
Leucaena - Adaptation, Quality and Cultural Practices in Pakistan

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ABSTRACT

Leucaena belongs to family Leguminosae (Mimosoidae). It is suited to sea coast, but can be grown in dry or wet districts. Sometimes it becomes weed in cultivated areas. It has a number of common names; leucaena; ipilipil, lamtara; guaje; yaje; vaxin; lead tree; koahaole; hawaii and lamtore. Leucaena has number of varieties, more than 55 but only know species are: leucaena Collinsii; Leucaena Diversifolia; Leucaena Esculenta; Leucaena Lanccolate; Leucaena Leucaena leucocephala; Leucaena Macrophylla; Leucaena Pulverulenta; Leucaena retusa and Leucaena shannoni.

Leucaena leaflets contain 25-30% protein, and rich source of carotene, vitamin, pro-vitamin A. Caloric value is 4,200-4,600 Kc1/Kg. It has a large number of uses which include; dye extracted, used in children feed to produce more yellowing glactomannan derived from leucaena seeds contain 25% yields of gum (mucilage). Tree helps in Honey been colonies formation. Its use in cattle produces extra ordinary weight gain. Wood is used for timber, firewood, charcoal, and its roots help in nitrogen fixation in the soil. It improves soil rebuilding tilth and surface texture, reduces run-off.

Leucaena contain Mimosine an un-known amino acid, so if the ruminant consume leucaena in excess they show the sign of loosing hair, and extreme condition shows goiter. Leucaena is highly resistant to pest and diseases, but is attacked by large number of insects like twig borers, chewing insects, mealy bug, nipacococcus vastator, and rat, rabbit, deer, monkey and snail. The most serious disease is fungal gummosis, the casual agents Fusarium Semitectum and Bark canker caused by phytophthora dreschleri are reported. It is based on genetically evolved new cultivars having promising and desirable characteristic. The future species may have more chromosomes. Leucaena Diversifolia and Leucaena Shannoni and their hybrid crosses with leucaena resulted in to disease resistant cultivars :

- Silviculture and leucaena wood, help in controlling reforestation, because of its fast growing abilities.
- The appropriate rumen bacterial could be introduced in to the ruminants so they will not suffer nutritional disabilities after feeding on high level of leucana.

INTRODUCTION

Leucaena belongs to family Leguminosae (Mimosoideae). *Leucaena glauca* is suitable to sea coast. It is a small quick-growing leguminous tree, 15-20 feet - high with small bipinnate leaves, suited to dry or wet districts. Some times used as shade for field crops, affording light shade. It some times becomes weed in a cultivated ground. *Leucaena* is a fast growing tree.

Common names of *Leucaena* are as under :

- *Leucaena*.
- Ipil-ipil (Phillippines).
- Lamtora (Indonesia).
- Guaje, Yaje, Vaxin (Latin America).
- Lead tree.
- Koahaole.
- Hawaii.
- Lamtoro.

VARIETIES

Leucaena has number of varieties but botanical literature claims 55 species. The only known species are: *Leucaena collinsii*; *Leucaena diversifolia*; *Leucaena esculenta*; *Leucaena lanceolata*; *Leucaena leucocephala*; *Leucaena macrophylla*; *Leucaena pulverulenta*; *Leucaena retusa*; *Leucaena Shannoni*; and *Leucaena trichodes*. *Leucaena* belongs to family Leguminosae, form mutually beneficial partnership with soil bacteria of the genus *Rhizobium*. This is used for nitrogen fixation. *Leucaena* is the common name for *Leucaena leucocephala*. Nine *Leucaena* species are recognised in addition to *Leucaena leucocephala*.

Leucaena leucocephala

- The botanical name is *Leucaena leucocephala* (Lam) de Wit. It is fodder tree. *Leucaena leucocephala* belongs to sub family: Mimosoideae.

Leucaena lanceolata

- It can easily be variable due to cross pollination.

Leucaena macrophylla Benth

- Is a fast growing, high in mimosine content.
- The variety *Leucaena cunningham* has lowest mimosine content, best suited for forage.
- *Leucaena glauca* Lamtoro small quickly growing tree with very fine bipinnate leaves suitable for green manure or low shade for young crops. Valued in Java as shade for coffee.
- *Leucaena diversifolia* (schlecht). These species can grow fast, low in mimosine content, produce more wood, high yields of seeds.
- *Leucaena trichodes*. Is important for hybridization and very slow in growth.

