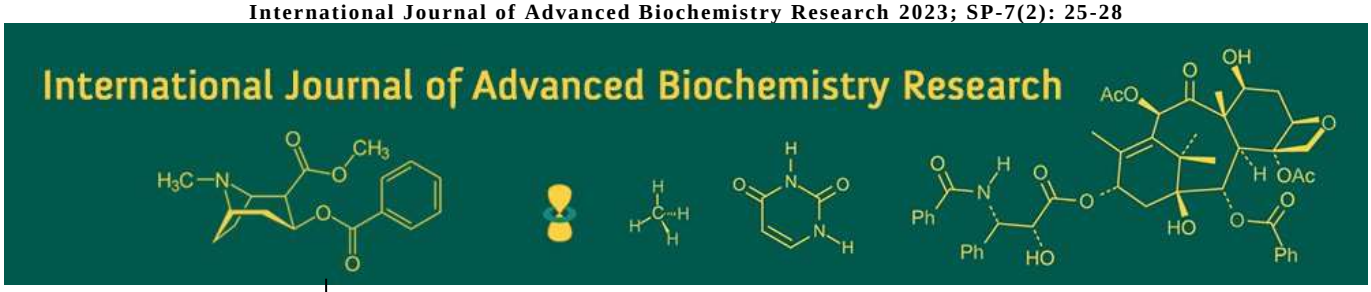

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Physio-chemical properties of soil and status of VAM under different stands of *Shorea robusta* in tropical forest ecosystem in Bilaspur Chhattisgarh

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Abstract
A study was conducted to estimate the nutrient status of soil under Sal Forest in Bilaspur Forest division of Chhattisgarh, India. Overall, the mean values of organic carbon, moisture content, VAM status and other content in soil including soil fertility status were recorded. Relatively, parameter was found higher in undisturbed stand of Sal species as compared to the disturbed area. Soil nutrient change the productivity of forests. Changes in soil act as indicator for monitoring forest plantation management and productivity. The t-test for paired means was also analysed and the result showed that all the soil properties and VAM spore in undisturbed and disturbed stand of Sal were significantly different.

Keywords: Sal forest, VAM status, soil parameter, t-test, tropical ecosystem

Introduction
Sal (*Shorea robusta* Gaertn. F.) is the maximum vital species of monetary fee and could be very vast in its distribution. In tropical wooded area region with pretty weathered soil, natural rely performs an crucial role in functioning and sustainability. The more essential Sal woodland was discovered the in the Chhattisgarh department. Sal consequently occurs below the distinctly extensive range of climatic and geological and conditions ion. Some of the wooded area sorts have been differentiated with the aid of Champion and Seth. Plant litter are the main source of soil organic remember, which affects the physico-chemical traits of soil such as texture, water maintaining ability, pH and nutrient availability (Johnston, 1986) [20]. The nature of soil profile, pH and nutrient cycling among the soils and timber are the essential dimensions to website's website online quality. Soil natural be counted (SOM) is an crucial component in comparing control machine of the woodland soil fertility (Doran and Parkin, 1994) [21]. In tropical and subtropical regions, wherein soils are strongly weathered and contained variable charged mineral, interaction of SOM and this soil can result in increasing SOM protection from Microbial attack compared with that observed in less weathered temperate soils (Martin et *al*. 1982, Parfitt *et al*. 1997) [22, 23]. Soil fertility is the potential of a soil to produce a big harvest.' So, it is clear that the concept of soil fertility is related to the physical, chemical and organic, climatic and anthropic characteristics of the web site.
Vesicular Arbuscular Mycorrhizal (VAM) are widespread, forming symbiotic associations with 85% of all terrestrial plants (Kumar *et al*. 1999) [14]. They are known to increase the plant nutrients by increasing volume of rhizosphere. Through symbiosis VAM can also enhance plant establishment and survival in stressful condition. Moreover, it is reported to be essential in increasing plant succession disturbs forest area (Doerr *et al*., 1984, Grime *et al*. 1987) [11, 12]. The objective of the study was to examine and compare the significance difference between the nutrient status of soil in two different forest sites.

Material and Methods
Site description: The observation turned into performed within the Sal stand of a natural forest place. The study place was situated between 22o24'-22o35' and 80o fifty-five'E longitude and elevation 262-721m mean above sea degree in a tropical deciduous forest of Chhattisgarh. The place is characterized by a massive tract of Sal Forest.

