Phoebe (Bonsum) family Lauraceae, is an evergreen tree, leaves alternate often clustered at ends of branchlets, penninerved.

About 50 species, those of fruiting perianth appressed, rigid almost horny are Indian and Malayan. Of the Indian species 2 are common to the two Peninsulas, the rest belong to the Eastern Region. Some of the North East Indian Species are:

1. Phoebe lanceolata. Nees- a middle sized tree, bark greyish fairly smooth, leaves 3.5-8 by 1-2.3 inches, lanceolate, glabrous, fruiting perianth segments, appressed, rigid, perianth glabrous. Berry black, ovoid or ellipsoidal, .3-.5 inches long.

   Fairly common in Kamrup, Sibsagar, Nagaon, Darrang Districts, N.C.Hills, Goalpara, Naga Hills and Khasi & Jaintia Hills (upto 5,000 ft.)

2. Phoebe angustifolia Meissn- a small tree with leaves pale green 2-7 by .3 -.7 inches, narrow, glabrous, linear-lanceolate 7.5-9 mm. broad. Fruit ellipsoidal, .3-.4 inches long, glabrous, smooth. Found in Garo Hills, Khasi & Jaintia Hills (2,500-4,000 ft.)
3. *Phoebe pallida*. Nees- a middle sized tree, bark reddish brown. Leaves puberulous or glabrous beneath, young shoots minutely puberulous. Leaves 3-8 by .9-1.5 inches, oblanceolate or elliptic lanceolate, lateral nerves 8-12. Fruit .4-.5 inches long, ellipsoidal.

*Found in Khasi Hills.*

4. *Phoebe paniculata*. Nees- a tall tree; bark dark grey. Leaves crowded at ends of twigs 3-8 by 1-2.5 inches, elliptic, oblanceolate, pubescent beneath, young shoots rusty tomentose, lateral nerves 6-12 on either half, prominent beneath, base narrowed into the petiole .3-.7. inches long. Fruit .3-.5 inches long, somewhat quadri-linear, ovoid, obtuse, reticulately rugose, blackish, seeds obovate.

*Found in Darrang district, Khasi Hills (Barapani upto 3000 ft.)*

5. *Phoebe attenuata*. Nees- a large tree (100'-112'). Bark dark grey exfoliating in papery flakes; young parts rusty tomentose with long soft hairs. Leaves crowded at the ends of branchlets, 5-10 by 1.5-3 inches, oblong or oblanceolate, entire, lateral nerves 15-20. Fruit narrowly ellipsoid; .5 inches long.

*Found in Khasi Hills (upto 3000 ft.)*
6. Phoebe cooperiana- a large tree, bark greyish, exfoliating in flakes, shallowly and reticulately furrowed. Leaves 5-11 by 2-4 inches, alternate, obovate, oblong-lanceolate, entire. Lateral nerves 10-14. Fruit 2.8-4 cm. long, blackish, glabrous and ellipsoid.

Found in the north-east Frontier tract (Kherrim, Morkong-Sellek, Pasighat); Darrang district.

7. Phoebe goalparensis(Hutch):- Vern. Nikahi Bonsum- Ass. a tall timber tree. Stem buttressing at the base. Bark greenish or blackish grey, reticulately furrowed; branches minutely puberulous, blackish; lenticels large, partly sunk. Leaves 2.4-6 by 1.2-2.0 inches; obovate or ovate, lanceolate, somewhat shortly or obtusely acuminate, rarely obtuse, rigidly charteous, glabrous, puberulous on the nerves beneath; midrib impressed above, prominent beneath; lateral nerves 9-12 on either half, distinctly prominent beneath, tortuous and getting obscure towards the margin; tertaries rather prominent on both sides and tortuous; base narrowed or acute; petiole .4-1 inches long, glabrous above, obscurely puberulous beneath. Inflorescence in long peduncled lax panicles; pedicels about .2 inches long, ashy, minutely puberulous; bracteoles minute, caducous. Flower buds ovoid, acute .25-.3 inches long. Perianth
segments- outer .17 inches by .12 inches, ovate, obtuse, cariaceous, puberculous outside, adpressed, villous inside towards the base; inner slightly longer, equipped with few inflexed hairs towards the apex on the inner side), stamens slender. Ovary depressed, globose, pubescent; style about .04 inches long. Fruit ellipsoid, blackish, about .6-.9 inches long, glabrous.

