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Tree Mortality In Sub Tropical Forest of India: A Review

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INTRODUCTION

Shisham is widely distributed in many parts of India upto 1000 m in the Himalayas.It grows typically on sandy and gravely alluvium well drained soil along the riverbeds and on the landslips or places where soil is exposed. It prefers to grow on porous soil of sand pebbles and boulders with adequate moisture while it avoides growing in clayey soil as it gets infected by disease (Chaturvedi et al., 2002). Shisham is planted as one of the major species under social forestry programme on road side, canal side, and river catchements and also block plantations on waste lands in north and eastern India. Shisham plays important role in soil and water conservation. During recent years major harmful biotic and a biotic stresses are responsible for shisham mortality. Widespread mortality of Dalbergia sissoo have recorded in last one decades have investigated the relationships between environmental and plantation characteristics with sissoo mortality. sisoo is an important tree grown mainly for its valuable timber (Rosewood). It has a long history in forestry in south asia- the earlist record of use dating as far back as 2500 years before present (White, 1994).Today ,sissoo is a widely planted tree species in india ,Pakistan,Nepal,and Bangladesh.In recent years,serious health problems in sissoo trees have been encountered within its full natural range.The disease syndrome has spread at an alarming rate but is at present poorly understood.Most likely explanations include (Baral *et al*., 1997; anon, 1999; Dhakal, 2001):

Taxonomic discription

Dalbergia sissoo is a medium to large sized gregarious and deciduous tree having thick,rough grey bark,with shallow board longitudinal fissures exfoliating in irregular woody strips and scales.Under favourable conditions.It attains a height upto 30 M and girth of 2.4 M.the stem is generally crooked:straight and clean boles are very uncommon. Leaves imparipannate, alternate,rachis 3.5 to 8 cm long, swollen at the base.Leaflets 3-5,alternate,3.5-9 x3-7 cm.broadly ovate, conspicuously and abruptly cuspidate at the apex,rounded at base, entire, coriaceous, pubescent when young,glabrous when mature,terminal leaflet larger,lateral veins 8-12 pairs.Infloresence axillary panicle,3.5-7.5 cm long. Flowers yellowish white,7-9mm long, sessile. papilionaceous, standard petal narrowed at the base into low claw,wing and keel petals oblong, clawed.Pods 4.5-10 x0.7-1.5 cm,linear oblong,strap-shaped,indehiscent,stipitate,glabrus,apex acute, reticulated against the seeds,usually1-4seeded. Seeds 8-10 x4-5.5mm brown to brownish-black,reniform,compressed,with papery testa.

Distribution

The species occurs throughout the sub-Himalayan tract and outer Himalayan velleys from the Indus to Assam,usually upto 900 m,but occasionally ascending to 1500 m.It descends the river valleys for some distances into the plains and is planted or self-sown in many parts of india.The tree is a characteristic species of Khair-sissoo primary seral-type forest(Champion and seth, 1968).It has been extensively planted along roads and canals of many other parts of india.the tree prefers porous soil with adequate moisture.It shows marked preference to soil composed of sand,pebbles and boulders in river beds.Outside India, the species in found in Nepal, Bhutan, Bangladesh ,Myanmar (Burma), Malaysia, Pakistan, and Afghanistan.The tree has been introduced in Java and Nigeria, Mauritius,

Srilanka,Kenya, Northern Palestine, Rhodesia and south Africa with varying degrees of success. According to Troup (1921), it is very likely that sissoo is indigenous only to the sub-Himalayan and Bhabar areas and has been introduced by man elsewhere.

Pest and Pathogens

Dalbergia sissoo is attacked by 125 insect pests of which ten are known to be of significance.Plecoptera reflexa causes defoliation and heavy and repeated attacks cause mortiality in plantation.Caterpillars of Leucopetra sphenograpta mine into the leaf destroying the pallsade and large veins of leaves.Cladobrostis melitricha bores the living twigs of trees causing heavy pruning of crowns of sissoo.Among the sap sukers Drosicha mangiferae,D. stebbingii are important ,feeding on the sap of the foliage,shoots and twings of the plant.Among the powder post beetles which make tunnels in the outer few inches of the log are Heterobostrychus acqualis and Sinoxylon annale.Most dangerous pests are heart wood borers of which Crossotarsus saundersi,Aristobia horridula are important .The beetles of Crossotarsus saundersi bore into dying or newly trees felled trees and construct tunnel running radially towards the heartwood and then turning parallel to the circumference.Vertical tunnels run upwards the from the main tunnel and downwards.The larvae of Aristobia horridula feed into the meristematic tissues and then penetrate into sapwood and heartwood making irregular galleries (Tewari,1994).

