis*. The moisture conservation structures were imposed as a main plot treatments and application of manures and fertilizers were imposed as subplot treatments. The perusal of results showed that the tree volume increment of *A. auriculiformis* plantation was significantly higher in (M_1XS_5) i.e., Ring Basin + Recommended dose of fertilizer (RDF) + Farm Yard Manure (FYM) when compared with control treatment. The perusal of results showed that there was significantly higher soil moisture content at depth of 0-30 and 30-60 cm in Continuous Contour Trenches as compared to control. The increase in tree volume of treatment M_1XS_5 was may be due to the availability of optimum soil moisture condition and good response of plants to the application of particular manures and fertilizers.

Key words: *Soil moisture conservation structure, contour, FYM, RDF and tree volume.*

Introduction

India with just 2.5 per cent of world's land area support nearly 15 per cent of the world's human population and 16 per cent of world's livestock population. This increasing population and rapid decrease in the forest cover, low growing stock, poor increment, low sustainable yield and increasing demand lead to shortage of timber and fuel wood in the country. The supply of firewood, industrial wood and timber from forest areas has been dwindling. Fuel wood need is partly being met from agricultural residues, agroforests and largely through unregulated and unsustainable extraction from the forests. The demand for fire wood is estimated to be 312 million tonnes against the production of 49 million tonnes and demand for industrial wood, timber is estimated to be 47 million cubic meters against the production of 14 million cubic meters (Shaikh, 2000). The gap between demand and likely domestic production is projected to grow to 36 lakh tonnes by 2010-2011 and 51 lakh tonnes by 2015-16 unless immediate steps are to promote pulp wood plantation for securing the future raw material supplies for industry (Singhania, 1997). Modernization, growth and expansion of wood based industries have suffered for demand for sustainable supply of industrial round wood at reasonable price resulting in import of newsprint paper and wood products (Lal, 2008). The annual productivity of Indian forests is 1.36 m^3/ha compared to the world average of 2.5 m^3/ha. (Pachauri and Mehrotra, 2002)

In order to meet ever increasing demand of wood some fast growing species like *Eucalyptus*, *Acacia, Casuarina etc.*, with short rotation period are being promoted by wood based industries. Large scale plantations are being raised on degraded forest lands, farm lands, community lands and road, rail, canal strips in India. These plantations are now providing resources like timber, poles and fuel wood.

In Uttar Kannada and southern districts district of Karnataka, *Acacia auriculiformis* was particularly being used for afforestation of lateritic soils. The wood is mainly used for fuel wood, furniture and paper making (Deb, 2007). Due to multifarious of this species, about 30-40 per cent of plantation area in Western Ghats of Karnataka has been planted with this species during last two decades (Anon, 2001). However, most of these earlier plantations have very low productivity ranging from 6 to 10 m^3/ha/yr and poor returns (Kulkarni, 2002). The main region for low productivity is high runoff and soil erosion leads 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 manures and fertilizers to improve the productivity with shorter rotation.

Materials and Methods

The experiment was carried out at Hegadekhatta watershed area in Uttar Kannada district of Karnataka. The experiment site is situated at 14º36" latitude and 74º47" longitude with land slope of 6%. *Acacia auriculiformis* was planted by Karnataka Forest Department during 2007 with spacing of 2 m x 2 m. The experimental sites consist of sandy loamy soil, medium deep and lateritic in texture with fairly good drainage. The annual rainfall in the experimental area was 1750 mm and major portion of the rainfall occurs in the July month of year.

The experimental site i.e., *Acacia auriculiformis* plantation was planned and designed with split plot design. The soil moisture conservation structures were imposed as a main plot treatments *viz.*, M_1- Continuous contour trenches (0.5 m Width X 0.3 m Depth), M_2- Ring basin (0.6 m Radius), M_3- Half ring basin (0.6 m radius) and M_4 - Control. The application of manures and fertilizers were imposed as a sum plot treatments *viz.*, S_1-FYM (Farmyard manure-2.5 t/ha), S_2- Vermi-compost (2.5 t/ha), S_3-Poultry manure (2.5 t/ha), S_4- Biofertilizers (Mycorriza + Azotobacter + Phospur solublizing Bacteria-30 g each/plant), S_5-RDF (Recommended Dose of Fertilizers - NPK 200:100:100 + FYM- 2.5 t/ha) and S_6- Control. In each treatment 5 plants were randomly selected for observation on the growth parameters *viz.*, plant height, Collar diameter, and Diameter at breast height (DBH) was recorded. Soil moisture content was studied at the depths of 0-30 cm and 30-60 cm using the soil auger, at 30 cm away from the plant base on its downhill side. Fresh weight of soil samples were recorded immediately after sampling, later samples were oven dried at 100^0c for 3 days to get constant dry weight, which was used to calculate per cent soil moisture content.

