Innovative Farming
-An International Journal of Agriculture

Popular Article

PROSOPIS JULIFLORA: A TREE FOR REHABILITATING SALT AFFECTED SOILS

Vijayata Singh*, Jogendra Singh, T.V. Vineeth and P.C. Sharma
Central Soil Salinity Research Institute, Karnal, Haryana-132001, INDIA
**Corresponding author's E-mail: vijayatasingh.gpb@gmail.com*

KEY WORDS:
Prosopis juliflora, Agroforestry, Rehabilitization

ARTICLE INFO:
Received on: 23.02.17
Revised on: 16.03.17
Accepted on: 17.03.17

ABSTRACT
The earth is experiencing a faster change in climate in the 21st century than it had in the past. Abiotic stresses such as drought and salinity, exacerbated by the fast changing climatic conditions pose a major hurdle in sustaining crop productivity. High salt concentration in the soil is a serious problem in vast areas of otherwise productive agricultural lands in India. Establishment of salt tolerant vegetation could be an effective way of ameliorating this problem. *Prosopis juliflora* has a lot of potential for rehabilitating and management of salt affected soils. Being a source of fuel, small timber wood and in some cases used as dry season fodder, *Prosopis* is playing a vital role in sustaining the livelihoods of the rural poor, society with disadvantaged resources including the landless labourers, small farmers and artisans in dry regions.

Introduction

Around the globe 932 million ha and in India, nearly 6.73 million ha area is affected with salinity and sodicity stresses covering various states of the country. Further, the arid and semiarid areas in different states are associated with saline underground water, which have to be used for irrigation purpose makes soil unfit for crop cultivation. High salt concentrations in the root zone soil limit the productivity of agricultural land. Many fertile lands in arid and semi arid parts of the country can no longer be cultivated due to the salt problem. There is an urgent need to stop this soil degradation process and to restore the health of already degraded lands. *Prosopis* is playing a vital role in sustaining the livelihoods of the people living in area with disadvantaged resources. In the rural areas, *Prosopis juliflora* is the only source of fuel, small timber wood and in some cases used as dry season fodder. The trees provide alternative livelihood security during the severe drought period when no other vegetation remains green and productive. It is estimated that more than 50 per cent of the total fuel wood requirement in arid and semi arid areas is met by *Prosopis juliflora*. Many scientists believe genus *Prosopis* is a nature's gift to reclaim wastelands and a source of livelihood to the poorest in the poor category.

Planting, management and Use of *Prosopis*

Prosopis juliflora is generally propagated by seed, root suckers, and hardwood cuttings. Hot water or acid treatment will expedite seed germination. In India, seeds collected in May–June may be sown right after collection, but September–October seed are not sown until April. For line fencing, seeds may be sown in two adjacent rows a 50 cm apart, with a spacing of 30 cm between the sowings. Transplanting one-year old in the rainy season is preferable to direct sowing. Root and shoot cuttings with minimum diameter 12.5 mm at the collar and 100 mm long are satisfactory. In areas where *Prosopis* has spread intensely, the woody plant usually reaches the size of a shrub when growing in dense thickets. However, there are several methods, tested in the field, that enable the woody plant to grow to the size

of a tree so that it has many applications in the wood-processing industry. Pruning enhances the growth of *Prosopis*, creating large, straight, and single-trunk trees with increased diameter and height. Pruning increases the stem diameter due to improved photosynthesis and the allocation of its products within the tree. *Prosopis* responds positively to pruning with a rapid increase of new leaf growth. Although the leaf biomass is reduced immediately after pruning, there is an increase of above ground growth after four months (ElFadl and Luukkanen, 2003).