Found in Goalpara, Sonitpur, Darrang districts in abundance & Nagaon & Sibsagar districts to some extent.

Of the above mentioned species Phoebe goalparensis (Bonsum) is found in abundance in Assam particularly in Darrang, Goalpara and Sonitpur districts and yield excellent light weight timbers, almost indistinguishable and constitute one of the most valuable timbers of Assam known as Bonsum in trade. In Batasipur located in the Darrang district the species grows naturally.

The Sap wood of Bonsum is greyish white, heartwood pale greenish buff when freshly sown, changing quickly to rich brown resembling teak hence sometimes called Assam Teak. It is fairly even or coarse - textured soft, moderately strong and light Bonsum can be air seasoned well with care. It can also be kiln seasoned without difficulty.
Phoebe goalparensis is an evergreen large tree of the Assam Valley Semi-evergreen forests buttressed at the base, light weight, hard, slow growing timber species of the family Lauraceae. It grows on soils varying from sandy loam to clay and attains a height of approximately 34 metres and a girth of 3.7 metres and found upto an altitude of 1,200 metres in the hills of Assam. The tree is a shade bearer and cannot stand direct exposure in young stages. Natural regeneration by seeds takes place profusely even under low covers. Artificial regeneration is done by seedlings raised in shaded beds in the nursery.

Phoebe goalparensis is a very steady wood. It is easy to saw and work and finishes to a fine smooth surface. Though not ornamental, it looks well under a wax polish. It is only moderately durable and is easily treatable under open tank process. It is used for house construction, door and window frames, veneers, plywood, packing cases, cabinet making, fittings of railway coaches, furnitures, general joinery, pattern - makings and in air craft construction. It is especially prized for cabinet work and is a medium quality fuelwood (Fl. of Assam, IV, 73; Bor, 56; Ind.For, 1948, 74, 279; Krishna Ramaswami, Ing.For. Bull. N.S., No. 79, 1932, 21; Trotter, 1944, 190-91; Ind.For; 1952, 43, 276, 263).
Leaves of **Phoebe** are used for cattle and buffalo fodder and ash of berries is said to cure sores.

The occurrence of forest types and the distribution pattern of **Phoebe** spp. are as follows:

**Nomenclature:**

1. General ---- Upper Assam Tropical Semi-evergreen forest.
   Sub-Himalayan Tropical Semi-evergreen forest- Champion (1936)

2. West Bengal-- Eugenia - Phoebe association (Cowan).

3. Assam -- Assam Valley Semi-evergreen forest.

(1) **Nomenclature** :

Assam Aluvial plains semi- evergreen. Phoebe- Amoora association. Goalpara East Division Assam---

**Description** :

A closed largely evergreen high forest including a varying proportion of deciduous trees mainly as a broken top storey. Less uniform and imposing than the Tropical evergreen forest but still including fine, tall and large trees. Middle storey dense and varied undergrowth including much cane etc. Buttresses are a common feature and strangling figs are numerous.
Distribution:-
In the heavy rainfall tract of North Bengal and the adjacent parts of Assam and Bhutan, at present often confined to the vicinity of Tarai streams and occupying only a limited area.

Locality factors:--
Occurs under a wide range of rainfall form 1,500 mm to 5,000 mm or more, with the no. of rainy days varying from 90 to 175, low figures mostly on light alluvial soil.

Floristics:--
(i) Kalimpong division, West Bengal (Cowan) - *Phoebe hainesiana* and *Phoebe attenuata*.

(ii) Aka Hills, Assam - *Phoebe* spp.

