

IMPROVED PACKAGE OF PRACTICES FOR POPLARS UNDER AGROFORESTRY

Introduction

Poplars are amongst the fastest growing tree species under appropriate agro climatic conditions. Poplars can be harvested at short rotations of 8 to 10 years. Wood obtained from poplars is eminently suitable for manufacture of match splints, veneering products, artificial limbs, interior paneling, cheap furniture and packing cases etc. Poplars with straight and cylindrical bole, moderate conical crowns mostly deciduous during winter months, combine well with intercultivation of agriculture crops. These features combined with good economic returns and availability of long-term bank loans have made versatile poplars the most popular tree species for planting under agro forestry system in the irrigated tracts of north-western plains of India.

Some species of poplars like *Populus ciliate*, *P.gamblei*, *P.alba*, etc, are indigenous to the Himalayan region of India. However, success story of poplar plantations in the north-western plains of Uttar-Pradesh, Haryana, and Punjab is based on exotic *P. deltoids* indigenous to United States of America. Certain clones of *P. deltoids* have been found to be eminently suitable for a forestation as well as agro forestry plantation under immigrated conditions. *P. deltoids* clones G3, G48 and D121 constitute bulk of these plantations. Additional clones like D61, D67, S7C8 and S7C15 have been included in the plantation programme. Poplars can attain 90 cms. Girth at breast height and mean annual increment of 20m³/ ha at 8 years rotation under good care.

Nearly 250 ha is covered with poplar plantations by the U.P Forest Department in terai areas of Nainital district every year. Poplars are in the second rotation in Nainital terai. More than 10,000 farmers have planted 91.61 lacks poplars under agro forestry covering an area of more than 18,320 ha between 1984-1990 in Punjab, Haryana and Uttar Pradesh under a project promoted by Wimco Limited with NABARD re-finance assistance.

Nursery Practices

Very well drained fertile soil with assured irrigation should be selected for raising nursery stock. Heavy clayey or sandy soils are not suitable. The area should be given preparatory irrigation and thereafter properly leveled and ploughed when the soil is under optimum moisture condition. One deep ploughing with a disc plough followed by two ploughings with a harrow are adequate. Cultivator could be used for removal of weeds. In case of heavy incidence of grasses and weeds, the same should also be removed manually after the cultivator operation in either direction. Planking operations should be done using a heavy roller.

Suitable, well leveled flat beds should be prepared for planting of cuttings. As poplars are very sensitive to zinc deficiency, zinc sulphate @ 25 kg/ha should be applied to the area at the time of ploughing and site preparation.

Planting Material for Nurseries

One year old plants from existing nurseries are used for preparation of cuttings for the new nurseries. Diseased, Dying off-type and suppressed plants must be culled from the beds where stock is reserved for preparation of cuttings for the new nurseries. The plants can be cut 2 cms. from ground level and the resultant sets should be graded and formed into bundles should be transported to the new nursery site immediately and stored there in the storage pits, which should be kept full with fresh water to be replenished every day. As the top most layers of the bundles will float the same should be kept submerged in the water by placing some wooden poles or sandbags. This is necessary to prevent loss of moisture from the sets and to maintain their freshness and viability.

Preparation of cuttings

Cuttings should be prepared with a very sharp and fairly heavy tool like "Gandasa" to obtain a very clean and smooth cut. Blunt and defective tools should never be used. During the preparation of cuttings, the cut must be given at a point of the set which is fully supported on a log/beam of wood to prevent splitting of cuttings.

The length of the cuttings should be around 20 to 22 cms and the upper cut of the cutting should be slightly above an active bud as far as possible. Maximum number of available cuttings from each plant down to one centimeter diameter can be used for planting. Splitting of cuttings at the time of preparation should be avoided and no split cutting should be normally used for planting. All cuttings must be submerged under fresh water in drums immediately after preparation of the cuttings.

