IndianFarming **63**(11): 59–61; February 2014

Gums and Resins:

Untapped potential of agroforestry systems for livelihood support

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THE gums and resins trade in India faces declining trend in the production base of the produce due to ruthless tapping and unorganized harvesting approaches. However, the demand for natural gums and resins has been continuously increasing in the world market since 90's. Integration of gums and resins yielding trees in agroforestry land use may help in increasing production base of gums and resins, and provide a new option of livelihood support to small holders at the edge of climatic vulnerability. Besides, the gum and resin based agroforests will also contribute in mitigating enhanced CO_2 in atmosphere. This article is an attempt to showcase the potential of agroforestry land use for producing gums and resins for livelihood support.

Gums and Resins

Gums are exuded by plants partly as natural phenomenon and partly as a result of disease or injury to the bark of wood. These arise chiefly from the stem but sometimes also from the roots and even from the leaves and other parts of plants. Gums are found in a large number of families such as Leguminosae, Sterculiaceae, Anacardiaceae, Combretaceae, Meliaceae, Rosaceae and Rutaceae. On the basis of solubility gums can be grouped into three category viz. soluble, insoluble and semi-soluble.

Natural oozing of gum from four-years-old tree of *Acacia nilotica* in Jhansi, Bundelkhand

Gums and resins are the most important non timber forest products (NTFP) widely traded in national and international market. In modern times applications of gums and resins have expanded world over in many industries such as paper, textile, petroleum, pharmaceutical, cosmetics, food, varnishes, lacquers and soap. The world's major producer of gums and resins include India, China, Sudan and Indonesia. India annually produces 281,000 tonnes which include about 224,000 tonnes of gums, 55,500 tonnes of resins and 1,500 tonnes of gum-resin. Traditionally, India is the largest producer of lac, guar gum and karya gum. The bulk of commercially important gums in the country come from the Central Indian Forests consisting of states like Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Odisha, Jharkhand and Bihar. The gum producing areas are the Western Ghats, Eastern Ghats, and surrounding areas. Though there are more than 30 commercially important gum and resin species available in India, the number of important trees with substantial production is rather small. Among the various kinds of gums, the important species are gum karaya (Sterculia urens), gum dhawara (Anogeissus latifolia) and gum arabic (Acacia senegal). Among resins, the important ones are Sal resin (Shorea robusta), Salai (Boswellia serrata), black dammer (Canarium strictum) and Guggul (Commiphora weightii).

Soluble gums dissolve in water and form more or less transparent, viscous and adhesive solutions, for example gum arabic. Insoluble gums often swell with the addition of water and forms gel, for example gum Karaya. The semi-soluble gums decompose completely without melting on heating. The use and commercial value of gum is determined by its physical and chemical properties.

Resins are oxidation products of various essential oils and complex in nature with varied chemical composition. They usually occur as derivatives of starch and are mixture of volatile and non-volatile compounds. All the natural resins are vegetable in origin with the exemption of lac (it is a natural resin and comes from an insect *Laccifera lacca* Kerr. Resins are not edible, aromatic and inflammable. They are insoluble in water but usually dissolve readily in alcohol, ether and certain other solvents. Resins can be classified into three categories. The first one is the Dammers, which are hard and transparent resins containing a small amount of essential oils. The important commercial species under this category are *Canarium*, *vateria* and *shorea*, *Copals* and *Shellac*. The second one is Myrrh, aromatic oleoresins containing considerable amount of essential oils, mainly from genus *Commiphora*. The third category is Frankincense that is gum resin from species *Boswellia*. Major resins available in India are Sal (*Shorea robusta*), Salai (*Boswellia serrata*), Frankincense, Black Dammer (*Canarium strictum*), Guggul (*Commiphora mukul*), Vellapine (*Vateria indica*), Chir pine (*Pinus roxburgii*), Gurjan (*Dipterocarpus terbinatus*) and Indian Gamboge tree (*Garcinia morella*). The major resin producing states are Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh and Odisha. Resins are found in a large number of families. Notable among them are Pinaceae, Fabaceae, Burseraceae, Dipterocarpaceae.