(iii) Brahmaputra Valley, Assam-Cinnamomun-Amoora association (Rowntree) - *Phoebe* spp.

North bank of Brahmaputra, Assam (Rajkhowa) - *Phoebe goalparensis* (6-13%).

2) Nomenclature:--
Schima- Bauhinia association (Cowan).
Description:-

Closed but rather irregular high forest with evergreen spp. predominating in the top canopy, but with a number of deciduous or nearly deciduous spp., the lower canopy is mainly evergreen and without bamboos and there is usually a shrubby undergrowth.

Distribution:-

In the Sub-Himalayan tract and the lower slopes of the hills between the mainly deciduous and mainly evergreen forests in North Bengal and adjoining parts of Assam and Nepal.

Locality factors:-

The type is associated with a heavy rainfall of even upto 5,000 mm. but usually occurs on well drained slopes from the foot of the range to about 760 m. or more.

Floristics:-

Phoebe lanceolata (4%)

3) Sub-Himalayan light alluvial semi-evergreen forest-
Sadiya, Doyang and Dhansiri Valleys of Sibsagar district, Assam- Terminalia- Phoebe associes (Rowntree)---
Phoebe cooperiana (Sadiya)
Phoebe cooperiana (Sibsagar).
Other tree species found in the Semi-evergreen forests besides Phoebe are Amoora wallichii, Dysoxylum spp., Tetrameles, Ailanthus grandis, Taluama hodgsonii, Castanopsis spp., Elaeocarpus, Magnifera indica, Michelia, Terminalia myriocarpa and climbers like Butea parviflora, Acacia pinnata, Embleica nutans, Ficus scandans, Bauhinia anguina, Messua ferrea, Altingia excelsa, Cedula toona, Shorea assamica, Amoora spp. etc.


The latest method of planting Phoebe goalparensis (Bonsum)

I) Diffused planting:-

This method consists in transplanting of 5-6 ft. high Bonsum seedlings 10 to 15 apart (in places much wider spacing than this are also adopted) in natural forests under moderately open canopy. Experience shows that big plants give comparatively better results than smaller plants and has the following advantages:

1. Economy in the use of planting materials as less number of seedlings are required for transplanting.

2. Economy in weeding costs since the big seedlings can get ahead of weeds and undergrowth more quickly.
(3) The survival percentage is higher.

(4) Thinning expenditure is comparatively less.

(5) Seedlings of other valuable species can grow along with Bonsum and can be retained if desired.

Disadvantages is the felling damage.

(II) Tunnel planting:- This method consists in transplanting fairly big Bonsum seedlings (5 to 6 ft.) long cleared strips. These tunnel-like strips are made at intervals of 10 ft. to 15 ft. by removing the shrub undergrowth and some of the trees of the middle canopy. The seedlings are planted 10' to 15' apart along the tunnel and the overhead canopy is gradually opened up with the progress of seedlings. This method is generally adopted to restock inferior miscellaneous forests by planting valuable shade bearer species like Bonsum, Gonsoroi taking advantage of the natural shade of the existing forests. The main advantage of this method are:

1) It obviates the necessity of opening out the forests drastically to avoid deterioration of soil by sudden exposure.

2) Some of the existing trees if denied can be kept to retain the mixed composition of the forest.
Phoebe goalparensis is susceptible to mottled spongy rot (Ganoderma applanatun); Brownish pocket rot (Polyporus gilvus); white spongy rot (Tramates corrugata); and white fibrous rot (Tramates serpens).

The wood of Phoebe goalparensis is light with a specific gravity 0.50; average weight 97 kg./cu.m. The data for the comparative suitability of the timber, expressed as percentages of the same properties of teak are: weight, 75; strength as a beam, 65; stiffness as a beam, 70; suitability as a post 65; shock-resisting ability, 65; retention of shape, 75; shear, 90; and hardness, 55 (Limaye and Sen, Indian Forest Record N.S., Timb.mech., 1953, 1,94; Indian Forest Rec., N.S., Silvicult., 1963, 11,51, Limaye; Indian Forest Record N.S., Util., 1942, 2,168; 1944, 3(5), 22).

