Jatropha Production Options Under Varied Resource Conditions

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Abstract

The upsurge in interest on biodiesel has resulted in the emergence of Jatropha as a favoured species among many. Information on cultivation aspects and the potential yield of Jatropha are available from many sources. However, not all the data in the literature circulated currently is based on locally carried out research. Whereas seed yield of more than 5.0 t ha^{-1} is often cited in calculations, actual yields realised appear to be less than 2.0 t ha^{-1}. Therefore, there is a likelihood of Jatropha growers getting misled by the high seed yields and profits being projected by enthusiastic promoters. It is appropriate to identify production niches based on resource availability and realistically estimate attainable seed yields under varied situations. Presently, the emphasis has to be on yield targets under average resource commitment rather than very high yields quoted in literature. The paper presents Jatropha yield data obtained by BAIF under low input conditions and examines possibilities under different production systems.

1. Introduction

The continuing search for energy options has resulted in the emergence of biodiesel as a potential alternative. This in turn has stimulated research and extension efforts to investigate tree species that produce oilseeds. Among the species being focussed on, Jatropha appears to be the frontrunner. There are several reasons for the greater interest in Jatropha. It already has a domestication record as research on it has been carried out in India and other countries. Seed oil characteristics of Jatropha are superior to others for biodiesel production. Besides its faster growing attribute when compared to most other tree-borne oilseed species, it also has the ideal size for agroforestry. Thus, Jatropha has emerged as the premier species for biodiesel production.

Cultivation of Jatropha is promoted through government and non-government initiatives and there are reports of establishment of large-scale plantations. Although its biodiesel application is proven, the projected seed production potential is yet to be demonstrated under different agro-climatic conditions. This is an area of concern as unrealistic claims may eventually lead to loss of interest among Jatropha growers. This paper examines the seed production possibilities under different sets of conditions in which Jatropha is likely to be cultivated.

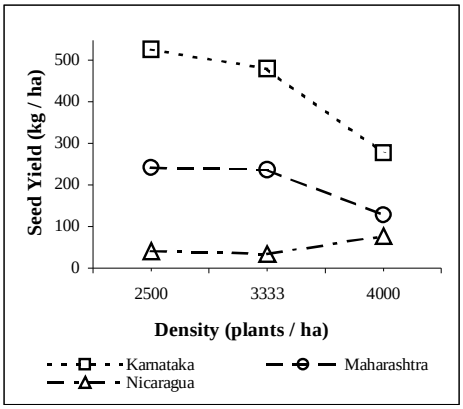
2. BAIF's Experience with Jatropha

The BAIF Development Research Foundation in Pune has been engaged in implementing rural development projects in several states. An agri-horti-forestry model introduced by BAIF, locally known as *wadi*, has been very successful in addressing biophysical and socio-economic issues on degraded small farms. The *wadi* model includes planting fruit trees such as mango with annual crops in the interspaces and forestry species like *Leucaena* along the farm border. In order to increase the agro-diversity of these farms, BAIF has been on the lookout for species that can add to the overall productivity of the *wadi* model.

Many farmers already include Jatropha as the forestry component of *wadi*, but it usually serves a protective role as live fencing and not a production function. As a production option under this system, it is possible to include 200-400 Jatropha plants per ha along the perimeter of the farm. This would result in Jatropha occupying about 8.0% of the area in a ha of land. The land under Jatropha can be increased by having it planted in three rows in a strip of 4.0 m along the farm border instead of a single row. This will increase its share of the land to about 15%. Including it between the trees within a row can further increase the area under Jatropha to 20-25%. Thus, a systematic approach in incorporating Jatropha in agroforestry models can help increase oilseed production with only minor reduction in the output of the other crops in the system.

BAIF conducted studies to determine the production potential of Jatropha on soils of low fertility under limited input and management conditions. The initial study conducted at BAIF's Central Research Station at Urulikanchan, near Pune in Maharashtra, was unsuccessful and was discontinued. Thereafter, experiments were established in the year 2005 at BAIF's Gramodaya Research and Training Centre at Lakkihalli, near Tiptur in Karnataka. The main study focussed on three genotypes under three plant densities while another examined the potential of Jatropha for agroforestry interventions. The study was conducted on land of average fertility and only protective irrigation was provided during the summer. The yields obtained in the fifth year are presented in Figure 1.

Figure 1. Seed yields of Jatropha in kg per ha in the fifth year.



There were pronounced differences in the seed yields of the genotypes in the study. The selection from Karnataka performed better than others, probably due to its adaptation to local conditions. The variety from Nicaragua did not do well in this location. The study also showed that an optimum plant density is necessary to maximise yields. In the Karnataka and Maharashtra genotypes that had satisfactory growth, seed yields declined with increasing plant density while the reverse is true for the Nicaragua variety. In the agroforestry study, neither the yield of the main Jatropha crop nor those of the intercrops finger millet and horse gram were affected by growing them together.

