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Tahir Mushtaq

Sher-e-Kashmir University of
Agricultural Sciences and
Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

Rakesh Banyal

Central Soil Salinity research
Institute, Karnal, Haryana,
India

Tehmeena Mushtaq

Sher-e-Kashmir University of
Agricultural Sciences and
Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

Aziz M Mujtaba

Sher-e-Kashmir University of
Agricultural Sciences and
Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

Understanding poplars: Silviculture, distribution and pest management

Tahir Mushtaq, Rakesh Banyal, Tehmeena Mushtaq and Aziz M Mujtaba

Abstract

Poplars are one of the fast growing industrial softwoods, which can be raised easily along with agricultural crops. The soft, attractive, strong and easily workable wood of poplar is suitable for manufacturing of matches, furniture, packing cases, plywood, sports goods, pulp and paper. Availability of raw material in the form of softwood is fast decreasing in most countries of the world. The poplars have the potential for narrowing down the gap between demand and supply of wood. Poplars are generally raised by vegetative means using cuttings. Poplars are fast growing trees; they recycle nutrients fast due to their shedding of a large quantity of leaves which decompose early. Poplar timber is being used for making apple boxes, interior wood work, beams, poles, and fuel wood. Poplar is one of the few forest species which is considered ideal for successful inter cultivation with agricultural crops. Poplars are known for their fast growth, easy vegetative propagation and enriching the soil with litter, and provide high production (10-30 M³/hectare/ year) on a short rotation of 8-12 years. Melampsora rust pathogens and Gypsonoma species are known to attack poplars throughout the world causing serious losses in nurseries as well as in plantations. *Apriona cinerea* (poplar stem borer) cause damage to the wood. These pests must be controlled to reduce loss of economy.

Keywords: Silviculture, distribution, pest management

Introduction

Forest cover of India has been estimated to be 6, 37, 293 km² of the total geographical area of the country. Out of this, 7.76% forest cover is in the form of open forests and another 1.58% is scrub forests. According to National Forest Policy 1988, one-third (33.33%) of the land area should be under the forest cover for sound ecological balance. It means that we have to bring another 13.94% areas under forest cover and at the same time improve quality of the degraded forests. However the horizontal expansion of land under tree cover is not possible. In order to increase the tree cover and fulfill the requirements of the people and industries, social forestry programs should be launched. As the country has a net sown area of 46.84% it is one of the most important potential areas for tree growing along with the agriculture crop. In order to attract farmers toward agroforestry, we should have viable agroforestry models, which can provide attractive financial returns to the farmers (Rajiv Kumar *et al.* 2004) [13]. There are many sustainable agroforestry systems in vogue in many parts of India and among them is poplar (*Populus deltoides*) based agroforestry system (Puri *et al.* 2001) [12].

Why Poplars?

The poplars has gained popularity because of the following reasons-

- They have features favourable for Agroforestry system.
- Ready marketability of the produce.
- Encouragement from the private firms.
- Huge demand in wood based industries.
- Use of poplars for Carbon sequestration.
- Use of poplars for Phytoremediation.
- Absorption of nitrate pollutants from farms.
- To mitigate salinity (Armitage, 1985) [1].

Features of poplars

- Fast growth-20-25m³/ha/yr (Singh *et al.* 2001) [14]
- Straight clean bole.

Correspondence

Tahir Mushtaq

Sher-e-Kashmir University of
Agricultural Sciences and
Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

- Leaflessness during winter.
- Multiple uses-Pulpwood, packing cases, poles, timber, etc.
- Compatibility with agricultural crops.
- High economic returns-Rs.88,749/acre @12 percent interest in seven years (Dillon *et al.* 2001) ^[5]
- Short rotation period (6-8 years).
- High CO₂ exchange rate (Nelson, 1984).
- High water use efficiency (Dickmann and Keathley, 1996) ^[6].

Silviculture of poplars

Nursery Practice

Nursery techniques for raising *Populus* species have been perfected at FRI and guidelines prepared are given as under. The same technique is applicable to all *Populus species* planted in India.