The soil on which the trees grow is the habitat of a complex microbiological community. Their requirement of nutrition, interaction among themselves, and between species and various biochemical activities make the soil a dynamic system. The importance of microbial aspects of soil was not felt before S.N. Winogradsky (1890) drew attention to the interesting aspect of biological transformation of N₂ in the soil. After that, extensive investigations were carried out on the ecological aspects of the soil micro-organisms by various pioneer investigators.
The importance of experimental ecology which concerns the biochemical interrelationship of the micro-organisms with the environment and the biochemical interaction among population of micro-organisms in the natural habitat. The poineer community characteristic of a particular ecosystem is a reflection of the interplay of the many physical, chemical and biological determinants of microbial life and activities. The pattern of microbial population may vary considerably at various places depending upon the moisture content of the soil, organic matters and types of cultivated crops. Timonin(1935) and Burges(1958) have reported that the micro-organisms markedly fall off in the lower layers and continues to decrease with depth. The vertical distribution of spores may be due to their downward movement which may be due to the downward movement of water (Burges,1950) and dispersion of micro­fauna (Hinson,1954). The fungal spores were found predominantly in the surface soil layers and less frequently in the deeper layers. Watt(1940) has shown that these layers contains less then 0.5% carbon. Several fungi habitually occur in deeper layer such as Zygorrhynchus (Waksman,1916), Gliomastix (Burges,1959) which was present as 12-30 inches depth and spp. of Fusarium were found upto a depth of 38" (Rathbun,19). Due to more aeration
and abundance of organic matter in the upper layers of soil, there are more micro-organisms in the top layer and the numbers are reduced with increased depth (10-15")

soil a particular type of micro-fungi is present. Warcup (1951) has recorded the frequency of occurrence of different species at different horizon by soil plate method. The distribution of micro-fungi is influenced by soil horizon and soil types. Soil is the natural medium for the growth of plant and associated with forest vegetation which gives rise to characteristic type of forest.

The distribution of micro-flora in soil are not all of the same types and numbers, it varies from place to place and from season to season. The distribution of soil fungal population in different seasons of the year may greatly be influenced by the climatic and adaphic factors. Das (1963) working on the rice field soil of West Bengal reported that seasonal variation of fungal population can be observed in the monthly intervals. He further observed that, only frequency of abundance varies but the composition of the species remains the same. Reddy (1962), observed Aspergillus tended to be suppressed during winter, while Penicillium predominated during winter at the high altitudes of the Nilgiri forest in India. Burges (1958), reported micro-organisms inhabiting the upper 25 cm. are markedly affected by variable
environmental conditions. Puri (1954) reported that the variation of moisture content in the soil depends on the depth and seasons of the year. The microbial activity in soil may be enhanced during the summer rainy season due to sufficient amount of moisture content in the atmosphere. Cobb (1932) reported that the highest number of fungal microflora in soil corresponds to the time of greatest moisture content in soil. Various workers Saksena (1950); Brown (1958); Ramarao\textquotesingle 1970); Joshi and Chauhan(1982) have studied the succession of microflora of different soil types at various season of the year. The variation of adaphic factors of soil and the change in the composition of the surface vegetation is the main reason for the appearance of restricted species in a particular season (Saksena,1955; Ramarao 1970; Monoharchary, 1977). Tresner \textit{et al.}(1954) investigated the distributional pattern of soil micro-fungi of heart wood forest of Wisconsin. Saksena (1954) has worked out the fungal flora of forest soil of Sagar and stated that the distribution of soil microfungi was governed by certain ecological factors. Curtis & Mc. Intosh (1971) studied that the composition of forest vegetation, climate and nature of soil greatly influence the soil micro-organisms. Mishra (1966) working in a low lying grassland reported that the fungal population changes both in quality and quantity
with the change of season. Seasonal fluctuations of fungi have been studied by Brierley (1923), England & Rice (1957), Pugh (1957), Warcup (1957), Witkamp (1960), Reddy (1962) and others. They all reported periodicity in the composition of the fungal flora.

