"Probing the Impact of different weed biochar on soil biological and biochemical indicators in relation to growth and yield of rice under green house conditions""

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By

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CERTIFICATE

Certified that topic entitled "**Probing the Impact of different weed biochar on soil biologica land biochemical indicators in relation to growth and yield of rice under green house conditions**" has been decided and formulated by the student herself and is appropriate for her programme.

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DECLARATION

I hereby declare that the project work entitle "**Probing the Impact of different weed biochar on soil biological and biochemical indicators in relation to growth and yield of rice under green house conditions**" is an authentic record of my work carried out at lovely professional university as requirements of project work for the award of degree of Master of science in Agronomy, under the guidance of Dr. Arun Kumar, Head of Department, School of Agriculture, Lovely professional University, Jalandhar, Punjab, india.

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INTRODUCTION:

Biochar is soil amendment technology which is increasingly attracting the attentionof researchers. Biochar production in environmentally friendly and is done by recycling weeds into fertilizers. Nitrogen is a important factor in crop growth, and the use of nitrogen source from biochar has been a subject of much study. As biochar contains more carbon than nitrogen so application of biochar as nitrogenous fertilizer is ineffective. Moreover the surface area of biochar is large and porous and it can retain nitrogen to a greater extent and can resist leaching by runoff. The characteristics of biochar greatly depend on the pyrolytic conditions used to produce biochar and the soil used in it.

Pryolyzis if biomass results in production of biochar. The main components of biochar are hydrogen, carbon nitrogen and other trace element. Using biochar in soil is better than organic matter and it also increases plant growth and reduces the effects of heavy metals and organic pollutants. Decomposition of biochar is a slow process, so it can retain biochar properties for many years. Pollutant emission is also reduced by adding biochar to soil and improves the soil quality.

As nitrogen is the major component for crops in soil and it is present in complex form before it can be incorporated so first it has to be ammonified toNH4+ and then nitrified to NO3.

History and damages caused by weeds

Comman name : Milky weed
Scientific name: ***Calotropis gigantea***
Local name: safed aak
Family: Apoclepiadoideae

Calotropsis gigantean commonly known as milk weed was one of the species of *Calotopsis* which is native to Cambodia, Malaysia, Philippines, Sri lanka, India, china, Pakistan, Nepal and tropical Africa. This was described as a genus in 1810. The production of *Latex* from them gave the name as milk weeds. This latex contains fatty acids, cardiac glycosides and

calcium oxalate. It is also a poisons plant rarely used for suicide but used as cattle poison and arrow poison and mainly as accidental poison. The latex from the milk weed is one of the major causes of vision loss and also toxic keratoconjuctivitis.

The flowers of this weed are used as floral arrangements in Thailand and are long lasting as compared to other flowers. During ancient times, the flowers were favoured by the queen of *Hawaiian Liliuokalani.* She used to wear these flowers strung into *lies* and considered the as symbol of royalty. This plant is common in temples in India and known by the name *madar* and leaves are used in *panch pallav* (a ritual assortment). These flowers are used in funeral in Cambodia and also house interior holding the funeral. It is well known by the name *Widuri* in Indonesia. According to Hindu religion, the flowers of these weeds were liked by lord shiva as madar or crown flower and are offered to them for peace and prosperity. Pillow or cushions are also made from crown flower cotton and also use for making ropes and fishing nets. For production of *nari* leather,a mixture of Calotropsis and salt is made to remove the goat skin and sheep skin for inexpensive book binding.

It is one of the poisonous plants whose active principles are *calotoxin, uscharin, calotropin, uscharin.* Crown flower keratitis disease was caused during the making of Hawaaiian lie flower necklace through touching the sap and then the ocular surface. Decreased in the visual activity and corneal stroma edema is a results of damaging of cornea endothelium. Decreased endothelial cell count with irregular shape is considered to be some permanent damage to corneal endothelium which recovers with completed resolution and normal vision. This type of condition resolved faster with topical steroids .Calotropsis is highly toxic to corneal endothelium and non toxic to corneal epithelium. Causes Redness and vesication when applied to skin. The juice of this weed produces an acrid, vomiting, diarrhea, burning pain in stomach and throat , bitter taste, dilated pupils, diarrhoea and ultimately leading to death. 6 to 12 hours is the fatal period.