Gum-resin based Agroforestry Systems

Agroforestry is the integration of trees into farming systems for producing various marketable food and non-food products. There are many gums yielding tree species which can be planted as woody components along with crops in an agroforestry model. The associated crop and trees can vary from region to region and such agroforestry models will be highly beneficial to the resource poor farmers in providing livelihood security. For development of gum and resin based agroforestry models, selection of tree species which produce gums and resin is first requisite. The tree species identified for different climatic region are:

- Arid and Semi-Arid: *Acacia nilotica*, *Acacia catechu*, *Acacia senegal*, *Anogeissus latifolia*, *Bauhinia retusa*, *Bombax ceiba*, *Boswellia serrata*, *Butea monosperma*, *Commiphora mukul*, *Shorea robusta*, *Sterculia urens.*
- Sub Humid: *Acacia catechu*, *Bombax ceiba*, *Canarium stritum*, *Dipterocarpus turpinatus*, *Garcinia morella*, *Hopea odorata*, *Shorea robusta.*
- Humid Tropics: *Bombax ceiba*, *Canarium stritum*, *Cochlospermum religiosum*, *Dipterocarpus turpinatus*, *Garcinia morella*, *Hopea odorata*, *Kingiodendron pinnatum*, *Lannea coromandelica*, *Pinus wallichiana*, *Sterculia urens*, *Veteria indica*
- Sub-Tropical: *Acacia nilotica*, *Acacia catechu Acacia senegal*, *Anogeissus latifolia*, *Bauhinia retusa*, *Bombax ceiba*, *Boswellia serrata*, *Butea monosperma*, *Cochlospermum religiosum*, *Commiphora mukul*, *Garcinia morella*, *Hopea odorata*, *Kingiodendron pinnatum*, *Lannea coromandelica*, *Pinus roxburghii*, *Sterculia urens*
- Temperate: *Butea monosperma*, *Dipterocarpus turpinatus*, *Garcinia morella*, *Kingiodendron pinnatum*, *Pinus roxburghii*, *Veteria indica*
- Moist: *Dipterocarpus turpinatus*, *Kingiodendron pinnatum*, *Pinus roxburghii*, *Pinus wallichiana*, *Veteria indica*

The agroforestry models can be developed by planting selected tree species for the given agro-climatic condition. Trees can be planted on boundary of the field or as rows inside the field. The distance between row to row and tree to tree in a row depends on growth behaviour of tree species and associated crops. Generally row to row distance should be such that agricultural operations can be performed without any hindrance. To reduce harm full effects of trees on associated crops, tree pruning must be conducted. Before establishing an agroforestry model, expert opinion of the specialist must be taken. The associated crops should be selected on the basis of selected tree species and its growth behaviour so that both components (woody and annual crop) offer minimum competition to each other. Gum and resin yielding tree species should be planted after getting complete information on produce quality and its market.

Among four major agroforestry systems based on the nature of woody perennial and annual components, agrisiliviculture system with different gum and resin yielding trees, fruit trees and agricultural crops in different combinations can be practised. As for as possible, wider spacing is

Mustard in Gum arabic based agroforestry model: *Acacia senegal* + *Aegle marmelos* + *Citrus limon* in Jhansi, Bundelkhand

advised to allow optimum sun light in the inter spaces and minimize reduction of annual crop yield. Choice of the annual crop will depend upon the farmer's interest and the local edapho-climatic conditions. In areas where soil quality is poor (degraded, sloppy, less soil depth, rocky out growth, low nutrient status), block planting of gum and resin yielding trees is recommended with 6 x 6 m spacing. In this system, intercropping of agricultural and fodder crops can be taken during the first 2 – 3 years. To ensure the seedling survival and better establishment, bigger pit size of 1x1x1 m is advocated in addition to soil and water conservation measures. The recommended spacing are 20 x 10 m for fruit tree and crop combination, 6 x 6 m for block plantations, 5 m spacing between trees for boundary plantation, 4 m spacing between trees for live fencing in case of thorny species and from 2.5 to 5 m spacing for fruit trees.

