JATROPHA CURCAS - A BIO DIESEL PLANT, IN RECLAMATION OF SILICA MINING AREA

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ABSTRACT

A silica mining area ,in Vindhayn hills of Allahabad District in Uttar Pradesh, India, is severely degraded due to open cast silica mining. This continuous process of opencast mining has scarred the landscape, disrupted ecosystems and destroyed microbial communities of the area. Apart from these unsightly impacts, the degraded environments created in the aftermath of opencast mining often cannot support biomass development. Over the long term, opencast mining reduces forest productivity, damages aquatic and atmospheric ecosystems and sometimes leads to substantial alterations in microclimates. Such changes, in turn, carry adverse economic and social impacts for nearby communities whose residents depend on the region's natural resources for large portions of their incomes. Therefore there is an urgent need to reclaim these abandoned areas by using such plants, which can easily establish themselves in such adverse conditions and also support the economy of the local people. ***Jatropha curcas*** has been found most suitable for the purpose, especially due to the use of its seed oil as bio diesel and its resistant nature. It can be grown on such lands, which are largely unproductive for the time being, and are located in poverty stricken areas. The present study is on the performance of different provenances of *Jatropha* in silica mining area of Vindhayn hills, India. For this, total twenty-three provenances were collected from different parts of India. Their seedlings were raised in nursery. The growth performance of these provenances of *Jatropha* was recorded in nursery. After that, the field trial of these seedlings was carried out in the silica mining area. The growth performance was recorded. The provenance with best performance may further be recommended for the reclamation of such areas under similar agro climatic conditions and through *Jatropha* plantations, three major objectives, viz. wasteland reclamation, production of eco-friendly bio fuel, and socio-economic development of degraded areas can be achieved simultaneously.

INTRODUCTION:

Mining industry is next to the agriculture and it serves as a vital sector of economy in almost all countries. The earth contains a vast richness of minerals, which human being extracts and fashions into various goods of daily use and serves the needs of industry. Since most of the mining areas are associated with forest, the exploration and exploitation of mineral wealth brings in complete destruction of forest and vegetation in the area and formation of new wastelands in the form of barren dumps of mine overburdens with consequential ecological disturbances and environmental hazards. Opencast mining, where ores are recovered from exposed areas, is particularly disruptive to both the landscape and the ecosystem. India produces as many as 84 minerals comprising 4 fuel, 11 metallic, 49 nonmetallic industrial and 20 minor

minerals. Their aggregate production in 1999-2000 was about 550 million tonnes, contributed by over 3,100 mines (reporting mines) producing coal, lignite, limestone, iron ore, bauxite, copper, lead, zinc etc. More than 80 per cent of the mineral production comes from open cast mines (T E R I. 2001). Silica, a mineral, is used in glass industry. Silica sand resources are distributed in Andhra Pradesh, Bihar, Gujarat Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh States of India. Major mines of silica sand are in Allahabad District of Uttar Pradesh State of India. The Shankargarh area - a part of Allahabad District - is famous for its Silica mines and for the quality of the silica deposits that are found here. These mines are situated in the Vindhyan Hills of the Allahabad District and extensive open cast silica mining activities are being performed since over three decades, causing great damage to the forest as well as productivity of the region. Therefore the reclamation of this mining area becomes a priority to counter environmental hazards and to restore the ecological balance. For reclaiming this mining area, proper selection of the species that will adapt with the climatic and local soil condition is a critical step. Moreover the selected species should also alleviate the economics of the local people. A perceived advantage of Jatropha for its capability to grow on marginal land and its ability to reclaim problematic lands and restore eroded areas, in the present study, performance of *Jatropha curcas* is studied in the silica mine area.

