International Journal of Pharmacy and Biological Sciences-IJPBSTM (2019) 9 (1): 213-220
Online ISSN: 2230-7605, Print ISSN: 2321-3272
Research Article | Biological Sciences | Open Access | MCI Approved
UGC Approved Journal

Renovate the Infertile Rubber Plantation Soil to Fertile Soil through House Hold Agronomics Wastes

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Received: 3 Oct 2018 / Accepted: 8 Nov 2018 / Published online: 1 Jan 2019
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Abstract

Soils normally play a major role in dictating the availability of nutrients to plants. The influence on this availability is primarily through the mineral reserves in the soil and the nutrients added to the soil. Chemically, soils contain different proportions of nutrients considered to be important for the rubber trees, viz. nitrogen, phosphorus, potassium and magnesium. Hence the present study framed the following objectives. Initially to study the physic-chemical characters of rubber plantation soil (Experimental soil-1) and mixture of agronomic wastes with rubber plantation soil (Experimental soil-2) quantitatively by soil analysis, secondly to investigated quality of these two soils through HPLC technique. From the result was showed that the rate also significantly reduced the percentage of seed germination (40%) in rubber plantation soil, it was remarkably minimum level of growth efficiency denoted when compared with other two soils. Initially, prolonged period of germination also been observed in experimental soil -1 In addition, maximum root length was observed in mixture of agronomic waste with rubber plantation soil it was statistically significant at the level of 0.05% but eight-fold decreased range of root length has been noticed in experimental-1 rubber plantation soil. Similarly, other four parameters like leaf length, number of leaves, stem length, and leaf breadth were drastically reduced when it compared with agronomic mixed and control soil. Among, the three experimental soils are clearly noticed which were oscillated or altered level (of the minimum to completely micro and macro elements are absent) in an essential and non-essential metal as well as proper nutrients also been absent for growth of many plants. The overall conclusion of this present study was clearly showed that when the major experimental soil scientifically analyzed, after five years of Rubber plantation soil drastically reduced the typical essential macro and microelements. So, no other crop plant was growing as a healthy in the same soil because important plant growth nutrients are totally reduced in the experimental soil-2.

Keywords

Experimental soil-1, Agronomic mixed soil, Fertile soil, HPLC

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INTRODUCTION

The rubber tree is grown on vast majority of acid soils of the humid tropics, but its performance and economic viability can be restricted severely where there is a limitation of a particular soil characteristic Rubber plantation have encroached deeply into the neighboring forest perennial and annual crop fields, and even into fuelwood plantations of *Cassia siamea* (Lalani, 2000). Rubber now covers the largest area among all land uses Rubber plantation has become the most important industry in the economy of developing countries. Demand for rubber is leading to the damage of the high biodiversity of rain forests in India (Lal and Pierce, 1991) and has replaced traditional swidden–fallow agro-ecosystems (Fuller, 1951; Halberg and Kristensen, 1997; Berry *et al*., 2006), undermining their key role in conserving traditional agroeco systems Calcium, and low organic matter is the most serious depicted by Hue (1992). Tropical soils are often unproductive because some of these soils are prone to strong phosphate fixation that renders phosphorus unavailable to plant. Previously, Beltran *et al*., (2002) denoted soils that are prone to strong phosphate fixation (adsorption to oxides and clay minerals) often require extremely high phosphate fertilization application in order to alleviate the effect of phosphate fixation. Cowpea (*Vigna unguiculata* L. Walp.) is widely cultivated in a range of ecologies especially in the savannah regions and in tropics and sub-tropics (Denison *et al*., 2004). It is one of the most important food legume crops in the semi-arid tropics covering Asia, Africa, Southern Europe and Central America (Elturet *al*., 2002). Cowpea is also an important food crop in west and Central Africa (Askegaard and Eriksen, 2000). High protein content of cowpea, ranging between 20 to 28% makes it an important supply to the diet of many African people (Granstedt, 1995). Cowpea also contributes to the soil nitrogen status through symbiotic N_2fixation, thereby enhancing soil fertility (Ryan *et al*., 2004). Later Gunapala *et al*. (1998) prescribed the soil acidity and mineral deficiencies can be corrected by mixture agronomic wastes and fertilizers. However, it has been reported (that green manures and composted organic material increase SOM, provides nutrients for plant growth, alleviate aluminum toxicity, and render phosphorus more available to crops Kaffka and Koepf, (1989). The work related no one work has been analyzed; hence the present study framed the following objectives. Initially to study the physic-chemical characters of rubber plantation soil (Experimental soil-1) and mixture of agronomic wastes with rubber plantation soil (Experimental soil-2) quantitatively by soil analysis, secondly to investigated quality of these two soils through HPLC technique. Moreover, third objective was to check and demonstration of leguminous seed *Vigna unguiculata* (L.) germination and study the growth performance until 20th day.