- *Leucaena pulverulenta* (Schlecht) Benth. Is an excellent wood, easy to make hybrid with *leucaena leucocephala*.
- *Leucaena esculenta* (Moc. And Sesse). Also low mimosine content high wood yield, low seed yields.
- *Leucaena retusa*. Easy to hybridize with *leucaena*, having unusual nitrogen-fixing bacterium. Species - *Leucaena Leucocephala* (Lam) de wilt (=L. *glauca* (L) Benth). Botanical name *Leucaena glauca* for the plant.
- More than to *Leucaena* species are found. Most common species is *Leucaena leucocephala*. *Leucaena pulverulenta* used for drought resistant. Having low content of mimosine. Many tropical broadleaved species show remarkable coppicing power, some genera of Leguminosa like *Lucaena*.
- Habit - Arborescent shrub or small tree if not maintained leafy by management.
- Ecological - wide range of freely requirement draining soil. 750-1, 500mm rainfall, low altitudes.

GENERAL

Leucaena is a fodder legume. Yields up to 30-40m³/ha/year. It shows yield 40-5-m³ of wood/hectare. Yields 24-100m³ per ha. Needs rainfall 1,100-1, 200mm. It needs minimum 600-700 mm rainfall. It grows best in rainfall 1,000-3,000 mm. *Leucaena* is killed by frosts. *Leucaena* grows well in alkaline soil. It grows well in soil having pH 6.0 - 7.7. it is ideal for pin steep slopes due to better root system. Population can reach range of 5,000 - 10,000 trees per hectare. Best forage production is 75,000 - 140,000 plants per acre. Row spacing is 75 cm.

Weeds are the major cause of slow growth. *Leucaena* grows best in full sun. It is adaptable, to acid soil. *Leucaena* is a drought - tolerant plant. It is drought resistant. *Leucaena* can survive on poor soil so used as reforestation. *Leucaena leucocephala* characters are: It grows up to 500m altitude. It gains height up to 20m. Some species are taller than 20m. Giant type can grow up to 20m height with large leaves. In 4-8 years with suitable condition it gains height up to 18m. *Leucaena* trees grow in dense stands of 20,000 plants per hectare.

The pod contain 15-30 seeds. Giant *leucaena* varieties contain 20,000 seeds/kg. Normal seedling rate is 5 kg/ha. Annual nitrogen fixation by *leucaena* is 100-200 kg nitrogen per hectare. One hectare of *leucaena* bushes provide 500-600 kg/nitrogen/year. One hectare of *leucaena* bush provides Nitrogen equivalent to 1 ton of ammonium sulphate fertiliser each year. It usually requires no fertiliser. Foliage rivals manure for nitrogen content. One hectare of *leucaena* foliage provides 44 kg of phosphorus 187 kg of potassium. Calcium and Micronutrients.

Leucaena require minerals like calcium, phosphorus, sulfur, potassium and magnesium. India produces 70-85 tons of forage per hectare per year. *Leucaena* pastures can carry up to 2.5 cattle per hectare. *Leucaena* one hectare of good land can produce energy equivalent to 25-30 barrels of oil per year. It has many branched shrubs, tall, single trunked tree. It has coppicing ability grafts, but only with difficulty. *Leucaena*'s strong, pliable branches are seldom damaged and leaves quickly regenerate. *Leucaena* tree are girdled by cutting a 20 cm wide ring of bark from the tree 1.5m above the ground. The burned *leucaenas* resprout from the root collar, and seed germinate, and soon the damaged tree are replaced.

NUTRITIVE VALUE

Leaflets contain 25-30% protein. The leaves are rich source of: carotene, vitamins and provitamin-A. Caloric value Kca1/kg is 4,200-4,600. Mimosine amino acid present in *leucaena* is considered protein. *Leucaena* also contain carotene, (vitamin-A), riboflavin, Vitamin K, *Leucaena* foliage contain; Calcium, phosphorus and dietary mineral nutrients.

Leucaena leucocephala (leucaena) Nutritive value are as under:

ITEMS	LEAF	GREEN FRUITS
• Calories.	332	306
• Protein (g).	14.2	43.6
• Fat (g)	03.9	04.7
• Total carbohydrates (g).	74.7	45.7
• Fiber (g).	08.8	19.7
• Ash (g)	07.3	06.2

INSECT, PESTS AND DISEASES

It is highly resistant to pests and diseases. Common pests are seed weevils, twig borers, and termites. The most serious disease is fungal gummosis. The causal agent being *Fusarium Semitectum*. Bark canker caused by *Phytophthora dreschleri*, funga attack called amping-off, leaf spotted fungus *comptomeris leucaeeae*, bacterial pod blight or rot. Seedlings are also affected by Moulds caused by *Botrytis* and *Penicillium*.

