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Original Research Paper

Evaluation of Variation in Seed Parameters and Morphology of *Pongamia pinnata*: A Biodiesel Yielding Plant in Bhadravathi Town, Karnataka

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ABSTRACT

Biodiesel is the name of a clean burning alternative fuel produced from domestic, renewable resources and it can be blended at any level with petroleum diesel to create a biodiesel blend and can be used in compression ignition (diesel) engines with no major modifications. The oil obtained from the seeds of *Pongamia pinnata* holds promise as fuel used as alternative for diesel. The plant has a variety of uses, but its economic exploitation has remained neglected for long time. Survey of *Pongamia pinnata* plant at the study area was conducted during January-September 2007 to know the density of the species and impact of morphological characteristics on the yield efficiency of the species. Since, lot of wasteland (4631 hectares) was found in the study area (Bhadravathi taluk), recognition of the potential use of these species as a source of biofuels and in wasteland reclamation has got promising scope. This paper reflects on the ecological and economical benefits of *Pongamia pinnata* as an energy source in the study area.

INTRODUCTION

India's contribution to the world's carbon emission has increased significantly. Vehicular pollution is estimated to have increased eight times of carbon emission over the last two decades in India. India faces the critical challenge of meeting a rapidly increasing demand for energy for fuelling its economic growth. With a population of over a billion people, the country has one-fifth of the world's population and ranks sixth in terms of the energy demand, accounting for 3.61 % of the global energy needs. The Indian economy is projected to grow by 7-8% over the next two decades, resulting in a substantial increase in the demand for energy. Assuming an average gross domestic product growth rate of seven per cent, the average annual per capita income will almost double by 2011 to 33867 rupees. Consequently, per capita energy consumption in India will also rise. As per the current projection, India's oil import dependence is expected to increase. Rudolf Diesel, in 1912 predicted the future problem and said that the use of vegetable oils (biodiesel) for engine may seem insignificant today, but such oils may become in course of time as important as petroleum and coal tar products of the present time.

There has been greater awareness of biodiesel in India in the recent times due to shortage of petrodiesel and soaring prices. India consumes more than 250 MT (million tonnes) of fossil fuels (nearly 40 MT of diesel), and ranks fifth in the world after China, Japan, Russia, and the United States in terms of fossil fuel consumption. Automobiles alone contribute to about 70 % of the total diesel consumption. Significant activities have picked up for the production of biodiesel, especially with a view to reduce the huge cost involved in import of petroleum fuel and to take care of the

shortage of petrodiesel anticipated within a few years from now. In addition, the process of production of biodiesel from non-edible vegetable oil will boost the rural economy and provide non-polluting, biodegradable and safe environment.

Fig. 1: Oil expelling unit.

Biodiesel production in India has reached a decisive stage, and the country is on the verge of making a beginning by introducing a five percent blend of biodiesel with conventional diesel, at least in selected districts and states. India has vast area of wastelands that is not being utilized for cultivation since it is infertile, dry, and saline or alkaline. The majority of India's population lives in villages. The country has state of the art technologies and hightech establishments, and human resources are available in plenty. While, the nation has achieved self-sufficiency in the food sector, energy and environment remain areas of concern for policy makers and scientists.

Considering all the aspects available among non-edible tree bearing oil (TBO) seeds, *Pongamia pinnata* has been identified as the most suitable for extraction of oil and subsequent processing of biodiesel since this plant grows well in tropical climate and can be grown in arid zones (20 cm rainfall) as well as higher rainfall zones and even on land with thin soil cover.

The present study was undertaken to know the primary information regarding the status of implication of this species as the source of energy and impact of morphological characteristics and water availability on the yield efficiency of the plants. The economical and ecological benefits from the this species as a source of energy are discussed.

Fig. 2: Photograph of *P. pinnata* plant.

STUDY AREA

Bhadravathi taluk is situated in the east zone of Shimoga district, Karnataka state. Average annual rainfall of Bhadravathi taluk is 816.01 mm. Most of the rainfall is received during in the months of July-September. The total land distribution of Bhadravathi Taluk is about 415376.5 hectares, which is used for various purposes. The area comes under irrigated region with moderately high temperature. The prominent agricultural crops of this region are paddy, arecanut and sugarcane. Oil expelling unit is present in the village named Tadasa in the study area (Fig. 1). The oil obtained from biofuel plants is used not only for diesel but also for various other purposes. The waste obtained from extraction of the oil is used as manure in farms.