Comman name: Devil horse whip
Scientific name : ***Achyranthes aspera***
Local name: Chirchra
Family: Amaranthaceae

Achyranthes aspera's origin is still unclear, possibly indigenous to south East Asia or Africa. It is well distributed in tropics and sub- tropics. Found generally near roadside, crops, gardens or moist or shaded area near tress. In 1920 this weed was collected by N. L. Brittion and C. T. Millispaugh. In 1924 this weed was seen in British Virgin Islands and US Virgin islands and collected by N. L. Brittion.

This weed has a major role in our Indian and folk medicine because in the ancient time people used this weed as a medicine to treat various disorders. to treat the bite of scorpion, the fresh leaves are taken and there paste is made into pulp and applied externally. Also the people who are bitten by mad dogs, this weed leaves are mixed with pills and rubbed over sugar and given internally. Wide spread dispersal of its seeds is seen as through the live stock or the wild animals or sometimes sticks to the footwear of human- being and clothes due to their shard pointed shape. Aggressiveness of this weed has gone outside its native range which has to be kept under control by natural enemies. It is a pan- tropical weed and has a very dangerous impact on the biodiversity. In south- Africa this weed is considered to be noxious and is prohibited plant that needs to be controlled. Moreover, this weed is adapted to wide range of environments. In Florida and pacific island it is considered as "potential problematic species" and "invasive species" respectively. This weed is highly mobile and often benefitted from cultivation and browsing pressure. The reproductive potential of this weed is high and due to its hardy nature its propagules remain viable for more than one- year and it is also resistant to 2, 4-D and MCPA. Against gram pod borer this weed displays antifeedent activity. Also, damages our natural eco- system services which influence habitat and also the agriculture. It adversely affects animal health.

Comman name: Coffee senna
Scientific name: ***Cassia occidentalis***
Local name: Kasunda
Family: Fabaceae

Occidetalis is derived from Latin word meaning 'of the west' which indicates that the plant is a native of the western hemisphere and cassia is Greek word defining 'fragrant shrubs'. This weed originated in the tropical and sub tropical regions of the America. Seeds are used as

coffee substitute in Egypt and on heating these seeds toxicity could be removed. Used in preparation of tea as it doesn't contain caffeine or tannin. Fruits, flowers and leaves are used as vegetable or added to soups. In some African countries used for religious purposes. In India it is used as ayurvedic medicine to treat coughs.

This weed was reported to be problematic in the 1980 in seven states of USA. Africa and Europe had the trade of its seeds and medicinal products. In china it was detected in sixteenth century and present in Africa since the 1800's and in Madagascar since 1950's. Also used in the diet of Maldives for centuries. From its origin i.e. tropical America this weed readily spread both internationally and accidentally. It has the capacity to become established in tropical and sub tropical regions due to high risk of introduction. In India, this plant is used as food and medicine by tribal population, and consumption of its seed has been a major cause of death of the children.

In soybean, cotton, groundnut and pastures crops this weed is a major problem. The seeds of this weed are spread through water flow over the soil surface, mainly flood waters. Seeds are found in mud which sticks to animal hooves, footwear and other vehicles and may also act as a contaminant in agriculture produce. The seeds of this weed have also been reported to damage the liver, heart and lungs of domestic livestock because it contains certain chemical compounds. It also affects the brain functions. Being an alternative host to diseases such as potato virus it harms the crops and also competes for water light and nutrients. Some brazilin groups reported that being contraindicated for pregnancy with abortive properties. Damage to ecosystem including biodiversity and agriculture and has a great negative impact on animal health and livelihood.

Objectives:

1) To study the impact of weed Bio char on rice and also analyse phosphorus content and rice productivity.
2) To study the impact of land used systems and management practices on microbial community composition and diversity at ecosystem level
3) To study the growth parameters on rice productivity using different kinds of combination of weed Bio char.
4) To study rice yield and nutrition check using Bio char
5) Our vision is to create a situation where waste is used in a positive way that is beneficial to society
6) The objectives of this study is to determine bio char effects on P availability in the presence and absence of external nutrient inputs.

Review of literature

Biochar amendment effect on soil

Nitrogen fertilizer has low uptake efficiency and it is a major environment problem. Most of the unabsorbed nitrogen fertilizer is carried by runoff water into lakes, rivers, ponds or oceans resulting in eutrophication or the soil bacteria converts it into gaseous nitrous oxide form which contributes acid rain. biochar cannot provide nitrogen directly to crops as most of the other conventional fertilizers do, as biochar contains recalcitrant aromatics rather than bio available enzymes. Also biochar has ability to resist leaching of nitrogen and it affects the availability of ammonia and nitrates in soil.

