# POTENTIAL OF INDIGENOUS SEEDS (*Vigna mungo*) AND PLANT NUTRIENT RECYCLING THROUGH BIOGAS TECHNOLOGY FOR SUSTAINABLE AGRICULTURE

**BY**

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*in fulfilment of the requirements*

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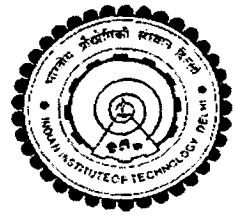
**to the**



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# CERTIFICATE

This is to certify that the thesis entitled "Potential of Indigenous Seeds (*Vigna mungo*) and Plant Nutrient Recycling through Biogas Technology for Sustainable Agriculture" being submitted by Mr. Vineet Rana to the Indian Institute of Technology, Delhi for the award of the degree of Doctor of Philosophy is a record of bonafide research work carried out by him. Mr. Vineet Rana worked under our guidance and supervision and has fulfilled the requirements for the submission of this thesis, which to our knowledge has reached the required standard. The results contained in this thesis have not been submitted in part or in full to any other university or institute for the award of any degree or diploma.

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## *Abstract*

*Modern agriculture has been known for its strength to make available the plant nutrients (in the form of chemical fertilizers) in an unlimited amount, broad range of chemical pesticides and the associated technology support for developing the hybrid, improved, and terminator seed varieties, which can respond to this type of plant nutrient system. However, it is now seen as the major threat to the very sustainability of the agriculture system in terms of economic, environmental, ecological and social consequences. Recently, importance of traditional agriculture system has been recognized as it has inbuilt sustainability features especially the potential of indigenous seeds, and efficient system of nutrients cycling.*

*Therefore, in search of sustainability in agriculture,, present study was taken up with two specific objectives: i) To study the potential of indigenous seeds vis-à-vis improved variety of Vigna mungo alongwith selected seed treatment techniques, through field experiments and ii) To develop an efficient system of biogas slurry production and management for plant nutrients as a supportive system for sustainable agriculture.*

*The thesis entitled "Potential of indigenous seeds (Vigna mungo) and plant nutrient cycling through biogas technology for sustainable agriculture" has been organized in 6 chapters, starting with a brief introduction on the theme, presents extensive literature survey on relevant aspects including understanding the concept of sustainability through traditional agriculture system. Details on experimental site and methodology are given in chapter3. Research findings on potential of indigenous seeds in respect of a pulse crop (Vigna mungo) along with a new seed treatment method derived from vedic literature, through field trials under controlled conditions for 4 consecutive years and field testing on a farm for 3 consecutive years, are presented in chapter 4. It is followed by experimental work on efficient management of digested biogas slurry by designing a new slurry filter system and recycling of filtrate (chapter 5). All the experimental data are statistically analyzed and discussed. Finally, overall research findings alongwith salient points as well as significance of the present study in sustainable agriculture are presented in the last chapter.*

*Based on the experimental data on comparative efficacy of certain seed treatment techniques, new seed treatment method (NSTM) consisting of naturally occurring ingredients like cow dung, honey, cow ghee was selected for detailed investigations. Integration of NSTM with rhizobium treatment gave very interesting results. It was noted that due to different genetic characteristics, the effect was much more pronounced in case of indigenous seeds as compared to improved variety (T-9). The new seed treatment method (NSTM) was also found quite effective to improve the low germination of indigenous seeds to significant*

*extent (from 77% to 91%). Use of NSTM improved the vigour index from 979 to 1825 in case of improved seeds and 746 to 1389 in case of indigenous seeds.*

*The data of field trials under controlled conditions (4years) indicated that the Indigenous seeds-organic manure system is at par with improved seeds-organic manure system in terms of both grain and biomass yield. The improved seeds alongwith organic manure on an average gave 3.7q/ha grain and 12.7q/ha biomass under different seed treatments as compared to that of 4.6q/ha grain yield and 18.1q/ha biomass yield of indigenous seeds. To validate the field trial data, experiments were carried out on farmers field for 3 consecutive years under actual field conditions. The data clearly revealed that indigenous seeds are in no way less productive than the improved variety (T-9). The grain yields were at par with improved seeds while the biomass production was ~ 40% higher in case of indigenous seeds. It is worth noting that only half the seed rate as compared to T-9 variety was used in case of indigenous seeds. This clearly shows that for achieving sustainability in agriculture system, indigenous seeds need to be conserved and promoted.*

*In order to improve the effectiveness of biogas system, for solving the problem of slurry handling and management, a new design of slurry water filter was designed and developed and compared with GAU model. Unlike other slurry filter designs, the new design has an inbuilt special feature that % recovery of filtrate can be regulated as per requirements related to water conservation. Chemical analysis of filtrate obtained from normal biogas plant and plant where 50% filtrate was used as a substitute of fresh water, indicates that it will not have any detrimental effect on performance of biogas plant. Also, by recycling 50% filtrate alongwith 20 liters digested slurry in a 1 $M^3$ biogas plant, 10% enhancement in biogas production (~55% methane content) was observed. The new slurry filter system requires less space and is cost effective as compared to other models.*

*The present study clearly reveals the potential of indigenous seeds–organic manure system coupled with new seed treatment method (derived from vedic literature), towards achieving food-nutritional security, environmental protection and enrichment of nature. The experimental findings on Vigna mungo cultivation and interaction with farmers have certainly helped us in understanding the potential and significance of long neglected indigenous seeds based farming system. In the changing paradigm of agriculture, the present work is a humble step in the direction, which is full of opportunity and challenges.*

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