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Determination of preservative chemicals leaching from treated bamboo sticks in betel farm soil and betel leaf

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Abstract

Bamboo is a woody, valuable, strong and exceptionally fast-growing material with remarkable mechanical properties. Bamboo is known as susceptible to fungal or insect attack for the huge amount of starch content and it is difficult to control. Beside this bamboo has versatile use. A huge amount of bamboo splits are used in betel farm for cultivation purpose. However, untreated bamboo sticks are deteriorated after one year, whereas the treated bamboo sticks service life is 4-5 years. A study was taken to use the chemically treated bamboo sticks in the betel leaf farm for determination of leaching materials. Baijja (*Bambusa vulgaris*) and borak (*Bambusa balcooa*) bamboo sticks were treated by soaking method using 10% water born copper chrome boric acid (CCB) preservative solution. Then the treated bamboo sticks were applied in a betel farm at Batajore, Barishal. Control samples data were taken from the experimental side before using the treated bamboo sticks. Furthermore, data were collected at the interval of every year and to analyze the sample for determination of preservative chemicals. After three years it was observed that preservative chemicals were not leached out from the treated bamboo sticks in the betel farm soil and betel leaf at the experimental plot. So, it is concluded that preservative chemicals were not significantly increased in soil by using treated bamboo sticks in the betel leaf farm.

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Introduction

Betel leaf (*Pipper betle* L.) is the leaf of vine plant. In Bangladesh the leaves of betel vine are commonly known as Paan. It has been cultivated in this country for centuries. Many districts in Bangladesh betel vine are cultivated such as Barishal, Sylhet, Chittagong, Rajshahi, Jessore, Naogaon, Gaibandha etc. Betel leaf is one of the important cash crops having medicinal value. It produced small geographically concentrated areas of Bangladesh and consumed throughout the country as well as exported to the countries like Pakistan, Dubai, Saudi Arabia, England and some African country. It is also used as an important entertainment item in the wedding ceremony in all over the Bangladesh. The betel leaf contents a huge amount of vitamin B and vitamin C and its acts as mild stimulant. It is also helps digest by encouraging salvation and neutralizes excess acid. Betel leaf is a good source of dietary calcium, ascorbic acid, carotene and also contains significant amount of amino acids.

The betel leaf ash a sharp taste and good smell, improves taste and appetite, tonic to the brain, heart and liver, strengthen the teeth, lessens thirst, clear the throat, vulnerary and styptic. They also mentioned that the juice of the betel leaf is dropped in to the eyes, if infected (Kirtikar *et al.,* 1979). It is also used to relieve cerebral congestion and to allay thirst. The essential oil of this leave is also used as an antiseptic. Fresh leaves are also used in the preparation of lotion protected fever, small pox etc. Apart from these use there is a scope to export betel leaf and to earn foreign currency for the nation. Betel leaf production may be the option to increase the rural income, employment generation and it is also may be a good source of foreign currency earnings. As a result a socio-economic development in the betel leaf production area. There are several varieties of betel leafs are cultivated in Bangladesh. Among them Deshi, Bangla, Sanchi and Mitha are generally marked by the growers.

Bamboo and bamboo sticks are the most important item for betel leaf production. It was used for pillar as well as the shed of a boroj. There are many types of bamboo are available in Bangladesh and the main disadvantage of bamboo is fungal, borer attack and their deterioration. There are about 33 items of bamboos are found in Bangladesh (Banik, 2000).