Research Initiatives in Bundelkhand

For developing suitable agroforestry models based on gums and resins yielding trees, research efforts are being made at National Research Centre for Agroforestry, Jhansi (NRCAF); which is one of the co-ordinating centres in the network project on Natural Resin and Gums headquartered at Indian Institute of Natural Resin and Gums, Ranchi. Under this project the major thrust is given to gum production techniques on naturally growing *Butea monosperma* trees (palas) and development of agroforestry models based on gum yielding trees viz., *Acacia nilotica*, *A. senegal* and *Anogeissus pendula* in Bundelkhand region of Central India. *Butea* tree is also a host for lac insect and offers great potential for lac cultivation, besides yielding gum. Hence, efforts are also made to assess effect of lac production on gum yield and vice versa in *Butea monosperma*. In Bundelkhand region of Central India, *Butea* trees occur naturally and widely distributed on farmer's fields, degraded land common grazing areas and forests. Studies at NRCAF have revealed that on average, 10-15 trees/ha of *Butea monosperma* are available on farmer's field and used by local tribe (Saharia) for collecting gum-butea called *kamarkas*. Yield of gum-butea greatly depends on tree growth factors and incisions made on bark of the stem. On an average, a tribal family earns ₹ 677 in a season. Significant correlations exist between number of man-days employed and number of trees approached, total amount of gum collected and total income. On performance of agroforestry models, it has been shown that after four years of planting of various agroforestry models, survival and growth of planted gum yielding trees and horticultural plants was more in models developed at research farm than the models on farmer's field. Out of the two gum yielding tree species, better performance has been shown by *A. nilotica* than *A. senegal*. Among horticultural species *E. officinalis* had shown maximum growth while *C. carandus* the least. *Acacia nilotica* planted at farm has been reportedly started exuding gum whereas, no gummosis has been observed either in *A. senegal or A. nilotica* on farmers' field. The main reason for poor survival and growth of planted species on farmers' field was uncontrolled grazing due to practice of *annapratha*.

For tapping of gum from the existing trees in the agroforestry system, improved tapping techniques and use of gum inducer (ethephon) are being experimented to obtain more gum yields. Results of studies conducted to assess whether type of incision on bark had any effect on yield of gum-butea revealed that out of four types of cuts *viz.* knotching, vertical cuts, slant cuts and horizontal cuts on bark of the stem, maximum gum-butea was obtained with knotching and minimum with slant cuts. The initial results of a study conducted to assess effect of inoculation of lac insect on gum yield of butea trees revealed that inoculation of lac insect increases gum exudation. On use of ethephon for inducing gummosis in *Butea monosperma* (Lam.) in Bundelkhand region, it has been observed that the yield of gum-butea was significantly increased by application of ethephon, however, varying doses of ethephon had no effect on gum yield. On an average, maximum amount of gum-butea was obtained when ethephon was sprayed on surface on tree stem before knotching. The studies on use of ethephon to induce gummosis in *Anogeissus pendula* E. revealed that maximum gum yield was obtained in the month of October followed by March. During rainy season and summer months, exudation in *A. pendula* was not observed. Dose of 1170 mg ethephon yielded highest gum (65.3g/tree) while 390 mg the least (37.5g/tree). The exuded gum was of variety of forms viz. globular, tear shaped or irregular masses and good quality. Use of ethephon did not show any negative effect on tree health. In view of negligible gum oozing from *A. pendula* in nature, application of ethephon @ 1170mg/tree in the month of October has been suggested for enhancing gummosis and gum yield.

SUMMARY

Agroforestry offers options for different combinations of gum / resin yielding trees, crops and fruit trees for better utilization of available resources and increasing productivity on sustainable basis. Agrisiliviculture models can suitably be adopted wherein the density of the fruit crops and the trees are altered to provide returns throughout the year. These agroforestry models offer opportunities for increasing tree cover, enhancing productivity of gums, resins and fruits, and insurance to ecological stability.

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