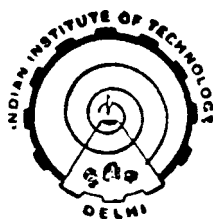


BIOMASS FROM UNDEREXPLOITED PLANTS :
STUDIES ON
Adhatoda vasica Nees & *Ipomoea fistulosa* Mart ex Choicy

Thesis submitted to the
Indian Institute of Technology, Delhi
for the award of the degree of
DOCTOR OF PHILOSOPHY

By
ARVIND SINGH



Centre for Rural Development and Appropriate Technology
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
MAY, 1988

CERTIFICATE

This is to certify that the thesis entitled 'Biomass from Underexploited Plants : Studies on Adhatoda vasica Nees and Ipomoea fistulosa Mart ex Choicy' submitted by Mr. Arvind Singh has been prepared under our supervision in conformity with the rules and regulations of Indian Institute of Technology, Delhi. The research report and results presented in this thesis have not been submitted for any degree in any other University/Institution.

Mira Madan

(MIRA MADAN)

Senior Scientific Officer-I
Centre for Rural Development &
Appropriate Technology,
Indian Institute of Technology,
Hauz Khas, New Delhi-110016.
India.

Padma Vasudevan

(PADMA VASUDEVAN)

Professor and Head
Centre for Rural Development &
Appropriate Technology,
Indian Institute of Technology,
Hauz Khas, New Delhi-110016.
India.

To

Maa & Darjee

they did everything for me

and

got so little in return.

ACKNOWLEDGEMENTS

Beginning with the formulation of research problem, till date, I have been especially privileged one in receiving invaluable guidance and incessant encouragement from my teacher, Prof. Padma Vasudevan. I do not know any better way to express my sincerest thanks and sense of gratitude except to admit it. I would be equally frank in admitting my regards and thanks to Dr. Mira Madan for her constructive suggestions and sustained interest during the entire period of investigations and preparation of manuscript.

I wish to put on record my thanks to my friends and fellow researchers at IIT, Delhi, especially Vanketraj, Anand, Silva, Joshi, Siddarth, Anuradha, Ramesh, Atul and Salim.

I am thankful to faculty members, laboratory and office staff of Centre for RD & AT for their favours, especially Drs. Giri, Gujral and Neeta for their moral support.

Thanks to University Grants Commission, New Delhi, for financial support under faculty improvement programme and L.N. Mithila University, Darbhanga and C.M. Science College, Darbhanga, my parent institution, for granting study leave.

It is with great pleasure that I record the continuous support and blessings of my parents and my brother and sisters, Ranjit and Ravindra, Jito & Manjeet, Baby & Inderjeet for keeping me aloof from all domestic problems. But for my Rani's incessant prayers and patience, I would not have completed this task. I tender my apology to my little darling, Vishi, my son, who did miss me a lot.

Arvind Singh
(ARVIND SINGH)

ABSTRACT

Although over dependence on biomass has increased over the time, the tendency to use selected conventional crops and plants for cultivation has left a large number of plant species un or underexploited. Today with the limitations on land availability, it has become important to consider plants, including weeds, inhabiting marginal and unproductive wastelands. Utilization of biomass as a whole, so that every part of it is fully used for satisfying the major needs of food, fuel, fertilizer etc., must be given special attention. Environmental issues associated with production and utilization of such nonconventional sources of biomass should also be taken into account. In view of this, studies were taken up on two such plants, Adhatoda vasica Nees. of family Acanthaceae and Ipomoea fistulosa Mart ex Choisy of family Convolvulaceae, for the present thesis.

Both the plants were found to be hardy, able to sustain and multiply under adverse agroclimatic conditions, with quick regeneration potentials and easily propagated through cuttings. Biomass yield potentials upto 100 tonnes hectare⁻¹ were observed for naturally growing shrubs. Growth periods for reaching the optimal height for first coppicing were estimated. Three cuttings each year yielded almost double the biomass as compared to plants not coppiced. Aerial biomass estimation was done based on linear regressions and fairly accurate estimates could be obtained by using these equations. By analysing soil samples around well established plants, it was seen that the plants tend to stabilize

pH, EC, ESP of the soil and augment its nutrient value. Macro and micro(elemental), proximate and ultimate analyses were done to get a data base for selecting utilization alternatives. Thermogravimetric and differential scanning calorimetry were also done. The biomass was evaluated for direct combustion, thermal conversion to charcoal, biomethanation, solid state digestion, by an edible mushroom, Pleurotus sajor-caju and extraction of oxalic acid. The study has brought out the potential of these weeds for providing biomass on a renewable basis and possibility of integrating various applications of the plant components in fulfilling fuel, food, fertilizer and material needs etc.

CONTENTS

Page
No.

	ACKNOWLEDGEMENT	
	ABSTRACT	
CHAPTER 1	INTRODUCTION	1-19
1.1	Wasteland utilization	7
1.2	Identification of some hardy weeds	10
1.3	Scope of the present work	19
CHAPTER 2	AERIAL BIOMASS ESTIMATION & GROWTH POTENTIALS	20-56
2.1	Yield potentials	20
2.2	Coppicing trials	22
	a. First coppice	23
	b. Frequency of coppice	26
2.3	Fertilizer trials	33
2.4	Aerial biomass estimation	36
2.5	Effect of weed growth on saline-alkali soils	48
CHAPTER 3	BIOMASS CHARACTERIZATION	57-80

CHAPTER 4	BIOMASS UTILIZATION	81-128
4.1	Fuel from weeds	82
	a. Direct burning	83
	b. Carbonization	90
	c. Anaerobic digestion	100
4.2	Food from weeds	110
4.3	Fertilizer from weeds	117
4.4	Chemicals from weeds	122
4.5	Integrated approach to biomass utilization	127
CHAPTER 5	SUMMARY AND CONCLUSIONS	129-134
	REFERENCES	135-162
	APPENDIX	