After pruning, *Prosopis* shows an increase in photosynthesis rates on leaf area unit compared to untreated trees. The reduced leaf area causes a reduction in the total transpiration rate, thus increasing the leaf water potential and leaf turgor and leading to greater leaf CO_2 conductance. The trees use the increased flow of photosynthates for growth and metabolic processes, with the effect of an increase of diameter growth to twice the rate found in unpruned trees. The height increases with more intensive pruning until a specific limit, beyond which a reduction is noted. It has been suggested that this is due to a decrease in light competition, since at a certain level of light intensity the tree crowns become flattened and the trees tend to invest in lateral growth of the lower remaining branches. Pruning has proved to be most effective when branches are removed up to three quarters of the total tree height, leaving only the top quarter with branches and foliage. In this way the tree grows a singular thick stem with a green leaf mass sufficient to provide the material and energy for growth. *Prosopis* is generally used in resource poor areas for following purpose:

a. As livestock feed

Almost half of the earth's land surface is used for grazing and the production of forage, which makes it the largest form of land use in the world. In arid and semi-arid areas, trees and shrubs supply the major feed for livestock. Livestock production in those areas is often the most economically viable, and often the only, way to utilize the vast lands that are characterized by scarce water resources and recurring droughts. The value of *Prosopis* species in general and *P. juliflora* in particular, lies in the fact that they are able to survive and grow in the most harsh dry land conditions where other plants would not survive. The use of *Prosopis* pods as a livestock feed is of great advantage in the arid and semi-arid areas of India. *Prosopis* grows naturally in drought affected areas, requiring only small quantities of water for its growth. Malnutrition is one of the multiple hazards that livestock faces under these harsh conditions. It has been observed that a mature 10-year-old tree grown under good conditions of soil and water availability is able to produce 90 kg of pods per year. A pod yield of 2,000 kg/ ha of *Prosopis* was estimated for the unmanaged Arizona dessert in North America and 4,000-20,000 kg/ha in the arid Hawaiian savannas (Felker and Bandurski, 1979). In the north-east of Brazil, pod yields of 2-3 tons/ha are produced even on shallow stony soils with vegetation typical of semi-arid regions and with no agricultural value. Pod production of *Prosopis* can be increased three to four times if irrigation is provided during the flowering period, which lasts two months. However, pod production may continue even after a drought period of 2-3 years. *Prosopis* pods contain 20-30 percent sucrose and about 15 percent crude protein. They can be used in various ways as animal feed without causing any adverse digestive effects when used properly. Although crushed and ground pods are suggested as an additional feed, the feasibility of these techniques is questioned due to limited availability of manpower that processes the pods, causing additional expenditure to the average livestock farmer. It is further suggested that the pods should be mixed with other feed and that continued feeding of pods to cattle as the only diet should be avoided. Pods in well-preserved silage have produced excellent livestock feed.

b. As a honey tree

Prosopis regularly produces an abundant amount of flowers that are used for forage by honeybees even during times of drought. After the introduction of *Prosopis* into Hawaii in the 1930s, the island became one of the largest producers of honey. The honey produced from *Prosopis* flowers is claimed to be of excellent quality. A substantial amount of this honey (300 metric tons) was harvested and marketed during a five year period in the early 1990s in the state of Gujarat alone. The rare local honeybee species *Apis florea* (Fabricius) and *A. cerana* (Fabricius) use the nectar and pollen of *Prosopis* to produce honey which is also used in traditional medicine (Pasiecznik *et al.,* 2001). A large number of beekeepers in South India earn their living from *Apis cerana* bees, which are known to be good pollinators. *Apis florea* (dwarf honeybee) has adjusted to the extreme climate of the arid and semi-arid zones

and occurs in large numbers in the arid zones of Gujarat; it is also present in smaller numbers in South India. Beeswax is used as a pharmaceutical and industrial raw material, out of which candles, creams and balms are manufactured.

Rehabilitating and management of salt affected soils by planting *Prosopis*

Growing trees on saline wastelands provides the unique opportunity to produce, timber, fuel and biomass for energy on land that is of little economic value for food production. Thus, one of the major drawbacks of the current production of biomass for energy: the competition with food production is avoided. With growing populations, increasing demand for basic resources (food, fiber and shelter) is growing hence these challenges is providing new opportunities for the salinized marginal lands that can be found in many arid, semiarid and even sub-humid areas in South-Asia and elsewhere. The world's salt affected soils are mostly degraded and desertified, deficient in soil nutrients, vegetation cover and biodiversity. Saline soils contain excess neutral soluble salts, mainly chlorides and sulphates of sodium, magnesium and calcium, in quantities sufficient to affect plant growth adversely. The water-saturated paste extract of these soils has an electrical conductivity of 4 dS/m and above and pH less than 8.2. When chlorides and sulphates of Ca and Mg pre-dominate soluble salts, the sodium absorption ratio (SAR) in the saturation extracts is usually less than 15. However, salinization with neutral soluble salts of Na invariably results in SAR greater than 15. The plant growth in saline soils is adversely affected, chiefly, due to the osmotic effects of excess salts on the availability of soil water, and the toxic effect of specific ions e.g., chloride, sulphate and boron is often an additional factor determining plant-growth relationships in saline soils. Surface drainage is the viable remedy to reclaim these soils but it is highly costly technique and cannot be accomplished without the Government's help. Therefore, raising salt-tolerant trees and crops remains the ideal option of rehabilitation of these lands.

