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Some Native Plants for Erosion Control Efforts in Coruh River Valley, Artvin, Turkey

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Abstract: There are many native shrub and tree species in the Coruh River Valley (Artvin) and the soil erosion has been going on seriously in the region. It is necessary to maintain ecological balance between soil and vegetation in this region where the terrain is very steep and rugged; thus, subject to significant soil erosion. Many native plants distributed in a wide range in the region. Some of these are *Acer divergens* Pax. var. *divergens* (Divergent maple), *Arbutus andrachne* L. (Hawthorn), *Capparis ovata* Desf. (Caper), *Cistus creticus* L. (Rock rose), *Colutea armena* Bois & Huet. (Bladder-senna), *Cotinus coggyria* Scop: (Common smoketree), *Cotoneaster nummularia* Fisch and Mey. (Cotoneaster), *Crataegus* L. (Grecian strawberry tree), *Eleagnus angustifolia* L. (Russian olive), *Ephedra major* Host. (Ephedrine, Ma Huang), *Jasminum fruticans* L. (Wild Jasmine), *Juniperus* L. (Juniper), *Paliurus spina-christii* Mill. (Christ's thorn), *Punica granatum* L. (Pomegranate), *Pyracantha coccinea* Roem. (Firethorn), *Quercus petrea* Lieb. subsp. *iberica* (Sessile Oak), *Rhus coriaria* L. (Elm-leaved sumac) and *Zizyphus jujuba* Mill. (Common jujube). This species are important seed and seedling material sources for erosion control efforts in the region.

Key words: Artvin, Coruh River Valley, erosion control, native plant

INTRODUCTION

Vegetation is one of the most important defenses in controlling erosion. It plays a key role in decreasing soil particle detachment and transport from sites where the soil surface has been disturbed by human activities. It promotes long-term protection of the soil surface by providing leaf cover, which intercepts precipitation and by establishing roots, which aid soil structure development, thereby increasing infiltration and soil stability. It also provides a viable alternative to many synthetic means of erosion control, increases species diversity and the aesthetic value of project landscapes (CA, 2004).

Native plant species are very important source of adapted plant material especially when unfavorable climatic and soil conditions are present. These species are also more effective than non-native species in controlling soil erosion. Once established, since they are adapted to local dry conditions, their care is easier than non-native species.

Woody vegetation provides better soil protection and lasts longer than annual plants. Their roots deepen and improve the soil and the shade they provide facilitates ecosystem metabolism. These functions are essential for ensuring the soil stability and the continuity of agricultural activities (FAO, 1989).

There is a lack of emphasis being given to natural shrub and tree species mainly for two reasons; first, erosion control capabilities of these species are not well recognized and second, seed production and nursery techniques of these species for mass seedling production has not been developed. When the poor and harsh soil and climate conditions of erosion control plantation sites are considered, advantages of utilizing locally adapted species in these plantations can be acknowledged.

Studies show that native plants more effective and successful in erosion control. Andreu *et al.* (1994) found that best control of runoff was the natural shrub vegetation. They stated that *Medicago arborea* (Moon trefoil) decreased soil loss by 41.7% and runoff by 25.7% compared with bare soil. They also stated that under natural vegetation soil loss was 27.5% less than under *Medicago*. Kaya (1999) observed that *Quercus* spp. Lieb (Oak), *Cotinus coggyria* (Common Smoketree), *Cotoneaster nummularia* (Cotoneaster) and Grecian strawberry tree (*Crataegus* spp.) species are well growing plants in erosion control areas in Firat Valley. He reported that these species may be used for prevent of erosion in erosion control areas in Firat Valley.

Successful results are obtained by planting native *Eleagnus angustifolia* L. (Russian olive), *Quercus* spp. and *Paliurus spina-christi* Mill. (Christ's thorn) in Erzurum