The Soil is red lateritic to clay loam. Based at the repeated survey of the place it is in addition divided into undisturbed and disturbed forest sites.

Soil evaluation: field survey change into performed and soil sampling became accomplished each in disturbed and undisturbed websites of Bilaspur woodland department. Soil samples have been amassed in the polythene luggage in triplicates from exclusive soil depth as much as zero-30 cm depth from each sampling website. A random sampling layout has been used to obtain samples from the website. Soil samples were dried in shade, lightly floor in mortar and passed thru a 2 mm sieve. Well known method became followed in analysing the soil samples. The moisture content material of sparkling soil samples changed into decided after oven drying them at one hundred and five o C and expressed as percentage of weight of the soil samples. Soil pH was measured the use of a virtual pH meter. Organic carbon and soil natural rely (SOM) have been determined following the moist digestion approach of Walkley and Black (1934a) [24]. Overall nitrogen became decided by means of Kjeldhal digestion, distillation and titration processes as described with the aid of Jackson (1958) [25] and Bremner *et al*. (1982) [4]. Mineral content material that is manganese (Mn), Copper (Cu), Zinc (Zn) and Nickel (Ni) were decided according to the strategies of affiliation of respectable analytical chemists (AOAC, 2000) the usage of absorption spectrophotometer. The flame photometer become implemented for macro factors i.E. Calcium (Ca), Potassium (k) and sodium (Na) determined in step with technique defined with the aid of Pearson (1976) [26]. While spectrophotometric technique was used for determination of phosphorus (P) content material of the examined pattern the use of ammonium molybdate as mentioned in the association of legit analytical chemists (AOAC, 2000). Vesicular Arbuscular Mycorrhizal (VAM) spore populace (Gerdemann and Nicolson, 1963) [13].

Statistical analysis: The descriptive statistics of all the physio-chemical properties of soil was calculated by Microsoft office excel 2010 and to determine the significance between the two soil sample t-test was performed using statistical tools.

Table 1: Descriptive statistics of soil physio-chemical properties under *Shorea robusta* in undisturbed forest

Soil properties	Mean	Max.	Min.	S.E.
pH	6.85	6.99	6.69	0.02
MC%	36.78	38	35	0.23
Sodium Absorption ratio	1.40	1.63	1.14	0.44
Nitrate (Kg/hq)	125.58	132	109	1.93
Phosphorus (Kg/hq)	24.95	31	20.4	1.22
Potassium (Kg/hq)	320.66	372	224	17.28
OC%	0.49	0.54	0.40	0.01
OM%	0.39	0.45	0.3	0.01
Calcium(ppm)	336.5	409	201	22.4
Boron (ppm)	0.26	0.32	0.2	0.02
Sulphur (ppm)	1.75	1.92	1.42	0.05
Magnesium (ppm)	375.9	390	329	4.8
Nickel (ppm)	121.9	145	110	5.43
Lead (ppm)	422.6	597	330	23.7
Mercury (ppm)	161	190	102	8.63
Manganese (ppm)	4.92	6.8	3.5	0.46
Zinc (ppm)	1.69	1.91	1.2	0.07
Arsenic (ppm)	218.4	290	180	12.3
Copper (ppm)	10.35	11.7	8.62	0.23
Iron (ppm)	6.575	7.88	4.25	0.34
VAM spore count (%)	249.5	274	125.3	18.6

Table 2: Descriptive statistics of soil physio-chemical properties under *Shorea robusta* in disturbed forest

Soil properties	Mean	Max.	Min.	S.E.
pH	6.27	6.74	5.9	0.90
MC%	32.7	36	30	0.62
Sodium Absorption ratio	1.15	1.22	1.04	0.02
Nitrate	109.83	120	103	1.92
Phosphorus	17.40	22.1	16	0.47
Potassium	228.25	254	217	3.5
OC%	0.39	0.48	0.36	0.01
OM%	0.27	0.4	0.2	0.01
Calcium(ppm)	240.75	381	200	19.03
Boron (ppm)	0.23	0.30	0.20	0.01
Sulphur (ppm)	1.40	1.91	1.0	0.09
Magnesium (ppm)	356.25	389	329	5.11
Nickel (ppm)	114.3	140	102	4.5
Lead (ppm)	526.25	620	403	24.6
Mercury (ppm)	149.4	191	121	7.8
Manganese (ppm)	2.7	6.25	2	0.34
Zinc (ppm)	1.55	1.9	1.23	0.07
Arsenic (ppm)	254.5	281	182	10.5
Copper (ppm)	9.3	11	8.5	0.22
Iron (ppm)	5.285	6.9	2.07	0.46
VAM spore count (%)	168.5	198.7	110	17.8

