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1442

COMPARISON OF AGROMANAGEMENT PRACTICES FOR SOIL AND WATER CONSERVATION IN RUBBER PLANTATION

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ABSTRACT

A field experiment was conducted at Rubber Research Institute of India, Kottayam to study the effect of various agromanagement techniques on conservation of soil moisture , growth of rubber and crop evapotranspiration(ETc). Moisture content in the soil recorded during dry months revealed variations in plots having different agromanagement practices. Girth of rubber and ETc also showed difference between various practices adopted.

INTRODUCTION

Rubber grown in the country often falls on land with varying degrees of slope.Ideal slope of land recommended for planting rubber is around 5 to 15 degree but rubber is being successfully grown in areas with upto 45 degree slope under adequate soil management practice (Pushpadas and M.K Amma, 1980).

The traditional rubber growing tract in India receives an average annual rainfall of 2500-3000 mm. Rain falling on the bare soil surface is likely to be runoff carrying top soil with it. In a rubber ecosystem optimum management of soil is needed to contain losses of soil and water and also to conserve moisture during the dry summer months.

The recommended soil management practice includes making contour terraces,silt pits and growing leguminous ground cover to check erosion. This particular investigation was taken up to monitor soil and water erosion and to compare agromanagement practices for soil and moisture conservation on growth of rubber.

MATERIALS AND METHODS

The trial was started at the Rubber Research Institute of India, Kottayam, Kerala (9° 32'N , 76° 86'E and 73 m above MSL) in 1988 with the following management practices as treatments.

1. Contour + Cover crop
2. Contour + No cover crop
3. Contour + Staggered silt pits in interrows + Cover crop

4. Footpath + Silt pits on planting lines + Cover crop
5. Footpath + Trench between rows +Pineapple on upper side of trench + Cover crop
6. Footpath + Trench between rows + Pineapple on upper side of trench + Banana intercrop
7. Footpath+ Stone wall after 3 rd contour + Silt pits +Cover crop

Treatments 1 and 3 are recommended practices. Pineapple and banana were planted with the dual purpose as a biological bund and also for added returns during immaturity period. Polybag rubber plants of clone RRII 105 were planted. Each plot accommodated 5 adjacent contour lines each with 4 plant points surrounded by plot boundaries made of brick walls. At the lower end of each plot a multislot devisor (Design- CWRDM,Calicut) was installed for collecting runoff and eroded soil. The length of slope was 33 m each with 20% slope.

The soil in the experimental area was lateritic. Bulk densities in the top 8 cm soil measured using core sampler varied from 1.1 to 1.3 g cm -3. Moisture percentage corresponding to -0.033 , -0.50 and -1.50 MPa was 27.8 %, 24.7 % and 19.7 % . The soil was medium in organic matter and available nutrients.

Soil moisture was determined by gravimetric method during summer months and mean values are reported.Girth of rubber plants were recorded at 150 cm height from 1990 onwards. ET of rubber was estimated using the formula $Pv = \frac{Pw}{100} \times BD \times d$

Where Pv = The depth of water in mm
Pw = Moisture %, BD = Bulk density (gm cm -3)
d = Depth of soil in mm

The values of ET in terms of depletion of soil moisture % were converted in terms of mm water.

Soil accumulated in the silt pit were collected by gently removing the soil upto the standard pit size of 4 x 2 x 2 ft.

RESULTS AND DISCUSSION

Estimation of soil moisture content in the 0 - 30 cm depth was carried out from 1990 onwards (Table 2). Mean soil moisture content of the top 30 cm layer in 1990 showed 13.6 % variation between treatments ,with treatment silt pit on planting line + cover crop recording the highest soil moisture.In the subsequent years also soil moisture content was higher in this plot .

Table 1.
Mean monthly weather parameters (1991-1994)

Month	Temp Max	Temp Min	RH I	RH II	Wind speed	Sunshine (hrs)	Evaporation (mm)
January	32.8	21.2	84	49	2.2	8.5	4.3
February	33.5	22.9	88	50	2.6	9.4	5.1
March	34.5	23.9	89	52	2.7	9.3	5.3
April	34.3	24.2	89	57	2.6	8.9	5.4
May	33.2	24.5	91	65	2.2	7.5	4.8
June	29.7	23.4	96	80	2.0	4.1	2.6
July	29.0	22.6	96	80	1.9	3.3	2.3
August	29.4	23.0	97	77	2.4	4.5	2.6
September	30.6	23.1	94	70	2.2	5.5	3.3
October	30.4	22.8	96	75	1.7	4.9	2.9
November	31.0	23.0	94	66	1.4	6.0	3.1
December	32.4	21.7	88	56	1.6	8.1	4.0

Mean annual rainfall

1991 - 3564.6 mm
1992 - 4080.7 mm
1993 - 3576.9 mm
1994 - 3340.0 mm

The plot with trench between rows and pineapple as biological bund also recorded high soil moisture values. Plot recording the highest soil moisture did not have complete contour terraces but only a footpath between plant points.The silt pits were however placed between 2 plant points unlike between plant rows as is done conventionally.

