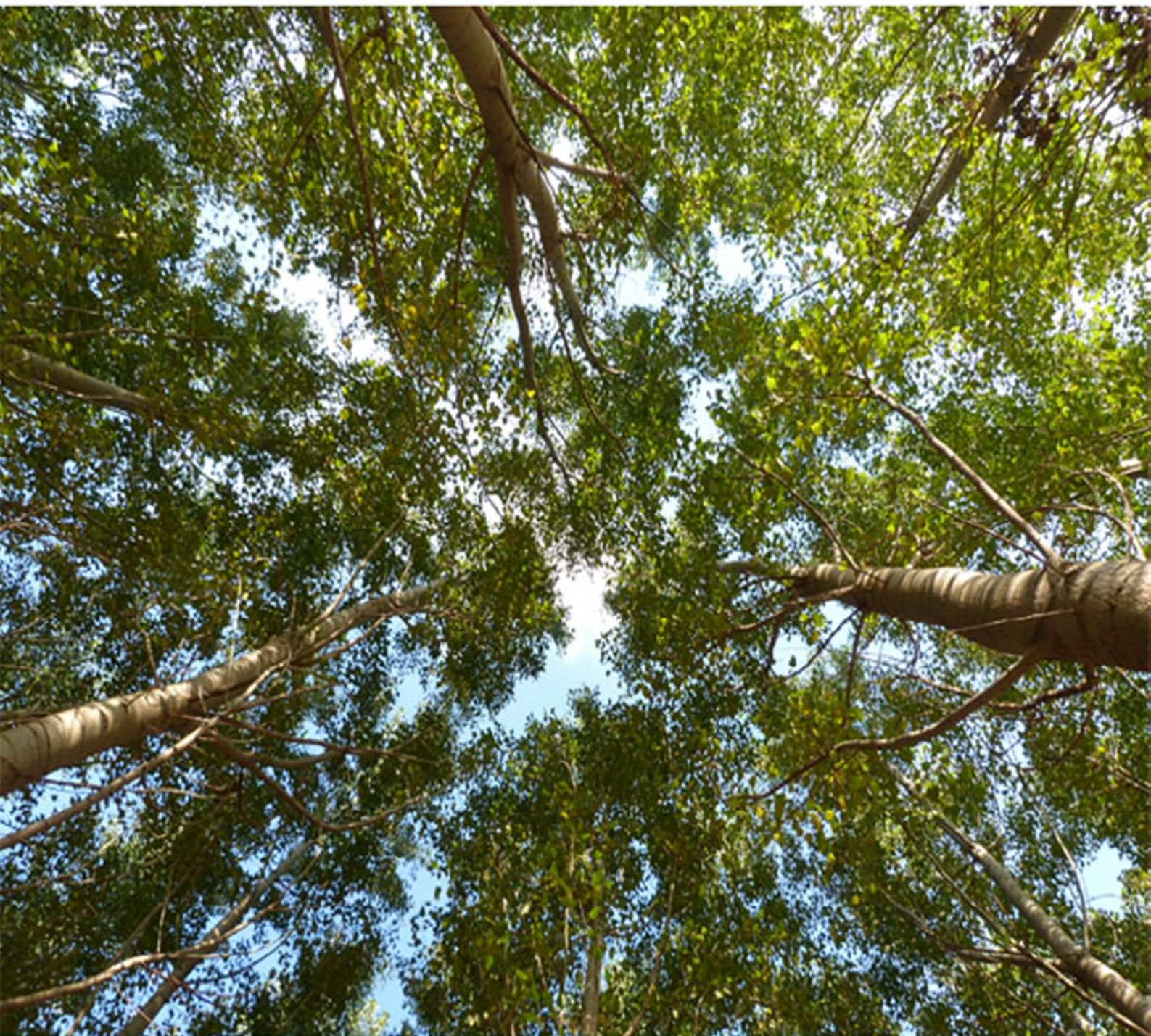




**General Directorate of Forestry
Poplar and Fast Growing Forest Trees
Research Institute**



**Poplars and Willows in Turkey
Country Progress Report of the National Poplar Commission
Time period: 2012 - 2015**

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Time period: 2012-2015

Prepared by: Poplar and Fast Growing Forest Trees Research Institute

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I. POLICY AND LEGAL FRAMEWORK

Poplar and Fast Growing Forest Trees Research Institute affiliated is General Directorate of Forestry (OGM), is an institution belongs to the Ministry of Forestry and Water Affairs performing the services for protection, enhancement of forest and benefitting from them in a sustainable way within the frame of authorizations granted by the Constitution and Laws for 173 years.

Main duties are;

- to manage forest and forest resources in an ecological integrity to provide multi-purpose sustainable benefits for society,
- to develop forest and forest resources a close understanding of the nature and
- to protect forest and forest resources against any kind of danger.

These activities are continuing in the forest areas which amount to 28,6 % of the country area in order to achieve specified aims of the forestry sector that is one of the important sectors in the economy.

Poplar and Fast Growing Forest Trees Research Institute established in 1962 at İzmit/Kocaeli as a result of an agreement between Turkish Government and the FAO, is one of the twelve Forestry Research Institutes affiliated General Directorate of Forestry and carries out its forestry activities throughout the country. The Institute's main activities are to carry out researches projects on poplar, willow and other fast growing forest tree species and provide technical assistance to private and public sectors to increase wood production from non-forest resources.