Roots and biochar interaction

Prendergast-Miller(2013) was the first one who draw two mechanisms for bochar effects on roots

1.biochar was one of the nutrient source

2. It improved nutrient availability.

Miscanthus straw and Salix wood chips were the two kinds of biochar that were compared under three soil conditions : rhizosphere, bulk and rhiosheath soil. From this he concluded that nitrogen retention in rhizosphere increased when biochar was used as direct source of nutrients and indirect source in bulk soils. Roots growth was seen towards the biochar while soil content was altered after its addition. By reducing nitrogen content in the biochar, weathering similarly reduced nitrogen present in soil which indicates that nitrogen in biochar is important factor in these interactions. (S.D joseph et al.) after the application to the soil interaction of biochar, soil microbes and plant rots may occur. Reactions that may occur after addition of biocahr are dissolution- precipation, adsorption, aid base and redox reactions.Therefore, different biochars types and pedoclimatic conditions are neede to determne which teels potential obiochar as soil ammendement and carbon sequsstration.

Benefits of weed biochar

(Feng Li et.al) investigated the characterization and preparation of biochar water hyacinth plant of temperature of 300 700 C for removal of cadminium from the aqueous solution. Also cadminium absorption was contributed by minerals in the biochar through precipitation.

Study wsa conducted by keppng in mind the factors such as contact time, solution ph and initial concerntration. Nearly 90% of Cd was removed at the ph value 0f 5.0. Langmur isotherm was calculated based ion maximum cd adsorption capacities that are 49.837, 36.899 and 25.826 mg per g. For the treatment of wastewater Cd proved to be a good adsorbent which helped in converting environment problem into a cleaning technology.Not only the environmental solutions are provided with the use of biochar but also its provides the rural communities with other benefits(Dr. David A. Laird) like high crop yields, improvement in soil quality, high fertilizer use efficiency, reducing groundwater contamination by the use of herbicides.Biochar also show impacts over degraded, disturbed and highly weathered soils as compared to soils that have high organic matter. Greater impact from the biochar application is seen in highly weathered soil in tropics than that in temperate on fertile soils .So research that has been done in tropics are:

50% increase in the cation exchange capacity (Glaser, 2002)

Increase in fertilizer efficiency by 10-30% (Guant an Cowie,2009)

Increase in soil moisture retention capacity up to 18% (Tryon,1984)

Methane emission decreased by 100% (Rondon et al:2005)

Reduction in soil dependent bulk density (laird,2008)

Great increase in crop productivity (Lehman and Rondon, 2006)

Increase in biological nitrogen fixation by 72% (Lehman and Rondon,2006)

(Tahweed Mohammed et al.) for enhancement of soil productivity, fertility and mitigate climate change by improving the soil and biomass with coal. Various benefits of biochar listed abve are not known by farmers. However, there is not full information about biochar properties to farmers, peasants or gardeners. Therefore, new opportunities are faced by farmers and defiance each day, to create food on fewer land and reducing environmental emissions. Proper utilization of biochar in agriculture and its application, environment protection, energy, forestry and additational areas has attracted scientist and investigators inside/ outside the country. The basic objective was to guide farmers about the use of biochar in soil to get high yields in all different types of soils.

Allelopathic effects :

Leeladarshni sujeeun et al. Strong allelopathic effects have been seen by many tropical invasive species. Liitle attention has been gained by sorption of allelochemicals. Two species thought to be allelopathic were: strawberry guava (Psidium cattleianum) and lemon grass (cympobogon flexuosa). Leaf extracts of these two species were treated with two biochars (made from coconut husk and maize stock) and was applied two the two crops radish amd maize. Large inhibitory effects were shown by the leaf extracted of both species on germination, particularly when the dose is higher consistent with allelopathic effects. Seed germination is positively affected by the treatment of biochar, Rescue effects were seen in some cases in which biochar counteracted allelopathic effects. Leaching of biochar alone has positive effects on seeding development and seed germination. Thus biochar prove to be a promising tool for combating invasive allelopathic plants in island and tropic ecosystem. So many uses of biochar in enhancement of soil productivity and carbon sequestration has make a good approach in developing countries.