Preparation of cuttings

Poplars are generally raised by vegetative means using cuttings. Cuttings are derived from one year old shoots from lower two-third portion or from nursery grown one year old plants, during the dormant season. Cuttings from the shoots are prepared using sharp cutters like secateur or Gandasa. The optimum diameter of cuttings (22 cm long) varies from 1-3 cm. Cuttings can safely be drawn at any time from the middle of January. Both ends of the cuttings should be sealed by wax,

as protection against moisture loss. The cuttings must be submerged in fresh water immediately after preparation and kept for 28 hours prior to planting, cuttings should be drenched with Aldrin (30 EC thoroughly mixed in 100 liter water) emulsion. Thereafter the cuttings are also treated with Emisan-an organomercurial fungicide (250 gm Emisan in 1000 litre of water).

Planting of cuttings

The cuttings are inserted vertically in well prepared nursery beds. The usual spacing between cuttings is generally kept at 50 cm or 60 cm and between rows 60 to 80 cm. The entire length of cuttings should be inserted into the soil keeping one bud above ground level. The soil around each cutting should be compacted gently but firmly without injuring the bark. The nursery raised plants called Entire transplants (ETP's) attain a height of about 3 to 4 meters in one growing season. These are utilized for planting in the field.

Distribution

World

Poplars in their natural range occur interspersed throughout the forests of temperate regions of Northern Hemisphere between the southern limit of around latitude 30° N and northern limit of latitude 45° N. Several species occur naturally in the land mass. There are 35 species of poplars currently recognized in the world.

Table 1: Important countries undertaking poplar plantations

Countries	
France	Canada
Japan	India
Italy	Pakistan
Korea	Turkey
Hungary	Syria
Yugoslavia	Iran
Australia	Iraq
Romania	Afghanistan
Germany	New Zealand
Netherlands	Morocco
Belgium	Tunisia
U.S.A.	Algeria

Table 2: Countries reporting Poplar stand area

Country	Natural Poplar stands area (1000 ha)	Planted Poplar stands (1000 ha)
Canada	28,300	-
Russian Federation	21,900	-
United states	17,700	-
China	2,100	4900
Germany	100	-
Finland	67	-
France	40	236
India	10	1000
Italy	7	119
Turkey	-	130
Argentina	-	64
Total	70,224	6,449

Globally, 91% of poplars grow in natural forests, 6% in plantations and 3% in AF systems. China (76%) and India (15.5%) are the major countries having higher planted area. The reports by IPC members suggest that the area of planted poplars appears to be increasing globally. Regionally, the area is decreasing or stable in Europe, increasing or stable in Asia,

increasing in North America and increasing or stable in South America. The planting of poplars in smallholder woodlots and in agroforestry systems is increasingly enhancing land use in Asia (especially China and India) and South America.

Distribution of Populus in India

Populus is widely planted above 28° N latitude in India in Jammu and Kashmir, Punjab, Haryana, Uttar Pradesh, North Bengal, Himachal Pradesh, Sikkim and Arunachal Pradesh, along roads, canals, in agriculture fields, towns, parks, orchards and home gardens.

Indigenous and Exotic Populus species

Indigenous Populus Species

There are six *Populus spp.* Indigenous to India growing along water courses in the higher hills, in valleys and also on hill

sides exposed due to landslides etc. Most of the indigenous *Populus spp.* Grow in areas having mean minimum and maximum temperature of 6 °C and 10 °C, respectively. They grow well on low lying and moist areas preferring loamy soils but may be planted on river beds with sandy soils and in areas with clayey loams in forest soils. The soil pH best suited to poplars ranges between 5.0 to 6.5. Poplars are known to naturally occur in sub-tropical broadleaved hill forests, wet temperate, moist temperate deciduous forests and dry temperate forests. Their distribution in nature is as follows:

Table 3: Indigenous *Populus species* distribution

Species	Distribution
<i>Populus ciliate</i>	Temperate and Sub-temperate region of Himalayas; altitude: 1200-3500m.
<i>P. laurifolia</i>	North-west Himalayas; altitude: 2400-4000m.
<i>P. gamblei</i>	Eastern Himalayas (Sikkim, North Bengal, Arunachal Pradesh); altitude: 400-1300m.
<i>P. euphratica</i>	North-west Himalayas; altitude: up to 400m.
<i>P. alba</i>	Western Himalayas; altitude: 1200-1300m.
<i>P. jaquemontiana</i> var. <i>glauca</i>	Eastern Himalayas (Sikkim, North Bengal); altitude: 1500-3200m.

