

NEW TECHNICAL PROGRAMME

Department of Forest Products and Utilization

Experiment No. 21.5.3.12

01.	Experiment No. and Title	:	Transforming lignocellulosic forest/agroforest waste material into valuable fuel through developing quality biomass briquettes
02.	Budget Head	:	352/18248/04 or 352/12036
03.	Collaborative department, if any	:	-
	Background information	:	
04.	<p>Waste Utilization play an important role in production of value-added products. Forest waste can also be used for production of value-added products. The utilization of tree species woody branches in combination with leaf litter from various commercial tropical tree species represents a novel approach towards enhancing the value and utility of biomass resources. In many tropical regions, diverse tree species contribute significantly to agricultural and forestry residues, including branches, wood, and leaves. These residues, often considered as waste, possess substantial potential for conversion into valuable products such as biomass briquettes. Briquetting is the process of compacting the biomass residue into a uniform solid fuel called briquettes. It has higher density and energy content and less moisture compared to its raw materials.</p> <p>Despite huge importance briquette and its significance there is a very limited information available on briquette production using powder of woody branches and litter including its fuel qualities.</p> <p>Keeping in view of importance briquette production and its significance, the present study was formulated with the following objectives:</p>		
	Hypothesis	:	The qualitative characteristics of biomass briquettes produced from powder of woody branches and leaf litter of different species are not significantly different from each other
05.	Objectives		<ol style="list-style-type: none"> 1. To assess the qualitative characteristics of biomass briquettes produced from powder of woody branches and leaf litter 2. To evaluate fuel value index (FVI) of biomass briquettes based on qualitative characteristics
06.	Principal investigator and associates	:	Principal Investigator: Dr. M. S. Sankanur Co- Investigators : Dr. R. P. Gunaga Dr. S. K. Sinha Associate scientist : Dr. R. S. Chauhan
07.	Location and Agro-climatic sub-region	:	Forest Nursery of College of Forestry, NAU, Navsari
08.	Year and Season	:	2025-26
09.	Crop and Variety	:	Woody branches powder of Sharu (<i>Casuarina equisetifolia</i> L.), Vaans (<i>Bambusa arundinacea</i> (Retz.) Willd.), Nilgiri (<i>Eucalyptus species</i> Labill.) <i>Limdo</i> (<i>Azadirachta indica</i> A. Juss.) and Poplar (<i>Populus deltoids</i> W.Bartram ex Marshall) including Leaf litter powder of Keri (<i>Mangifera indica</i> (L.)), Chiku (<i>Manilkara zapota</i> (L.) P.Royen), Nilgiri (<i>Eucalyptus species</i> Labill.), Saag (<i>Tectona</i>