According to the data of 2015, The Ministry of Forestry and Water Affairs is responsible for 22.3 million hectares of "forest land" and was produced about 18.3 million cubic meters wood material. The total area of natural poplar stands in different forest regions of Turkey is about 260 681 ha (142 322 ha pure stand, 118 359 ha mixed stand with other forest trees). The natural poplar stands are mainly consist of *Populus tremula*. Wood production is about 65.000 m³ annually. Some natural stands of *Populus euphratica* occur in South and South-east Anatolia. The other poplar species (*Populus nigra*, *Populus alba* and *P. x canescens*) occur at different sites of Turkey as individual trees or small groups.

In Turkey, there is a shortage of raw wood material to meet the demand by forest industries. In fact, Turkey has started importing wood material. So, industrial plantations with fast growing species are given priority to fill the gap of raw material shortage. The production of fast growing species in Turkey is estimated about 3.7 million cubic meter annually. The only 80 thousand m³ of this production are produced by the Gölardı Poplar sub-district affiliated Samsun District Directorate of OGM. In recent years, the share of private nurseries in the production of poplar saplings decreased considerably. Almost all of poplar plantations is carried out by a private growers in Turkey. State owned nurseries continue to producing poplar sapling of selected poplar clones for demonstrative purposes of nursery and plantation techniques.



II. TECHNICAL DATA

1. Identification, registration and varietal control

Registration and identification of poplar and willow clones from different origins have been continuously conducted in the experimental nurseries belong to the Poplar Research Institute in accordance with the adopted criteria. In addition to these works, materials were produced from some selected individuals which were included in first selection *populeta* with temporary clone numbers in previous years.

Varietal control was accomplished in all state owned nurseries during this period. Improved and controlled materials were supplied for private poplar nurseries in order to secure varietal control. Number of private nurseries has notably increased during last two years, and this situation creates difficulties in accomplishing varietal control over them.

Euramerican and Eastern cottonwood clones; *P. x euramericana* "I-214", *P. x euramericana* "45/51" and *P. deltoides* "Samsun" have been used in the regions which are suitable for hybrid poplar plantations. In the Black Sea region "Samsun" has been preferred by poplar growers. Plantations with *P. deltoides* clone "Samsun", have been extended in Marmara and Black Sea regions owing to the fast growth of this clone. The poplar clone "İzmit (S-307/26)", which was selected among cultivar of Eastern Cottonwood (*Populus deltoides* Marsh.) could be used in nurseries and commercial plantations successfully in after the Black Sea regions.

2. Production Systems and Cultivation

Poplar cultivation has a long past in Anatolian peninsula. The people of Anatolia have traditionally cultivated poplars for ages. During past 40-45 years modern poplar cultivation techniques have been demonstrated by the Poplar Research Institute in Turkey. Promising results of planned extension activities for poplar development have been observed in the beginning of 80's. Mechanisation methods have extensively introduced in poplar cultivation both nursery and plantation stages. Furthermore the demonstrations of modern poplar cultivation techniques and extension activities have been extended to the relatively less developed regions of the country such as: The Central Anatolia and The South-eastern Anatolia.

(a) Nursery Practices and Propagation

Planting material is very important for a successful plantation. Poplar plantation is generally established by using stem cuttings, one or two-year old rooted and unrooted plant. According to the research, cutting plant, one or two-year old rooted and unrooted plant showed similar results on survival rate, diameter and height increment. As known, using unrooted saplings are cheaper and practical than using rooted saplings. In this way, a great deal of economy is secured in the poplar plantations.

According to the results taken from nursery stage of study, in one year old parcels, the production unrooted plants and cutting plants with motherness method for



can be made for four periods. For two years aged parcels, the production unrooted plants and cutting can be made for two periods.

Poplar cuttings are produced from one year old poplar plants by cutting them into segments of 18-20 cm in length. In general, these one year old poplar plants from which the cuttings are derived are established by planting cuttings. The cuttings are planted on lines in stool bed (motherness) parcel generally by man power. The distance between planting lines of cuttings is limited depending on the working width of tractor and equipment to be used in running the tending operations. According to the results taken from nursery stage of research; At production of one and two year aged unrooted saplings and stem cuttings with motherness method:

- the best amount of the production for *I-214* and *Samsun (77/51)* clones are given by using 1.3x 0.4 m or 1.6x 0.4 m spacing, no treatment to decrease shooting is necessary.

- the best amount of the production for Black poplar clones (*Kocabey*, *Gazi* and *Geyve*) are given by using 1,6 x 0,9 m and 1,6 x 0,4 m spacings, no treatment to decrease shooting is necessary.

According to the used poplar sapling standardization in Turkey, both one and two years old planting materials are classified by measured diameter from 1 m height. Otherwise, there is not a standardization for one year planting material. Because of that, a new standardization studies for one year old planting materials to be used in the poplar nurseries in Turkey are go on.

(b) Planted Forest

In the beginning of 60's a carefully and seriously designed poplar development program has been commenced. In the early stage of this program several research projects and surveys have been taken into account. During early years of poplar development scheme Turkey was surveyed from the climatological point of view and the main climatological zones have been determined. Turkey has been divided into two main zones according to the climatic features. First; coastal or mild zone where *P. x euramericana* and *P. deltoides* clones are planted. Second; continental zone where *P. nigra* clones are planted.