Results

The tree volume of *Acacia auriculiformis* trees was calculated at the starting and at the end of the experiment *ie*, 12 month after treatment (MAT) and expressed in terms of m^3/ha. The tree volume increment of *A. auriculiformis* trees differed significantly due to the effect of moisture conservation structures and application of manures and fertilizers. The perusal of results from figure 1 showed that, the tree volume at the end of experiment was maximum in ring basin (20.55 m³/ha) followed by continuous contour trenches (18.78 m³/ha) and minimum volume was recorded in control (15.22 m³/ha) respectively at 12 MAT. The volume in ring basin (M_2) was significantly higher compared to control. In sub-treatment the highest volume was recorded in (S_5) combination of organic and inorganic fertilizers (20.56 m³/ha) followed by (S_3) poultry manure (19.02 m³/ha) and (S_2) vermin-compost (18.57 m³/ha) and lower volume was recorded in (S_6) control (15.09 m³/ha). The volume in S5 at 12 MAT was significantly superior over control. The moisture conservation structures in combination with application of manures and fertilizers had significantly influenced on volume increment of *A. auriculiformis*. In the interaction study maximum volume was observed in (M_2XS_5) ring basin with FYM + RDF (23.95 m³/ha), followed by (M2XS3) ring basin + poultry manure (22.28 m³/ha) and (M_1XS_5) continuous contour trenches + FYM + RDF (20.66 m³/ha) respectively, and minimum volume was observed in control (14.45 m³/ha) at 12 MAT.

Soil moisture content differed significantly due to the effect of moisture conservation structures, in *A. auriculiformis* plantation. Among the different main treatments, the maximum soil moisture content observed at the depths of 0-30cm and 30-60 cm are in the (M1) continuous contour trenches (16.48% and 19.71%) followed by ring basin (14.64% and 17.84%) and minimum moisture content was observed in the control (13.41% and 16.64%) at 12 MAT (Figure 2 and 3). In the interaction treatment, highest moisture content was recorded in (M_1XS_1) continuous contour trenches X FYM followed by continuous contour trenches X FYM + RDF and lowest moisture content was observed in control at 12 MAT (Table 1and 2).

In general the continuous contour trenches followed by ring basin and half ring basin were best for soil moisture conservation as they can store and conserve more. But in terms of increase in tree volume the ring basin treatment has shown significant increase when compared to control treatment.

Discussion

Generally availability of optimum soil moisture and nutrients are important factors for the growth and development of plants. In the present study the increase in volume might be due to the effect of soil moisture conservation structures and application of manures and fertilizers. This might have provided optimum moisture and nutrients during study period intern boosting the growth and productivity of *A. auriculiformis*. Similar observation was reported by Raghavendra (2005) in both *Acacia auriculiformis and Casurina equisetifolia,* where significantly higher soil moisture conservation was observed in trapezoidal basin method in both the species. Mutanal (1988) observed the teak volume was significantly increased by 16.3 per cent with application of 200:50:200 (N:P:K). The increase in soil moisture leads to increased in availability of minerals, which were utilized by plants, thus resulting in the higher biomass production (Wasan and Bunvong, 1975; Puri *et al.,* 1995). The soil moisture content followed the same trend as that of rain fall (Figure 4). The soil moisture conservation structures reduce the runoff and helps in infiltration of rain water during rainy season, which will be available for plants during dry period. Hence plants grow vigorously and put more increment. In control, there no soil moisture conservation structures were adopted, so moisture conserved was very less. The highest soil moisture conservation in continuous contour trenches was mainly because of more rain water storage capacity compared to other treatment. These findings are line with the Panigrahi *et al.,* 2008, evaluated the various rain water harvesting structures. The continuous contour trenches conserved more moisture (9.4%) over a control (7.4%). The performance of tree species in continuous contour trenches (CCT) was attributed to more moisture availability for growth of plants. (Manivannan and Desai, 2002). But in current investigation performance of *Acacia auriculiformis* was good in ring basin moisture conservation structures it's mainly because of *Acacia auriculiformis* is a xerophytic plant it's required less amount of water for good growth and can't perform will in water logged areas. In contour trenching, the stagnation of water affected the aeration of roots. Hence, growth was hider, These findings are line with the Bhardwaj and Bhattacharya (1996), on *Acacia catechu* and C*elitus australis* under different soil working and rain water harvesting techniques such as trenches and ditches maintain higher moisture content than pits, but growth of both the species was good in pit method. Similar trend was also observed in teak by Sharanabasappa (2007). From the experiment it is concluded that ring basin structure is a suitable moisture conservation structure which improved the *Acacia auriculiformis* plant growth remarkably. Ring basin moisture conservation structure and application of organic manure especially farm yard manure with inorganic fertilizers increased the growth of *Acacia auriculiformis.*