Treatment of cuttings

The next step is to treat the cuttings with Aldrin as an ant termite measure. 250ml Aldrex 30 E.C. should be thoroughly mixed in 100ltr. Water and the cuttings should be soaked in the emulsion for 10 minutes. Thereafter, the cuttings should be treated with Emisan – an organ mercurial fungicide (250 g. Emisan-6 in 100 ltr. Water)

Cutting treated with Aldrex should be transferred to drums containing Emisan solution as above and kept submerged for 10 minutes. Thereafter the cuttings should be issued for planting in the beds.

Safety precaution must be taken and rubber gloves should be used while treating and grading the cuttings. Cuttings can be graded thickness-wise and it will be useful to plant cuttings of more or less uniform thickness in a bed.

Planting of cuttings

The best time for planting of cuttings is January-February. Spacing for setting of cuttings in nursery beds should be 80 x 60 cms. Planting rods with the lower ends flattened and sharpened like a screw driver should be used for making the planting holes. Planting rods should have a ring of paint at 22 cms length from the bottom and the same should be given to labourers engaged in planting operation. Planting rod should be inserted at the point of the stake up to the marked with paint, so that the planting holes are neither too long nor too short. Each cutting with its thinner end up should be planted in the hole in such a way that the upper portion is just 2 cms above the ground level.

After planting the soil around each cutting should be compacted gently but firmly without injuring the bark of the cutting in any way. The soil all around the cutting should be drenched with Aldrex emulsion immediately after planting the cutting 0.2% Aldrex emulsion may be used for this prophylactic measure against termites.

Irrigation in Nurseries

Irrigation should be provided as soon as the planting of cuttings in any bed is completed. Undue delay in irrigating the beds can cause dehydration of the planted cuttings and result in poor sprouting. The first irrigation should be medium heavy so that about 5 to 7 cms water is uniformly above ground level at the time of irrigation. Subsequent irrigation should be light and the interval may vary between 7 to 10 days depending upon the type of soil. Light sandy soils will need frequent irrigations whereas soils with need irrigation at longer intervals. The top soil should not be allowed to develop cracks and become absolutely dry. Next irrigation should be applied before such a stage develops till completion of sprouting.

Thereafter irrigation can be at 10 to 15 days interval depending upon the type or soil and need of individual nurseries till onset of monsoons. Proper and effective drainage of excess water during rainy season is essential to prevent lodging and collar rot. After the rainy season one to two irrigations per month will be adequate.

Site Selection for Poplar Plantations

Selection of proper sites for poplar plantations is of utmost importance because survival and growth rates of plants depend largely on the site quality. Suitable sites will ensure optimum survival and growth with normal inputs. Unsuitable sites will pose innumerable problems and despite best efforts survival and growth rates will be far below normal expectations. Therefore great care must be taken in selecting sites for future plantations. Amongst others following points may be kept in mind while deciding about the suitability of any farm for poplar plantations.

Farmland must be extremely well drained as poplars do not withstand water logging. Low lying areas subject to accumulation of water during rains should be avoided. Frequent and timely irrigation are key to the success both in respect of survival and growth rates of poplars. Therefore assured irrigation facilities to irrigate poplars should be available.

Type of soil and its fertility status are important. Heavy clay soil and very sandy soil should be avoided as the clay soils will invariably have impeded drainage and sandy soils will be very poor in organic matter, plant nutrients and water holding capacity.

Therefore fertile loam or silt loam soils rich in organic matter should be preferred. Saline and alkaline soils are not suitable for optimum growth of poplars and areas affected with salinity/alkalinity should be avoided. Saline and alkaline soils will often have a hard kankar pan in the subsoil. This impedes drainage and prevents penetration of roots. Zinc deficiency and toxicity of molybdenum increase in saline and alkaline soils. In case of any doubt soil tests should be carried out before deciding about taking up any marginal site.

