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INTEGRATION OF INTERCROPPING AND ENGINEERING MEASURES ON SOIL AND WATER CONSERVATION IN COCONUT PLANTATION

R. Dhanapal, C. Palaniswami, A. C. Mathew, C. Manojkumar and K. Samsudeen
Central Plantation Crops Research Institute,
Kasaragod – 671 124, Kasaragod

ABSTRACT

An experiment was conducted in October 2000 for sustaining productivity in combination with soil and water conservation measures. The highest runoff was observed under the control treatment where no conservation measures were taken up (7.23 t/ha) followed by the vegetable intercrop. The least soil loss was observed in the treatment husk filled in trench with pineapple border. Among the different treatments, husk filled in trench with pineapple border was observed to be the best in soil and water conservation measure. The cultural operation where soil is disturbed increases the soil loss during the monsoon season. Performance of CO_3 grass is better during summer than other seasons.

INTRODUCTION

Coconut a traditional plantation crop of India, assumed the status of a high value commercial crop with an annual production of 15 thousand million nuts and export earning of Rs 313 crores. Of the 1.91 million ha, the southern states account for 90% of area and production. About 80% of the coconut holdings in the country are either small or marginal, and the average holding size is around 0.22 ha. The income derived from such smallholdings is quite insufficient to sustain even the small families. Under such situations coconut based cropping system is an important and most relevant activity towards sustaining productivity. Sustainability is the objectivity of farming system where production process is optimized through efficient utilization of the inputs in safeguarding the environment with which it interacts. In humid tropics where high rainfall induces loss of nutrients through surface run off cropping and farming systems insulate the soil from such losses and prevent land degradation.

The future food, fodder, fuel and fiber requirements have to be met through by increasing their productivity and through efficient use of available natural resources like soil. However, this precious non-renewable resource is subjected to various degradation processes, which diminish the productive capacity of many crops.

In India, out of the total geographical area of 328.5 million ha, 148.9 million ha is suffering from degradation hazard due to water erosion (Sehgal and Abrol, 1994). It has been estimated that more than 5334 million tonnes of top soil is being eroded every year. Of this about 1600 million tonnes representing 30 per cent of the total eroded mass is permanently getting lost to the sea. About 10 per cent of eroded soil gets deposited in the reservoirs and reducing their capacity 1.2 per cent per year (Singh *et al.*, 1992).

Among the different kinds of degradation, water erosion is the major land degradation problem in many parts of the world. About 1093 million ha in the world have been degraded due to water erosion, followed by 549 million ha by wind erosion, 134 million ha by nutrient depletion, 77 million ha by salinisation, 22 million ha by pollution, 108 million ha by compaction (ISRIC, 2000). Therefore investigations on the major land degradation *viz*, water erosion is very much needed for national and regional developmental plans.

Keeping the above point in view, an experiment was started in October 2000 for sustaining coconut productivity through soil and water conservation measures in the hilly regions of Western Ghats.

MATERIALS AND METHODS

The experimental plot is located at CPCRI Research Centre, Kidu at an elevation of 219 m above MSL and has a slope of 12-16 %. The latitude and longitude are 12.30° N and 75.2° E respectively. The average maximum and minimum temperature are 40°C and 18° respectively in summer and 33°C and 10° C in winter. The average rainfall received at the experimental location was around 4000 mm

and most of it was concentrated during the monsoon season, June to September. Soil moisture deficit was observed from mid of November to May second fortnight (Fig.1). The soil type is laterite with a pH of 5.5 to 6.5. All the treatments were taken up in the inter space of 30 years old coconut garden in an 800 m^2 area with 3 replications along the slope with following treatments:

T_1 Half moon type with pineapple border

T_2 Catch pit with pineapple border

T_3 Trench filled with coconut husk with 2 lines of pineapple border

T_4 Drip irrigation daily @ 66% of E0 for coconut with grass in the interspace

T_5 Cover crop with vegetables

T_6 Absolute control

T_7 Irrigation as per farmers practice with grass in the inter space.

