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A COMPARATIVE STUDY OF POTENTIAL OF CHARCOAL, CRUSHED PAPER AND WOOD PULP FOR SUSTAINABLE AGRICULTURE

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ABSTRACT

Agriculture is the backbone of our country. In recent year due to enormous rise in population of our country an increase agricultural activity is reported which has increased the demand of fresh water. It is found that the farmer basically rely on rainwater in the hilly terrain of Arunachal Pradesh as there is no other source for irrigation. Hence, there arises the need to better manage fresh water use, particularly agricultural usage, is paramount. The main purpose of this study was to determine the effect of charcoal, crushed paper and wood pulp amendment on the water holding capacity of loamy sand soil with different mixture rates. For this an experiment (gravimetric method) is carried out to check the water retention capacity of soil mixture with charcoal, wood pulp and crush paper in different proportion. Results show a doubling in water holding capacity by mass using a 20% mixture of charcoal, wood pulp or crushed paper with soil. High percentage mixtures of charcoal, wood pulp or crushed paper increases water holding capacity (WHC) dramatically. These results suggest the use of charcoal powder, wood pulp or crush paper has potential to increase the water retention capacity. Mixing of charcoal, crushed paper and wood pulp also acts as soil conditioner which increase the soil fertility and friendly microorganisms in soil showing a drastic change in growth pattern of plant.

KEY WORDS: ***Charcoal, Crushed paper, Wood pulp, Loamy sandy soil, Gravimetric, water holding Capacity (WHC), Soil Conditioner.***

INTRODUCTION

Arunachal Pradesh, the land of the dawn lit mountains is located in north-east India bordering the state of Assam and Nagaland to the south and shares international border with Bhutan in the west, Myanmar in the east and the Peoples Republic of China in the north. It is the most sparsely populated state in the entire country. It stands between 26°28′ and 29°30′ north latitude and 91°30′ and 97°30′ east longitude and covering an area of 83743 sq. km. The population of the state according to 2011 census is 13.82 lakhs. Biogeographically it is situated in the Eastern Himalayan provinces; the richest biogeographically province of the Himalayan zone. The entire territory forms a complex hill system with varying elevations ranging from 50m in the foothills and gradually ascending to about 7000m traversed throughout by a number of rivers and river-lets. Amliang is a small village located in Hayuliang sub division of Anjaw district. It is about 10km far from Hayuliang market. On the foot hills, Lohit River flows downwards. Along the bank of the river a pucca road is running connecting various part of the Anjaw District with Tinsukia District of Assam. In this survey conducted in Amliang and nearby villages it was found that most of the villagers depends on agriculture for their livelihood. During the survey the soil sample was collected and with the help of Krishi Vigyan Kendra, Anjaw it was identified as Sandy loam. This soil has the less water holding capacity. The villagers face problem for irrigation at regular interval of time as the only sources of irrigation is rain water in this hilly terrain. Keeping this in view we tried to overcome this problem by better management of rain water by increasing the water holding capacity of the soil. This can be done by mixing the charcoal powder, wood pulp or saw dust and crushed waste paper. Charcoal powder, wood pulp and crushed paper used as a soil amendment improves the soil properties. It acts as a soil conditioner and improves water retention capacity, soil fertility, increases the microbial population and ultimately improving the plant growth and productivity. Application in soil also leads to carbon sequestration, as carbon captured by the plants from the atmosphere are buried in the soil for a long time. Thus, with proper knowledge and guidance the villagers can solve this serious problem faced by them without spending any money by using the waste they generate while cooking the food. As we know as per a survey report it was found that around 80 % of household in villages uses firewood as kitchen fuel.

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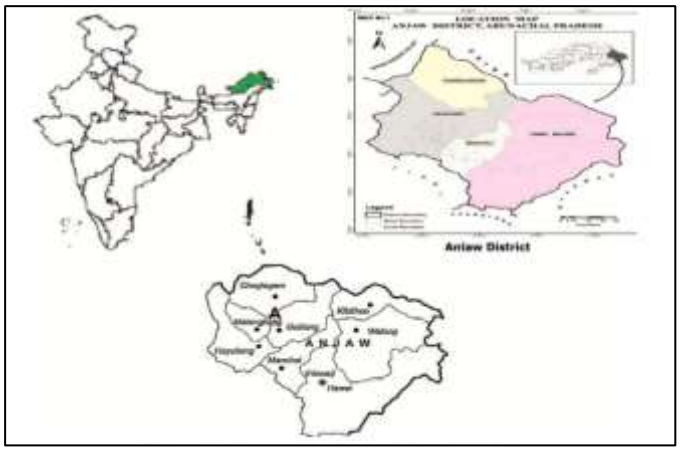