Fig. 3: Dry seeds of *P. pinnata.*

MATERIALS AND METHODS

The survey was conducted by selecting four sites in Bhadravathi taluk, two of them representing irrigated land (B. R. Project and Talikatte), and the other two sites, representing dry regions (Agardhahalli and Ranganathapura). The sites were selected on the basis of density of the plant species, rainfall, pattern of irrigation and soil characteristics of the region. The survey was conducted in the months of January-September 2007. During the study period primary information about the density of *Pongamia pinnata* was collected. In each location, mature pods from 10 healthy tree species were collected. Seed weight was determined with a sample of 100 seeds. Number of pods and seeds per kg were also calculated. The fruit pods of the plants were split open and the seeds were separated. Seed length, breadth and thickness were measured with digital vernier calipers. Figs. 2 and 3 show a tree of *Pongamia pinnata* and matured seeds respectively. The parameters such as girth, height (at chest level) and yield were measured at each sampling site using standard methods for twenty plants of different ages.

RESULTS AND DISCUSSION

All the sites of the study area received normal rainfall throughout the study period. The physical characteristics such as weight, length, breadth and thickness of the seeds of plants in all the four sites were measured (Fig. 4). Seed polymorphism in many tree species has been found to play a great role in variation of seed size, chemical composition and seedling growth (Harper et al. 1970, Wood et al. 1977, Basada 1979). It is evident from the obtained results that the seeds of irrigated regions have slight increase in the tested parameters as compared to the dry regions. Kumar et al. (2003) also found the same results in the different parts of Tamilnadu for *Pongamia pinnata.* Almost all the parameters for the species have the order Site-1 > Site-2 > Site-3 > Site-4 (Tables 1 and 2).

From *Pongamia pinnata* various economical and ecological benefits will be gained such as self reliance and fuel security increasing rural income and women's involvement increasing rural em-

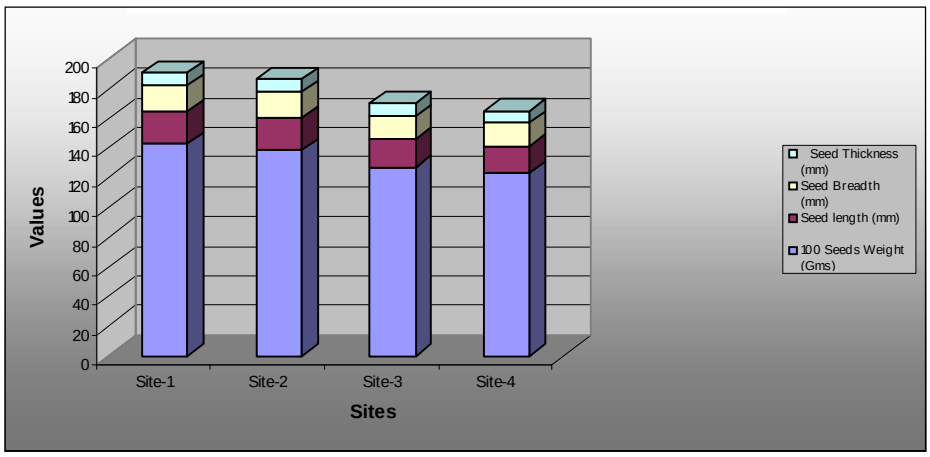

Fig. 4: Variation of physical characteristics in *P. pinnata.*

Table 1:Variation in physical characteristics of *Pongamia pinnata* at four sampling sites of the Bhadravathi taluk.

Sites	Physical characteristics			
	100 Seeds Weight (g)	Seed length (mm)	Seed breadth (mm)	Seed thickness (mm)
B.R.Project (Site-1)	142.8	22.2	17.5	8.6
Talikatte (Site-2)	138.6	21.9	17.4	8.6
Agardhahalli (Site-3)	127.2	18.7	15.9	8.1
Ranganathapura (Site-4)	123.4	17.9	16.1	7.9

Table 2: Effect of morphological characters of *Pongamia pinnata* on its yield efficiency at four sites of the study area.