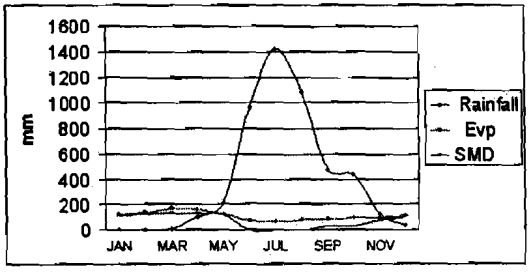

Fig. 1: Rainfall, Evapotranspiration and Soil Moisture Deficit of experimental location

Each plot was separated from other plot with GI sheet to prevent the surface runoff from entering the adjacent plot. Drip irrigation was provided to grass and coconut at the rate of 66% of open pan evaporation. Separate laterals were provided for grass and coconut. Irrigation water was supplied from an overhead tank. At the bottom of each plot a multi slot devisor, with11slot, was provided to collect the runoff water. The farmer's practice of irrigation is irrigating the palms manually with hose pipe once in seven days. The water overflowing from the multi slot devisor was collected in a PVC drum to quantity the total runoff water. Sediment load in the runoff water was determined by collecting water samples (500ml) during monsoon period of 2002. The performance and yield of main and component crops were recorded for the year 2001-2002. Results obtained from different treatments was compared with that of a control plot where no conservation measure was used.

RESULTS AND DISCUSSION

Soil Loss

Among the various treatments tried, the least soil loss was observed in the treatment, husk filled in trench with pineapple border. The highest runoff was observed under the control treatment where no conservation measures were taken up (7.23 t/ha) followed by the vegetable intercrop (table 1). In the plot where vegetable was grown for dual purpose (soil conservation and extra income) the crop failure and soil disturbance led to more run off and soil loss.

The soil loss observed under grass plots was in the medium range compared to different treatments, which may be attributed to the soil disturbance for fertilizer/ manure application to the grass. In general with increased runoff percentage the soil loss also increased.

Bund Deformation

Pineapple was planted on the bunds (half moon type in coconut basin, catch pit and trench filled with coconut husk) to avoid damage to the bund. However it was observed that there was damage both in height and width of the bund (Table 2). The height and width of the bunds before and after rains were recorded. And it was observed that there was 19-50 % reduction in height and 17-45% in width. The soil dugout from the catch pit was put on the down slope which formed a bund, where pineapple was planted. The soil filled in the catch pit was also recorded and it was noticed that around 14 to 18 cm height of soil was filled in catch pit. The bund dimension in this treatment i.e. the trench filled with coconut husk with 2 rows of pineapple border was measured and it was observed that the height of the bund which was 22 cm before rain as reduced to 18 cm and the width has come down from 30 cm to 25 cm inspite of planting pineapple on the bund to avoid beating effect of the rain.

Table 1: Run off and soil loss

Treatments	Rainfall (mm)	Run off (mm)	Run off (%)	Soil loss (t/ha)
Half moon type with pineapple border	2311	10.96	0.47	0.47
Catch pit with pineapple border	2311	13.57	0.59	0.46
Trench filled with coconut husk with 2 lines of pineapple border	2311	4.02	0.17	0.11
Drip irrigation daily @66% of Eo for coconut with grass in the inters pace	2311	33.11	1.43	1.67
Cover crop with vegetables	2311	175.3	7.6	6.89
Irrigation as per farmers practice with grass in the interspace.	2311	29.59	1.28	1.51
Absolute control	2311	282.5	12.24	7.23

Table 2: Deformation/setting of bund

Treatments	Before rain		After 2 months of rain	
	Height (cm)	Width (cm)	Height (cm)	Width (cm)
Half moon type with pineapple border	22	26	15	21
Catch pit with pineapple border	20	33	10	18
Husk filled in trench with pineapple border	22	30	18	25

Pineapple Yield

Out of the various treatments where pineapple was grown on the bunds, it was observed that higher yield was obtained in the treatment husk filled in trench with pineapple border (49.44 t/ha) followed by catch pit and half moon bund (table 3). Number of fruits and average fruit weight contributed to more yield. The reason for higher yield in husk filled in trench with pineapple border can be related to moisture conservation by the husk.

Vegetable Yield

Three vegetables pumpkin, ash guard and cucumber were compared for the purpose of soil conservation and for additional income from a slope land during first year of planting (table 4). It was observed that pumpkin performed the best among the different vegetables tried not only in fruit yield but also in the soil binding capacity and land coverage. Since pumpkin vegetable having good demand locally marketing this vegetable is not a problem.