Effects of biochar on soil properties:

(Shaon Kumar Das et al.)Long term benefits are provided by biochar such as soil fertility and productivity. Soil physical characteristics such as (bulk density, infiltration rate water holding capacity and porosity) can enhance plant growth and chemical properties such as (nutrient retention, ph and nutrient availability) along with soil biological properties (microbial biomass carbon) all contributes to increase soil productivity. Highly porous structure which is responsible for improved water retention capacity and increased soil surface area are major qualities of biochar that makes it attractive as a soil amendment. Biochar application increased water holding capacity ain sandy soil as well as improved saturated hydraulic conduction of the top soil. Suitable habitat for microorganisms is provided by the pore spaces in the biochar which protection them from predation and drying providing them with diverse carbon mineral nutrient needs and energy. So the ability of biochar to form complex with different soil types and its properties has impact on soil plant microbe interactions. (Simon Jeffery et al.) adding biochar to soil increased crop productivity by 10%. In acidic soil 14% and netural soils 13%and in soils with coarse10% and medium texture 13% positive effects with regards to soil analyses were seen there.(K. Y. Chan et al.) pot experiment was conducted to know about the effect of biochar produced from green waste by pyrolysis of radish crop and soil quality of alfisol. Three rates of grren waste biochar i.e 10, 50 and 100 t/ha with and without N wrere investigated. Results showed that in

absence of N, application of biochar to soil did not increase yield of radish even with high rates but shows a great increase in yield when N was added and it increases with increases rate of nitrogen. (Shih-Hao Jien et al.) study was done to know the effect of biochar made from wood of white lead tress on the physiochemical and biological properties of long-term cultivated, acidic ultisol. Three applications of biochar i.e 0%, 2.5% ,5% with incubation time of 105 daus in all cases with and without addition of biochar. Results showed that a physiochemical and biological properties of soil improved and increase in sioil ph with increase in cation exchange capacity was there when biochar was added and without its application biochar bulk density decreased, increase mean weight of soil. (Mohamma l. et al.) influences of pyrolysis and types of feedstock on biocahar properties and theses properties affect the properties. Different type of biochar and pyrolytic properties are the main factors in controlling biochar properties such as pH, recalcitrance and nutrient content. Production of biochar at low temperature may improve crop yield and nutrient availability in acidic and alkaline soils where as at high temperature may lead long term carbon sequestration. By enhancing the microbial activity the efficiency of organic and inorganic fertilizers and reduce the nutrient loss thereby making them more available to the plants.

(Yongfu Li et al.) in terrestrial ecosystem and mitigation aof global climate change forest palys an major role. Management of forest soils have negative impacts on the qulity of soils via reduction of organic carbon contenet, reduction of soil biological properties and soil acidification. Results showed that addation of biochar to forest soils helps in improving soil moisture retention and aggerate stability.

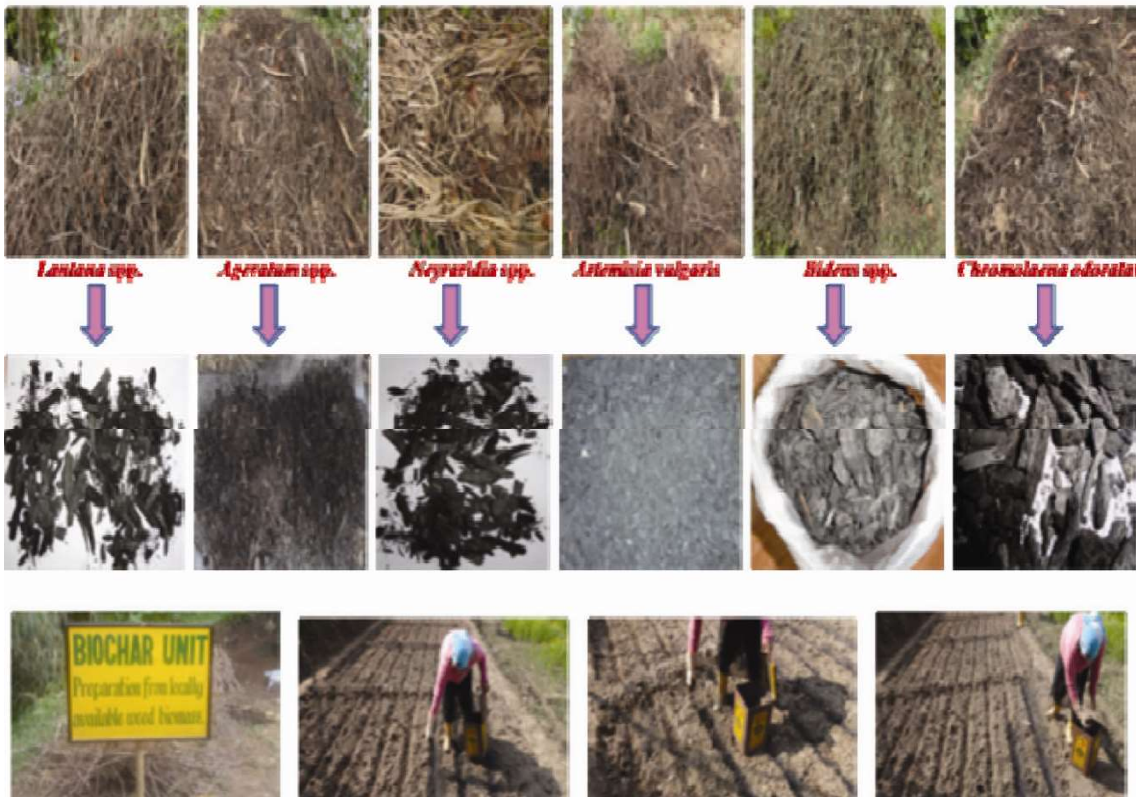
Effect on soil Ph:

As biochar has ph>7.0 which means it is alkaline in nature . so to lower its affect or to make it neural, farmers add tonnes of dolomite/lime in large amount to farm soils. Biochars have a great impact on soil ph. It can act same as agricultural lime by increasing the ph. Soil is not able to retain the mineral nutrients and these nutrients are leached out if the soil has low cation exchange capacity. Due to large pores in the surface area biochar develop some negative charges so it can provide more negative charged sites to cations to be retained when these added to soils. On the surface of biochar negative charges have been developed which can buffer acidity in soil. Aluminium toxicity is al reduced due to its highly alkaline nature. (Rajesh Chintala et al.) a study was conducted by incubation of acidic soils of ph < 4.80 with the biocgars for 165 days. Two feedstocks were usedc for biochar production i.e corn stover

(zea mays L.) and switch grass (Pancium virgatum L.). corn stover , lime and switch grass were applied at four rates to acidic soils. Retalively lrger increase in soil ph is seen by the cor stover application as compared to switch grass. (Y. Luo et al.) study ws done to determine the magnitude of primiting effect i.e addition of biochars for the short term changes in rate of mineralisation of native soil organic carbon. Production was biochar was done by miscanthus giganteus. Results showed that a priming effect may occur if biochar is used to sequester carbon.

Carbon- negative charge from weed biomass:

Bichar making from locally available biomass provide great opportunity to farmers to improve soil health for longer period of time. Application of biochar in the soil may also offer financial benefits with carbon credit. biochar should be added to the soil ever year with other farm inputs like compost ,manure etc for the economic benefits. During the conversion of weeds to biochar, farmers can obtain energy by capturing energy given off during its production process. Weathering can occur at unpredictable rate especially in hilly areas such as Sikkim which can greatly imbalance the ecosystem. So biochar has a major role for sustainable soil health by improving management practices, not by the leaching of those nutrients but by improving soil productivity.



Biochars prepared from locally available weed biomass

MATERIALS AND METHODS

3.1 Experimental site

The experiment will be conducted on Agricultural research farm, LPU, phagwara. Geographically it is situated at 31 degree 22 minutes and 31.81 seconds' north latitude and 75 degree and 23 minutes and 3.02 seconds' east longitude with an altitude of about 252 meters above the sea level which falls under the Trans-Gangetic plain region of agro-climatic zone of Punjab.