Among the six species, *P. anoria* and *P. gamblei* are fast growing and offer a potential to meet the increasing demand of wood for packing cases and for other industrial uses; *P. euphratica* is seen to be thriving well in the cold desert region of higher Himalayas. Other species grow slow but yield good quality wood.

Exotic Populus Species

Since poplars prefer longer hours of day light, the natural zone of poplars lies only from 31° N latitude and upwards. Therefore exotic poplars were initially introduced in India in areas between 28° N to 31° N. Individual plants in the genus *Populus* are either male or female therefore their seeds produce a large number of hybrids. This character offers excellent opportunities for improvement and selection. To produce true to type plants they must invariably be propagated vegetatively.

As a result of research trials with various species of poplars,

Forest Research Institute (FRI), Dehradun and State Forest Departments could identify suitable clones of *Populus species* to suit the different agro-climatic conditions in the country. The technology of raising poplar perfected by the FRI scientists have helped popularize the species amongst Forest Departments and farmers within a short span of less than two decades. After initial screening, the State Forest Departments and the industries like WIMCO (Western India Match Company Limited) are provided with the germplasm of the successful clones which they multiply and distribute to the farmers, along with technical know-how on their culture developed at this institute.

In India large number of exotic species/clones have been tested, screened and recommended for raising large scale commercial plantations above 28° N latitude. Several states have raised commercial plantations of exotic poplars. Suitable clones/species of *Populus* adapted to the different regions/states are as follows:

Table 4: Suitable Exotic species for different states

State	Suitable Exotic Populus species
Uttar Pradesh	<i>Populus yunnanensis</i> , <i>P. robusta</i> , <i>P. deltoides</i> 'G-3', 'G-48', 'D-121'.
Jammu Kashmir	<i>P. nigra</i> var. <i>italica</i> , <i>P. euramericana</i> 'I-488', <i>P. eugenei</i> , <i>P. robusta</i> , <i>P. deltoides</i> 'IC'.
Himachal Pradesh	<i>P. euamericana</i> 'I-488', 'I-65', 'I-15', <i>P. Rubrapoirot</i> , <i>P. deltoides</i> 'IC'.
Punjab	<i>P. deltoides</i> 'G-3', 'G-48', 'D-121'.
Haryana	<i>P. deltoides</i> 'G-3'.
Arunachal Pradesh	<i>P. deltoides</i> 'G-3', 'IC'.
Maharastra	<i>P. deltoides</i> 'D-121', 'G-3', 'G-48'.

Some of the new clones introduced recently that have shown success in farming systems in North India are 'ST-67' 'S7C4', 'S7C8'. Clones of 'L' series developed at Haldwani (U. P.) from open pollinated seeds of 'G-48' and 'D-121' have also shown promise and may replace the existing clones in near future (Tewari, 1993) ^[15].

Economic Importance of poplars

Growth and Yield

Growth and yield of poplars depends upon geographic location, site quality, clone, age, spacing, and silvicultural conditions. On average, poplars typically grow in height from 2.5 to 7.0 feet per year. Diameter growth ranged from 7 to 9

inches in 10 years. Average annual diameter growth ranges from 0.5 inch per year to 4.25 inches per year. New cottonwood clones are expected to grow even faster (Rajiv *et al*, 2004) ^[13]. Biomass yields ranges from 2.6 to 4.5 tons per acre in 8 to 10 years, and currently operational plantings have yield over 4 tons per acre. The productivity of hybrid poplar trees depends on site, location, and clone. Some trees attain 200 lbs of leafless dry weight in 10 years. Thus, 10 trees of this size would yield a ton of biomass. Volume growth for poplars varies from 100 to 350 ft³ per acre per year in 10 to 20 years. There are reports of annual volume growth of 100 ft³ per acre in 5 years, to over 400 ft³ per acre per year after 12 years (Dickmann and Keathley, 1996) ^[16]. Improved volume

growth could be expected with the new clones grown under the Best Management Practices (BMPs).

