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Effect of 2% aqueous (boiling) Potassium Hydroxide extract (Neutralized with 10% hydrochloric acid) of Bagasse on productivity of different variety of rice

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The Neutralized Liquid Extract (NLE) of Bagasse was found to be active in all varieties of rice namely BR-10, BR-11, BR-34 and BR-56 that were under research investigation in the current experiment. Percentage increase of productivity of the treatment group was higher than that of the chemical group for all the four varieties. But the highest increase of productivity was found in case of BR-34 (15.2%). The NLE is a mixture of different types of natural compounds, and a lot of which might have biological activity like insect repellant, transduction of cell signal, gene activation, growth promotion, Cell differentiator, PCD promoter, plant pathogen killer etc. So, periodic application of NLE at dosage 37.35 ml/ha had became beneficial at different stages of paddy cultivation, up to the increased productivity, with enormous reduction of fertilizer and pesticide cost in rice production.

Key words: Neutralized Liquid Extract (NLE); Lignin; Bagasse; Rice

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INTRODUCTION

Sugar occupies an important place in the industrial sector of Bangladesh which directly and indirectly employs over 4-5 million people and there are 15-17 state-owned sugar mills operating (Gani, 2012; Banglapedia, 2014) in Bangladesh. During sugar processing, the sugarcane stalk is crushed to extract sucrose. *Sugarcane stalk* consists of two parts, the inner pith containing most of the sucrose and the outer rind that contains mainly lignocellulosic fibers (Boopathy, 2004). In sugar industries a large volume of by-products known as bagasse, press mud, molasses, sugarcane top, dried leave, root stock (Gani, 2012) are produced in different steps of the whole process as sucrose is extracted. Sugarcane bagasse, the residue produced after sucrose extraction, is a plentiful lignocellulosic feedstock, composed by 39% cellulose, 25% hemicelluloses and 23% lignin, among other minor components (Carroll & Somerville 2009, Rabelo *et al.,* 2011). About 150,000 tons of sugar, 100,000 tons of molasses and 400,000 tons of bagasse is produces per year (Banglapedia, 2006) in Bangladesh. Many research efforts have explored using bagasse as a renewable power generation source and for the production of bio-based materials (Teixeira *et al.,* 2011). However, the utilization of sugarcane bagasse is still limited and is mainly used as a fuel to power the sugar mill (Antaresti *et al.,* 2002; Charles *et al.,* 2003). In India paper production is the second-largest revenue stream from bagasse (Kunnur *et al.,* 2013). It is mainly composed of lignin and cellulose both of which are abundant organic polymers of any woody materials. Lignin is a complex chemical compound of aromatic nature which contains large amount of carbon than cellulose, and an integral part of the secondary cell walls of plants. The lignin content varies from 17-30% by weight depending on sources (Košiková *et al.,* 2009). Waste generated from sugar mill as well as paper mill is also an environmental issue. That’s why the pulp and paper industry is always interested in finding new, and more effective, environment friendly and cheaper ways to separate lignin from the fiber. So, the development of new more effective method to separate lignin from sugarcane bagasse as well as diversification of the uses of the lignin will be helpful for the waste management, profitability and sustainability of sugar and paper industries. Khanam *et al.* already investigated the efficacy of sugarcane bagasse-based lignin against four stored grain insect pests (Khanam *et al.,* 2006). Therefore, the present study was undertaken to separate lignin from the sugarcane bagasse by a simple and cheap way and evaluation of its effectiveness to increase the productivity of different rice variety.

MATERIALS AND METHODS

Collection of Bagasse: The bagasse was collected from Harian Sugar Mill, Rajshahi, Bangladesh. Then it was washed with water and dried under sunlight for about 12 hours. The dried materials were stored at room temperature to be used for the preparation of insecticidal fertilizer.

Preparation of Neutralized Liquid Extract: 5 kg of dried bagasse was immersed in 100 liter of 2% KOH solution in a stainless steel container and boiled for 4 hours. The mixture was allowed to rest for cooling. After cooling the liquid was collected from the mixture and neutralized with 20 liter of 10% HCl. Then the solution was cloth filtered and preserved in plastic container at room temperature for application in the experimental field.