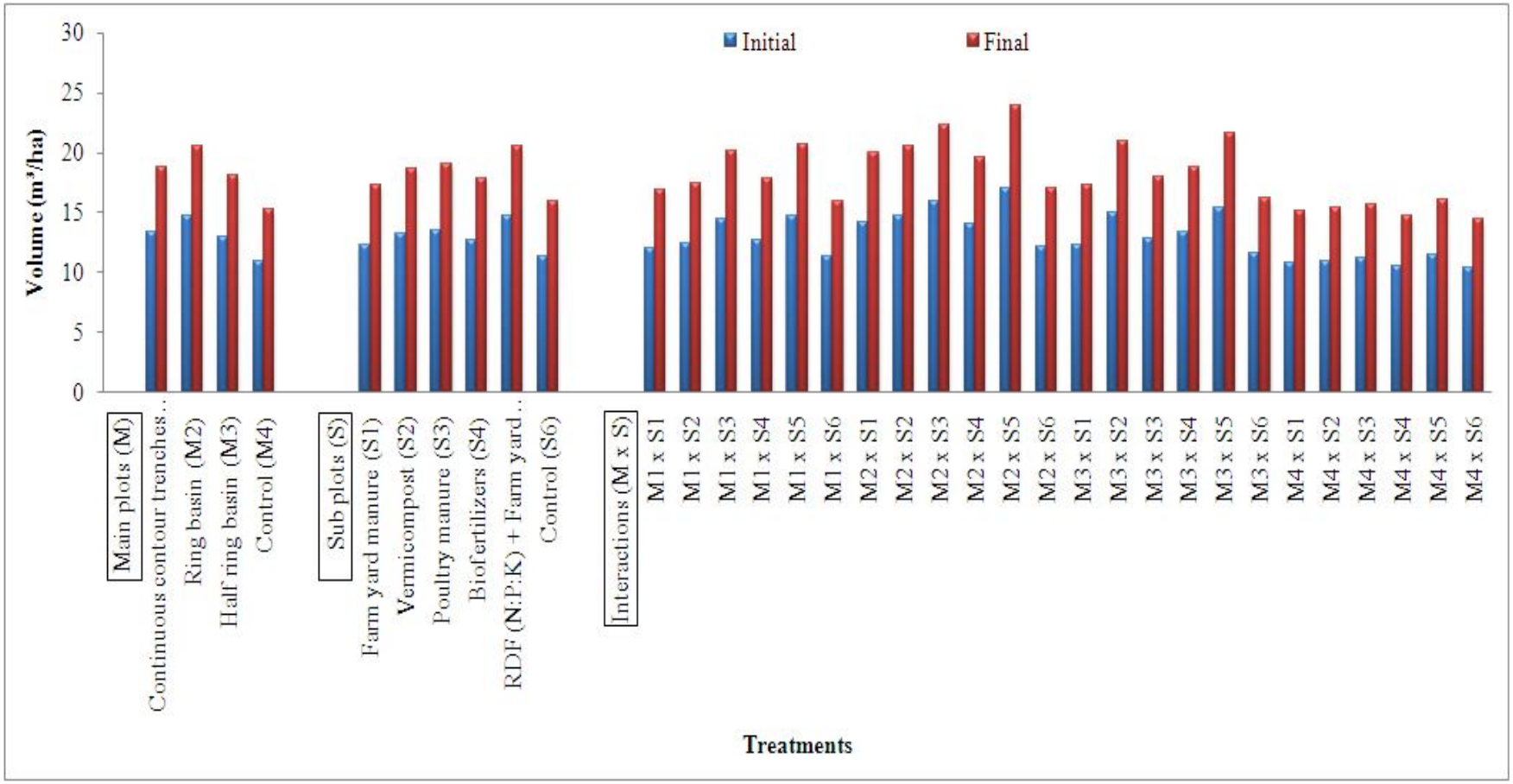

Figure 1: Effect of moisture conservation structures, manures and fertilizers on tree volume (m³/ha) of *Acacia auriculiformis* during the start of experiment and 12 Months after treatment.