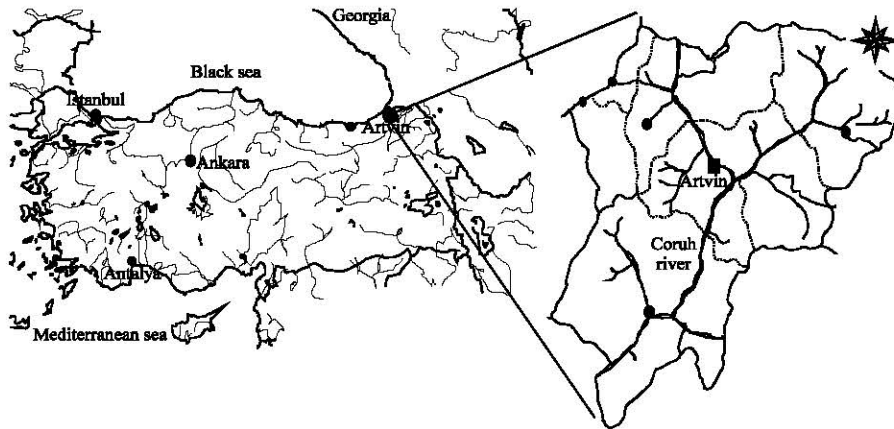


Fig. 1: Study area, the Coruh River Valley of Artvin, is located in the northeast part of Turkey

and Erzincan regions (Dasdemir *et al.*, 1996). Olmez (2001) found that native *Capparis ovata* (Capper) can be used in erosion control plantations in Artvin region.

The soil erosion has been going on seriously in the Coruh River Valley. Climate, changes to dry terrestrial climate from marine as one moves to inland through the valley (Anonymous, 1990; Gokturk *et al.*, 2004). Native plants on this region are partly destroyed or disappeared completely. It is necessary to maintain ecological balance between soil and vegetation in this region where the terrain is very steep and rugged and subject to significant soil erosion in order to protect soil and provide safety of life and property of humans living around.

Several dams are being built on Coruh River and places where many of these plants naturally range will be covered with dam lakes soon. Once the dams are in operation, natural habitats of native (drought tolerant) species will be restricted and they may be in danger of extinction in the valley. Utilization of these species in plantations may serve as conservation refuges for these species and ensure their presence in the region.

Some native plants used in the erosion control efforts in Artvin region like *Capparis ovata*, *Castanea sativa* Mill. (Sweet chestnut), *Juglans regia* L. (walnut) and *Tilia* spp. (linden tree). Although it is an exotic, *Robinia pseudoacacia* L. (black locust) is used much more than native plants in erosion control plantations owing to its strong erosion control capability. Besides, essential forest trees of Artvin region like *Pinus sylvestris* L., (scotch pine), *Picea orientalis* L. Lin (oriental spruce), *Fagus orientalis* Lipsky (beech), *Abies nordmanniana* Stev. Spach. subsp. *nordmanniana* (caucasian fir), *Quercus* spp. and *Alnus glutinosa* L. Gaertn. (common alder) were used in erosion control efforts, too (Ucler *et al.*, 1998). However, a lot of native species that will be used in erosion control efforts in the Coruh River Valley Artvin are not used in the erosion control efforts.

Native species of the erosion control areas will be identified by taking sample from them. Then, their characteristics about adaptation capability of erosion control areas will be put into consideration, leading to the determination and realization of erosion control efforts better and successfully.

The aims of this study was to determine the native shrub and tree species distributed naturally near the erosion control areas in the Coruh River Valley and to bring up their characteristics and suitability for erosion control plantations in the region.

MATERIALS AND METHODS

Shrub or small tree species were determined from wild plants growing in erosion control areas in Artvin region, located in the Northeastern part of Turkey, between the altitudes of 200 and 1200 (Fig. 1). Erosion control areas were determined by using the management plans of Artvin Region produced since 1983. Then, samples of species were collected from these areas to identify them. Later, characteristics of these identified species were investigated from literature. Most suitable species for erosion control effort were determined according to their erosion control characteristics.

RESULTS AND DISCUSSION

There are 153915 ha erosion control areas in Artvin Region according to management plans of Artvin region (Table 1). Table 2 shows identified drought tolerant species distributed naturally in these areas in Artvin Region.

The inner part of Artvin region and Yusufeli shows Mediterranean climate that has semi-dry and seldom rainy characteristics (Akman, 1999). Therefore, it is possible to see plants belonging to Mediterranean origin in these

areas (Atalay *et al.*, 1985; Atalay, 2002). Some of the species distributed naturally in Artvin region seen in Table 2 are belong to Mediterranean origins.

Shrub plantations are one of the effective methods in controlling erosion on deforested or bare lands (Andreu *et al.*, 1994). Urgenc (1986) reported that species used in erosion control efforts should be adapted to land that lost its surface soil and biological activity and should have excellent root spread and strength. In addition to this, species should be appropriate to the site (e.g., salt tolerant, drought hardy) and they should have superior erosion control value, a wide biologic amplitude of adaptability, favorable spread and reproductive capability (Menashe, 2001). Most of the shrub species found naturally in Coruh River Valley posses these features. Characteristics of each native drought tolerant plants are given below.