MATERIALS AND METHODS:

Control-normal fertile soil for control soil

Experimental Soil-2was act as a Five years rubber plantation soil was a one set of experimental soil

Experimental Soil-3 was a combination of five agronomic waste mixtures along with the five years rubber plantation soil

Preparation of five agronomic mixture compositions

Five different household wastes of egg shell, coffee dust, leaf litter, coconut husk and cow dung were collected and thoroughly mixed with infertile soil of five year more rubber plantation soil. After three weeks processing was over this particular soil was used for sample soil for check and investigate the germination of *Vigna unguiculata L.* Walp. seeds.

Collection of substrates:

Principal household wastes were preparation for fertile soil from the rubber plantation infertile soil. The five different raw materials were collected from various students' home in and around Mariagiri, Kaliakkavilai and Parassala region Tamilnadu and Kerala States.

Preparation of Five Agronomic Wastes

Leaf litter, coffee dusk, egg shell, coconut husk and cow dung mixtures are thoroughly powdered mixed were degraded then dried under shade and broken to small pieces. The substrates were mixed in the ratio of 1: 1. Required amount of water was added to the mixer to hold 70 – 80% moisture. This mixer was pre- decomposed for 10 days and filled in a trough having proper drainage facilities. The unit was kept in shade. Sufficient moisture level was maintained by sprinkling water, within one week for mixture of all the ingredients in to the experimental rubber plantation soil. *V.unguiculata* seeds were purchased from the Kaliyakkavilai region.

Soil Analysis

In the experimental soils were analyzed the primary and secondary nutrients by the methods of Manual STI, (2011).

Analysis of soil Microbial Load

Autochthonus bacterial population in the experimental soil was done by the method of Parkinson and Paul, 1982

ISSN: 2230-7605 (Online); ISSN: 2321-3272 (Print)
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HPLC Analysis Systems:

HPLC having UV/ visible detector (Perkin Elmer) was used for identification and quantification of pesticides. Separation was performed on reversed phase C-18 column. Samples were injected manually through an Injector. The working condition of HPLC was binary gradient, mobile phase was acetonitrile: water; (70:30), flow rate was 1 ml min-1, injection volume was 20 µL and the wavelength of the UV/visible detector was fixed at 230 nm for the soil elements. HPLC was used to determine the residues of Metalaxyl in plants. The analysis was conducted with HPLC (having UV/ visible detector (Perkin Elmer), with a mobile phase of 50 % acetonitrile and 50 % water, which was estimated by HPLC, equipped with a 20 µL fix loop, C18 reversed phase column, flow rate 1.4 ml/min, UV detector and peak area responses used in quantification were measured at wavelength 220 nm. Separation was achieved with a mobile phase of 12% methanol and 88% water. Essential nutrients was estimated by HPLC, equipped with a 20 µL fix loop, C18 reversed phase column, flow rate 1.4 ml/ min UV detector and peak area responses used in quantification were measured at wavelength 196 nm by Islam *et al*. (2009). The growth performance data was analyzed statistically using SPSS version 11.5 and treatment means were compared using Duncan Multiple Range Test at the level of 0.05 of significant.