Areas known to be affected with termites should be avoided as termites can interfere with proper establishment of poplars after transplanting. Termites can also cause serious damage to the xylem of growing poplars including causing death of the plants in severe cases. Areas prone to damage by cattle particularly adjoining residential areas of a village should be avoided unless proper fencing is arranged. Grazing cattle can cause serious damage to poplars particularly by causing physical injury to the stem by rubbing their horns or bodies. Damaged plants either do not develop into proper trees or they may die altogether in case of severe damage. For single line planting areas affected by shade from the existing trees should be avoided as poplars are strong light demanders and will not grow well under the effect of shade.

Ideal sites fulfilling all the conditions mentioned above may not be available. Minor compromises may be needed. However, sites with unsuitable soil or with inadequate irrigation facilities must be rejected.

Pre-planting Operations

Two months of January and February is the best period for transplanting poplars from nursery to the field in Northern India. Late transplanting results in heavy casualties. Recommended spacing is 5 m x 4 m. i.e. 500 plants/ha.

Interested farmers should prepare well aligned pre-planting irrigation channels 5 m apart from centre to centre at the time of sowing rabi crops. The minimum effective width of these irrigation channels excluding the berm should be 30 cms. and minimum depth from normal ground level excluding the height of the berm should also be 30 cms. Such channels will

facilitate optimum and timely irrigation of poplars irrespective of the irrigation requirements of the intercrop.

Digging of pits in the preplanned irrigation channels after proper alignment should be completed before obtaining the plants from nursery. The depth of the pits should be 1 m from bottom of the irrigation channel. These pits are made with specially designed hand augers which will give 15 cms diameter pits or with a tractor mounted auger.

One year old nursery plants with naked roots called "entire transplants" (ETPs) 3 to 4 meters in height are used for transplanting in the field. Nursery beds should be given a light irrigation 7-10 days before uprooting without damaging the roots or causing injuries to the stem is likely to interfere with normal placing of ETPs. Careful uprooting without damaging the roots or causing injuries to the stem is necessary. Any thick roots which are likely to interfere with normal placing of ETPs in the pits should be pruned. Root pruning must be kept to the minimum as the roots have an essential role to play and should not be unnecessarily trimmed. Unless the apical tip of any ETP is damaged no trimming of the growing tip should be carried out.

Handling of ETPs at the Farm Sites

Immediately on receipt of the ETPs at the farm site, all ETPs should be placed in preplanned storage pits. Bundles of ETPs should be placed horizontally in the pits which should be kept full of fresh water to be replenished from time to time. Storage under fresh water for minimum 48 hours is desirable. If necessary ETPs can be safely storage under fresh water for 4-7 days before transplanting. Improper storage or storage of ETPs in stagnant water will do more harm than good.

Prevention of loss of moisture and dehydration of the ETPs, from the time these are uprooted from the nursery till same are transplanted in the field, is of utmost importance for success of poplars. If the ETPs suffer dehydration and damage to phloem and cambium layers the establishment and survival of the plants will be difficult. Therefore dehydration and drying of ETPs should be prevented as a top priority measure at all stages of handling.

Pre-treatment of ETPs and Transplanting

Two large drums should be arranged for pretreatment of ETPs just before planting. First the ETPs up to 1m length from roots should be soaked in Aldrin emulsion (250 ml Aldrex 30 EC in 100ltr of water). This anti-termite treatment should be given for 10 minutes.

The bundle of ETPs should then be transferred to Emisan solution in the second drum for 20 minutes (250 gms of Emisan-6 in 100 ltr of water) to prevent fungal infection.

Entire soil taken out of the planting pit should not be used for refilling it after transplanting. Only top soil rich in plant nutrients should be used. As far as possible only surface soil collected from upper 15 to 20 cms of the field should be used 50 gms of single super phosphate 25 gms muriate of potash and 5 cc of Aldrex 30 EC diluted with water should be mixed with the top soil to be used for pit filling as mentioned above. ETP should be held vertically in the planting pit which should then be filled completely with treated soil. But compaction should not be done at this stage. After filling the pits as arranged. The irrigation channels should be filled completely. The level of the upper part of the pits unfilled. It should be allowed to remain like that.