Acer divergens var. *divergens* is an endemic species and distributed (440 m) from Artvin to Ardanuc. The

species is apparently confined to dry valleys in northeast Anatolia (Davis, 1967).

Arbutus andrachme is distributed commonly in Mediterranean countries, especially on the southern coast of Turkey. This shade intolerant species (Gungor *et al.*, 2002) can be found on rocky slopes between Borcka and Artvin (Eminagaoglu and Ansin, 2003). It can tolerate summer droughts and develop strong shallow lateral roots (Gungor *et al.*, 2002).

Capparis ovata is a plant of drought and semi-drought regions (Olmez, 2001). It distributes naturally between 200 and 1000 m altitudes in Artvin. It is an important species for erosion control efforts and with its flower buds and fruits it can generate an extra income source for the local people. It endures long dry summers of Mediterranean regions with its deep roots. It can tolerate to extremely high temperatures (Olmez, 2001). Caper's nursery techniques have been developed and the species is being utilized in erosion control efforts in Artvin (Yahyaoglu *et al.*, 2002).

Cistus creticus is naturally distributed along all coastal parts of Turkey. It contents with very little. The plant prefers sandy and loamy soils and can grow in nutritionally poor soil. It is shade intolerant and can tolerate drought and maritime exposure. It develops shallow root system and it does not please with root competition (Gungor *et al.*, 2002).

Colutea armena ranges from Artvin to Ardanuc, Erzurum, Tortum, Oltu and Ispir (Davis, 1970). It prefers

Table 1: Erosion control areas in artvin region

Location	Erosion control areas	
	(ha)	(%)
Artvin	40499.0	26.3
Ardanuc	19990.5	13.0
Arhavi	11727.0	7.6
Borcka	6569.5	4.3
Murgul	11708.5	7.6
Savsat	27584.5	17.9
Yusufeli	35836.0	23.3
Total	153915.0	100.0

Table 2: Shrub or small tree species distributed naturally in the erosion control areas in artvin region

Species	Common name	Erosion control areas
<i>Acer divergens</i> Pax. var. <i>divergens</i>	Divergent maple	Borcka
<i>Arbutus andrachme</i> L.	Hawthorn	Fistikli-Erenler
<i>Capparis ovata</i> Desf.	Caper	
<i>Cistus creticus</i> L.	Rock rose	Yeni Mahalle-Ormanli-Erenler
<i>Colutea armena</i> Boiss. & Huet	Bladder-senna	Artvin-Seyitler
<i>Cotinus coggyria</i> Scop.	Common smoketree	Yeni Mahalle-Seyitler
<i>Cotoneaster nummularia</i> Fisch. & Mey.	Cotoneaster	Yusufeli-Pamukcular-Artvin-Sehitler
<i>Crataegus</i> L.	Grecian strawberry tree	
• <i>Crataegus microphylla</i> C. Koch		Hatila Vadisi
• <i>Crataegus monogyna</i> Jacq.		Hatila Vadisi
• <i>Crataegus pseudoheterophylla</i> Pojak		Yusufeli-Pamukcular
• <i>Crataegus monogyna</i> subsp. <i>azarella</i>		Artvin
• <i>Crataegus pontica</i> C. Koch		Yusufeli-Pamukcular
<i>Eleagnus angustifolia</i> L.	Russian olive	Yusufeli-Pamukcular
<i>Ephedra major</i> Host.	Ephedrine, Ma Huang	Yusufeli-Ishan
<i>Jasminum fruticans</i> L.	Wild Jasmine	Artvin
<i>Juniperus</i> L.	Juniper	
• <i>Juniperus oxycedrus</i> L. sub sp. <i>oxycedrus</i>		Ardanuc
• <i>Juniperus excelsa</i> Bieb		Yusufeli-Pamukcular
• <i>Juniperus foetidissima</i> Willd		Besavul-Hatila Vadisi
<i>Paliurus spina-christii</i> Mill.	Christ's thorn	Seyitler
<i>Punica granatum</i> L.	Pomegranate	Zeytinlik
<i>Pyracantha coccinea</i> Roem.	Firethorn	Savsat
<i>Quercus petraea</i> Lieb. subsp. <i>iberica</i>	Sessile Oak	
<i>Rhus coriaria</i> L.	Elm-leaved sumac	Artvin-Seyitler
<i>Zizyphus jujuba</i> Mill.	Common jujube	Zeytinlik

sunny locations (Dirr, 1990) and requires well-drained soils (Gungor *et al.*, 2002; Huxley, 1992). In temperate regions *Colutea* species are cultivated primarily for ornamental purposes but they can also be used in erosion control (Krussmann, 1984).