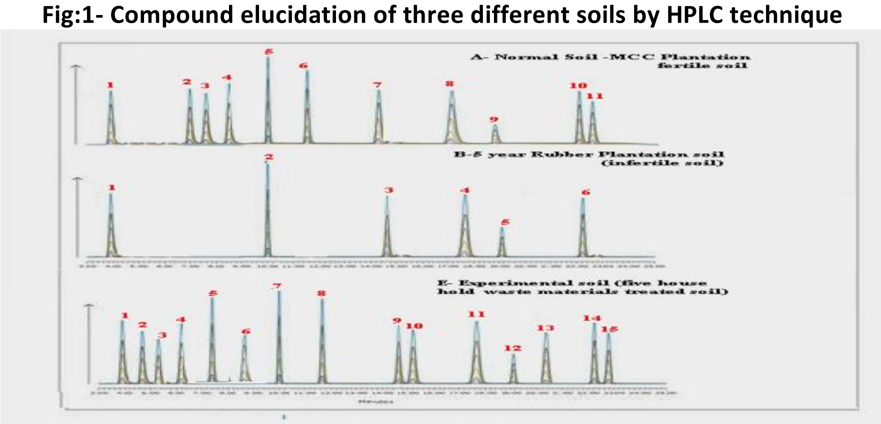
RESULT

From the present result clearly showed that the maximum eleven kinds of compounds were elucidated in normal fertile soil similarly agronomic wastes mixed experimental soil also been possessed totally fifteen different compounds. But when the rubber plantation soil subjected under HPLC remarkably minimum amount of compounds were noticed. It was primary result notification for rubber plantation soil necessary for addition of the absent compounds in the experimental -2 soil. Among the three-soil experimental three soil was clearly noticed fluctuate or altered level of the minimum or completely absent of micro as well as macro elements in an essential and non-essential metal as well as proper nutrients also been absent for growth of many plants Fig-1.

From the three soils autochthonous bacterial population clearly showed that rubber plantation soil possessed only one bacterial strain has been identified followed by processed soil of mixture of five agronomic wastes with five years rubber plantation soil consisted more than six different kinds of bacterial species (Table-1). It was remarkably significant level of autochthonous bacterial population observed in experimental-3 soils when it compared with control fertile soil Fig-2. Hence the current study was clearly denoted that when the agronomic wastes are definitely providing the improvement of soil fertility especially five years above rubber plantation soil too. Moreover, this study revealed that soil fertility also been determined the soil possessed beneficial bacterial strains, such a way this result expressed the rubber plantation soil showed very much reduced number of bacterial counts, it's also another one reason for failure for growth of the legume as well as other crop plants.

Moreover, table-1 was clearly showed that totally seventeen parameters were analyzed among the seventeen; sixteen compounds were remarkably reduced except chlorine it was remain constant compared with control and experimental soil-2. While, sulfur, Manganese and aluminum kinds metals are drastically five to ten-fold decreased in experimental soil-1 than the other two soils. Moreover, the arsenic content totally absents in control and agronomic mixed soil but very few 0.01% was available in experimental soil -1.

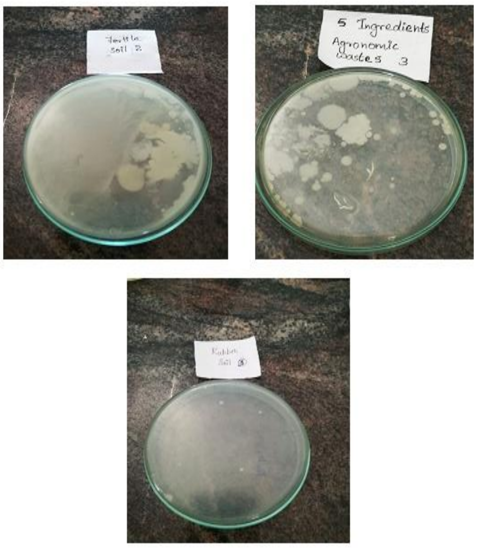
Fig:1- Compound elucidation of three different soils by HPLC technique



ISSN: 2230-7605 (Online); ISSN: 2321-3272 (Print)
Int J Pharm Biol Sci.