Bamboo sticks are subjected to outdoor exposure under natural weather conditions in the betel leaf farm at Batajor, Barishal. In different areas of Bangladesh a lot of bamboo sticks are used in betel leaf farm for climbing the plants. The main disadvantage in the utilization of bamboo is its non-durability. It is liable to attack by insects and rot fungi (Purushotham, 1963; Tewari and Singh 1979; Tewari, 1981; George, 1985). The average service life of non-treated bamboo is less than three (3) years when it is exposed to atmosphere and soil. Bamboo is very susceptible for fungal or borer attack. It was observed that bamboo is swiftly deteriorated by white rot, soft rot fungi and borer attack in 1- 4 years (Lies, 1980). As a result, it has reported that bamboo materials do not last long (Younus-uzzaman, 1998). Preservative treatment is the way to make it long lasting than the normal condition that saves the bamboo resources as well as to improve the socio- economic condition. Therefore, to improve the socio- economic condition and reserve the forest resource it is needed to make the bamboo more durable by treating it with more effective and more suitable preservatives.

The preservative treatment of bamboo culm depends on the species, anatomical structure and its moisture content. It was investigated that the chemical constituent of bamboo consists of 50-70% hemicellulose, 30% pentosans and 20-25% lignin (Tamlang *et al.*, 1980; Chen *et al.*, 1985). It was observed that the anatomy of bamboo is significantly differs from the wood (Grosser and Liese, 1971; Liese, 1980, 1985). BFRI has investigated that the CCB preservative treatment of split muli (*M. baccifera*) bamboo by soaking process for outdoor use (Akhter and Chowdhuri, 2006). It was also observed that treatment of baijja (*Bambusa balcooa*) and ora (*Dendrocalamus longispathus*) bamboo stick by soaking process for betel leaf farms for outdoor use

(Rahman *et al.,* 2018).The present study was taken to determine the leaching rate of the chemical in betel farm soil from the treated bamboo stick.

Materials and methods

Chemically preservative treated bamboo sticks were used in the betel leaf field for determination of preservative chemicals leaching from treated bamboo materials in soil and betel leaf. It has reported that 10% CCB solution is more effectiveness for treatment of bamboo sticks and it has been lasted upto four years (Rahman *et al.* 2018). So, the treated and untreated bamboo sticks were applied in the betel leaf field. Ten mature borak and baijja bamboo culm (3 to 3.5 years) were collected from local area.

After collection of bamboo the culms were first cross cut into section of the desired length 2.0 m, breath 0.24 m and wide 0.072 m. Then each piece was splitted into 8-10 strips. After this the strips were kept for drying. The moisture content of the borak and baijja bamboo strips was measured and the moisture content was 25-27%. Then the strips were treated using 10% CCB preservatives (2:2:1) aqueous solution by soaking process (Fig-A). The duration of soaking time was 72 hours. After the treatment the samples were taken away from the solution and storing the treated bamboo strips in shade for use. Then the treated bamboo sticks are used in the betel leaf farm for climbing the betel leaf plant (Fig-B). Some part of the bamboo stick goes direct contract with soil and rest of the part of the stick upward on the soil. As a result, the soil may be contaminated due to the direct contact with treated bamboo stick. Besides this after heavy raining the preservative chemicals may be leach out from the treated bamboo stick in the soil. For this the betel leaf farm soil may be infected by the preservative chemicals. Due to the presence of preservative chemical, the soil may be acidic, basic or salinity

The soil samples are taken from betel farm at Batajor, Barishal during the month of January – March in every year (2014-2016). The control samples were collected from the same field before use the treated bamboo sticks. Then the soil samples were collected at different points from the betel leaf field after using the treated bamboo stick. The samples were collected from three different depths in cm. First samples were collected from (0-15 cm), second samples and third samples were collected from 15-30 cm & 30-45 cm depth respectively. Then the soil samples were analyzed for determination of Cu, Na, B, Cr etc. It was observed that the leaching of active components from preservative-treated timber in the semi field stage (Niels Morsing and Berit Lindegaard, 2004).

The CCB preservative solution is based on copper sulphate, sodium dichromate and boric acid. The bamboo sticks were treated using 10% water born CCB preservative solution. After treatment the average retention of preservative chemical in the bamboo sticks were determined (Table-1).

Determination of Leaching Materials

Initially earlier all collected sample have to be dried in open air. Then the dried soil sample has been treated by different method. The extractive sample has been measured by Atomic Absorption Spectrophotometer (AAS), Spectrophotometer and Color development method.