Table 2
Mean soil moisture content at 0-30 cm depth (January & February)

Treatments	1990	1991	1992	1994
Contour+CC	15.76	13.16	14.47	18.93
,, +No CC	17.03	12.66	15.01	18.87
,,+SP +CC	18.78	13.43	16.86	17.32
SP* + CC	22.24	15.93	18.11	20.81
TR + PA+CC	17.96	14.48	17.40	19.82
TR + PA+BA	15.67	13.46	16.24	20.75
SW +SP +CC	18.13	15.07	17.66	22.04
SE	0.95	0.44	0.52	0.59
CV(%)	13.61	8.34	8.29	7.91

CC : Cover crop SP: Staggered Silt pits PA: Pineapple
SP* : Silt pits on planting lines BA: Banana intercrop
TR : Trench between rows

Girth of plants recorded from 1990 onwards showed better girth for plants grown in plots with footpath + trench + pineapple + banana, followed by that in the recommended practice of Contour + Silt pit + Cover crop (Table 3).However the plot under footpath + Silt pits on planting lines + Cover crop also recorded good girth. Coefficient of variation between plots were only 4.47 % in 1994.

Evapotranspiration of rubber was higher in January during 1991 and 1992 but in 1994, February recorded higher ET values (Table 4). This could be due to the higher quantum of rainfall received during the latter part of January,94. Higher ET values were observed in plots having trench between plant rows + pineapple above the trench + banana intercrop suggesting higher moisture retention in these plots. This was followed by the plot with stone wall after 3 rd contour + silt pit + cover crop.The stone wall would have controlled the runoff water thereby conserving more moisture in the profile. Silt pit between planting lines + cover crop also had high ET values. Jessy et.al.,(1992) reported that mean ET values of Immature rubber during summer months vary from 2.6 to 7.53 mm\day. Changes in ET observed were due to the variation in soil moisture and evaporative demand.

Table 3
Girth of rubber as influenced by soil conservation methods

Treatments	1990	1991	1992	1994
Contour+CC	10.86	14.45	21.23	39.02
,, +No CC	10.87	14.83	22.78	41.66
,,+SP+CC	11.05	15.40	23.85	43.30
SP* + CC	10.61	13.77	21.55	42.26
TR+PA+CC	10.21	13.92	22.02	42.05
TR+PA+BA	11.42	15.88	24.89	45.22
SW+SP+CC	10.22	13.98	22.26	41.47
SE	0.17	0.30	0.49	0.71
CV(%)	4.08	5.51	5.77	4.47

CC : Cover crop SP:Staggered Silt pit
TR : Trench between rows
SP* : Silt pit on planting lines PA:Pineapple
BA : Banana intercrop

Multislot devisors were placed at the lower end of each plot for collecting runoff. There was no runoff collection in these devices from the beginning. This suggests that all the conservation methods adopted in this experiment had some amount of conservation which was effective in conserving soil and water. The cover crops which were established may have contributed in curtailing the impact of rain on the bare soil surface in the initial years.Soil moisture content has been reported to be higher on soils with cover crop (Kothandaraman, 1989). The leguminous cover helps in the formation of large size aggregates which in turn enhances the infiltration (Krishnakumar,1989). In the 2 plots which did not have cover crops

treatment 2 and 4) the contour terrace in treatment 2 and trench, biological bund and intercrop in treatment 4 may have effectively checked runoff and erosion.

Table 4.
Estimated Evapotranspiration of rubber (January & February)

Treatments	1991		1992		1994	
	Jan	Feb	Jan	Feb	Jan	Feb
Contour+CC	4.4	4.7	5.9	4.2	6.2	6.5
,, +No CC	4.1	3.5	4.9	4.2	5.0	6.4
,,+SP+ CP	4.3	3.3	5.3	4.2	3.9	5.9
SP * + CP	5.3	4.4	6.3	4.7	5.7	5.7
TR + PA+CC	4.7	4.1	5.8	4.6	5.6	6.4
TR + PA+BA	5.1	4.1	6.0	5.0	6.5	7.6
SW + SP+CC	5.1	4.2	6.4	4.5	6.4	7.3
SE	0.17	0.18	0.20	0.12	0.35	0.26
CV(%)	3.7	4.6	3.5	2.6	6.2	4.0

Cover crop SP:Staggered Silt pits PA: Pineapple
SP* :Silt pits on planting lines BA: Banana intercrop
TR: Trench between rows

There was silt deposition in the silt pits in plots 3,4 and 7 over a period of six years (Table 5).Mean soil collected showed less accumulation of silt in plots having contour terrace than in ones with only a footpath between plant points.

Table 5.
Mean soil deposited in silt pits (1988-1994)

Treatments	Soil Kg - pit
Contour + SP + CC	12.09
SP + CC	15.50
SW + SP + CC	14.27

The agromanagement practices tried viz treatments 6 and 4 shows promise in terms of moisture conservation and growth of rubber.These will have to be tried out on a larger drainage area as a block trial to effectively evaluate its usefulness.

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