Fig. 1 Map of Anjaw District of Arunachal Pradesh

Fig. 2 Map of Amliang and nearby villages selected for survey

LITERATURE REVIEW

Biochar has the potential to increase the water retention capacity of soil to great extent, which also results in crops yield (**Yu et al., 2013**). Sand dust/wood pulp act as a soil conditioner promotes the plant growth and improve the water holding capacity of the different type of soil (**Rajor et al., 1996).** Wood pulp has the potential to increase soil flocculation and soil aggregation (**Ciroma et al., 2006**). Sludges and sludge composts may be utilized in agriculture to increase soil organic matter, improve soil physical properties, provide nutrients, and increase soil pH (**Camberato et al, 2006**). biochar contributed to ecosystem function by increasing total carbon in the soil. We also found that biochar increased plant species richness and the 5.2% biochar treatment increased the biomass of plant species in the seed mix (**Biederman et al., 2017**).

OBECTIVES OF THE STUDY

The primary objectives of this study are to analyse the potential of charcoal powder, wood pulp and crushed paper in increasing the soil moisture and also to study the growth pattern of the same kind of plant in the soil mixed with charcoal powder, wood pulp and crushed paper in different proportion.

SCOPE OF THE STUDY

In our country India, excessive use of fertilizer has resulted in reduce water holding capacity of soil and has turned the soil sand and less fertile. The result of the study helps in turning the unfertile sandy soil into fertile land by increasing water retention capacity of the soil. It is greatly helpful to the farmer of the hilly terrain where the only source of water for irrigation is rain water or has the very limited source of water for agriculture. This technique helps the farmer in proper management of water.

MATERIAL REQUIRED & METHODOLOGY

Materials Required:

Flower pot, Sieve, Soil, Charcoal, Waste paper, Rotten wood, Beaker, funnel, Filter paper, Plant seed, Crusher, Dropper, water, funnel stand and Weighing scale.

METHODOLOGY

1. Soil collected are sieved and dried in sun untill all the moisture is removed
2. Charcoal, Paper and wood pulp are crushed in fine pieces.
3. Four Mixture of charcoal are made at different proportion and labelled as Sample A, Sample B, Sample C and Sample D.
4. Sample A (0% Charcoal), Sample B (10% Charcoal), Sample C (20% charcoal) and Sample D (30% charcoal)
5. Similarly the mixture of Charcoal, Wood pulp and Crushed paper are made and labelled as Sample I, Sample II, Sample III and Sample IV.
6. Sample I (Only soil), Sample II (20% Charcoal), Sample III (20% crushed paper) and Sample IV (20% wood pulp).
7. Now the water retention for each sample is measured twice and the mean is taken by gravimetric method which is shown in Table 1.
8. Water Holding capacity (WHC) was calculated using the following formula:

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$$\text{WHC (\%)} = \frac{\text{Wet Mass(b)} - \text{Dry Mass(a)}}{\text{Dry Mass(a)}} \text{ X } 100\%$$

9. Then the seeds of same plants (Pea) are sown in each sample and its growth pattern is recorded in table-3
10. Data was presented using simple statistics and mathematics.

Fig.3- Charcoal Powder, Crushed Paper, Wood

Fig. 4- Preparation of Soil Mixture

Fig.5- Collection of Soil Sample

Fig. 6- Survey in Ama Village where charcoal is used in soil

Fig. 7- Observation in field after 20 days

Fig.8- Measuring height of the Plant

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Table 1: Calculation Water Retention by mixture of soil and charcoal mixed at different Proportion

Soil Mixture	Water Retention By gravimetric method					
	Dry Mass (a)	Wet Mass		Mean (b) $\left(\frac{I+II}{2}\right)$	Mass of water (b – a)	Water Holding Capacity (%) $\frac{\text{Wet Mass(b)}-\text{Dry Mass(a)}}{\text{Dry Mass(a)}}$ X 100%
		I	II			
Sample A (Only Soil)	100	137	131	134	34	34
Sample B (10% Charcoal Powder)	100	148	149	148.5	48.5	48.5
Sample C (20% Charcoal Powder)	100	182	175	178.5	78.5	78.5
Sample D (30% Charcoal Powder)	100	210	213	211.5	111.5	111.5

*** All Mass are measured in Grams (Gms)

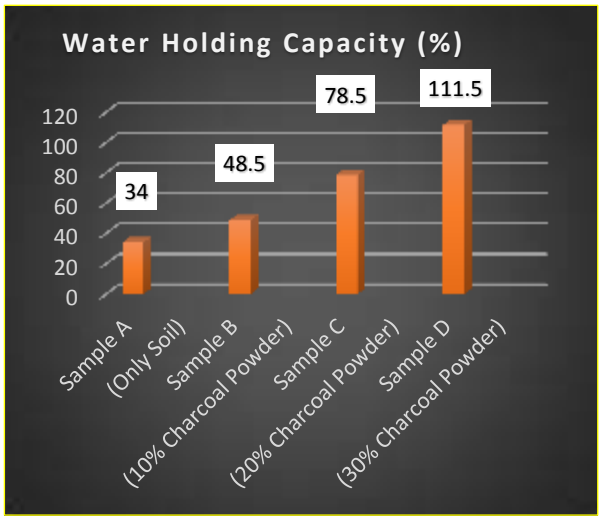

Fig. 9 Bar graph for table- 1

Table 1 shows that use of charcoal powder in soil increases the water retention capacity of the soil. With the increase in percentage of charcoal in soil the water holding capacity of the soil increases gradually.