Cu

First of all the soil sample extraction by (DTPA) diethylenetriaminepenta acetic acid. Then the extractive sample measured by atomic absorption spectrophotometer (AAS).

Cr

Digest the soil sample in di-acid mixture (HNO_3-$HClO_4$). Then the digestive sample measured by atomic absorption spectrophotometer (AAS).

B

The dried soil sample first of all treated by hot water and 0.01 M $CaCl_2$. Then the treated sample determined by Azomethine-H method by UV-spectrophotometer.

Na

Previously treated soil sample extracted by 1N

Ammonium acetate (NH_4COOH). The treated sample determine by Atomic Absorption Spectrophotometer (AAS).

Results and discussion

The analytical data of the preservative chemicals (CCB) for betel farm soil and betel leaf after using the treated bamboo stick have been represented in Table 2. From the analytical data (Table-2) it was observed that the average pH of control soil sample and treated soil samples were 5.65 & 6.06 respectively. In the control soil sample the average soil micro nutrients of boron (B), copper (Cu), sodium (Na) and chromium (Cr) were 0.28, 1.71, 1.29 and 0.31 ppm. On the other hand in the treated soil sample the average soil micro nutrients of B, Cu, Na and Cr were 0.31, 1.29, 1.84 and 0.30 ppm. The pH value of control betel leaf solution is 3.53 and the micro nutrient of B, Cu, Na and Cr are 0.0024, 0.011, 0.013 and 0.001 ppm. The pH of experimental betel leaf solution is 3.56 and the micro nutrient of B, Cu, Na and Cr are 0.0026, 0.014, 0.015 and 0.001 ppm.

Table 1. Average retention of preservative chemical in the bamboo sticks.

Concentration of CCB solution (%)	Retention of bamboo stick (kg/m^3)		
10	1 day	2 day	3 day
	10.87	14.81	19.01

From the experimental data it was observed that the pH of control soil sample and experimental soil samples are almost same, that is slightly acidic condition and near about to neutral pH value (pH=7). It was showed that the pH of betel leaf is acidic character and both control or treatment sample pH value is very close.

Table 2. Effect of pH and micro nutrients of betel farm soil and betel leafs after using the treated bamboo sticks.

Treatment	Depth in cm	Parameters				
		pH (Mean±SE)	B (ppm) (Mean±SE)	Cu (ppm) (Mean±SE)	Na (ppm) (Mean±SE)	Cr (Mean±SE)
		Year-2014				
Control soil sample	0-15	5.6±0.42	0.22±1.05	1.83±1.02	1.82±1.05	0.30±0.87
	15-30	5.7±0.37	0.28±0.98	1.75±0.85	1.87±1.02	0.31±1.01
	30-45	5.5±0.40	0.31±0.87	1.48±0.98	1.79±0.54	0.31±0.85
Treated soil Sample	0-15	6.0±0.35	0.31±0.78	1.25±0.82	1.75±1.02	0.30±0.92
	15-30	6.1±0.41	0.31±1.02	1.18±1.21	1.65±0.75	0.31±1.01
	30-45	6.1±0.43	0.30±1.01	1.32±1.02	1.63±0.68	0.30±1.00
Controlled betel leaf		3.52±0.54	0.023±0.24	0.012±0.54	0.015±0.25	0.001±0.52
Experimental betel leaf		3.58±0.65	0.024±0.27	0.017±0.63	0.014±0.42	0.0014±0.22
		Year-2015				
Control soil sample	0-15	5.7±0.53	0.25±0.98	1.87±1.12	2.07±0.98	0.30±1.07
	15-30	5.5±0.24	0.27±0.78	1.79±0.95	2.10±1.01	0.31±0.76
	30-45	5.8±0.47	0.29±1.02	1.64±1.02	2.18±0.85	0.31±0.95
Treated soil Sample	0-15	6.0±0.24	0.33±0.64	1.52±0.92	1.85±0.93	0.31±0.93
	15-30	6.1±0.54	0.30±1.03	1.47±1.01	1.77±1.02	0.32±1.05
	30-45	6.1±0.45	0.34±0.91	1.63±1.03	1.67±0.86	0.32±1.01
Controlled betel leaf		3.50±0.52	0.022±0.31	0.015±0.42	0.012±0.54	0.001±1.08
Experimental betel leaf		3.53±0.42	0.025±0.24	0.016±0.56	0.014±0.37	0.0012±0.82
		Year-2016				