Table 3: Result of t-test comparing soil physio-chemical properties under *Shorea robusta* in undisturbed forest and disturbed forest

Soil properties	Disturbed Forest	Un-disturbed Forest	t-test
pH	6.27	6.85	-36.58
MC%	32.7	36.78	4.88*
Sodium Absorption ratio	1.15	1.40	-5.37
Nitrate	109.83	125.58	6.0*
Phosphorus	17.40	24.95	5.69*
Potassium	228.25	320.66	5.43*
OC%	0.39	0.49	-24.5
OM%	0.27	0.39	-25.8
Calcium(ppm)	240.75	336.5	3.19*
Boron (ppm)	0.23	0.26	-4.89
Sulphur (ppm)	1.40	1.75	1.04
Magnesium (ppm)	356.25	375.9	2.78*
Nickel (ppm)	114.3	121.9	1.23
Lead (ppm)	526.25	422.6	-2.54
Mercury (ppm)	149.4	161	0.92
Manganese (ppm)	2.7	4.92	3.52*
Zinc (ppm)	1.55	1.69	0.42
Arsenic (ppm)	254.5	218.4	-2.17
Copper (ppm)	9.3	10.35	2.52*
Iron (ppm)	5.285	6.575	2.57*
VAM spore count (%)	249.5	168.5	7.86*

*are significantly different beteen two population at 5% level

Result and Discussion

Woodland tree play a essential role in retaining and regenerating soil fertility trough the action of their roots and clutter (Kjoller and Struve, 1982). Within the tropics, the elimination of natural rely commonly from surface outcomes inside the depletion of soil fertility in some years (Pinho *et al*., 2012) [17]. The plant life of the look at place turned into dominated through *Shorea robusta* (Sal) and different essential related tree species like *Pterocarpus marsupium*, *Syzgium cumini*, *Terminalia chebula* and many others. Desk 3 result of t-test comprising soil homes beneath *Shorea robusta* in disturbed and un-disturbed wooded areas. The t-take a look at showed that the soil homes measured in disturbed and undisturbed forest websites have been sizeable (t=0.05) for nitrate, phosphorus, potassium, calcium, magnesium, manganese, copper, iron and VAM spore count at the same time as other suggests non-good sized differentiation. The measure of soil pH is an important parameter that allows in identity of chemical nature of the soil (Shalini *et al*., 2003) [2] as it measures hydrogen ion attention in the soil to signify its acidic and alkaline nature of the soil. The pH of the soil ranged 6.9 to six.69 in undisturbed woodland region whilst it ranged 6. Seventy-one to five. Nine in disturbed wooded area. The most moisture content became found in undisturbed wooded area locations which was comparatively low in the disturbed woodland region. Nitrate inside the plant available shape of nitrogen that happens within the soil. Nitrogen is most usually the restricting nutrient for plant growth. Excess soil moisture content material is one of the crucial factors affecting nitrification in water logged soil and is having foremost contribution to various factors. Phosphorus is the second one most vital macronutrient to be had in organic device which constitutes more than 1% of the dry natural weight. Potassium is the also the most required factors by means of the flowers. The significance of organic count number in the soil is implied in definition of soil. It acknowledges fertility of the soil as nutrient popularity and also determinant of improved soil shape, moisture and standard nutrient popularity in soil. Calcium is the secondary nutrient that is vital for cell nutrition and it also benefits plant life to responds better in environmental stress. Sodium absorption ratio (SAR) is taken into consideration as a higher degree of sodium chance in irrigation as it's miles related to absorption of sodium via soil. The SAR values in all soil sampled analysed ranged from 1.04 t0 1.63 belonging to awesome category. Magnesium is critical for plant photosynthesis and it facilitates move phosphorus inside the plant. For root development zinc is considered as desirable element. The VAM spore remember ranged from 198.7 to one hundred ten in each woodland web sites and found better in undisturbed wooded area region. VAM don't forget to improve the soil nutrient fame and recovers the degraded land. Hence, the prevailing examination showed that the undisturbed forest website becomes tremendously enriched better with vitamins and VAM repute as compared to disturbed wooded area websites.

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