It is generally accepted type of soil is the first and the most important step for a successful plantation. The most preferable soils are sandy loam and alluvial soils, because these group of soils the roots easily penetrate in the soil down to least 2.0 m deep and keeps sufficient amount of water. The soils in which roots cannot freely spread and capillary action is blocked are not suitable for poplar plantations. If the soil pH values are between 6.5-7.5 the growth of poplar trees will be optimum. But the calcareous soils (i.e. soils with high calcium carbonate) are not recommended for poplar plantations.

Soil preparation is another important step in the establishment of poplar plantations. Suitable lands and clones have to be selected and the land has to be conveniently prepared for successful results. In recent years mechanisation has



intensively been needed in poplar cultivation as well. Heavy and modern machinery have been demonstrated to poplar growers especially in the Central and the South-eastern Anatolia where a great potential exist for poplar cultivation. Some areas in those regions above mentioned the soils have traditionally cultivated not deeper than 30-35 cm. To eliminate the problem caused from shallow cultivation, deep ploughing or ripping and discing, in brief intensive soil work is necessary. Therefore a new mechanisation demonstration program has been launched in target areas where poplar development programmes are supported by the government. According to the research results intensive mechanization methods are also necessary for levelling of the soil drainage which are important for irrigation. For systematic irrigation levelling operation should be carried out carefully. After this operation, deep ploughing and discing should be done in complete area before opening of planting pits.

As a general practice planting pits are drilled at the locations marked with a stick using an auger. The recommended dimensions of planting pits are 80-90 cm deep and 50-60 cm wide for rooted plants. Pits are 15-20 cm smaller in size for black poplars. The augers with a smaller helix diameter such as 30 cm, can be used for planting unrooted plants.

The choice of planting spacing depend on the site conditions and the objective of management of the plantation owner. 5m x 5m and 6m x 6m are the most commonly used spacing in the plantations established with *Euramerican* and *deltoides* clones. Recently narrower spacings (3m x 1,5m, 3m x 2m, 3m x 3m, 3m x 4m,) are recommended to produce more wood product from poplar plantations, established these clones for pulp and chip wood industry.

The success of poplar plantations depends on sufficient amount of water and nutrients. Irrigation is necessary in the areas where the water level falls under the root zone in the soils especially in the central region of Turkey where long summer drought is observed. Poplars are called water demanding species and it is known that they never survive without enough water. Irrigation is generally performed by surface or sprinkler irrigation systems. Drip irrigation systems are used small scale in poplar plantations.

The poplars are very vulnerable to competition with natural vegetation, especially water and nutrients are concerned. That is why in the most regions of Turkey, it is particularly important to limit the transpiration losses due to invasive weed growth. If there is no inter cultured crop, frequent cultivation should be undertaken at least twice a year for four years in May and July and once a year for fifth and sixth years in May or June. Generally, irrigation should be carried out four times for the four years and tree or two times for the remaining years. But the number of irrigation depends on the soil and site conditions.

As a general practice pruning is started at the 2nd or 3rd years of the plantation. Evidently, pruning is not made in the plantations which are established to produce more wood product for pulp and chip wood industry.



(c) Indigenous Forests

In our country there are five naturally occurring poplar species. These are;

1. Black Poplar (*Populus nigra* L.)
2. White Poplar (*Populus alba* L.)
3. Grey Poplar (Hybrids *tremula x alba* named as *Populus x canescens* Smith)
4. Aspen (*Populus tremula*) L.
5. Euphrates Poplar (*Populus euphratica*) Oliv.

There are some small scale natural poplar stands in different regions of Turkey. The total area is about 260 681 ha (142 322 ha pure stand, 118 359 ha mixed stand with other forest trees). The natural poplar stands are mainly consisting of *Populus tremula*. Wood production is about 65.000 m³ annually. Some natural stands of *Populus euphratica* occur in South and South-east Anatolia. The other poplar species (*Populus nigra*, *Populus alba* and *P. x canescens*) occur at different sites of Turkey as individual trees or small groups.

Aspen (*Populus tremula*) is being ranged in large area in Turkey and can be encounter between the altitudes of 0-2700m as small stands, groups, and individuals. Aspen have a wide range of distribution area in Turkey, approximately 133.716,98 ha. This land is characterized as productive high forest and remaining area of 57.217,78 ha. is considered as degraded high forest. The broadest range of Aspen trees is seen in the Regional Directorates of Trabzon (36.603,20 ha), Erzurum (31.777,90 ha) and Giresun (20.878,70ha), respectively. That is particularly focused on its ability to withstand high salinity, Euphrates poplar's natural ranges over the world are greatly diminished. Two most important natural ranges of the species are Tigris and Euphrates rivers. Distribution of Euphrates poplar and Aspen in our country are shown in Figure 1.



Figure 1. Distribution of Euphrates poplar (as four population) and Aspen (▲) in Turkey.



Black poplars (*Populus nigra L.*) are one of the main tree species in central and east part of Turkey. Row plantations with Black poplars are of the traditional practiced of poplar cultivation in Anatolia. River or stream side, field and road side plantations have been established for centuries by the farmers. The other poplar species (White Poplar and Grey Poplar) often can be seen along the edges of streams and rivers.