Control soil sample	0-15	5.8±0.50	0.26±1.13	1.84±0.58	2.02±1.05	0.35±1.14
	15-30	5.5±0.29	0.30±1.02	1.80±1.17	2.14±0.82	0.32±1.04
	30-45	5.8±0.63	0.34±0.95	1.56±1.09	2.23±1.13	0.36±0.93
Treated soil Sample	0-15	6.0±0.43	0.32±1.02	1.00±1.04	2.10±0.81	0.32±0.82
	15-30	6.1±0.66	0.34±1.12	1.10±0.98	2.07±1.15	0.31±1.12
	30-45	6.1±0.48	0.34±0.93	1.00±1.12	2.12±1.05	0.32±1.09
Controlled betel leaf		3.50±1.06	0.024±098	0.011±0.78	0.013±1.05	0.001±1.13
Experimental betel leaf		3.53±0.87	0.026±1.08	0.014±1.04	0.015±0.64	0.001±1.04

The micro nutrient of boron, copper, sodium and chromium in the experimental samples are very close to control sample. In the experimental sample the content of sodium is slightly higher than the control sample and the content of copper in experimental sample is lower than the control sample. The pH and micro nutrient of betel leaf were alalyzed. Both controlled betel leaf and experimental betel leaf data are almost same and no significant chemicaly change of betel leaf composition.

Fig. 1. Treated bamboo sticks at betel leaf field (A&B).

It was investigated that the soil condition, proper preservative treatment, moisture of soil and proper timing for using the treated materials were depends on influencing leaching rates of the preservatives chemicals (Hingston, 2001). Currently used most of the wood preservatives formulation contain copper because of its fungicidal characteristics and copper appears to be the primary case of toxicity to aquatic organism (Brooks, 2000; Breslin, Ivanbroox and Weis and wei, 1999). So the copper formulated wood preservative is used for inhibition of fungal attack. If the soil is contaminated for leaching the preservative chemicals then the betel leaf is also may be contaminated by taking the chemical from the soil as micro nutrients. The experimental data of the soil and betel leaf are analyzed by different equipment and procedure. The consecutive three years data were represented that the soil condition is well and betel leaf quality for chewing is good. It was carried out an assessment of active compound of the sample (Kenedy, 2001). The chemical composition of soil and betel leaf in the betel leaf farm are same in both controlled and experimental sample. So it would be conclude that after using the treated bamboo sticks in

betel leaf farm, no preservative chemicals were leached out from the treated bamboo sticks in soil.

Conclusion

The objective of the study was to determine the leaching material in the betel farm soil and betel leaf from the treated bamboo sticks. The betel farmer were used the untreated bamboo sticks in the farm. The untreated bamboo sticks were destroyed by fungal or borer attack within one year however, treated bamboo sticks were extended upto 4-5 years. For this reason the betel farmer can use this treated bamboo sticks in the farm and they will be economically benefited.

The fixation period of the preservative has an effect on the leaching of the preservative chemicals. So, it is summarized that the bamboo stick will be treated at least two or three month earlier to use in betel leaf farm or any other place. Then the rate of leaching chemical will be reduced, the soil and betel leaf will free from preservative chemical contamination. From this study it was observed that after using the treated bamboo stick in betel leaf farm the rate of chemical leaching is favorable condition. So, it is concluded that preservative chemicals were not significantly increased in farm soil and betel leaf by using treated bamboo sticks in the betel farm.

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