Application of Neutralized Liquid Extract and calculation of yield and productivity: Twelve bighas of research field was prepared accordingly. The prepared land was divided in to three different fields namely control field, treatment field and chemical field for each of the variety of paddy under research investigation. The paddy seedlings of BR11 were planted at 30.06.2013, BR10 planted at 6.07.2013, BR56 planted at 1.07.2013 and BR34 planted at 21.07.2013. In the control field nothing except pond water were applied, in the treatment field 5 ml of NLE diluted with 10 liter of pond water was applied per bigha (37.35 ml/ha.) by a spray machine in the paddy field. The NLE solution was applied in the treatment field with 3-7 days interval until paddy start to become yellowish (ripen). And in the chemical field chemical fertilizers were applied NPKS @ 101-9-64-6 kg/ha (Shah *et al.,* 2008). BR11 was harvested at 11.11.2013, BR10 at 11.11.2013, BR56 at 20.10.2013 and BR34 at 4.12.2013. After harvesting, weight of paddy of each group was measured and yield per hector was calculated and percentage increase of productivity of different varieties of rice was calculated by comparing the yield with that of the control field according to the following formula:

% Increase in Productivity = $(Y_{t/ch}-Y_c)*100/Y_c$
Where,
$Y_{t/ch}$= Yield of rice per hector in the treatment or Chemical field
Y_c= Yield of rice per hector in control field

STATISTICS

The experiment was setup in three replicate for each group. A one way ANOVA (SPSS statistics- 22) was performed for all analysis (n=3) followed by Tukey Post Hoc Test.

RESULTS

The results obtained with the application of Neutralized Liquid Extract (NLE) of Bagasse are shown in Table 1. The NLE was found to be active in all varieties of rice namely BR-10, BR-11, BR-34 and BR-56 that were under research investigation in this experiment. Percentage increase of productivity of the treatment group was higher than that of the chemical group for all the four varieties (Figure 1). But the highest increase of productivity was found in case of BR-34 (15.2%) (Figure 1).

Table 1: Effect of 2% aqueous (boiling) Potassium Hydroxide extract (Neutralized with 10% hydrochloric acid) of Bagasse on productivity of different variety of rice

Rice Variety	Yield in (Kg/Hectare) ± SEM		
	Treatment	Chemical	Control
BR-10	5485.5*±50	5352.7*±57	5156.8±35
BR-11	6064.2*±59	5931.4*±47	5591.6±55
BR-34	3688.3*±44	3262.7*±30	3199.6±78
BR-56	5099.5*±48	5045.1*±36	4622.0±70

* In a column indicate statistically significant difference ($p<0.05$)
SEM- Standard Error of Mean, BR-Brri