Willows have a wide natural distribution in Anatolia. The number of natural willow taxons in Turkey is 24. They can spread out in the valleys of major rivers as small groups, and individually. The total area is about 2087,28 ha (877,73 ha. pure stand, 1209,28 ha. mixed stand with other forest trees). The most important willow species in Turkey is *S. alba*. All forms ranging from large tree to large shrub are known. Many ecotypes and hybrids especially with *S. fragilis* and *S. excelsa* occur. *Salix rizeensis* (in Soğanlı mountains in Black Sea region), *Salix anatolica* (in Adana) and *Salix purpurea* subsp. *leucodermis* (in Aegean region) are endemic species of willow in Turkey. Distribution of Willow species in our country are shown in Figure 2.



Figure 2. Distribution of Willow species in Turkey

(d) Agroforestry and Trees Outside forest

Agricultural intercropping can be applied during the first three years of exotic poplar plantations. The intercropping under poplar plantations is applied mainly for two objectives. The first objective is to increase the profitability of poplar plantation investments. The second objective is to provide some annual income for the farmers who have allocated a part of their limited land for poplar cultivation. Poplar plantations should be established at larger spacings such as 6m x 6m, 5m x 7m and 5m x 8m in order to increase the productivity and profitability of agricultural intercropping. Some agricultural crops can be grown successfully along the strips of in-between rows of young poplar trees where the ground is out of the limits to be exploited by trees during the first three years period. The recommended agricultural intercrop species are bean,



tomato, maize, sugar beet, melon, water melon, green pepper, aubergine, courgette, lettuce and cucumber, where all of these intercrops require irrigation and top soil working for their cultivation

3. Genetics, Conservation and Improvement

(a) **Aigeiros section:** Most of the cultivated poplars of the Turkey belong to this section.

1. Indigenous Black poplars (*Populus nigra L.*) are one of the main tree species in central and east part of Turkey. Therefore breeding of Black poplar activities concentrate on this part of Turkey.

Since 1965, the indigenous black poplar clones of “*Gazi* (TR- 56/52)” and “*Anadolu* (TR-56/75)” have been grown in nurseries and planted in plantations in the Central, Eastern and South-eastern regions of Turkey where the continental climatic conditions prevail. Subsequent to further research studies conducted by the PRI, three new clones of indigenous black poplars were selected in addition to previously selected clones, and they were registered by the National Poplar Commission as “*Behicbey* (TR-62/154)”, “*Geyve* (TR-67/1)”, and “*Kocabey* (TR-77/10)”. Research results and field observations show that these new clones of indigenous black poplars can also be used in commercial plantations successfully as the previously selected clones.

According to 6th year data, 6 first selection field clone trials (3 trial at Central Anatolia, 2 trials at South-East Anatolia and 1 trials at East Anatolia), second selection field clone trials 3 (1 trial at Central Anatolia, 1 trials at South-East Anatolia and 1 trials at East Anatolia) established in 2012 and 2014 by using successful clones of first selection field clone trials. Observations on trial sites are continuing by the institute.

Conservation program of black poplar continued by Poplar Research Institute at 2012-2015 period. A project named “Genetic characterization of Turkish Black poplar genetic resources and development of molecular black poplar breeding program” began at 2010 with collaboration of Poplar Research Institute (PRI) and Middle East Technical University. The aim of project is to determine genetic diversity in black poplar genetic resources and to provide genetic identity information of clones in clone bank and re-develop the Turkish black poplar breeding program and to make the program more efficient with molecular techniques.

At the result of genetic classification, clone bank populations and natural populations are divided into two groups. It was shown that the populations which are close each other as geographically, at the same time close to each other as genetically from in sub-groups the populations located in the first group populations. Eastern Anatolia, Southeastern Anatolia and Black Sea populations are located within the first subgroup. Likewise, the Marmara and Aegean populations are similar each other both geographically and genetics.

There is no big difference in terms of genetic diversity between natural poplar stands and were cultured populations of Black poplar plantations. The genetic diversity parameters contained the clone bank are enough to make new breeding studies. The new



clones from the populations of Melet, Tunceli and Eastern Anatolia because of including the most original alleles should be added to increase the genetic diversity in the clone bank.

2. The cultivars and hybrids of Eastern Cottonwood (*Populus deltoides* Marsh.)

Since the year 2000, the clones of “Samsun (I-77/51)” and “I-214” were successfully grown in commercial poplar plantations in Marmara and Black Sea regions of Turkey. The results of the countrywide observations of the pilot plantations and the populeta established by the PRI showed that the poplar clones “Samsun (I-77/51)” and “İzmit (S-307/26)”, which were selected among cultivars of Eastern Cottonwood (*Populus deltoides* Marsh.) and the *Euramericana* clone “I-45/51”, could be used in nurseries and commercial plantations successfully in Turkey.

According to first stage field clone trials of *P. x. euramericana* and *P. deltoides* at Marmara and Black Sea regions, 3 second stage field clone trials established at Marmara Region at spring of 2014. 8 th year results of first stage clone trials show that, 2 Eastern cottonwood clone (89.M.004, 89.M.006) which were obtain from controlled hybridization shows superior performances. Clone 89.M.004 has 62 m³/year volume increments per hectare at trial in Black Sea region. At the same trial clone 89.M.060 has 44,5 m³ volume increment while control clone has 29,8 m³ volume increment per hectare per year.