Sl. No	B.R. Project (Irrigated)			Agardhahalli (Dry)			Talikatte (Irrigated)			Ranganathpur (Dry)		
	Height (m)	Girth (cm)	Yield (kg)	Height (m)	Girth (cm)	Yield (kg)	Height (m)	Girth (cm)	Yield (kg)	Height (m)	Girth (cm)	Yield (kg)
1	6	59	6	6	76	25	5	45	20	6	42	9.5
2	6	74	6	6	67	26	5	68	20	6	71	19.6
3	5	43	10	7	71	30	5	73	25	6	45	11
4	5	77	28	6	73	30	5	47	20	5	63	17
5	4	61	4	7	93	25	6.5	70	25	5.5	65	35
6	5	78	27	4	55	20	6	47	10	6.5	74	31
7	6	34	10	5	58	20	6	79	20	4	56	14
8	6	47	10	7	64	25	6	46	10	4	79	26
9	6	79	20	6	49	20	4	69	15	6.5	20	16
10	6	46	10	7	54	22	6	79	35	6	25	18
11	6	69	15	6	60	35	5.5	59	6	4	20	11
12	6	109	60	4.5	66	25	5	74	6	5	22	16
13	5.5	89	30	7	64	25	5	43	10	5.5	35	22
14	4	56	15	5	45	20	5	69	28	6	25	19
15	4	79	20	7	68	20	4	61	8	5.5	20	14
16	4	85	20	7	73	25	6	76	25	6	25	21
17	5	81	35	5	47	20	6	77	26	5	20	14
18	5.5	65	25	9	80	25	5.5	81	30	6	30	29
19	5.5	69	35	7	70	20	6	63	30	4	61	41
20	4	75	35	9	64	30	4.5	73	25	5	81	30

ployment. Bhadravathi Taluk has got nearly 4631 hectares of waste lands and half of the waste land can be used for cultivation of this species to achieve waste land reclamation.

At the same time the morphological characters like height, girth and yield of the species at four sites of the study area are given in Table 2. From the results it is evident that there is no such significant impact of water availability, height and girth on the yield efficiency of this species, as there is no such reduction in yield in the species in irrigated and dry regions.

Although, present status of *Pongamia pinnata* as a future energy source in the study area is at primary stage, initiation towards the development has been started, as the NGO's like SUTHRA and SAMAGRA VIKASA came forward to encourage the farmers of the study area and gave suggestions about the cultivation, marketing and benefits from the biofuel plants.

CONCLUSION

The *Pongamia* oils can be used as diesel substitute, and if its production is increased, it will be economically beneficial to the producers and the cake produced will also be available for additional production of fuel energy. There is a need of awareness and education through state government and NGOs. Participation of research institutes, voluntary organizations and farmer associations is required for the development. There is also a need to establish resource centre where information on aspects of protection, processing and utilization of biofuels is available. Economical and ecological values from the species are valuable and play an important role in sustainable development of the study area. It may be concluded from the study that the *Pongamia* species can be grown as a commercial crop in wastelands as they will be the source of energy in future.

REFERENCES

Basada, R.M. 1979. Effect of seed size on germination, seedling growth and survival and height growth of *Shorea contorta* Vidal. Sylvatrop, 4: 77-80.

Harper, J.L., Lovell, P.H. and Moore, K.G. 1970. The Shapes and Size of Seeds .Ann. Rev. Ecol. Sys., 1:327-356.

Kumar, S., Parimallam, R., Arjunan, M.C. and Vijayachandran, S.N. 2003. Variation in seed parameters and biochemical composition of *Pongamia pinnata* (L.) Pierre in Tamilnadu. *Jatropha* and Other Perennial Oil Species, Proceedings of the National Workshop, Pune, India.

Wood, D.W, Longden, P.C. and Scott, R.K. 1977. Seed size variation, its extent, source and significance in field crops. Seed Sci. and Technology, 5: 337-352.

Conferences/Symposia/Workshops on Environment

Nuclear Power
2 to 5 August 2010, Singapore, Singapore
Website: http://www.nuclearpowercongress.com
Contact name: Peggy Phor

5th National Conference on Coastal and Estuarine Habitat Restoration
13 to 17 November 2010
Galveston, Texas, United States
Website: http://www.estuaries.org
Contact name: Harvey Potts

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Website: http://www.venicesymposium.it
Contact name: Organising Secretariat

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Contact name: IASTED Secretariat – AfricaWRM 2010

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