Insects

Mound-building ants damage the leaves and bark as under: Inchworms, Twig borers, Chewing insects, Mealy bug *Nipaecoccus vastator*, Weevil and larvae of the moth *Ithome lassula*.

Pests

Those attack on leucaena are as under :

- Snail.
- Rate.
- Rabbit.
- Deer
- Monkey.
- All other wildlife animals.
- Leucaena effected by aggressive wood, termites, rodents and climatic conditions.

Fungal diseases

The Leucaena seedlings are attacked by fungal disease. There are also numerous diseases damaging the tree seedlings. Dumping-of-diseases affecting seedling this is caused by *Phylhium*, *Rhizoctonia*, *Penicillium*, *Phytophthora*.

USES

It has an extra ordinary values like :

- Dye is extracted from leucaena which is used to colour wool, cotton, fishing lines and other materials. Dye is extracted by boiling the pods or wood gives red colour, while old pods produce various shades of brown colour. Red, brown and black dyes are extracted from the pods, leaves and bark.
- it provides support for vine and climbing crops.
- In chicken fed leucaena, the yellowing of the skin and egg yolks is a desirable characteristics.

- Glactomannan derived from the leucaena seeds contain 25% yield of gum (mucilage).
- Bee keeping can easily thrive on leucaena tree.
- The seed is used to derive various medicines like stomach diseases, use of contraception and abortion.
- Leucaena produce extra ordinary weight gains in cattle. Cattle can gain one kg each day, for more than 200 days. Leucaena will increase milk and meat production, if fed correctly. Leucaena - fed cow produces attractive milk, yellowed by carotene.
- The pods are suitable for human if eaten sparingly. Leucaena young leaves and seeds are used for human food. Leucaena pods are eaten raw or in soups or tacos. It is not recommended for extensive hair loss in non-ruminant animals and show adverse effects on human.
- It is easy to digest by animal as a forage and timber, grows as hay or forage rich source of protein, have greater nutritional value. Leucaena pasture gain 2 meter height, and it has the ability to re-grow new foliage. One hectare can produce up to 10-20 tonnes of edible dry matter.
- Leucaena have following uses:
 - Nutritious forage, used as fire wood and timber, rich in organic fertiliser, windbreak, shade, and ornamental, firewood, charcoal and cattle feeding, soil improvement. It is nitrogen fixing legume, green manure, cover crop, mulching, inter-crops and catch crops, is a herbaceous bushy character, rapid growth, capable forming good cover in a short space of time. It belongs to family Leguminosae.
 - The benefits are as green manure, cover crop, mulching, intercrops and catch crops as under:
 - To supply humus to the soil, retaining capacity for moisture increase many folds, to prevent surface wash or soil erosion on steep land, improvement of the mechanical condition of the soil by action of the roots of the green manure or cover crops, protection of the roots of main crops from excessive radiation from the ground surface suppression or reduction of weeds, therefore economy of labour.
 - Fixation of atmospheric nitrogen in the soil by leguminous species. Produce large quantities of foliage. The mimosine acid causes weight loss and ill health in nonruminants like pig, horses, rabbit and poultry, many ruminants carry small micro-organisms in the stomach, which render mimosine, harmless, can digest leucaena without ill effect.
 - Leucaena increased nitrogen to the soil, rebuilding the tilth and surface texture. Bee keeping, hardpan of the soil breaking, improves aeration, water absorption to the root, reduces run-off, soil slippage and erosion. Leucaena is used as green manure, soil reclamation and controls soil erosion. The taproot helps in breaking the compacted subsoil layers. Leucaena is used to control erosion, provide green manure increases crop yields. Leucaena Shannoni donn. Smith is used for soil cover, controls erosion, low forage yield, low seed production.
 - It carries nitrogen fixing ability. Leucaena enriches the soil, builds-up mulch and aids, neighbouring plants. It is used as nitrogen fixing bacteria that symbiotically provide it with nitroge compounds that fertilise is growth, also benefit to the soil, whereit grows. The wood has high caloric values. Leucaena pulp, is high in holocellulose, low in Silica, ash, lignin, alcohol-benezene, solubles and hot water solubles, Low lignin content varieties are also available.
 - Leucaena produces seed in abundant and wood is used for charcoal heating value is 7,000 Kcal per Kg, which is 70% of the heating value of fuel oil. It has giant varieties showing rapid growth, used for wood and paper. Leucaena leucocephala is used for wood, food, timber, to control soil erosion, fodder and green manure, and it is suitable for fodder tree for Silvi-pastural system is a Leucaena Latisqua. Wood is also used for timber and playwood. This wood has good tensile, compressive bending and shear strength for use in the construction. It is also used for posts, girts, girders, floor joints, rafters for small houses, shade for plantation crop. Leucaena Esculenta is used as ornamental, having attractive foliage should be recommended. Wood is also used for fuel for tractor or electric generators.
 - Leucaena used for energy plantation and fuelling, brick and charcoal kiln, saw mill electric generator, rail road locomotive, drier for coconut, fish, forage and other agricultural products.