Fusarium wilt casued by fusarium solani(mort)Appel & Wr.f. dalbergiee,is a facultative parasite inhabiting soil and attacks the tree through dying or weakened root.clayey or stiffy soil with water logging conditions favour the development of the disease.The disease is absent in soil containing a high percentage of sand and low silt provided the drainage is good.In tarai area,where the water table is high and may come up to the surface during the rains,sissoo not grow healthy and may suffer from wilt.The characteristic symptoms of the disease are yellowing and death of leaves in acropetal succession up the tree, the affected trees die within a few months (Bakshi,1975).

Factors For Shisham Mortality-Edaphic,Ecological and Biotic

Improper species-site matching: Sissoo grows naturally as a colonizing pioneer species on sandy soils along newly formed reverbeds,but has been widely planted on heavey clays. According to Tiwari and Sharma (1994) plantings of sissoo on stiff clay in India have reduced growth and become susceptible to disease after some years.However, in a recent study sah and Sharma (2003)did not find any correlation between poor health and physical properties of the soil,although local water logging may play an important role (Sah *et al.*, 2002).

Extensively use of important seed sources of non-local origin:Important seed sources were extensively used during the years of large plantings in the 1980s and 1990s.From trails it is known that the e.g. the Pakistan seed sources grow poorly in Nepal (Joshi and Thapa, 1997). Dieback is a regional problem,and can therefore hardly be explained by movement of seed across ecological zones.but the poor performance of the Pakistan seed sources in Nepal suggests that the problem may at least have been increased by large-scale use of wrong seed sources during the last two decades.

Climate changes : There is evidence of continuing climate changes influencing on the instability of vegetation and the microenvironment of the forest.It remails unknown f these changes are a long termed development(global changes),or the result of a short termed fluctuation.

New aggressive fungi or pests:- Either caused by introduction of new pests or strains,mutation of turned exisiting pathogen at the genetic level tht hve turned exicting pathogens aggressive, or as a result of increased susceptibility of sissoo to exicting pests.

Unsuitable site selection is one of the main reasons of shisham decline,it grows well on welldrained sites and does not grow well in soils of heavey texture .Improper soil aeration in stiff and clayey soils cause death of fine/feeder roots due to asphyxiation besides water logging,even for a short

duration,causes poor aeration and death of fine/feeder roots due to asphyxiation.

Mortality Cases in India

Farmers are also planting this species for protitable economic return in their agricultural fields under agro-forestry system.Shisham plays an important role in soil and water conservation.During resent years major harmful biotic and abiotic stresses are responcible for shisham mortility.Recent survey shows that its mortality varies from 10-22% in Bihar,Harayan,Punjab,UttarPradesh,West Bengal and Assam(Chaturvedi et al.,2002).Flora of eastern UttarPradesh is also rich with the availability of shisham trees which are also suffering with wilting due to different stress.Information regarding this type of mortality in different district of eastern Uttar Pradesh is lacking.Percent mortality of the trees varied from 8.94 to 20.80% maximum being in districts Gonda (20.80%) followed by Baharaich (20.48%) and Gorakhpur (18.33%).Minimum mortality of 8.94% was recorded in district Varanasi.

Another case of mortality seen in the plantation of Punjab is 154,886 Ha,with an average annual production of 28,000 m3 (Khan & Khan,2000) .Maximum mortality of 25-30% was observed in kasur and T.T Singh.Maximum disease incidence of 20.5 to 40.4%was recorded in Hafizabad and gujrawnwala.A number of disease like powdery mildew,leaf rust,leaf blight,color rot,wilt,dieback and Ganoderma root rot are reported by various research workers like Khan et al. (1956),Khan (1960,1961),Khan and Bokhari(1970),Bagchee (1952),Bakshi(1954) and Zakaullah(1999) to occur on this plant .No bacterial or Viral Disease has so for been made.There was an invariable association of Botryodiplodia theobromae with aerial as well as under ground parts.Fusarium solani was mostly isolated from roots and stem while,colletotrichium sps. Was only isolated from stem and branches.Inoculation of healthy plants with B.theobromae either alone or in combination with F.solani and colletotrichium sps.produced typical symptoms whereas, F.solani and colletotrichum sps. Failed to produce these symptoms.

Since 1993 a severe disease called dieback has been recognized in several countries of the Indian subcontinent (Shukla 2002). The disease is characterized by a combination of symptoms, beginning with wilting of leaves. Later leaves become necrotic and fall down, as well as development of smaller twigs, leading to increasing crown transparency. Loss of branches follows and the disease ends up in the final stage of stag headedness, where the affected trees loose almost all parts of the canopy. Black spots with gummosis appear on the base of the trunk and are found up to a height of three to five meters with progressing disease (Baksha and Basak 2003). Various factors have been discussed as causes of the dieback disease. Abiotic factors have been suggested to contribute to the dieback of sissoo such as drought, flooding or soil conditions (Sharma et al. 2000), while other authors negate the importance of such factors (Webb and Hossain 2005). Fungi have been predominantly claimed as causative agents of dieback, including Fusarium solani, which was reported from India as early as in 1954 as putative agent of a disease on sissoo similar to dieback (Bakshi 1954). More recently a collection of various fungal species were detected in dieback affected sissoo (Dargan et al. 2002). However, none of these putative