Just before second irrigation pits should be filled in and proper compaction should be arranged with the help of thick wooden stick. Make sure that the plant remains in proper position vertically. After adequate compaction leave about 10 cms of the pit unfilled to ensure that enough water percolates down to deeper layers and enough moisture is retained around the plant. While compacting the bark of the plant should not be damaged.

Care after Planting

Sprouting starts by the end of March and should be completed by end of April. Certain clones like D-61 and D-67 sprout fairly late up to the middle of May. Some of the plants may not sprout all and this can be ascertained by inspecting the buds of the plants. If the buds do not show signs of swelling/opening, the plants should be cut back at the ground level in early May. Special care by way of irrigation and soil working should be taken for the cut back plants which will sprout if the same were green and alive at collar level at the time of cutting back. Unless irrigation channels act as drains during rainy season the same should not be retained after the onset of monsoon lest any water accumulated in these channels should create condition close to water logging. Precautions should be taken to ensure that wet or very moist soil is not heaped around the stem of the plants as that may encourage collar rot damage.

Irrigation

Frequent adequate and timely irrigation hold the key to the successful establishment and growth of poplar plants. Frequency of irrigation will depend upon the soil type and its moisture holding capacity. However during the first year of the plantation adequate irrigation should be arranged through the irrigation channels at weekly intervals till the onset of monsoon rains excluding the period during which there may be reasonably good rains. During July-September irrigation may be given as per requirements depending upon the rainfall and intervening dry spell. During October-December two irrigations per month will be adequate.

In the second year of the plantation irrigation at 15 to 20 days interval during winter and at 7-10 days interval from March till onset of monsoon will be required. From the third year onwards two irrigation per month during summer season will be very helpful in accelerating the growth. During winter two irrigations each year will be useful.

As the poplars grow and root system develops and spreads over large parts of the plantation area flood irrigation during summer months in beds to cover the entire area will be very helpful. However flooding can result in lodging if there is a strong wind storm.

Application of Manure and Fertilizers

Well decomposed farmyard manure which is rich in macro as well as micro nutrients essential for the plants should be applied to the total area under poplars while preparing the land for intercultivation of Rabi and kharif crops. Application of nitrogenous potassic and phosphatic fertilizers as well as micro nutrients will depend on the fertility status of the land and on the and the second during August- September atleast during the first year of the plantation may be arranged to guard against any possible micronutrient deficiency.

Pruning Operations

Pruning is essential for ensuring a large clear bole with concentration of maximum volume in the main stem for improving yield and quality of commercial timber. However this must be done most carefully as excessive or unscientific pruning can cause more harm than good. It is difficult to prescribe uniform and rigid rules for this operation. However general guidelines are as under:

During the first year of growth debudding operations should be carried out in the lowest one-third part of the stem during June-July and leader training operations should also be carried out simultaneously during the same months. While carrying out leader training all precautions must be taken and only co-leaders competing with the main leading shoot should be carefully pruned. If the apical bud sprouts and grows as leading shoot, no leader training may be required during the first year. Leader training should be carried out again during winter after completion of two season's growth as per requirements of the individual plants.

Pruning of branches at the lower portion of the stem should be carried out as per requirements. However between second and third years of age pruning should be restricted to a maximum of lower one-third part of the total height of the tree. During subsequent years pruning could be carried out up to a minimum of one-third and maximum of half of the total height of the tree. But each case will have to be decided on merits and requirements.

Main stem should not be damaged during pruning and leader training operations. Bordeaux paste should be applied immediately after carrying out pruning/leader training operation. This will protect the stem from possible entry of insect pests and pathogens.

Excessive pruning is very injurious as it encourages development of vigorous epicormic branches. Over-pruning also results in retardation of diameter growth. Therefore over-pruning must not be carried out under any circumstances. In pruning operations it is always better to be on the safer side. After 1st year pruning and leader training operations should be carried out only during winter and not in summer or rainy season.