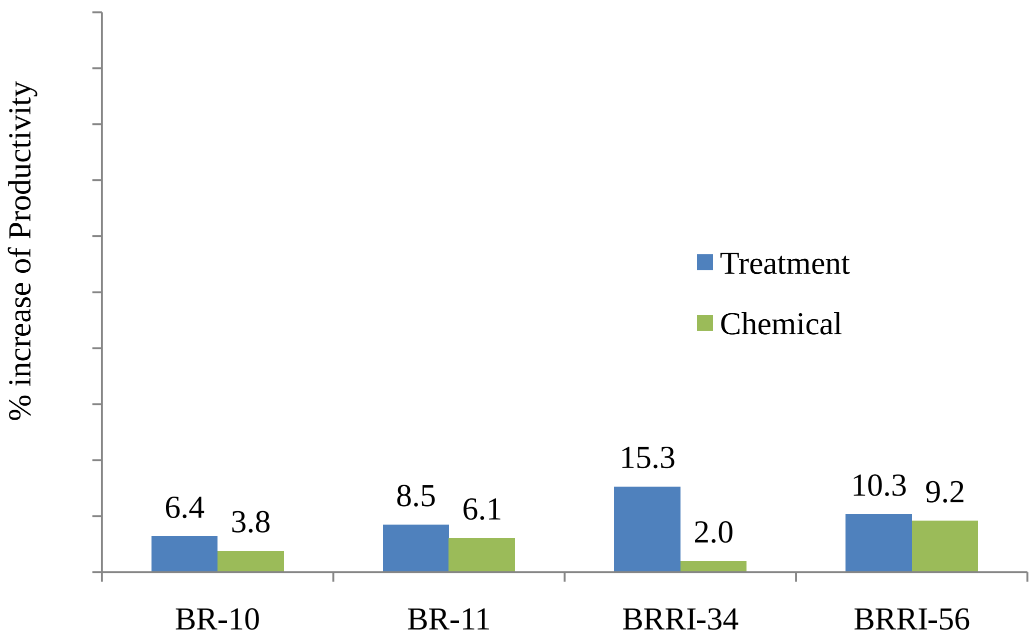

Figure-1: Effect of 2% aqueous (boiling) Potassium Hydroxide extract (Neutralized with 10% hydrochloric acid) of Bagasse on Productivity of rice

DISCUSSION

Fundamentally biomass consists of cellulose, hemicelluloses and lignin (Sun and Cheng 2002). Among them lignin is the most structurally complex, high molecular weight heterogeneous phenolic polymer (Carvalho *et al.,* 2013) produced by the oxidative combinatorial coupling of mainly three p-hydroxycinnamoyl alcohol monomers, the so-called monolignols (Cesarino *et al.,* 2012) and its' the most recalcitrant which aids in plant defense and structural support (Raes *et al.,* 2003). The biosynthesis of the lignified plant cell wall is a complex and dynamic process, requiring the coordination of well over 2000 different genes (Wang, 2012). The monomer composition of lignin vary depending upon the plant family and morphological region under consideration, even there are significant differences in lignin composition from one sub-cellular region to another (Lewis and Yamamoto, 1990). In the current experiment bagasse was subjected to alkaline hydrolysis in boiling water followed by neutralizaton with 10% HCl. The β-O-4 ether bond represents the predominant interunit linkage in lignin (Abreu et al. 2009; Mostaghni and Mirshokraei, 2014; Adler, 1982) and is susceptible to both acidic and alkaline hydrolysis where as α-ether linkage is cleaved in mild acidic condition (Santos et al., 2013) but the carbon-carbon bonds in lignin are some of the most difficult bonds to break and many of this linkage tend to survive the traditional pretreatment process. The fragmentation of this linkage (β-O-4 and α-ether) lead to generation of smaller water soluble molecules (monomer, dimer, oligomer etc. of monolignol nucleus) consisting different types of functional groups. Also, hemicelluloses are a kind of polysaccharides extracted with alkali from cell wall from biomass that include xylans, xyloglucans, and mannans etc. as well as other photochemical. In brief, the liquid extract is a mixture of different types of natural compounds, and a lot of which might have biological activities like insect repellant, cell signal transduction, gene activation, growth promotion, Cell differentiation, PCD promoter, plant defense mechanisms elicitors, plant pathogen killer etc. So, periodic application of the NLE at dosage level 37.35 ml/ha has become beneficial at different stages of paddy cultivation, lead to increased productivity (Fig-1), with great reduction of fertilizer and pesticide cost in rice production. Yet, the exact molecule and mechanisms behind the observed effect is still a research interest.

REFERENCES

Abreu HS, Latorraca JVF, Pereira RPW, Monteiro MBO, Abreu FA and Amparado KF. A (2009). Supramolecular proposal of lignin structure and its relation with the wood properties. *Anais da Academia Brasileira de Ciências* 81(1): 137-142. ISSN 0001-3765. www.scielo.br/aabc

Adler E. (1982). Lignin chemistry: past, present and future. *Wood Sci. Technol.* 11:169- 218.

Antaresti YS, Setiyadi HW and Yogi YP. (2002). The effect of chemical and biopulping process to bagasse pulp. *Proceeding of RSCE and SOMChe*, Petaling Jaya, Malaysia.

Boophthy R. (2004). “Use of post-harvest sugarcane residue in coastal reclamation: A feasibility study,” *Sugar Cane International,* Jun/Feb, 9-13.