Fig: - 2-Total Autochthones bacterial population of two different experimental soils

(A) (B)



(C)

A— Stands for Control normal fertile Soil
B---- Stands for Agronomic mixture with rubber plantation soil
C---Stands for Five years rubber plantation soil

Table:1: Physico- Chemical and Microbiological Characteristics of experimental soils

S.NO.	Analyzed Parameters In the soil	Control Soil	Rubber plantation Soil (Infertile)	Processed soil
1.	PH	7.3	8.6	7.1
2.	Phosphorus	652	403	672
3.	Nitrogen	75	19	79
4.	Ammonium	1108.8	145.6	1124.9
5.	Potassium	60	23	58
6.	chloride	61	60	60
7.	sulfur	1139	904	1147
8.	Iron	65	42	69
9	Zinc	30	11	35
10	Manganese	7	3	10
11.	Copper	4.71	2.03	7.63
12.	Aluminum	255	154	204
13.	Sodium	2138	1468	1587
14.	Calcium	98	42	84
15.	Magnesium	12.45	-	15.07
16	As	-	0.01	-
17.	Boron	0.2	0.001	-
18	No. of bacterial population	5	O	7

Table2: - Germination efficiency of *V. unguiculata* (Linn.) seeds in two different experimental soil

Sl.No	Name Of the Experimental soil(s)	Days of germination							Total Germination (%) Of seed (in %)
		1st	2nd	3rd	4th	5th	6th	7th	
1.	Fertile soil	-	-	75	20	5	-	-	100
2.	Rubber plantation soil	-	-	-	-	-	20	20	40
3.	Mixed soil	-	-	85	15	-	-	-	100

Seed germination rate was also clearly revealed that hundred percentage of germination observed in control and agronomic mixed soil but very minimum percentage 40% of seeds were germinated in experimental soil1 (rubber plantation soil. Moreover, experimental soil-2 and control soil sowed seeds were minimum to maximum

Table 3: -Growth performance of *Vigna unguiculata* (Linn.) in two different experimental soil (20th Day).

S.NO.	Parameters	Control (cm)	Processed fertile soil	(Rubber plantation soil) Infertile soil
1.	Root length	9.27±0.72	12.63±0.20**	4.30±0.85*
2.	Leaf length	4.26±0.23	4.86±0.07*	1.65±0.11
3.	No. of leaves	17.15±0.34	19.46±0.14*	10.17±0.34*
4.	Stem length	3.82±0.56	4.92±0.04**	1.69±0.21is
5.	Leaf breadth	1.74±0.75	2.11±0.01	0.55±0.02

***- it shows highly significant at 0.00 5% level**
****-it shows significant at0.05% level**
In- insignificant

From the table- 2 clearly revealed that the effect of agronomic wastes on Shoot and Root Length, Number of Leaves per Branches and Leaf Length also Breadth of *Vigna unguiculata* (L.) (20th Day). Initially, maximum root length was observed in mixture of agronomic waste with rubber plantation soil it was statistically significant at the level of 0.05% but eight-fold decreased range of root length has been noticed in experimental-1 rubber plantation soil. Similarly, other four parameters like leaf length, number of leaves, stem length, and leaf breadth were drastically reduced when it compared with agronomic mixed and control soil. Even though, from the present study was clearly depicted that the experimental-2 soil effect remained significantly potential result observed in the above said tested parameters; interestingly it was utmost reflected performance when noticed with the control agronomic mixed soil.

Table:4- Primary nutrients in fertile, experimental soil-1 and agronomic waste treated experimental soil-2

Treatment	Organic matter (%)	Moisture content (%)	Nitrates (ppm)	Phosphates (ppm)	Potassium (ppm)	Calcium (ppm)	Magnesium (ppm)
control	1.46	5.59	25.73	33.26	208.15	3425.71	174.31
experimental soil-1	0.91	0.52	10.31	14.67	72.56	1021.57	24.13
Experimental soil-2	20.18	8.63	27.15	36.09	213.45	3673.84	189.24

Table-3 clearly showed that growth promoting elements of phosphorous, calcium, Magnesium, Nitrates, organic and moisture content were critically amble amount was noticed in experimental soil-1. It was significantly declined amount primary nutrients were observed when compared with control and mixed experimental soil -2.