agents could be detected at all dieback affected sites (Baksha and Basak 2003) and in no case a definite proof of the pathogens via fulfilling of Koch's postulates was shown. It is therefore, very likely that other or additional biotic agents such as bacteria, phytoplasms, viruses or viroids might also or primarily be involved in the dieback disease. Phytopathogenic bacteria as putative agents had been neglected until we could demonstrate by 16S rDNA sequence analyses that bacteria of the genus Pseudomonas were associated with dieback affected sissoo trees from various sites in Bangladesh (Tantau et al. 2005). Diseases of trees caused by Pseudomonas species including P. syringae and its numerous pathovars are of major concern world-wide (Kennelly *et al.* 2007).

Khejri tree

Prosopis is a moderate sized evergreen tree with a thin spreading crown and feathery foliage.It is a species of southern tropical dey deciduous forest and southern tropical thron forests.Farmers adopt this tree for plantation in the agricultural land,easteland and on field boundaries especially in Harayana,Rajasthan,Punjab and uttar Pradesh.In last decade,large scale mortality of kikar trees had been observed in most parts of Haryana is causing panic amongst the farmers,foresters,scientists and policymakers because not only the individual get very attractive return for the mature tree planted 15-30 years back but it is also an integralpart of agroecosystems in plains of north wesern india.a total of 68 trees were found dead in the whole district along roadside/canal side /railway line(49),scattered over farmers field (15) and on bunds (4).Average mortality of kikar was 6.8% in the Faridabad district.The mortality varies from location to location and was 8.5,7.5,7.0,6.0,and 5.0% in Faridabad, Ballagarh,Palwal,Hodaland Hasanpur blocks, respectively.both biotic and abiotic factors were found responsible for the mortality of kikar tree.

Recently, heavy mortality of this tree in the Nagaur, Jhun-jhunu, Jodhpur, Churu, Sikar and Jaipur districts have raised an alarm in the all walks of the society (starting from politi-cal to the farmers).

The Central Arid Zone Research Institute has initiated its research in this direction. Closed observations revealed that the mortality was more in the old trees > 50 years or so and the casual organisms were the beetle (Acanthophorus serra-ticornis) and white rot fungus (Ganoderma lucidum). The insect damages the older roots and the fungus grows on these roots which impaired nutrient and water transport system of the trees. Light frosts cause dieback of branches, with complete stem mortality with harder frosts, and complete death of the plant when frosts are more severe or longer lasting (Felker et al 1982b). Frost damage is more severe on seedlings and younger trees of P. juliflora and on trees in interdunal or other low lying areas (Muthana 1974). P. juliflora and P. pallida seedlings in the nursery arise from roots out-growing their containers and either growing into the soil and becoming broken when moved, or spiralling round at the base of the bag leading to root-balling. If not cut off, the roots may continue to spiral even when planted in the field leading to very poor field establishment and eventual plant mortality. To reduce the incidence of root-balling and root damage, it is best to undertake field planting at around 3 months of age before the roots out-grow the bags. Failing this, bags should be moved regularly, or larger bags used.The main restrictions to the planting of P. juliflora and P. pallida are on sites that suffer from frost, high rainfall, thin soils, on impermeable hard pans or very saline or alkaline soils. Very low rainfall, when combined with low relative humidity or a lack of permanent sub-surface water, will limit growth and may lead to mortality after several seasons. In India, rats, squirrels and other small mammals can completely destroy whole plantations of P. juliflora (Muthana and Arora 1983, Rana and Jain 1984). Rodents eat the cotyledons, young leaves and buds, and gnaw at the roots, base of the stems and even the trunks of trees 2-3 m high, leading to plant mortality. Ants and termites are only damaging to seedlings and young trees of P. juliflora and P. pallida. They attack roots and leaves reducing growth rate, but termites, particularly, can cause widespread mortality in young Prosopis plantations. Termites

are a serious pest in young P. juliflora plantations in India but can be effectively controlled with the use of chemical insecticides (Muthana and Arora 1983) or biological treatments (e.g. neem, Tewari et al 2000) applied to the base of the planting hole or mixed with the planting soil. Other insect pests injurious to P. juliflora and P. pallida trees include defoliators, sap suckers, flower eaters, seed feeders and wood borers. The need for rain or a high water table is reduced in coastal areas, where there is sufficient atmospheric moisture. Tap roots are essential during long droughts when deep sources are the only available water, and this supply ensures tree survival. An extended dry period prior to tap roots reaching ground water may explain the mortality of young

trees. Light frosts cause dieback of branches, with complete stem mortality with harder frosts, and complete death of the plant when frosts are more severe or longer lasting (Felker et al 1982b). Frost damage is more severe on seedlings and younger trees of P. juliflora and on trees in interdunal or other low lying areas (Muthana 1974).

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