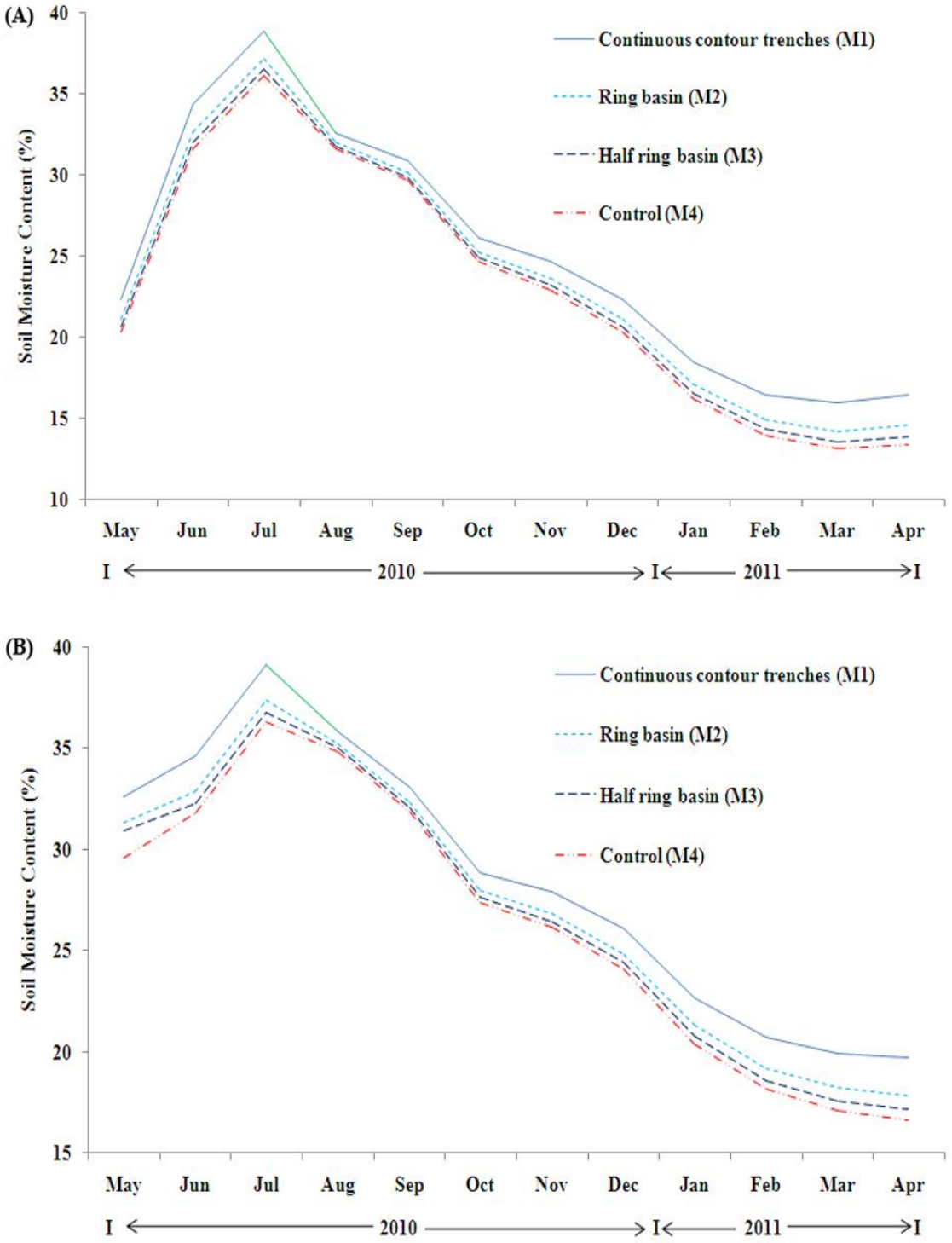

Figure 2: Variability of soil moisture content (%) at (A) 0-30 cm and (B) 30-60cm depths in main plots during the study period, at Hegadekhatta watershed area.