The oil plant *Jatropha curcas* (Jatropha) or physic nut is a multipurpose and drought resistant large shrub or small tree from the family Euphorbiaceae. Although a native of tropical America, it now thrives throughout Africa and Asia. Jatropha is adapted to a wide range of climates and soils. It can grow almost on any type of soil whether gravelly, sandy or saline and thrives even on the poorest stony soils and rock crevices. It is a drought resistant perennial, living up to 50 years. In India *Jatropha curcas* is found in almost all States. Being drought tolerant, it can be used to reclaim degraded areas (G. Francis et. al., 2005; K. Dubey et. al., 2005; Jones and Miller, 1992). It is an economically important species and adds to the capital stock of the community, for sustainable generation of income and employment (Openshaw, 2000). Jatropha seeds contain about 35% of non-edible oil that can be used for making soap, candles, and varnish and as lubricant, hydraulic oil etc(Anon., 2001; Singh et.al. 2005). Jatropha oil is an environmentally safe, cost-effective, renewable source of non-conventional energy and a potential substitute for diesel, kerosene and other fuel oils(Chaudhri and Joshi, 1999). After the extraction of oil from the seeds, the oil cake left behind can be used for Bio Gas production and being rich in nitrogen, phosphorous and potassium it is excellent organic manure. Another special feature of Jatropha lies in its high level of carbon absorption from the atmosphere, which is stored to the woody tissues of the plant and assists in the build up of soil carbon. Therefore, the crop also earns carbon credits. Various parts of the plants are of medicinal value, its bark contains tannin, the flower attracts bees and thus the plant has honey production potential. The latex of *Jatropha curcas* contains an alkaloid known as “jatrophine” which is believed to have anti cancerous properties. It is also used as an external application for piles. Its roots are used as an antidote for snakebites. The leaves are used for fumigating houses against bed bugs (Katwal and Soni, 2003). Owing to its multiple uses and its hardy nature, a plantation trial was carried to study the growth performance of different provenances of *Jatropha curcas* in the silica mine area under rain fed conditions.

MATERIAL AND METHODS:

Site selected for the study was situated at Shankargarh in Allahabad District. The area was degraded due to open cast silica mining and other biotic interferences. Area involved in mining in Shankargarh includes 40 villages covering about 150 sq. km. Over burden in the area is not uniform and varies from place to place. The soil has low moisture retaining capacity. The area suffers from high temperature during most of the period of the year. For Jatropha plantation, total of twenty-three provenances were collected from different part of India. The seeds of these provenances were procured from the different research organizations from all over India. Seedlings were raised from these seeds at Padilla Research Nursery of the centre. The seeds were cleaned manually. Before sowing, the seeds were soaked in water for 12 hours at ambient temperature and sown in polythene bags which were filled with soil, Farm Yard Manure and sand in 1:1:1 ratio in the month of February. The germination started within a week. . The weeding and hoeing and irrigation of the seedlings of Jatropha provenances were done regularly. The field plantation trial of all provenances was carried out at Silica mining area of Shankargarh, Allahabad District, under rain fed conditions. The plantation site is situated at Shankargarh range of Allahabad forest division. The plantation trial was established in Randomized Block Design with three replications and 2m X 2m spacing in the month of August. Survival and growth data (height and girth) were recorded.

RESULT AND DISCUSSION:

The growth data *viz* . plant height and collar diameter, were sown in Table 1. As far as the survival was observed almost all provenances were performing well in silica mine area. It is revealed from the Table that the highest survival percentage was found in case of Jabalpur (TFRI-I) provenance followed by Allahabad (Shankargarh), Coimbatore (TNMC-2), Coimbatore (TNMC-3), Coimbatore (TNMC-4) and SFRI, Jabalpur (Indore) provenances. As far as the growth increment in height was concerned, the highest increment was obtained in Akola PKVJ-DHW-1 provenance followed by Coimbatore (TNMC-5).The increment in height was lowest in case of Panthnagar (PJ Sel-1). The highest increment in collar diameter was observed in provenance, Coimbatore (TNMC-4) followed by Jhansi (NRCJ-41) provenance. The lowest increment in collar diameter was observed with Panthnagar (PJ Sel-1) provenance. It is observed from the table that Akola PKVJ-DHW-1, Coimbatore (TNMC-5) provenances have shown the best performance, as far as overall growth performance is concerned. Provenances, Kanpur, Jhansi (NRCJ-41), Akola PKVJ-MKU-1, Coimbatore (TNMC-2) and Coimbatore (TNMC-4), have also performed well on such problematic site. These provenances may be planted for revegetation of such sites.