Banglapedia (2006). http://www.banglapedia.org/httpdocs/HT/G_0045.HTM

Carvalho A, Paiva J, Louzada J and Lima-Brito J (2013). The Transcriptomics of Secondary Growth and Wood Formation in Conifers. *Molecular Biology International*, Article ID 974324: 1-12 page.

Carroll A, Somerville C. (2009). Cellulosic biofuels. *Annual Review of Plant Biology.* 60:165-182.

Cesarino I, Araújo P, Júnior APD and Mazzafera P. (2012). An overview of lignin metabolism and its effect on biomass recalcitrance. *Brazilian Journal of Botany* 35(4): 303-311.

Charles M. and Shuichi F. (2003). Electricity from bagasse in zimbabwe. *Biomass and Bioenergy*. 25: 197-207.

Gani O. Challenges in Sustainability and Corporate Social Responsibility The Sugar Industry in Bangladesh. 43, 2nd Cross, Ramaya Layout, St. Thomas Town Post, Kammanahalli, Bangalore 560 084, India, 1st Edition-2012, ISBN: 978-81-908155-8-1, www.prakruthi.org

Khanam LAM, Talukder D and Hye MA (2006). “Toxic and repellent action of sugarcane bagasse-based lignin against some stored grain insect pests” *University Journal of zoology Rajshahi University.* 25: 27-30.

Košiková *et al.* (2009). “Lignin affinity towards genotoxins,” *BioResources* 4(1): 72-79.

Kunnur S, Kurbet SN and Ganganallimath MM. (2013) Proposal for the Development of a Device to Load Bagasse at Sugar Industry. *International Journal of Scientific and Research Publications*, 3(9): 1-6.

Lewis NG and Yamamoto E. Lignin: occurrence, biogenesis and biodegradation (1990). *Annu. Rev. Plant Physiol. Plant Mol. Biol.* 41: 455-9.

Mostaghni F and Mirshokraei SA. (2014). Conformational analysis of thethreo and erythro diastereomeric forms of a guaiacyl β-O-4 dimer using molecular mechanics calculations *International journal of pharmaceutical, chemical and biological sciences*. 4(3): 802-806. ISSN: 2249-9504, www.ijpcbs.com

Teixeira SR, De Souza AE, Peña ARV, De Lima RG and Migue AG. (2011). Use of Charcoal and Partially Pirolysed Biomaterial in Fly Ash to Produce Briquettes: Sugarcane Bagasse. InTech Publisher(Online), Pp-177, ISBN 978-953-307-372-9

Raes J, Rohde A, Chrisrensen JH, Van der Peer Y, Boerjan W (2003). Genome-wide characterization of the lignification toolbox in Arabidopsis. *Plant Physiol*. 133:1051-1071.

Rabelo SC, Carrere H, Maciel Filho R, Costa AC. (2011). Production of bioethanol, methane and heat from sugarcane bagasse in a biorefinery concept. *Bioresource Technology.* 102:7887-7895.

Santos RB, Hart PW, Jameel H and Chang H-m. (2013) Wood Based Lignin Reactions Important to the Biorefinery and Pulp and Paper Industries. *BioResources.* 8(1): 1456-1477.

Sun Y, Cheng J. 2002. Hydrolysis of lignocellulosic materials for ethanol production: a review. Bioresource Technol 83:1-11.

Whiting P and Goring DAI. (1982). Chemical characterization of tissue fractions from the middle lamella and secondary wall of black spruce tracheids. *Wood Sci. Technol.* **16:**261-67.

Wang JP-Yu. (2012). Towards a Systems Approach for Lignin Biosynthesis in Populus trichocarpa: Functional Redundancy of the Two 5-Hydroxylases and Kinetic Modeling of the Monolignol Biosynthetic Pathway, Doctor of Philosophy dissertation, North Carolina State University, Raleigh, North Carolina

Weckhuysen BM and Bruijnicx PCA (2013). Catalytic Conversion of Lignin for the Production of Aromatics. Pp-26. ISBN: 978-90-393-6001-9. Printed by: Gildeprint Drukkerijen- www.gildeprint.nl