DRAWBACK OF LEUCAENA CROPS

5% of the leaflets contain Mimosine, an uncommon amino acid. If taken in excess the cattle produce less than normal quantities of thyroxine, a thyroid hormone. The signs show loose tail and rumen hair and extreme cases become completely debilitated with goitre. Extensive use of leucaena may lead to goitre, animal becomes listless, and weight gain suppress, excessive saline result and all hair fall down. Pregnant animals fed on leucaena produce weak off-spring enlarge thyroid gland. Mimosine amino acid, cause hair loss, affect foetal development in non ruminants leucaena comprise 3-5% dry matter.

Mimosine related toxicity rarely occur in leucaena. Cattle feed on leaves and stems of bush varieties of leucaena, its foliage contains mimosine, toxic to ruminants if consumed in excessive amount. The amino acid mimosine, which is present in leucaena, breakdown in the digestive system of grazing animals to a toxic compound cattle DHP, which may affect thyroid gland. Mimosine effects can be seen in rabbit as loose hair, in poultry delay sexual maturity, in horses after eating loose hair from their manes and tail and pregnant mares may abort, if leucaena grown in horse paddocks the mimosine contents and it will become toxic to ruminants if eaten in excess.

DIGESTION PROBLEM WITH MIMOSINE TO THE RUMINANTS

In order to digest mimosine the ruminants stomach contain microbes, which convert rumen to 3,4-dihydroxy Pyridine (DHP), which break into non-toxic compound. Leucaena contain Rhizobium beneficial mycorrhizal fungus, which helps in digestion of mimosine. It is suggested that leucaena must be fed with grass or other feed varieties to the animals.

FUTURE WORK

The genetic diversity of leucaena offers the plant breeder much promise for enhancing desirable characteristics. Leucaena produce hybrids with leucaena *Leucocephala*. This hybrid is used for increasing the range and productivity of leucaena itself. Hybrid can be used to develop new genetic variation to leucaena. The future species can have high chromosome number. Leucaena species like leucaena *Diversifolia* and leucaena *Shannoni* and their hybrid crosses with leucaena result into disease resistant cultivar.

Silviculture and leucaena wood, future reforestation, fast growing methods should be studied, germplasm collection, various tolerance abilities, wood quality and desirable characteristics should be introduced, fiber length, holocellulose content, pulp, and breeding practices for the above quantities, fire-resistant species include leucaena.

The appropriate rumen bacteria could be introduced into the ruminants so they will not suffer nutritional disabilities after feeding on high level of leucaena. Guide to pelting legume, genera and species with acid-producing Rhizobium pellet with calcium carbonate is a Leucaena *leucocephala*. Syn. *L. Glauca*. Various methods of detoxifying mimosine like ferrous sulphate, ammonium phosphates and suitability of this feed after treatment must be studied. Transfer DHP-degrading bacterial into commercial herds, for which in vitro multiplication of the bacteria is necessary. Rhizobium strains NGR8 or NGR 35 are used in alkaline soils. Seeds must be treated to ensure uniform germination.

Leucaena can grow in a soil low in phosphorus. Research need for pulp wood study of leucaena *Leucocephala* to reclaim highly aluminous soil. *Leucaena leucocephala* is used as a shade plantation crop. Tree is used to support to climbing crops. The dense plantation of leucaena *leucocephala* is used as low cost stakes for Yam, pole, beam, leucaena foliage is used for forage or green manure.

Research is needed in trial adaptability and agronomic feature of leucaena. Breeding and selecting varieties are best grown under various conditions waterlogged spot, drought and various latitudes. Foliar analysis is used to find nutrient requirement for phosphorus, sulphur, calcium, magnesium, potassium, molybdenum, zinc and

copper. Study in the various methods of seed treatment should be used. Study the various insects and diseases and develop hybrid immune to these attacks.

Research should be done on breeding the low mimosine leucaena varieties, cross with plant with low mimosine leucaena species, could lower the mimosine content to half than normal. Crossing of leucaena Pulverulenta with leucaena leucocephala, produce vigorous hybrid having low level of mimosine.

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