Insect/Pests and Disease Management

Leaf defoliators *Pygaera cupreata* and *P. fulgurita* become active during the rainy season and multiply extremely fast. These insects may cause almost complete defoliation any time after the onset of monsoon rains and before the normal leaf fall in winter. There can be considerable set back to growth in case defoliation takes place early during in case defoliation takes place early during the active growing season

Endosulfan spray at 0.04% concentration (a.i.) is quite effective in controlling these defoliators in nurseries and young plantations. Natural parasites and predators which include the common crow often contain the periodical epidemic attack of defoliators in plantations.

Leaf spot diseases which may cause premature defoliation in case of heavy attack have been noticed and fastest growing clone G3 is comparative more susceptible. Main fungi causing leaf spot diseases have been identified as *Bipolaris maydis*, *Pseudocercospora salicina* *Phoma macro stoma*, *Myrothecium roridum*, ECT.

Incidence of *Ganoderma* root rot has also been recorded. Fortunately, *P. Deltoids* plantations are so far free from dreaded exotic *Melampsora* rusts. As it is difficult to control leaf spot diseases through chemical sprays, choice of disease resistant clones combined with clean cultivation practices is the best safeguard against damage by leaf spot diseases.

Poplars are sensitive to high temperature and hot summer winds which may cause sun scorch damage to bark and stem as well as premature leaf fall. Adequate and timely irrigations safeguard against such damage. However planting of poplars in tracts subject to desiccating hot winds and high temperatures exceeding 43 C should be avoided.

Physical injuries to the stem because of faulty pruning or damage by cattle/ agricultural implements during inter-cultivation operations must be avoided Prophylactic measures and clean cultivation operations to prevent damage by termites is necessary for raising poplars successfully. Poplars are also extremely fire tender and no debris should be burnt in the vicinity of poplar plantations. Excessive flood irrigation should be avoided to safe-guard against uprooting/lodging by strong wind storms.

Intercultivation of Agricultural Crops

Intercultivation of agricultural crops benefits the farmer by way of additional income. Poplar plants are also benefited because of additional inputs for the inter-crops and adequate control over weeds. Any traditional crops except paddy can be grown reasonably well in

between the lines of poplars during the first 2 years. Subsequently shade tolerant crops like ginger, turmeric and colocasia can be raised as less sunlight percolates to the ground during active growth period of poplars because the crowns cover most of the canopy. Short duration winter vegetables or rabi crops like wheat lentils toria. Etc. can also be raised as most poplar clones are leafless during autumn. However intercrop yield decreases with the increase in age of poplars. Care should be taken to avoid physical injuries to the stem of poplars during intercultivation operations.

Yield and Returns

Under reasonably good care poplars can attain 90 cms girth at breast height and mean annual increment of 20m³/ha (under bark) at 8 years rotation. Good veneer quality logs suitable for the match and wood panel industries will be available from the bole and lops and tops will yield good quality pulpwood on harvest. There is a possibility of further improving the yields through intensive management practices and appropriate inputs; regular and timely irrigation bring one of the key inputs. Minimum support price @ Rs. 1250/m³ (under bark volume) has been offered for match-wood quality poplar logs on harvest of plantations being raised in U.P. Punjab and Haryana with NABARD re-finance assistance. Based on this minimum support price and current cost of raising and maintenance of poplar plantation farmers can get net returns amounting to approximately

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SUMMARY

Certain clones of exotic poplar *P. deltoides* have been found to be extremely fast growing and well adapted for farm forestry plantations under irrigated conditions in north-western plains of Uttar Pradesh parts of Haryana and Punjab. Availability of long-term bank loans and possibility of good economic returns at short rotations of 8 years and multiple industrial uses of poplars have made them extremely popular under agro forestry in Uttar Pradesh Haryana and Punjab states. Improved package of practices for nursery raising selection of suitable sites transplanting operations and maintenance of poplar plantations have been described for improving yields quality of timber and economic returns.