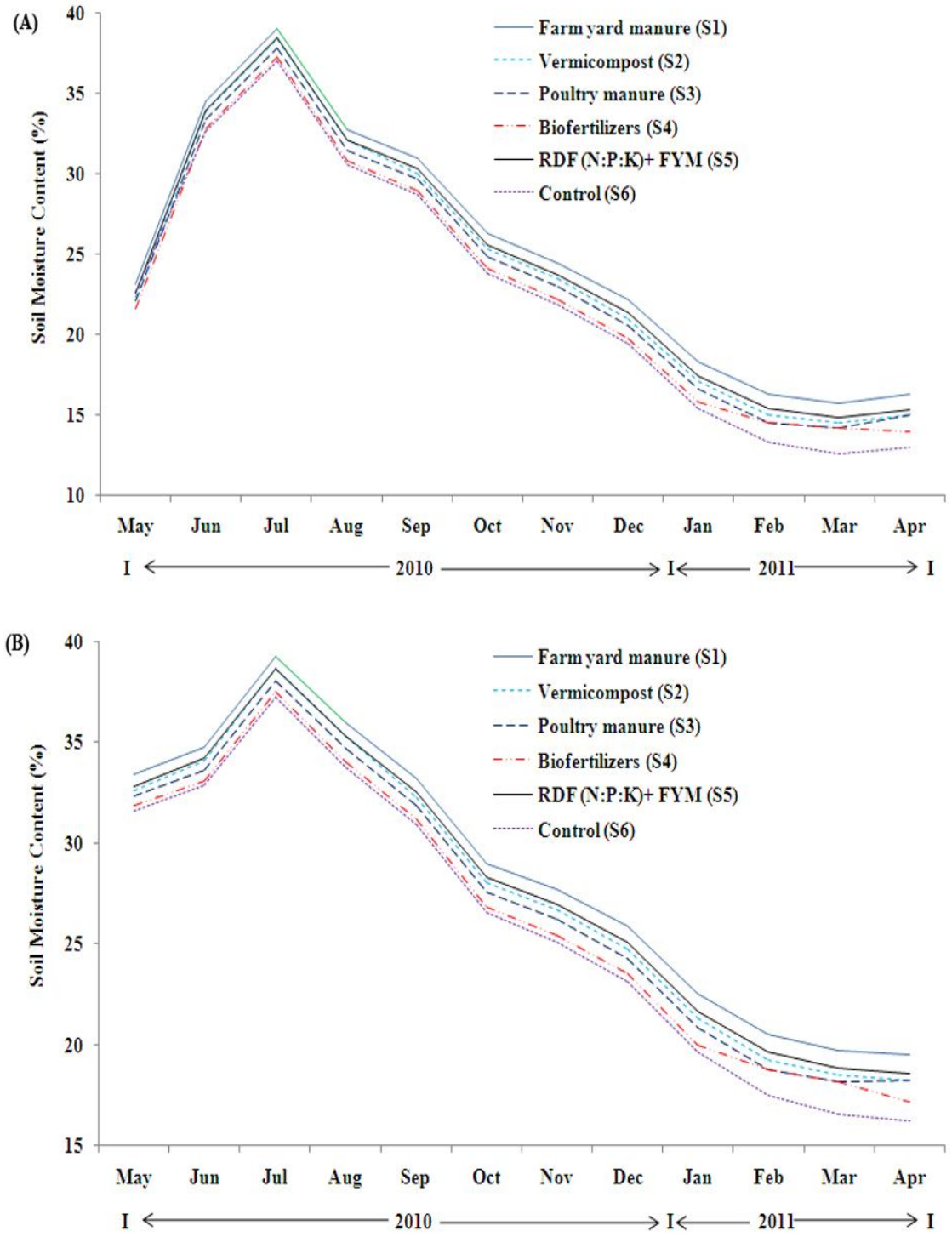

Figure 3: Variability of soil moisture content (%) at (A) 0-30 cm and (B) 30-60cm depths in sub-plots during the study period, at Hegadekhatta watershed area.