Reddy (1962), observed Aspergillus tended to be suppressed during winter, while Penicillium predominated during winter at the high altitudes of the Nilgiri forest in India. Tolba (1952) and Tolba and Moubasher (1957) recorded a high prevalence of Fusarium during the summer months among the fungi recovered from damped-off seedlings of lettuce and cotton.

Living plants excrete certain chemical substances through their root-system into the surrounding soil (Sachs, 1860; Knop, 1864). In 1904 Hiltner introduced the term "Rhizosphere" to designate the zone of enhanced microbial activity influenced by root excretion around the living roots. In the majority of plants the rhizosphere effect may extent several mm. beyond the roots (Starkey, 1958). The association of micro-organisms with plant roots is highly beneficial for both plants and microbes. The microbial population of this region is subjected to certain variations through the influence of factors as the kind of crops, soil types, age of the
plants, soil treatment, temperature, season and moisture condition (Starkey, 1929 I & II; Graf, 1930; Clark, 1930, Timonin, 1940; Das, 1963; Kagti, 1964). Many reviews (Katznelson, 1965; Rovira, 1965) and a recent book by Curl and Truclove (1986) discussed the concept and its implications to plant growth and health. The root stimulates the microbial population and the plant in turn is affected by increased activity of micro-organisms in the rhizosphere (Starkey, 1929). Graf (1930), Poschenrieder (1930) have made clear distinction between rhizosphere Viz. outer rhizosphere (soil adhering to the roots) and inner rhizosphere (root surface). Highest number of microbial population has been recorded in the inner rhizosphere where the biochemical interaction among microbes and roots are more distinct. In 1958, Peterson; Chester & Parkinson (1959) emphasized that the age of the plants effects the microbial population of the roots. Katznelson et al (1948) observed that the rhizosphere effect was highest at the height of growing period. Satyaparsad (1982) studied the rhizosphere mycoflora of resistant and susceptible variety of chickpea and found the greatest number of rhizosphere mycoflora recorded in the susceptible cultivar than that of the resistant one.