Table 3: Pineapple yield from bunds of different treatments

Treatments	Avg. Fruit Weight (kg/fruit)	Yield (t/ha)
Half moon type with pineapple border	1.22	38.23
Catch pit with pineapple border	1.32	47.5
Husk filled in trench with pineapple border	1.39	49.44

Table 4: Performance of vegetable crops grown in the inter pace of coconut

Vegetables	Yield in kg/ plot	Root volume in ml	Land coverage %
Pumpkins	160	12	90
Ash guard	80	10	71
Cucumber	35	6	33

Grass Yield

CO_3 grass, which is a hybrid (Bajra x Napier grass) is fast growing and has high regeneration capacity. This grass has a differential growing habit when grown in the west coast region. During summer season, with bright sunshine and irrigation, very good vegetative growth was observed. When harvested in the monsoon season the regeneration capacity was very poor. Regeneration picked up slowly after the monsoon, i.e. during the month of November to January. Peak biomass yield was obtained during the month of May and June (28.21t/ha). The lowest yield was obtained when the grass was harvested from July to September. After September the yield increased rapidly. Then there was a lull period in the growth, which can mainly be attributed to low temperature (10°c) especially during night. Because of continuous rain and reduced sunlight the tiller production got affected resulting in lower biomass yield. In spite of all these reasons the average yield obtained in both the treatments were around 100t/ha/year. Drip irrigation treatment and farmer's irrigation practice did not show any remarkable difference in yield.

Coconut Yield

The observations on coconut yield indicates that there was an increase in yield in all the treatments which may be attributed primarily to the proper management practices (mulching, irrigation and fertilizer application) after taking up the plot under experiment (table 5). Though the treatments also would have slight effect on yield it is too early to come to any conclusion.

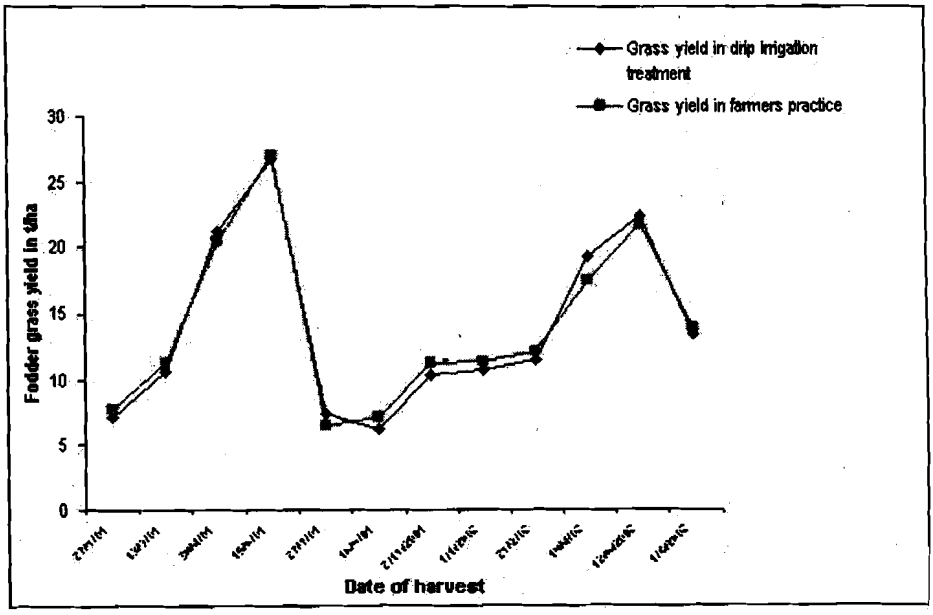

Fig 2: Seasonal variations of CO_3 grass yield

Table 5: Coconut yield under different bio-engineering treatments

Treatments	Nut yield/palm/year			
	1998-99	1999-2000	2000-01	2001-02
Half moon type with pineapple border	33	23	57	79
Catch pit with pineapple border	20	22	45	56
Trench filled with coconut husk with 2 lines of pineapple border	23	28	58	68
Drip irrigation daily @66% of Eo for coconut with grass in the inters pace	19	21	49	57
Cover crop with vegetables	15	25	46	72
Absolute control	27	23	50	70
Irrigation as per farmers practice with grass in the interspace.	26	24	52	74

CONCLUSION

Among the different treatments, husk filled in trench with pineapple border was observed to be the best in soil and water conservation measure and was observed to reduce 98 % of the soil loss compared to control. The cultural operation where soil is disturbed increases the soil loss during the monsoon season. Performance of CO_3 grass is better during summer than other seasons.

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