DISCUSSION

Generally, 20-45% lowers on organic farms than conventional farms primarily due to reduced levels of plant available nutrients (Fowler *et al.*, 1993). Changes in the soil biological community do not overcome this limitation also verymuch need for microbe's role especially beneficial bacterial load for improvement of the micro a macro element in fertile soil the similar kind of result has been agreed by the Hue, (1992); Laird *et al*. (2001); Bourn and Prescott, (2002). An understanding of the numerous soil factors affects) soil fertility is a prerequisite to proper management of soils for better performance of rubber. But after five years the particular soil is not enough for any single crop even one legume plant too portrayed by Fliessbach and Mäder*et al*., (2000) because most of the macro and micro elements are very lack in this soil. While soil fertility was drastically reduced especially the present study clearly observed that autochthonous beneficial bacterial strain also been absent when it compared with fertile and mixture experimental soil similar view has been published by Sivapalan *et al.*, (1993); Ritz *et al*., 1997). Previously these kind of similar opinions were suggested by several authors (Hue, 1992; Eghball and Laird *et al*., 2001).Consequently previous evidence was in essence, rubber can best be grown in areas where the soil is deep and readily drained with no compacted or impermeable horizons close to the surface with any toxic or extreme deficiency levels of nutrients opined by Motavalli (1997); Gaur and Adholeya, (2000). Meanwhile the present work demonstrated the similar view of result has been noticed that the soil should be able to retain and supply sufficient nutrients and moisture for proper plant growth by Nyamangara *et al*. (2003).

This increased availability of phosphorus is probably caused by the reaction of organic matter-derived molecules with soil minerals in rubber plantations (Hue, 1992). Previously, Motavalli, (1997) reported household agronomic wastes act as organic manure is being popularized. Importance of organically grown products is in demand at present due to health awareness Hessel *et al*., 1999. A natural agronomic waste is a process of bio-oxidation and stabilization of organic wastes and by the joint action of house hold kitchen wastes and as a result of this improvement of soil microorganisms similar view was opined by various researchers Cook and Ellis, (1987); Schoningh and Wichmann, (1990); Gustavsson, (1998); Rainbow and Wilson, (2002); Islam *et al*. (2009). Hence, these wastes have a great potential as plant growth media and shown to promote growth of cereals, vegetables, ornamental plants etc (Laird *et al*., 2001). Agronomic waste can also be used as a structural addition for poor soils this opinion also been agreed by Robertson and Morgan, (1996). An important feature is that during the processing of the wastes by other beneficial organisms (Kirchmann *et al*., 2004) and many of the nutrients that they contain to forms which are more readily taken up by plants, such as nitrates, ammonium nitrogen, exchangble phosphorus, soluble potassium, calcium and magnesium (Lal and Pierce, 1991; Drinkwater *et al*., 1998; Kirchmann, (1994). This present finding agrees with the findings of Eltun *et al*. (2002) who earlier reported reduced all the growth performance of any crop plant under rubber plantation soil. Percentage (%) of seed germination increases significantly ($P<0.05$) with increased soil nutrient levels mixture of agronomic soil with rubber plantation soil (Data is not shown) authenticated by AQIS, (1998); Johnson, (1996). The control (untreated) recorded the highest percentage of seed germination than the experimental soil. This kind of concept has been agreeing with the findings of Andrén *et al*., (1999) and Angel, (1999) who reported that decreasing the soil texture properties should be reduces the rate of seed germination and other fertility criterion in the soil.

CONCLUSION

Rubber trees will grow better on a good structured soil of lower chemical fertility than on a poorly structured soil with very high chemical fertility as a result after five years rubber plantation soil is not fit for any crop. However, these inputs or addition of other necessary micro and macro elements to this rubber plantation soil for gained normal fertile soil quality for agricultural purposes. The overall conclusion of this present study was clearly showed that when the major experimental soil scientifically analyzed, after five years of Rubber plantation soil drastically reduced the typical essential macro and microelements. So, no other crop plant was growing as a healthy in the same soil. Because, minimum to maximum important plant growth nutrients are totally reduced in the rubber plantation soil (experimental soil-2).

ACKNOWLEDGEMENT

We would like to sincerely thank **Rev. Fr. Jose Bright** Correspondent and Bursar **Rev. Fr.Robinson,** our beloved Principal **Dr. J. Thampi Thanka Kumaran** in Malankara Catholic College, Mariagiri for providing the facility and encouraging for publication of this manuscript. We would also like to acknowledge all the staff members of the Biotechnology Department in Malankara Catholic College for providing the necessary facilities for completion of this work. We are grateful to TNAU through a Department of Agriculture & Cooperation Ministry of Agriculture Government of India for sample (soil) composition analysis result.

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