Seed borne fungi play an important role during
storage of seeds. They are responsible to a great extent in deteriorating the quality of seeds. Peterson (1959) studied the relationship between the seed borne fungi and their colonization on roots of barley, wheat and flax. According to him the soil is the principle source of mycoflora which colonize the roots of healthy plants. Sathe and Subramanyam (1931) reported that the microorganisms associated with the seed of a given crop were derived from the soil. It was known that seeds are carriers of different types of fungi (Christensen, 1951, 1964; Christensen and Gordon, 1948; Flanigan, 1970; Lambat et al, 1969). Parkinson & Clark (1964) reported that the different group of fungi isolated from the seeds of Shallots and garlic colonized adventitious roots of these plants growing in sterile medium. Certain fungi like Aspergillus flavus, Penicillium notatum and Helminthosporium oryzae exhibit toxic effects on plant. The mycotoxins produced by them inhibited germination and their growth (Baruah et al, 1980). Mycotoxins are secondary fungal metabolites capable of eliciting a toxic response, a mycotoxicosis, in a living host. Mycotoxin production can occur in field, during pre and post harvests, storage and shipment of given commodity. Owens (1969) considered phytotoxins as non-enzymatic and Diamond and Waggoner (1953)
termed "Vivotoxin" to the substance produced in the infected host by the pathogenic fungus. In recent years a number of terms as phytoxin, vivotoxin (Diamond & Waggoner, 1953), pathotoxin (Wheeler and Luke, 1963) or host specific toxin (Pringle and Scheffer, 1964) were coined to define toxin but none seems to be an absolute definition and the debate on the definition of toxin hardly changed the common perception that a toxin is a substance diffusable and translocable in nature and in very lower concentration act on the physiology of host metabolism. The presence of toxins in culture filtrate of various vascular fungi was demonstrated by their ability to cause wilt in excised shoots (Gaumann 1957, 1958, Trione 1960, Davis 1967a, Hardegger et al 1963, Kulkarni 1934, white 1926, Gottlieb 1943, Graniti 1964 and Meiler 1970). Toxin disturbs water balance of host Hursh (1928), Linford (1931), Gottlieb (1944), Kern (1967) suggested that wilting in the diseased plants were due to increased in the permeability of the host cells caused by toxins. Peterson (1959) studied the relationship between the seed borne fungi and their colonization of roots of barley, flax and wheat. They may be either in parasitic or in symbiotic form. The pure culture of this fungi should that some of the fungi have the inhibitory effect on the germination of seeds.
Vishnuvat and Shuble (1981) also recorded the maximum increase in the root length of lentil seed when the seeds were treated with culture filtrate of *Curvularia lunata*, whereas the culture filtrate of fungi like *Fusarium equisitii*, *Penicillium sp.*, *Fusarium semisectum* and *Aspergillus niger* significantly could reduce the root length. Singha *et al.* (1986) have worked on the culture filtrate of seed micro-fungi of soyabean upon the seed germinability and the growth of seedlings. Similarly, Singh & Prasad (1981) concluded that the increase of germination potential of seed may be due to auxin-like substances secreted by the fungi. Bhowmick & Das (1985) studied the effect of metabolites on the germinability of paddy, maize and wheat seeds and most metabolites have inhibitory effect on the germination of seeds. A great variety of fungi secrets exotoxins causing reduction in seed germination (Dwivedi and Singh, 1973; Tripathi, 1974). The culture filtrates of different seed fungi were known to produce stimulatory or inhibitory effect of seed germination Vidyasekaran *et al.* 1970; Mridha and Anwar, 1987; Singh and Gupta, 1984). Reduction in seed germination due to seed borne fungi had been attributed to the secretion of phytoxins (Anwar & Mridha, 1987). Certain chemical changes, e.g., loss in sugars, ascorbic acid, proteins, and production of phenols in fruits contaminated with
mycotoxin was recorded (Sinha and Singh, 1982 & 1887). The results of Scott and Furell (1970) indicated that the pathogenicity of *Fusarium moniforme* is dependent upon its ability to produce a toxin which in turn caused the seedling blight of corn. Some work on inhibition of mycotoxin production has also been carried out (Bilgrami et al., 1981; Sharma et al., 1981). Histopathological damages in skin, liver and kidney by aflatoxin contaminated feed had been reported (Bilgrami et al., 1986).

Numerous are the researches on different aspects of cultivation, hospitalisation techniques, sowing in nursery, method of propagation, the latest method of planting of timber plants keeping quality of wood and also on different environmental factors that affect the growth of microorganisms in cultivated soil of different parts of India. (Indian Forest record Vol. 1 (1936), Indian Forest record Vol. II 5 (1937) manual of Indian Timber J.S. Gamble, Silv, Assam, Survey of Forest Types of India, 1968, Assam Forest record Vol. II October 1937, Indian Forester, Vol. 90. No. 4 April, 1964). Much attention has been paid to studies of various diseases encountered
during cultivation in field and in storage (Macalpine, Tockali exp. station. Memor., No. 24, 1952, 95; Jacob, Indian For., 1952, 78, 602; Kadambi & Dabral, ibid, 1955, 81, 129; Bagchee & Ujagar Singh. Indian For. Rec., N.S., Mycol; 1954, 1, 275) but very little is known on timber plants of Assam especially on Phoebe goalparensis (Bonsum).

The aim of the present investigation has been, therefore, to determine as far as possible the impact of microfungal contamination on Phoebe goalparensis (Bonsum) seed viability during germination, seedling establishment and growth, in Assam.
PHORE GOALPARENSIS Hutch.
Phoebe gunlarensis seedlings.