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Soil Mixture	Water Retention By gravimetric method					
	Dry Mass (a)	Wet Mass		Mean (b) $\left(\frac{I+II}{2}\right)$	Mass of water (b – a)	Water Holding Capacity (%) $\frac{\text{Wet Mass(b)} - \text{Dry Mass(a)}}{\text{Dry Mass(a)}} X$ 100%
		I	II			
Sample I (Only Soil)	100	137	131	134	34	34
Sample II (20% Charcoal Powder)	100	182	175	178.5	78.5	78.5
Sample III (20% Crushed Paper)	100	186	180	183	83	83
Sample IV (20% Wood Pulp)	100	188	193	190.5	90.5	90.5

Table 2: Calculation of Water Retention by mixture of soil, charcoal, Crushed paper and Wood pulp mixed at Same Proportion

*** All Mass are measured in Grams (Gms)

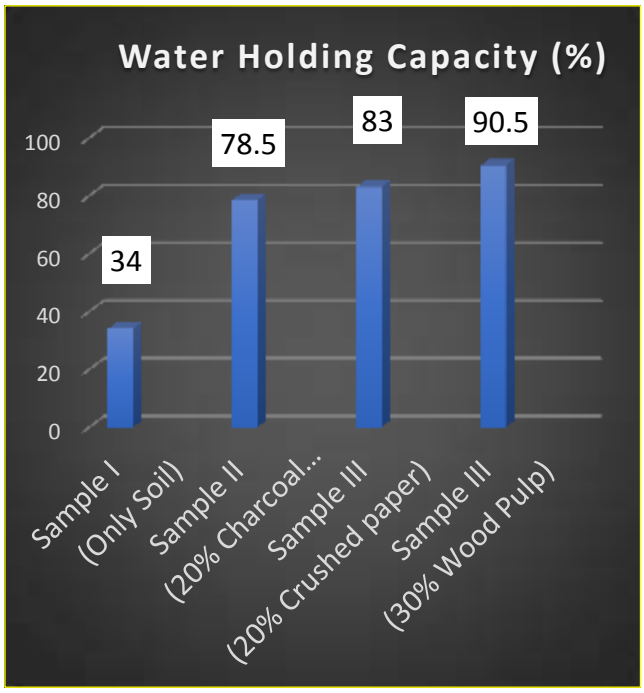

Fig. 10 Bar graph for table- 2

Data recorded in Table-2 shows that along with the charcoal powder, Crushed Paper and wood pulp can also be used for increasing the water retention capacity of the soil. During the experiment it was found that the wood pulp has the greater potential among the three to increase the water retention capacity of the soil.

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Growth Pattern	Sample I (Only Soil)		Sample II (20% Charcoal)		Sample III (20% Crushed Paper)		Sample IV (20% wood Pulp)	
	Day 10	Day 20	Day 10	Day 20	Day 10	Day 20	Day 10	Day 20
Germination %	70%	70%	100%	100%	80%	80%	100%	100%
Plant Height	6 cm	15 cm	10 cm	22 cm	13 cm	20 cm	12 cm	21 cm
No. of leaves	9	13	18	24	16	23	14	20
No. of branches	3	4	4	5	3	5	2	5

Table 3: Observation of Plant growth in different sample

Table- 3 shows that the growth pattern (i.e. Germination Percentage, Plant height, No. of leaves and No. of branches) recorded for 20 days is much better in Sample- II, Sample-III and Sample IV than that of Sample- I.

RESULT

The above data revealed that use of charcoal powder, crushed paper and wood pulp in soil increases the water retention capacity of soil and also enhance the growth pattern of the plant. High percentage mixtures of charcoal, wood pulp or crushed paper increases water holding capacity dramatically, a 20% mixture of each increases the water retention capacity to more than double.

CONCLUSION

The use of charcoal powder, Crushed paper and Wood pulp in soil is an effective way to convert the infertile sandy loam soil into a fertile land by increasing its water retention capacity. The addition of these in the soil acts as soil conditioner which helps in increasing the agriculture friendly microbes. Application of charcoal in soil leads to carbon sequestration, as carbon captured by the plants from the atmosphere are buried in the soil for a long time. Thus, the waste charcoal, paper and saw dust can be utilized in its best to make an infertile soil to fertile land without much financial burden on farmers.

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