			<i>grandis L.f.) and Sharu (Casuarina equisetifolia L.)]</i>																																																																														
10.	Experimental details	:	-																																																																														
	(a) Treatments	:	<p>Total 25 treatments</p> <table border="1"> <thead> <tr> <th>Treatments</th> <th>Woody branch powder</th> <th>Leaf litter powder</th> </tr> </thead> <tbody> <tr><td>T1</td><td>Sharu +</td><td>Keri</td></tr> <tr><td>T2</td><td>Sharu +</td><td>Chiku</td></tr> <tr><td>T3</td><td>Sharu+</td><td><i>Nilgiri</i></td></tr> <tr><td>T4</td><td>Sharu+</td><td><i>Saag</i></td></tr> <tr><td>T5</td><td>Sharu+</td><td><i>Sharu</i></td></tr> <tr><td>T6</td><td>Vaans+</td><td>Keri</td></tr> <tr><td>T7</td><td>Vaans+</td><td>Chiku</td></tr> <tr><td>T8</td><td>Vaans+</td><td><i>Nilgiri</i></td></tr> <tr><td>T9</td><td>Vaans+</td><td><i>Saag</i></td></tr> <tr><td>T10</td><td>Vaans+</td><td><i>Sharu</i></td></tr> <tr><td>T11</td><td>Nilgiri+</td><td>Keri</td></tr> <tr><td>T12</td><td>Nilgiri+</td><td>Chiku</td></tr> <tr><td>T13</td><td>Nilgiri+</td><td><i>Nilgiri</i></td></tr> <tr><td>T14</td><td>Nilgiri+</td><td><i>Saag</i></td></tr> <tr><td>T15</td><td>Nilgiri+</td><td><i>Sharu</i></td></tr> <tr><td>T16</td><td>Limdo+</td><td>Keri</td></tr> <tr><td>T17</td><td>Limdo+</td><td>Chiku</td></tr> <tr><td>T18</td><td>Limdo+</td><td><i>Nilgiri</i></td></tr> <tr><td>T19</td><td>Limdo+</td><td><i>Saag</i></td></tr> <tr><td>T20</td><td>Limdo+</td><td><i>Sharu</i></td></tr> <tr><td>T21</td><td>Poplar+</td><td>Keri</td></tr> <tr><td>T22</td><td>Poplar+</td><td>Chiku</td></tr> <tr><td>T23</td><td>Poplar+</td><td><i>Nilgiri</i></td></tr> <tr><td>T24</td><td>Poplar+</td><td><i>Saag</i></td></tr> <tr><td>T25</td><td>Poplar+</td><td><i>Sharu</i></td></tr> </tbody> </table>	Treatments	Woody branch powder	Leaf litter powder	T1	Sharu +	Keri	T2	Sharu +	Chiku	T3	Sharu+	<i>Nilgiri</i>	T4	Sharu+	<i>Saag</i>	T5	Sharu+	<i>Sharu</i>	T6	Vaans+	Keri	T7	Vaans+	Chiku	T8	Vaans+	<i>Nilgiri</i>	T9	Vaans+	<i>Saag</i>	T10	Vaans+	<i>Sharu</i>	T11	Nilgiri+	Keri	T12	Nilgiri+	Chiku	T13	Nilgiri+	<i>Nilgiri</i>	T14	Nilgiri+	<i>Saag</i>	T15	Nilgiri+	<i>Sharu</i>	T16	Limdo+	Keri	T17	Limdo+	Chiku	T18	Limdo+	<i>Nilgiri</i>	T19	Limdo+	<i>Saag</i>	T20	Limdo+	<i>Sharu</i>	T21	Poplar+	Keri	T22	Poplar+	Chiku	T23	Poplar+	<i>Nilgiri</i>	T24	Poplar+	<i>Saag</i>	T25	Poplar+	<i>Sharu</i>
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	(b) Experimental Design	:	For analysis, CRD design will be used for estimation of qualitative characteristics of biomass briquettes viz., moisture content, basic density, ash content, calorific value and fuel value index.																																																																														
	(c) Replications	:	Three samples will be drawn randomly and used for assessment of variation in qualitative characteristics of biomass briquettes.																																																																														
	(d) Plot size (if applicable)	:	Gross - ____ m x ____ m																																																																														
		:	Net - ____ m x ____ m																																																																														
	(e) Spacing	:	NA																																																																														
	(f) Seed rate (kg/ha)	:	NA																																																																														
	(g) Manures and fertilizer	:	NA																																																																														
	(h) Any other detail, if required	:	-																																																																														
11.	Observations to be recorded	:	<p>Observations to be recorded:</p> <p>The following observations will be recorded from biomass briquettes produced from lignocellulosic waste material</p>																																																																														

			<ol style="list-style-type: none"> 1. Moisture content (in %) 2. Basic density (in g/cc) 3. Ash content (in %) 4. Calorific value (in MJ/kg) and 5. Fuel value index (in Kcal/kg) 6. Burning time 7. Amber quality 8. Smoke quality
12.	Methodology	:	<p>Methodology: The biomass briquettes produced in this study will be 8 cm × 3 cm (length × width) with the help of the briquette-making machine using powder of woody branches viz., Sharu (<i>Casuarina equisetifolia</i> L.), Vaans (<i>Bambusa arundinacea</i> (Retz.) Willd.), Nilgiri (<i>Eucalyptus species</i> Labill.) Limdo (<i>Azadirachta indica</i> A. Juss.)] and Poplar (<i>Populus deltoids</i> W.Bartram ex Marshall) including leaf litter powder of Keri (<i>Mangifera indica</i> (L.), Chiku (<i>Manilkara zapota</i> (L.) P.Royen), Nilgiri (<i>Eucalyptus species</i> Labill.), Saag (<i>Tectona grandis</i> L.f.) and Sharu (<i>Casuarina equisetifolia</i> L.)] among five commercial tropical tree species along with the waste flour as a starch adhesive with three replications. Mixing of powder of woody branches in combination with leaf litter powder among different commercial tropical tree species along with waste flour as a starch adhesive will be performed manually in a bucket until evenly distributed. The adhesive content used was 10% based on oven-dry stem power and leaf litter powder among different commercial tropical tree species. The powder of woody branches in combination with leaf litter and adhesive will be mixed evenly then transferred into briquette-making equipment and the material will be subjected to compression through a hydraulic press machine at a pressure of 30 kgf/cm². The biomass briquettes obtained will be then dried by exposing to sunlight for 3 days.</p> <p>Outcome of the study: Data base on transforming lignocellulosic forest/agroforest waste material into valuable fuel through developing quality biomass briquettes will be generated for the first time in South Gujarat. The study helps to outline best combinations of lignocellulosic waste material <i>i.e.</i> stem wood powder and litter powder among commercial tropical tree species to develop the a viable, sustainable and environmentally friendly alternative to traditional fuels. It supports energy security, environmental stewardship and economic development in regions where these resources are abundant.</p>