A project aimed to select hybrid clones suitable South-east Anatolia and East-Mediterranean regions carry out at 2014. According to the results 83011015 *Euramericana* hybrid clone shows the superior growth performances. Registration of clone will perform at 2016.

A new project began at 2011 for investigation suitable clones for fiber production by using narrow spacing plantation model. Three field trial established at Marmara region and 50 *P. x. euramericana* and *P. deltoides* clones used at each trials. Evaluation of clones regarding to the survival, diameter and height growth were made at the end of 3 year. And superior 11 (5 *euramericana* hybrid, 6 *P. deltoides*) clone selected for next stage trials which will observe for 5 years.

(b) Leuce section: This section is divided into two sub section as white poplars (*Albidae*) and Aspens (*Trepidae*).

All white poplars are placed in the single species *Populus alba* which occurs at different sites of Turkey as individual trees or small groups like *Populus x canescens*. *Populus alba* does not have economic value to be grown commercially in Turkey. It is only grown as ornamental tree.

Populus tremula has a large geographic range in Turkey. It occurs in natural forest, sometimes forms pure stands as initial forms of development of forest communities, but this species mainly occurs in groups or individual trees. At the last period, the factors to be effective production with stem cutting of aspen (*populus tremula*) have been determined by PRI. Propagation with seed of *Populus tremula* has



been started to be used for plantations at Central and East Anatolia in Turkey. Stem cutting propagation parcels of *Populus tremula* have been established at İzmit Nursery by PRI. Also, 2 Gene Conservation Forest (One of them is 109,3 ha. in Araç-Kastamonu, the other is 39,4 ha in Şebinkarahisar) and 1 Seed stand (360 ha. in Hasankale-Horasan-Erzurum) in aspen are selected and are made national registration.

(c) Tacamahaca section:

Balsam poplars are not naturally distributed and the species and cultivars of it have been used in any study in Turkey.

(d) Turanga section:

This section contains only a single species, *Populus euphratica* Oliv. It does not have economic value to be grown commercially in Turkey. The most important region for Euphrates poplar's natural distribution in Turkey is where known as Mesopotamia, where is located in between of Euphrates and Tigris-Botan Rivers. In recent researches, new natural distribution sites, other than the region between Euphrates and Tigris-Botan Rivers, have been found for Euphrates poplar.

At the 2012-2015 periods, the environmental factors threatening Euphrates poplar is explored in distributed along the Euphrates and Tigris-Botan Rivers areas. Besides, the information about the researches are presented, which have been carried out to protect Euphrates poplar plantations from these environmental factors. The research priorities in future have been suggested for conservation and inbreeding of natural areas of this species. Also, seed morphology and germination characteristics and correlation and regression relationships between the morphological characters have been determined of the Euphrates poplar (*Populus euphratica* Oliv.).

(e) Willows:

Firstly, genetic variations of various willow (*Salix excelsa*, *Salix alba* and *Salix acmophylla*) 55 clones selected from natural tree-size willow populations occurring in Black Sea, Marmara, Central Anatolia and South-east Anatolia regions, were investigated by PRI. The selection of determined genetic characteristics of the clones, such as rooting percentage, growth performance, vegetation period, stem form, basic density, dry matter and holocellulose production, calorie and protein values to be used for further research studies was made. In the subsequent study, growth performances and particleboard properties of the selected willow clones at the trial sites, representing the Lake district, were investigated. Evaluations were made on diameter, height, survival and index values of 11 willow clones, at the end of 8 year period. Stem analysis were also made for the top 2 willow clones determined from the evaluation of index values. Volume productions and annual volume increments of these clones per hectare were calculated. Considering the volume productions, the best *Salix excelsa* clone (84/28) was selected for making particleboards.



4. Forest Protection

Chrysomela populi L., *Hyphantria cunea* Drury, *Parantherene tabaniformis* (L.), *Agrilus ater* L., *Melolontha melolontha* Fab., *Capnodis miliaris* (Klug) and *Lepidosaphes ulmi* (L.) are important pests of *Populus* sp. (=poplar) in Turkey. They damaged on individual trees or groups of the poplar in different areas and plantation of Turkey between 2012 and 2015.

Poplar tip moth *Clostera* (=Pygaera) *anastomosis* (Lep.;Notodontidae) is native to Turkey and has not been reported for any major epidemic until 2014. Its first epidemics in the country occurred in 2015, affecting 300 ha poplar plantation area in the sub-districts of Akyazı, Erenler and Hendek in the district of Sakarya.

Meanwhile, fungal agents *Melampsora allii populina* and *Marssonina brunnea* (Ell. et Ev) P. Magn. pathologically occurred in poplar plantations.

Lack of tending (i.e. cultural operations) has generally contributed to the aforementioned entomological and pathological issues.

5. Harvesting and Utilization

(a) Harvesting of poplars and willows

The amount of annual poplar wood produced by the OGM (General Directorate of Forestry) is 80 thousand m³. Of this production, approximately %20, and %80 are from plantations of *Samsun* (77/51) clone which are produced by the Gölardı Poplar sub-district affiliated Samsun District Directorate of OGM, it is the single Forest sub-district, produced poplar in Turkey) and *Populus tremula* stands, respectively. Two-thirds of the total production of poplar wood is fiber chip wood.