3. Jatropha Promotion

Promotional efforts make out Jatropha to be a wonder crop. Common beliefs, based on actual observations in the field, combined with exaggerated claims by enthusiastic promoters have raised the expectations of new entrants to the field beyond realistic limits. Table 1 summarises some of the beliefs and claims associated with Jatropha.

Table 1. Some of the beliefs and claims about Jatropha.

Particulars	Belief / Claim
1. Soil and climate	Hardy plant that grows anywhere
2. Fertiliser and irrigation	Grows with little or no inputs
3. Gestation period	Seed production from the first year
4. Multipurpose species	Bark, leaf, root and latex have uses
5. Crop protection	No serious pest or disease problem
6. Management	Grows on its own

All these observations are valid if the purpose of establishing Jatropha is for live fencing or revegetation of barren land. None of these claims hold good if it is grown for the production of seed. When raised as a plantation crop, the requirements of Jatropha in terms of nutrition, irrigation and protection may not be any different from those of other commercial crops.

4. Production Options with Jatropha

The success of Jatropha from the cultivation point of view will depend on the seed yield and the price realised for the produce. While there is some agreement on the price, at least Rs. 5.00 per kg, it is the projected yields that vary widely and often tend to be exaggerated. The potential seed yield of Jatropha, according to conventional literature, is 10-12 tons per ha per year. This is probably the biological potential and may not be attained under normal cultivated conditions, especially those prevailing in India.

4.1 High Resource Condition

The annual seed yield cited by enthusiastic promoters of Jatropha is 5.0 tons per ha. This may be attained, but not with the ease as it is often projected. Obtaining such high yields will require a high level of resource commitment that includes elite cultivars, cultivation on fertile land with high levels of irrigation, nutrition and management. Additionally, the trees have to be pruned and trained regularly during the first 2-3 years to develop a well branched-out canopy. Under such an intensive management strategy, a plantation of Jatropha may yield 5.0 tons or more once it reaches maturity more than eight years after establishment. Plantations of this nature will possibly encounter problems of pests, diseases and nutrient deficiencies. Hence they have to be managed like orchards of high-value crops.

It is unrealistic to expect a yield of 5.0 tons in the second or third year. There are claims of 0.5 kg or more seed yield in the first year itself. Any seed yield during the juvenile phase, especially the first two years, should be discouraged as it may lead to inhibition of vegetative growth and result in weaker plants. The management option should be to remove the flowers during the first three years. Hence the yield of 5.0 tons per ha per year will be attained only in mature plantations. At present, it does not appear such plantations exist in India, but some of the intensive efforts by commercial undertakings may belong to this category. Because such yields will be realised at very high cost, they may not necessarily be the most profitable options. Moreover, people may dispute the logic of diverting fertile land and irrigation water from food crops to an energy crop.

4.2 Medium Resource Condition

Among the arguments put forward to support the case for oilseed production for biodiesel are the availability of wastelands, income and employment opportunities for rural poor and the

suitability of species such as Jatropha for not so ideal farming conditions. Therefore, large-scale development initiatives for tree-borne oilseeds cannot ignore the combination of wasteland, poor people and hardy species / varieties. This is an average-resource condition that should look at a semi-intensive approach to Jatropha cultivation. The potential yield of Jatropha under this combination, at lease for the immediate future, has to be taken as 2.0 tons per ha. This is a safer option that does not raise the expectations to extremely high levels. Working with a conservative return can avoid disappointment later and anything above this can be considered a bonus.

4.3 Low Resource Condition

The approach for low-resource condition has to be extensive cultivation of Jatropha. The production target under such conditions should be in the region of 1.0 ton per ha. This is not an attractive proposition at first glance, but does hold promise where optimising resource use is a greater priority than maximising yield. Vast areas of common and institutional wastelands that remain barren at present can be brought under Jatropha in this option. There are marginal lands belonging to small farmers in dry areas where some crop is cultivated during the rainy season. The returns from those crops are so meagre that Jatropha may turn out to be a better option. There are others who raise crops on a part of their land while the other part, usually the less fertile one, remains barren. Such land can also be brought under Jatropha with limited commitment of inputs and labour.

5. Concluding Remarks

The biological potential as well as the yields reported from intensive production conditions are unlikely to be realised when Jatropha is cultivated under resource-limited situations. The resources available and the priority of their allocation are such that bulk of the seed production in the country has to come from less intensive production options. In this regard, promotional efforts should focus on semi-intensive options for farms having average resource conditions. Commercial ventures will be on an intensive scale while an extensive option will be appropriate for wastelands.