Table 1: Effect of interaction between moisture conservation structures and application of manures and fertilizers on soil moisture content at 0-30 cm depth in *Acacia auriculiformis* plantation during study period (May-2010 to April-2011).

Interactions (M x S)	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
M_1 x S_1	22.74	34.43	38.94	32.63	30.92	26.19	24.56	22.25	18.37	16.38	15.85	16.39
M_1 x S_2	22.34	34.12	38.63	32.32	30.43	25.70	24.07	21.66	17.78	15.75	15.22	15.76
M_1 x S_3	22.23	33.88	38.35	32.00	30.25	25.48	23.81	21.46	17.54	15.51	15.08	15.74
M_1 x S_4	22.00	33.6	38.05	31.68	29.91	25.12	23.43	21.06	17.12	15.51	15.08	15.21
M_1 x S_5	22.46	34.15	38.64	32.31	30.58	25.83	24.18	21.85	17.95	15.94	15.39	15.91
M_1 x S_6	22.5	33.49	37.93	31.55	29.77	24.97	23.27	20.89	16.94	14.88	14.28	14.75
M_2 x S_1	22.13	33.58	38.09	32.34	30.55	25.74	24.03	21.64	17.68	15.61	15.00	15.46
M_2 x S_2	21.73	33.27	37.78	32.03	30.06	25.25	23.54	21.05	17.09	14.98	14.37	14.83
M_2 x S_3	21.62	33.03	37.50	31.71	29.88	25.03	23.28	20.85	16.85	14.74	14.23	14.81
M_2 x S_4	21.39	32.75	37.20	31.39	29.54	24.67	22.90	20.45	16.43	14.74	14.23	14.28
M_2 x S_5	21.85	33.30	37.79	32.02	30.21	25.38	23.65	21.24	17.26	15.17	14.54	14.98
M_2 x S_6	21.89	32.64	37.08	31.26	29.40	24.52	22.74	20.28	16.25	14.11	13.43	13.82
M_3 x S_1	21.90	33.25	37.76	32.22	30.40	25.56	23.82	21.40	17.41	15.31	14.67	15.10
M_3 x S_2	21.50	32.94	37.45	31.91	29.92	25.08	23.34	20.82	16.82	14.68	14.04	14.47
M_3 x S_3	21.39	32.7	37.17	31.59	29.73	24.85	23.07	20.61	16.58	14.44	13.90	14.45
M_3 x S_4	21.15	32.42	36.87	31.28	29.40	24.50	22.70	20.22	16.16	14.44	13.90	13.92
M_3 x S_5	21.62	32.97	37.46	31.91	30.07	25.21	23.45	21.01	16.99	14.87	14.21	14.62
M_3 x S_6	21.65	32.31	36.75	31.14	29.25	24.34	22.53	20.04	15.98	13.81	13.10	13.46
M_4 x S_1	21.73	33.02	37.53	32.15	30.30	25.44	23.68	21.24	17.23	15.10	14.44	14.85
M_4 x S_2	21.33	32.71	37.22	31.84	29.82	24.96	23.20	20.65	16.64	14.47	13.81	14.22
M_4 x S_3	21.22	32.47	36.94	31.52	29.63	24.73	22.93	20.45	16.40	14.23	13.68	14.21
M_4 x S_4	20.99	32.2	36.65	31.2	29.3	24.38	22.56	20.05	15.98	14.24	13.68	13.68
M_4 x S_5	21.45	32.75	37.24	31.83	29.97	25.09	23.31	20.84	16.81	14.67	13.99	14.38
M_4 x S_6	21.49	32.08	36.52	31.07	29.15	24.22	22.39	19.88	15.80	13.60	12.87	13.21

Main plots (M): Continuous contour trenches (M_1); Ring basin (M_2); Half ring basin (M_3); Control (M_4). **Sub-plots (S):** Farm yard manure (S_1); Vermicompost (S_2); Poultry manure (S_3); Biofertilizers (S_4); RDF (N:P:K)+ farm yard manure(S_5); Control (S_6).

Table 2: Effect of interaction between moisture conservation structures and application of manures and fertilizers on soil moisture content at 30-60 cm depth in *Acacia auriculiformis* plantation during study period (May-2010 to April-2011).