Productivity enhancement of salt-affected soil and water resources through crop-based management has the potential to transform them from stress prone into productive. *Prosopis* species have agricultural significance in terms of their local utilization on the farm. Therefore, crop diversification systems based on these salt-tolerant plant species are likely to be the key to future agricultural and economic growth in regions where salt-affected soils exist and saline water is used for irrigation (Qadir *et al.,* 2008). Research has shown the usefulness of different *Prosopis* species in rehabilitating and protecting various soil types in various parts of the tropical arid and semi-arid zones and agricultural practices can be successfully re-introduced.

Prosopis is potentially useful for rehabilitating degraded saline soils due to high temperatures and irregular precipitation in dryland ecosystems (Singh *et al.,* 1993). *Prosopis* planted when by auger hole and pit methods (original soil was treated with gypsum at 3 kg/plant and then refilled) on degraded sodic soils increases soil fertility through adding to and increasing the soil organic C (0.19-0.31%) apparently due to litter fall from tree, available nitrogen (88.6 to 109.7 kg/ha) attributed to increased organic carbon (OC) content, available phosphorus (26.1 to 36.4 kg/ha), available K, (524.4 to 570.4 kg/ha), Ca and Mg levels. In addition, decreases in the exchangeable Na level, pH and EC as well as improvement in water infiltration. It possibly may be due to improved soil environment in terms of organic matter build up, soil aggregation and reduced sodicity hazard and increase biomass accumulation which has a positive effect on the rehabilitation of sodic soils through the improvement of nutrient cycling and detoxifying sodicity (Singh *et al.,* 1988).

Conclusion

This article suggests that *Prosopis* is appropriate plants for salt lands. It has the potential for fuel, fodder and timber production. This agroforestry practice appears to be promising for exploiting those salt lands which cannot be readily reclaimed through conventional techniques.

References

ElFadl, M.A. and O. Luukkanen. 2003. Effect of pruning on *Prosopis juliflora*: Considerations for tropical dryland agroforestry. *Journal of Arid Environments,* **53**(4): 441-455.

Felker, P. and R.S. Bandurski. 1979. Uses and potential uses of leguminous trees for minimal energyinput agriculture. *Economic Botany*, **33**(2): 172-184.

Pasiecznik, N.M., P. Felker, P.J.C. Harris, L.N. Harsh, G. Cruz, J.C. Tewari, K. Cadoret and L.J. Maldonado. 2001. The *Prosopips juliflora-Prosopis pallida* Complex: A Monograph. HDRA, Coventry, UK, pp. 162.

Qadir, M., A. Tubeileh, J. Akhtar, A. Larbi, P.S. Minhas, and M.A. Khan. 2008. Productivity enhancement of salt-affected environments through crop diversification. *Land Degradration & Development*, **19**: 429–453.

Singh, G., I.P. Abrol, and S.S. Cheema. 1988. Agroforestry on alkali soil: Effect of planting methods and amendments on initial growth, biomass accumulation and chemical composition of mesquite (*Prosopis juliflora* (SW) DC) with inter-space planted with and without Karnal grass (*Diplachne fusca* Linn. P. Beauv.). *Agroforestry Systems*, **7**: 135-160.

Singh, G., N.T. Singh, and J.C. Dagar. 1993. Agroforestry in salt-affected soils. Technical Bulletin No. 17, CSSRI, Karnal, India, pp. 65.

How to cite this article?

Vijayata Singh, Jogendra Singh, T.V. Vineeth and P.C. Sharma. 2017. *Prosopis juliflora*: a tree for rehabilitating salt affected soils. *Innovative Farming,* **2**(1): 80-83.