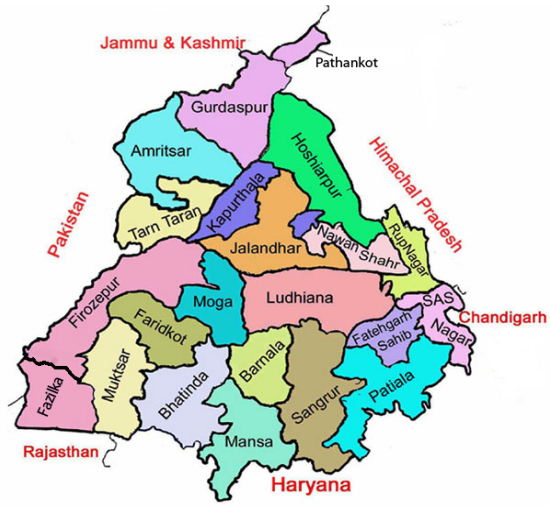


Fig 1: Map of Punjab

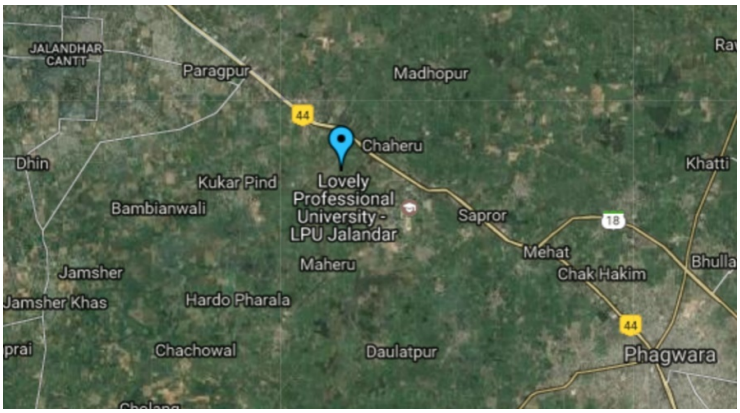


Fig 2: Satellite map of LPU

3.2 Weather and climatic conditions

Region of experimental site comes under sub tropics with cool weather in winter season, hot weather in summers and distant rainfall period in month of July, August and September. South west monsoon is the main source of rainfall. During winter season the temperature never goes below zero.

Normally rice is best suited to high temperature, high humidity, prolonged sunshine and assured water supply throughout the crop growth cycle. A temperature range from 20 to 37.5^{0}C is required for optimum crop growth.ice required low temperature initially but high at tillering stage. 26.5 to 29.5^{0}C required for blossoming. Almost 83 to 85 percent relative humidity is favorable.

Experimental details

1. Year of experimentation :2018
2. Recommended dose of fertilizers : As per package and partice of rice
3. No. of treatments : 10
4. No. of replications : 3
6. No. Of Pots : 150
7. Date of sowing :4th week of may
8. Experimental design (RCBD) :Complete Randomized block design
9. Crop :Rice
10. Method of sowing : Seeds
11. Crop and variety :Pusa basmati 386
12. Kilo gram of soil in one pot : 4 kg

D) Treatment details:

T-0 = Control

T-1 = 100% RDF

T-2 = 75% RDF + 4% weed biochar-1 + 25% sewage sludge

T-3 = 75% RDF + 6% weed biochar-1+ 25% Sewage sludge

T-4 = 75% RDF + 4% weed biochar-2 + 25% Sewage sludge

T-5 = 75% RDF + 6 % weed biochar-2 + 25% Sewage sludge

T-6 = 75% RDF + 4% weed biochar-3 + 25% Sewage sludge

T-7 = 75% RDF + 6% weed biochar-3 + 25% Sewage sludge

T-8 = 75% RDF + 4% (weed biochar 1 + weed biochar 2 + weed biochar 3) + 25% sewage sludge

T-9 = 75% RDF + 6% (weed biochar 1 + weed biochar 2 + weed biochar 3) + 25% sewage sludge

Layout:

R1	R2	R3
T0	Control	Control
T1	T2	T3
T2	T3	T4
T3	T4	T5
T4	T5	T6
T5	T6	T7
T6	T7	T8
T7	T8	T9
T8	T1	T2
T9	T2	T1

Laboratory Analysis of soil samples to be conducted

- **pH**

  pH was determined using a glass electrode method by *(Sparks,1996)* .in a 1:2.5 ratio of biochar water suspension in a pre calibrated ph meter

- **Electric conductivity**

  Electrical conductivity also measured using1:2.5 ratio of biochar water suspension in a pre- calibrated EC meter. It will be followed by conductivity meter method given by (sparks, 1996).

- **Organic carbon**

  The determination on soil organic carbon was determined according to Walkey- Black chromic acid wet oxidation method.(Allison, 1965).

- **Availavle nitrogen**

  Biochar available nitrogen was determined after Subbiah and Asijia (1956).

- **Total Nitrogen**

  The method to find the amount of total nitrogen in the biocharwill be kjeldahl method which is invented by johanKjeldahl in 1883.

- **Available phosphrous**

  Biochar available phosphrous was determined after Olsen et al. (1954) and Jackson (1973).

- **Available Potassium**

The method of flame photometer given by Toth and Prince, 1949 will be followed

Photographs

Cutting of weeds in the field

Weeds

Laboratory experiments

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