Interactions (M x S)	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
M_1 x S_1	32.97	34.66	39.17	35.86	33.15	28.92	27.79	25.98	22.60	20.61	19.83	19.62
M_1 x S_2	32.57	34.35	38.86	35.55	32.66	28.43	27.30	25.39	22.01	19.98	19.20	18.99
M_1 x S_3	32.46	34.11	38.58	35.23	32.48	28.21	27.04	25.19	21.77	19.74	19.06	18.97
M_1 x S_4	32.23	33.83	38.28	34.91	32.14	27.85	26.66	24.79	21.35	19.74	19.06	18.44
M_1 x S_5	32.69	34.38	38.87	35.54	32.81	28.56	27.41	25.58	22.18	20.17	19.37	19.14
M_1 x S_6	32.73	33.72	38.16	34.78	32.00	27.70	26.50	24.62	21.17	19.11	18.26	17.98
M_2 x S_1	32.36	33.81	38.32	35.57	32.78	28.47	27.26	25.37	21.91	19.84	18.98	18.69
M_2 x S_2	31.96	33.50	38.01	35.26	32.29	27.98	26.77	24.78	21.32	19.21	18.35	18.06
M_2 x S_3	31.85	33.26	37.73	34.94	32.11	27.76	26.51	24.58	21.08	18.97	18.21	18.04
M_2 x S_4	31.62	32.98	37.43	34.62	31.77	27.40	26.13	24.18	20.66	18.97	18.21	17.51
M_2 x S_5	32.08	33.53	38.02	35.25	32.44	28.11	26.88	24.97	21.49	19.40	18.52	18.21
M_2 x S_6	32.12	32.87	37.31	34.49	31.63	27.25	25.97	24.01	20.48	18.34	17.41	17.05
M_3 x S_1	32.13	33.48	37.99	35.45	32.63	28.29	27.05	25.13	21.64	19.54	18.65	18.33
M_3 x S_2	31.73	33.17	37.68	35.14	32.15	27.81	26.57	24.55	21.05	18.91	18.02	17.70
M_3 x S_3	31.62	32.93	37.40	34.82	31.96	27.58	26.30	24.34	20.81	18.67	17.88	17.68
M_3 x S_4	31.38	32.65	37.10	34.51	31.63	27.23	25.93	23.95	20.39	18.67	17.88	17.15
M_3 x S_5	31.85	33.20	37.69	35.14	32.30	27.94	26.68	24.74	21.22	19.10	18.19	17.85
M_3 x S_6	31.88	32.54	36.98	34.37	31.48	27.07	25.76	23.77	20.21	18.04	17.08	16.69
M_4 x S_1	31.96	33.25	37.76	35.38	32.53	28.17	26.91	24.97	21.46	19.33	18.42	18.08
M_4 x S_2	31.56	32.94	37.45	35.07	32.05	27.69	26.43	24.38	20.87	18.70	17.79	17.45
M_4 x S_3	31.45	32.70	37.17	34.75	31.86	27.46	26.16	24.18	20.63	18.46	17.66	17.44
M_4 x S_4	31.22	32.43	36.88	34.43	31.53	27.11	25.79	23.78	20.21	18.47	17.66	16.91
M_4 x S_5	31.68	32.98	37.47	35.06	32.20	27.82	26.54	24.57	21.04	18.90	17.97	17.61
M_4 x S_6	31.72	32.31	36.75	34.30	31.38	26.95	25.62	23.61	20.03	17.83	16.85	16.44

Main plots (M): Continuous contour trenches (M_1); Ring basin (M_2); Half ring basin (M_3); Control (M_4). **Sub-plots (S):** Farm yard manure (S_1); Vermicompost (S_2); Poultry manure (S_3); Biofertilizers (S_4); RDF (N:P:K)+ farm yard manure(S_5); Control (S_6).