Pulp and paper

The most important use of poplar wood is pulp and paper. Poplar wood substitutes well for aspen for pulp and paper products, and is being grown for pulpwood extensively in all parts of the world (Ball *et al*, 2005) ^[2].

Solid wood products

Poplar wood has been used locally for construction lumber. Currently, it is used for a broad range of the solid wood products including pallets, crates, boxes, and furniture components. The advent of modern dry kilns with improved drying capabilities has opened up more poplar lumber opportunities including molding, paneling, flooring, fine furniture, picture frames, and decorative boxes (Chauhan, 2000) ^[4].

Composite products

Poplar wood is increasingly used for composite wood products. These products are in high demand for construction in the housing industry. These products include particleboard, fiberboard, waferboard, oriented strandboard, veneer, plywood, and composite lumber such as laminated veneer lumber (LVL), laminated strand lumber (LSL) and composite I-beams (Dhillon, 2001) ^[5].

Bioenergy

Poplar wood, chips, or pellets can be burned directly for energy production or mixed with coal to produce electricity. This co-firing approach is a cleaner, cheaper, and more environmentally acceptable than burning coal alone. Bio-fuels are renewable fuels that are neutral with respect to carbon dioxide emissions, thus, decreasing greenhouse gas emissions.

Poplar wood contains between 7,000 and 8,000 BTU per pound depending on its moisture content. Therefore, a ton of poplar contains nearly 16 million BTU of energy (Gordan and Newmen, 1997) ^[7]. That energy equivalent is over 4 million kilo-calories, or 133 gallons of gasoline, or more than 16,000 ft³ of natural gas (Nandal, 2005) ^[11].

Animal feed products

The foliage from poplars is rich in nitrogen and protein and can provide a valuable source of animal feed. Poplar leaves are used for fodder in many parts of the world especially for sheep and goats (Balatinecz, 2001) ^[3].

Pest Management

Different pests are known to attack causing serious losses in nurseries as well as in plantations of *Populus deltoides*, *Populus Alba* and *Populus ciliata*. Melampsora rust pathogens are damaging leaves of poplars in nurseries and plantations. Quantitative precautions must be strictly taken against entry of pest infected cuttings in the nurseries. Gypsonoma species attacks the apical buds and shoots of Poplars. The larvae bore the apical buds and tunnel down the shoots, thus killing the buds and hollowing the shoots. Application of bavistin at 0.1 percent concentration is found effective against the pest in the nursery.

Poplar stem borers (*Apriona cinerea*) is a serious pest in the foot hills of Kashmir valley and adjoining plains. The pest attacks all age group of poplars. Attacked trees deteriorate the quality of wood. Pruning of affected branches in September-October and fumigation with para dichlorobenzene successfully controls borer population. Soil application of Furadan (granular formation) can protect nursery plants from the borer damage. Collateral hosts of the stem borer may be removed from the vicinity of poplar plantations.

Table 5: Pest management of Poplar Plantations

S. No.	Pest	Species Infected	Control
1	Melampsora Species	<i>Populus deltoides</i> , <i>Populus alba</i> and <i>Populus ciliate</i>	Removal of pest infected cuttings
2	Gypsonoma species	<i>Populus deltoides</i> , <i>Populus nigra</i> and <i>Populus ciliate</i>	Application of bavistin at 0.1%
3	<i>Apriona cinerea</i>	<i>Populus deltoides</i> and <i>Populus ciliata</i>	fumigation with para dichlorobenzene

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