In our country, Fiberboard and Particleboard installed capacity increased at very high level (12 million m³/year) and has been among the leading countries in the world in terms of capacity. In parallel with this growth has increased the need for fine-scale poplar wood. In parallel with this growth has increased the need for fine-scale poplar wood. The production model used the narrower spacing has recommended for production of wood raw material suitable demand of the sheet and paper industry. This planting spacing interval ranged from 4,5 m²-12 m².

Willow does not have economic value to be grown commercially in Turkey

(b) Utilization of poplars and willows for various wood products

The supply and demand of poplar wood were in balance to a great extent in Turkey for a long period of time. The foreign trade in poplar wood has been of minor importance to affect the balance between the domestic supply and demand, however, there may be some occasional imports and exports of poplar round wood. As a matter of fact, almost the entire quantity of poplar wood used in Turkey has been produced in domestic plantations.

The clone of *Populus x euramericana* cv. (I-214) was introduced in Turkey in 1962 and it has been cultivated at an increasing rate since 1962. In the following years, the clones of “*Samsun* (I-77/51)” and “*İzmit* (S-307/26)”, cultivars of American black poplars (*Populus deltoides* Marsh.), and the *Euramericana* clone of “I-45/51” were also



selected as suitable poplars to be grown in Turkey. In the years following 1990, both, *Populus x euramericana* (I-214) and “*Samsun* (I- 77/51)” were used at an increasing rate to establish plantations in Turkey. The conventional fields of use of this poplar clones wood can be summarized as stated below:

- Veneer industry (veneer covering, boxes, plywood, and matches),
- Packaging industry (pallets, crates, boxes etc.),
- Furniture industry (sawn wood, mostly used for internal parts),
- Wood chipping industry (paper pulp, panels from chipped wood) and
- Construction sector (sawn wood, mostly for roof construction).

The wood of this poplar clones has been used increasingly in production of medium density fiber board (MDF), wafer board, oriented structural board (OSB) since 1975. Poplar wood can also be used efficiently in production of composite panels, laminated veneer lumber (LVL), parallel strand lumber (PSL) and laminated strand lumber (LSL). Some of the wood characteristics of exotic poplars such as being clear in color, white or ivory, ease of working (peeling, drying, gluing and surfacing), having a low density etc. makes it a suitable material for veneer peeling which is widely used in manufacturing veneer coat, packaging boxes and crates, plywood, matches etc.

The wood of this poplar clones is used as a useful raw material in the manufacturing industry, particularly in the following products:

- Special paper production; napkins, serviettes, towels, thin packaging papers and paperboards.
- General purpose paper pulp production; well bleached semi chemical sulphide pulp.
- Production of construction panels; insulation panels, ceiling covers and fiber boards.

Also, the poplar saw logs are highly demanded by the industry for use in production of a wide range of materials such as pallets, packaging boxes and crates, elements of furniture and wood based panels. Finally, the identifying characteristics

The poplar wood is used widely by the industry in producing pallets, packaging boxes and crates, elements of furniture, fiber boards and wood based insulation panels. The chemical composition of exotic poplar wood makes it a suitable raw material for paper pulp production and it is widely used in this field.

Indigenous black poplars (*Populus nigra* L.) and willows have been cultivated in Anatolia (Asia Minor) for many centuries. The two clones named *Populus thevestina* cl. “*Gazi* (TR-56/52)” and *Populus thevestina* cl. “*Anadolu* (TR-56/75)”, were selected among the cultivars of indigenous black poplars (*Populus nigra* L.) and they were registered by the International Poplar Commission of the United Nations in 1962. In the years following 1962, these two registered clones of indigenous black poplars were cultivated in the Central, Eastern and the South Eastern regions of Anatolia, especially where the forest cover was poor.



The indigenous black poplar wood is traditionally used in rural constructions; mainly as a round wood and as saw logs to a lesser extent. Black poplar wood is also used in urban construction, albeit to a lesser extent, as boards supporting reinforced concrete cement blocks, as sawn lumber in roof construction and as beams in wooden constructions. Also, the indigenous black poplar wood can be used for the medium quality wood of spruce and fir, consistent with its mechanical strengths.

Traditionally, poplar leaves have been used to feed livestock as a supplementary fodder from branches trimmed off the trees. Poplars are planted for improving the environment for recreational purposes. For example, in the Eastern Mediterranean basin of Turkey, various cultivars of *Populus nigra* var. *thevestina* and are grown for ornamental purposes because of their elegant cylindrical boles of long-lasting clear color. The poplar can also serve a protective function as a windbreak and to improve the view of the countryside

Willows have been traditionally cultivated in Turkey. They are commonly planted in lines around the margins of moist meadows and fields, and generally are pollarded to produce small sized fuel-wood cut at short intervals. Rural communities use willow timber as sawn planks and the various assortments useful for agricultural and household purposes. They provide raw material supplies valuable non-wood products (e.g. livestock, medicinal extracts). Also, *Salix viminalis* used in basket making because of flexible branches in the villages of Anatolia is an important value in terms of ethnobotany.

(c) Utilization of poplars and willows as a renewable source of energy (“bioenergy”)

As a result of field trials in three different ecological environment, 11 poplar clones (L.AVANZO, 89.M.004, 1\82, 89.M.044, PY-202, OSTIA, 84.001.044, 89.M.063, İZMİT, 89.M.066, 89.M.060) from among total 50 clones belonging to *P.x euramericana* and *P. deltoides* were selected to produce wood raw materials as biomass for thick diameter wood raw material processing industry (fiber-chip, peel, pallet, packaging, paper, timber).