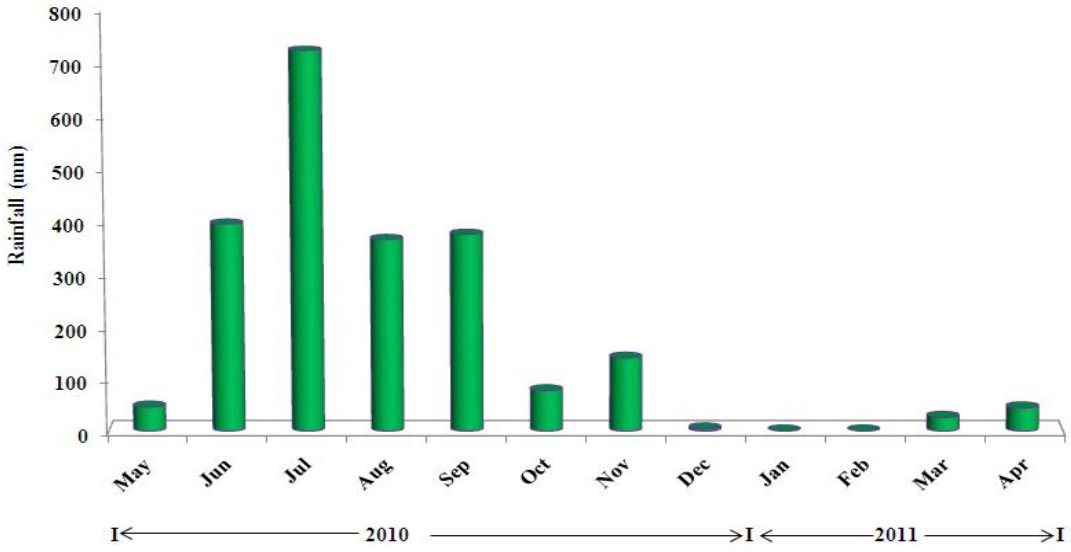

Figure 4: Rainfall (mm) during the study period at Hegadekhatta watershed area in Uttar Kannada district of Karnataka.

References

Anonymous. (2001). Annual Reports, Forest Survey of India, MoEF, Dehradun, India.

Bharadwaj and Bhattacharya., 1996, Comparative performance of two planting stock of *celitus australis* Linn under different soil working techniques. *Ann. Forest.*, **3** (1): 15-20.

Deb, S. B. (2007). Climber like modification in *Acacia auriculiformis* plants. *The Indian forester*, **133**(9): 1279-1280.

Lal, P. (2008), Clonal *Eucalyptus* plantation in India. *Indian Forester*, **134**(12): 1561-1570.

Manivannan, S and Desai A. R. (2002). Effect of *in-situ moisture* conservation practices on runoff, soil loss and initial growth of cashew (*Anacardium occidentale). Indian J. Soil Cons.*, **35**(2): 147-150.

Mutanal, S. M. ((1998). Studies on teak based Agroforestry system and fertigation. *Ph. D Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Panigrahi, P., Srivastava, A. K., Huchche, A. D. and Shyam Singh., 2008, Improving productivity in acid lime (*citrus aurantifolia* Swingle), *Indian J. Soil Cons.*, **36**(2) : 109-111, 2008.

Puri, D. N., Narain P. and Dhyani, S. K. (1995). Soil working techniques in degraded lands– *Eucalyptus hybrid*. *The Indian Forester*,**121**(7) : 600–607.

Raghavendra, K. N. (2005). Influence of moisture conservation structures and application of mulches on growth and productivity of four year old *Acacia auriculiformis* and *Casurina equesetifolia, M. Sc. Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Shaikh, M. H. A. (2000). Forestry in the New Millinium. *The Indian Forester*, **126** (1): 103-110.

Sharanabasappa, B. N. (2007). Effect of moisture conservation and integrated nutrient management on two year old teak plantation. *M. Sc. Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Singhania, H. S. (1997). Presentation to Hon'ble minister for industries, GOI on the findings and recommendation of the committee to suggest an action plan for pulp and paper industry at New Delhi on May 28 (Unpublished).

Wasan K. and Bunvong T. (1975). Some chemical properties of soil at klang dong teak plantation Nakornrachasima province. *Research Note*, Faculty of Forestry, Thailand No. 75, p. 15.

Pachauri, R. K. AND Mehrotra, P. (2002). Vision 2020: Sustainability of India's Material Resources. India Vision 2020. Planning Commission of India. pp. 112-119.

Kulkarni, H. D. (2002). Bhadrachalam clones of *Eucalyptus* an achievement of ITC, Paper presented at the IUFRO Science/Policy interface task force regional meeting held in Chennai, India at the M. S. Swaminathan Research Foundation, p. 4.