Cotinus coggyria naturally grows in Mediterranean, Blacksea and Inner Anatolia regions (Gungor *et al.*, 2002) at approximately 1300 m elevations. It naturally distributes between Artvin and Borcka (500 m) (Davis, 1967). Common smoketree is an upright, spreading, multi-stemmed shrub that is grown because of its many ornamental qualities and its adaptability to wide soil and pH ranges (Dirr, 1990). It tolerates most soils (Davis, 1990), but prefers a well-drained dry or moist soil in a sunny position (Huxley, 1992). An investigation shows that Common smoketree well grows on erodible areas (Kaya, 1999). Established plants are drought tolerant. Plants are slow to establish but are then quite fast growing at early ages but growth rate decreases as plants age (Davis, 1990). Common smoketree is used in Bulgarian medicine for its anti-inflammatory, antibacterial and wound-healing properties (Tsankova *et al.*, 1993).

Cotoneaster nummularia distributes naturally in Coruh River Valley (Davis, 1972). Cotoneasters are adapted to sunny locations with moderately deep and moderately well-drained silty to sandy soils. They require little maintenance and provide ground cover, soil stabilization, snow entrapment and aesthetic values (Slabaugh and Shaw, 2003). Roots of a single *C. microphylla* plant can bind soil up to 1.88 m² with the strong lateral and fibrous roots. Intricately branched aerial portion of this species spreads on an average over 2.26 m³ land surface and helps in checking splash erosion (Singh *et al.*, 1992).

Crataegus spp. content little for soil and are drought resistant (Gungor *et al.*, 2002). In Artvin region, *C. pseudoheterophylla* (500-600 m), *C. microphylla*, (300-1400 m), *C. nummularia* (300 m), *C. monogyna* Jacq. subsp. *monogyna* (1370 m), *C. pentagyna* (1250 m), *C. orientalis* var. *orientalis* (1870 m), *C. curvicephala* (1870 m), *C. monogyna* Jacq. subsp. *azarella* (720 m) and *C. microphylla* (1325 m) are naturally found (Eminagaoglu and Ansin, 2003).

Eleagnus angustifolia distributes naturally Mediterranean, Marmara, South Anatolia and southwest Anatolia regions up to 2000 m altitude. It contents little for soil. It grows well on sunny locations, dry and hot soils. It tolerates drought and cold. It develops strong lateral roots and grows fast (Gungor *et al.*, 2002) and is valued for their ability to reclaim degraded soils and as soil-improving nurse trees (Dawson, 1990). It has also been used for wildlife habitat plantings, erosion control

and highway beautification (Brothers and Timothy, 1988; Olson, 1974).

Ephedra major is usually found on dry regions in Turkey. In addition, found on Coruh River Valley in Artvin region (Ansin, 1994). It requires a well-drained loamy soil and exposure to sun. Established plants are drought resistant and lime tolerant. This species is the richest source of ephedrine, the stems containing over 2.5% total alkaloids, of which about 75% is ephedrine (Chopra *et al.*, 1986).

Jasminum fruticans is naturally distributed in Artvin (Ansin *et al.*, 2002). It prefers well drained and rich soils. It grows on limy soils as well. The plant grows fast and has spreading and shallow root system (Gungor *et al.*, 2002).

Juniperus spp. perform an important ecological task in the Mediterranean region. They are often the only ones that survive under conditions of extreme drought (Piotto *et al.*, 2003). Juniper species can grow on poor soils and can resist to extremely high and low temperatures. They are adaptable to very poor soils (Pamay, 1955). They are used in soil conservation due to their spreading root systems, resistance to extreme climatic conditions and adaptation to unsuitable soil conditions (Gultekin *et al.*, 2003).

J. communis is found near Kordevan Mountain, Ardanuc (2700 m). *J. foetidissima* can be found between Artvin and Ardanuc (700 m) (Davis, 1970). *J. communis* L. subsp. *hemiphaerica* (Presl.), *J. oxycedrus* L. subsp. *oxycedrus* and *J. excelsa* are naturally found in Artvin region (Ansin *et al.*, 2000).