6. Environmental Applications

(a) Site and Landscape Improvement

Combating desertification (Cold and Drought Resistance) and Salinization

Poplar has been adopted as a model perennial woody species for forest tree genetics to understand molecular processes of growth, biotic interactions and adaptation, development and responses to environmental stresses.

As it is known, salt stress is a major abiotic stress that limits productivity in many regions of the world. In the study related salt stress, *Populus tremula x Populus alba* (717-1B4) genotype was preferred because it can be transformed by *Agrobacterium tumefaciens*. In this research, an integrated physiological and proteomic approach was used to understand the salt stress responses of *Populus tremula x P. alba* (717-1B4). At the end of the stress time courses, the elemental distribution in the roots,



cuttings, stems and leaves of the young trees were measured and compared to the control many differences have been seen.

In the study related cold resistant related genes in *Populus nigra* L. clones, seasonal changes in antioxidant enzymes activities including glutathione reductase (GR), ascorbate peroxidase (APX), dehydroascorbate reductase (DHAR) and catalase (CAT) were examined in black poplar (*Populus nigra* L.) clones. It was found that GR, APX and DHAR activities increased with low air temperatures in winter, whereas they decreased under high temperatures. Information generated from this study can be used for further understanding of the molecular mechanisms of cold tolerance in black poplars. Low temperature related antioxidant enzyme activities and gene expression data could be effectively used in breeding programmes for the purpose of high productivity in low temperature areas.

In the other study related transcriptional and physiological responses to drought stress in *Populus nigra* L. investigated a number of drought related physio-biochemical processes and transcriptional comparisons at different stages of water availability to understand adaptation and response mechanisms of the black poplar (*Populus nigra* L.). According to their drought response, three adaptation strategies were identified in black poplar. One of the three genotypes was found to evolve a drought evading strategy (sensitive) in which their active portion of life generally takes place mostly during water abundant periods. Therefore, the clone could resist only mild drought stress. The sensitive clone was characterized with least leaf water potential (-12 ± 0.9 bars), complete defoliation and highest increase in antioxidant enzyme activities under progressive drought levels. On the contrary, another clones exhibited strong dehydration tolerance strategy (resistant) to even severe drought that the productivity of these resistant clones was much higher during post-drought recovery period. Although its leaf water potential values (-8 ± 0.7 bars) were significantly reduced, defoliation rate of this genotype was very low. Antioxidant enzyme results and hydrogen peroxidase content of the leaves of this genotype indicated lesser ROS production and stress situation as compared to the sensitive genotype. The last genotype in the study found to have drought avoidance strategy (moderate resistant). In this genotype, leaf water content did not decrease down to critical values (-4 ± 0.6 bars) as compared to other two genotypes.

“A Study to Determine Resistance to Salinity of Some Poplar Clones and The Possibility of Establishing Poplar Plantations on Irrigated Saline Soils” named research project were completed by our Institute, also. As a result of this study, the salinity adaptive species and clones of poplar have been determined for unused areas in Edirne-İpsala on the edge of the Maritsa river since a long time due to salinity.

Row (or shelterbelts and windbreaks) and Gallery plantations

Row plantations are of the traditional practised of poplar cultivation in Anatolia. The edges of fields or alongside roads, watercourses, and ditches plantations have been established for centuries by the farmers. In some regions of Anatolia cultivable land is limited for agriculture and there is a great demand for wood, in such areas, row



plantations save arable land and provide wood for rural needs. Also, row plantations often fulfil an important function as shelterbelts and windbreaks, with a dry climate and in areas swept by wind. Therefore row plantations are supported through the poplar development program. Especially in Central Anatolia a great potential exist for row plantations. In row plantations, the distance between trees is recommended to be 5 m for *I-214*, *Samsun* clones and 1 m for indigenous black poplars.

Turkey has a great potential for gallery plantations. The main river basins of Turkey offer a great opportunity to make them more productive for rural people and natural economy. It has been estimated that the potential for gallery plantations is about -45000 km along the river and stream banks. The poplar clones of “*I-214*” and “*Samsun* (I-77/51)” like alluvial and fertile soils. These two clones which are widely cultivated in Turkey are almost intolerant to any extreme site condition or any extensive technique of cultivation. Therefore, “*I-214*” and “*Samsun* (I-77/51)” poplars widely used in block plantations should not be given priority to be used in gallery plantations. The poplar clone of “*I-45/51*” and the indigenous black poplar clones of “*Gazi* (TR-56/52)” and “*Anadolu* (TR-56/75)” are fairly tolerant of extreme site conditions and extensive cultivation techniques. Therefore, the clone of “*I-45/51*” and the indigenous black poplars should be given priority in establishing gallery plantations.

(b) Phytoremediation

As it is known, the ability of *Populus* to absorb and accumulate significant quantities of heavy metals in aerial parts offers the possibility to use them for removing pollutants from their substrate.

In the study related metal stress, *Populus tremula x Populus alba* (genotype INRA 717-1B4) was exposed to two consecutive Cd concentrations (3.2 mmoles and 16mmoles Cd) in order to better understand the cumulative effects Cd. The results of analysis showed that, *Populus* might be a good candidate for phytoremediation, especially for phytostabilization.