Mining is essentially a destructive developmental activity; where ecology suffers at alter of economy. Unfortunately, in most regions of the earth, the underground geological resources are superimposed by biological resources i.e. forests. This is particularly evident in India. Hence mining operations necessarily involve deforestation. It also affects the economics and social life of local communities whose residents depend on the region’s natural resources for large portions of their incomes. Shankargarh where these silica mines are situated is a backward area despite the rich mineral resources that it has and despite the revenues that the state gets from mining. Its extensive quarrying and open cast mining have resulted into long barren, unproductive and deeply irregular sloppy lands therefore unfit for cultivation. The local

Table 1: Relative Growth Performance of Different Provenance's of *Jatropha curcas* at Silica mining Area:

S.No.	Provenance	Height at the time of plantation (cm)	Collar Diameter At the time of plantation (cm)	Height after six months of plantation (cm)	Collar Diameter after six months of plantation (cm)	Survival Percentage after six months of plantation	Increment in height after six months of plantation	Increment in collar diameter after six months of plantation
1	Kanpur	43.29	4.15	87.5	6.58	91.67	44.21	2.43
2	Jhansi (NRCJ-41)	39.38	2.52	76.08	6.33	91.67	36.70	3.81
3	Jhansi (NRCJ-42)	40.30	3.74	61.17	6.33	89.58	20.87	2.59
4	Jhansi (NRCJ-47)	42.58	2.74	59.92	5.67	95.83	17.34	2.93
5	Jhansi (NRCJ-53)	45.92	4.04	72.5	6.5	91.67	26.58	2.46
6	Akola PKVJ-MKU-1	50.10	3.46	89.58	5.83	97.91	39.48	2.37
7	Akola PKVJ-DHW-1	35.28	4.35	103	7.58	89.58	67.72	3.23
8	Rahuri (RJ-117)	40.99	3.50	70.08	6.08	85.42	29.09	2.58
9	Panthnagar (PJ Sel-1)	49.51	3.47	62.67	5.25	91.67	13.16	1.78
10	Panthnagar (PJ Sel-2)	46.34	3.89	63.33	5.83	93.75	16.99	1.94
11	Jabalpur (TFRI-I)	38.64	3.59	55.58	5.83	100.00	16.94	2.24
12	Jabalpur (TFRI-II)	42.83	4.62	68.75	6.58	91.67	25.92	1.96
13	SFRI, Jabalpur (Indore)	32.65	2.70	65.67	6.25	97.91	33.02	3.55
14	SFRI, Jabalpur (Sagar)	40.12	3.21	60.25	6.25	91.67	20.13	3.04
15	Jabalpur (Silviculture nursery)	45.56	3.77	70.33	6.0	91.67	24.77	2.23
16	Jabalpur (Barah Expt. area)	40.99	3.21	64.16	5.08	95.83	23.17	1.87
17	Allahabad (Shankargarh)	42.16	3.63	66.25	5.5	97.91	24.09	1.87
18	Coimbatore (TNMC-2)	42.67	4.95	85.83	7.75	97.91	43.16	2.80
19	Coimbatore (TNMC-3)	40.12	4.71	74.67	7.42	97.91	34.55	2.71
20	Coimbatore (TNMC-4)	37.19	3.85	74.5	7.75	97.91	37.31	3.90
21	Coimbatore (TNMC-5)	36.38	3.76	87.33	7.33	91.67	50.95	3.57
22	Coimbatore (TNMC-7)	50.36	3.81	72.63	6.5	85.42	22.27	2.69
23	Coimbatore (TNMC-22)	44.20	3.22	72.42	5.42	91.67	28.22	2.20

population has no other source of income than from mining. Since Jatropha is a perennial hardy drought resistant, valuable multi-purpose crop to alleviate soil degradation, desertification and deforestation (Henning R., 1996). It helps to increase rural incomes, self-sustainability and alleviate poverty and hence this plant offers the option both to cultivate wastelands and to produce vegetable oil suitable for conversion to bio-diesel and other economically important by products as an alternative resources of income (Francis, G. et. al., 2005). Because of these attributes, *Jatropha curcas* was found suitable species for reclaiming such degraded areas, especially that are located in poverty-stricken areas. In previous reclamation studies of silica mining site, suitability of other species has also been studied (Dubey, K. et. al., 2006). But through *Jatropha* plantations, three major objectives, viz. wasteland reclamation, fuel production, and socio-economic development of degraded areas can be achieved simultaneously.

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