Paliurus spina-christii has a wide range in Artvin (Eminagaoglu and Ansin, 2003). It is usually found on limy soil (Dasdemir *et al.*, 1996) and tolerates light shade (Davis, 1990). It grows well in dry soils and once established, is drought tolerant (Phillips and Rix, 1989). It prefers a light sandy soil in a warm sunny position (Genders, 1994). It is reported that this species will be used for erosion control efforts owing to have tapering root system (Dasdemir *et al.*, 1996).

Punica granatum is found between Artvin and Yusufeli (Davis, 1972). It grows on sandy or rocky scrublands. The pomegranate is quite adaptable, but prefers very sunny, warm locations. It develops shallow root system (Gungor *et al.*, 2002). The plant favors a semi-arid climate and is extremely drought tolerant (Morton, 1987). It grows well in desert areas. Plants will take considerable drought, but grows best with regular watering.

Pyracantha coccinea is a native of Coruh River valley (Eminagaoglu and Ansin, 2003). It succeeds in soils that are warm and not very heavy. Another report says

that it grows well in heavy clay soils. It prefers moist, well drained soils in full sun, but is very urban tolerant and adaptable to poor soils, compacted soils, soils of various pH, heat, drought and heavy pruning. It succeeds in sun or part shade. It does not fruit so well in shade. It tolerates atmospheric pollution (Huxley, 1992). It grows fast (Gungor *et al.*, 2002).

Quercus petraea subsp. *iberica* is widely distributed in Artvin region (Ansin and Ozkan, 1997). It is drought tolerant and contents little for soil. It develops tapering root system and grows fast (Gungor *et al.*, 2002).

Rhus coriaria is found on rocky places and waysides in Coruh River Valley (Eminagaoglu and Ansin, 2003). Roots of sumac can spread more than 16 m around its trunk, forming an extensive root network near the surface (Rowe and Blazich, 2003; Duncan, 1935). Sumacs are valuable for erosion control because of proliferation of rhizomes that results in an extensive root system. The species is ideally suited for roadside plantings, revegetation of areas of eroded or depleted soils, range reclamation and mine spoils restoration and other conservation plantings (Rowe and Blazich, 2003; Brinkman, 1974; Humphrey, 1983).

Ziziphus jujuba succeeds in most soils so long as they are well-drained (Simmons, 1972). The plant prefers an open loam and a hot dry position (Simmons, 1972; Chittendon, 1956). Plants are fast growing, even in poor soils. Tree grows in part sun and tolerates drought (Edward and Watson, 1994). It is suggested to use in erosion control (Urgenc, 1986).

In erosion control plantation in Artvin, a special emphasis is given to plant species that can help improving local people's welfare. Fortunately, these species were not used for erosion control efforts in the region (Ucler *et al.*, 1998) but only *Capparis ovata* started to be used for erosion control in recent years (Olmez, 2001).

Some of the unsuccessful results obtained from these studies can be attributed to seed dormancy. Therefore, if any attempt will be made towards utilizing natural tree and shrub species in erosion control plantations, germination problems of their seeds need to be determined and ways to overcome dormancy should be developed.

Nowadays use of juniper species in erosion control plantations is being seriously considered. Seed dormancy in these species however hampers these efforts because it creates problems in producing sufficient number of seedlings. A few studies have been conducted on overcoming seed dormancy in various juniper species in Turkey with successful

results but validity of these methods needs to be verified in Artvin conditions.

Bladder-senna, Christ's thorn, elm-leaved sumac, prickly juniper (*Juniperus oxycedrus*), Cotoneaster and Common smoketree can be found within mixed stands and different altitudes sparsely distributed over entire Artvin. These species may be used successfully in erosion control efforts in Artvin. However, not to face difficulties in obtaining their seedlings, first seedling production techniques for these species should be determined. Various seedling production techniques determined for each species will probably determine the species composition used in erosion control plantations, favoring species with non-dormant seeds and quality seedlings. Use of quality seedlings will increase plantation success.

Using native plants in erosion control efforts not only provides protection for these species against extinction, but also help continuity of biological diversity. This is especially important because, presently, the number of plant species threatened by environmental problems such as erosion and pollution has been constantly increasing. In erosion control plantations, native plant species should be given the priority, so that the biological diversity of native flora is protected and alternative income sources of local people can be sustained.

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