III. GENERAL INFORMATION

1. Administration and Operation of the National Poplar Commission or equivalent Organization

(a) National Poplar Commission of Turkey has conducted activities in accordance with the regulation which was adapted by the assemble of The Turkish Government in 1964. The postal address of the Commission is as follows:

Kavak ve Hızlı Gelişen Orman Ağaçları Araştırma Enstitüsü Müdürlüğü
Ovacık Mahallesi, Hasat Sok. No: 3
41140 Başiskele- Kocaeli /TURKEY

(b) The 8 th National Poplar Commission was gathered in November 2014 in İzmit/Turkey. The local and national problems faced of poplar producers and poplar wood processing enterprises with needs to done the priority scientific studies have tried to examined at this meeting. The Meeting consists of technical paper presentations with



discussions are the more useful to examination the local and national problems and to be encourage improved poplars culture.

The solving of problems faced of poplar producers and poplar wood processing enterprises throughout the country and the light on in the creation of vision for the future are helped by PRI. Also, evaluation-extension of research findings is carried throughout the country.

(c) Each year, a daily education including technical information and applications on the poplar cultivation are given for the students of Faculty of forestry.

The book named ‘‘Poplar Cultivation In Turkey (Selected Clones – Nurseries – Plantations Pests And Diseases – Wood Yields – Economics Wood Properties)’’ was published as Turkish and English.

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3. Relations with Other Countries

In this period, “Poplar Development Project in Uzbekistan (2010-2015)” named co-operation project was carried out with Uzbekistan.

4. Innovations not included in other sections

White hairy seeds (cottony tufts) which are spreading to the air from poplar and willow trees, are mostly supposed to be a pollen grain by many people and there is a misconception that consisting allergenic symptoms thought to be due to these seeds. Therefore, Turkey's pollen research was conducted in the atmosphere of many cities. In many regions those airborne studies performed, pollen grains of poplar tree found in the air especially in march-april term and the pollen grains of willow tree in april-may term. In poplar tree pollen season, for those who are allergic to poplar it is reported to be very mild symptoms because it does not require drug use for allergy sufferers.

White hairy seeds of poplar and willow trees are supposed to be a pollen grain are matured and dispersed in the air at the time when it has been reported that there are not any pollen grains of these plants in the atmosphere. In this term meadows and olive tree pollens were found.

IV. SUMMARY STATISTICS

Table 1. Indicate area (ha) of Poplars and Willows

Forest categories		Total Area 2015 (ha)		
		pure stand	mixed stand	Total
Indigenous	Poplars	142 322	118 359	260 681
	Willows	877,73	1209,28	2087,28
	Total	143199,73	119568,28	262768,21
Planted	<i>P.deltoides, P x.euramerican</i>	77 000		77 000
	<i>Populus nigra</i>	68 000		68 000
	Willows	Data not available		
	Total	145 000		145 000
Agroforestry	Poplars	700		700
	Willows	Data not available		
	Total	700		700

Table 2. Main purpose in management of Poplars and Ownership

Description (Poplars)	Main Purpose of Management	Ownership Percentage (%)		
		Public	Private corporate	Private smallholder
Natural Forest	Wood production	100		
	Environmental			
Planted Forest	Wood production	1	1	97
	Environmental	1		

Table 3. *In-situ* conservation forests of *Populus tremula*

Seed resources	National registration number	The name of sub-district	Area (ha)	Altitude (m)
Seed stands	388	Horasan-Hasankale	360	2200
Gene conservation forests	152	Araç-Karkalmaz	109,3	1400
	246	Ş.karahisar- Ş.karahisar	39,4	1800

Table 4. *Ex-situ* conservation areas of Poplars and Willows

Species	Facility location	Establishment purpose	The number of clones	Establishment year	Area (da)
<i>P. nigra</i> spp.	Ankara/behiçbey	Cuttings-Orchards	354	1995	0,7
Hybrid poplars	Ankara/behiçbey	Cuttings-Orchards	50	2008	0,3
<i>P. alba</i>	Ankara/behiçbey	Cuttings-Orchards	3	1995	
<i>P. nigra</i> spp.	Ankara/behiçbey	populetum	250	2006	5
<i>Salix</i> spp.	Ankara/behiçbey	Cuttings-Orchards	169	2011	0,5
<i>Salix</i> spp.	İzmit	Cuttings-Orchards	169	2013	0,5
Hybrid poplars+ <i>P. deltoides</i>	İzmit	Cuttings-Orchards	354	2015	1,5
<i>P. nigra</i> spp.	Seydişehir	Cuttings-Orchards	248	2008	1

Table 5. Poplar Memorial Trees in Turkey

Province	Species of Poplars	Age	Height (m)	Diameter d _{1,30} (m)	Circumference (m)
Konya	<i>Populus tremula</i>	100	20	2,5	8
Yozgat	<i>Populus alba</i>	300	20	2,5	8
Gümüşhane	<i>Populus nigra</i>	500	30	1,55	4,15
Ankara	<i>Populus nigra</i>	110	20	1,5	
Ankara	<i>Populus alba</i>	320	21	1,45	
Ankara	<i>Populus alba</i>	340	20,5	1,4	



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