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Effects of some agroforestry applications on the rate of erosion and some other crop performances in marginal lands of the Aegean Region

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RESUME – *"Effets de certaines applications agro-forestières sur le taux d'érosion et sur les performances des cultures dans les terres marginales de la région Egée". Sur les terrains marginaux de la Région Egéenne, afin de déterminer les choix agro-forestiers les plus favorables et le taux d'érosion et leurs influences sur les performances de plantes, on a cultivé isolément certaines plantes de pâturage et de champ ou avec des espèces différentes de pin (*Pinus pinea *et* Pinus brutia*) dans les années 1997, 1998, 1999 et 2000 sur un terrain marginal contenant de la terre argileuse. On a constaté les taux de survie des pins, les tailles des plantes et les quantité d'érosion. Selon les résultats de 4 années d'essai, on peut commenter que le mélange de pâturages et partiellement leurs combinaisons avec les pins sont les choix les plus réussis au point de vue de protection de la terre. Cependant, l'influence des plantes de pâturage sur les performances de croissance des espèces de pin était évidente. De même, la combinaison* Pinus *spp. +* Origanum onites *était aussi un choix prometteur.*

Mots-clés : *Agro-forestier, protection de la terre, terrains marginaux.*

Introduction

About 5 % of the grazing lands of Turkey are located in Mediterranean region. Although there is intensive farming in Antalya and Adana plains, in the other parts of the region farming is extensive in character. Almost all of the coastal areas up to 500 m are covered with *maqui* vegetation being composed of shrubs and small trees which have no economic value except as fuel and for soil protection. For this reason in most of the Mediterranean countries *maqui* vegetation, neighboring to forests have been destroyed and replaced by either field crops or pastures. On average, the grazing lands of the region produce only about 500 kg hay per ha (Avcıoğlu, 1996). The more arid the climate the more eroded are the soils, the depleted is the initial vegetation and more difficult it is to improve the marginal lands (Avcıoğlu *et al.*,1996). Many research workers stressed the impact of agroforestry on soil conservation and agronomical incomes and emphasized the significance of information collected from the plant societies of pastures, forests or their combinations (Adina *et al.*, 2001; Anonymus, 1971; Doug, 2001). Success in agroforestry is highly dependent on the tree and herbivorous vegetation relations, particularly on the competitive ability and on the association characteristics of counterparts (Nair, 1993; Valerie and Chopin, 2001).

White *et al.*, (2001) took another concept of forest-pasture relation into consideration and over viewing the social and economical relations between the human population living in forest area or agricultural land, they stated that priority should be given to the intensification of pasture management to protect forests in Latin America. Forrester (1992) and Avcıoğlu(1986) also painted out resembling approaches in mediterrenean coastal parts of Turkey.

Materials and methods

This research study conducted during 1997, 1998, 1999 and 2000 on a silty-clay soil with 6.42-7.40 pH in Sarıgöl site of Manisa. Experimental area was located at about 450 m a.s.l. with typical Mediterranean climate characteristics. Meteorological data in 1997, 1998, 1999 and 2000 were monthly mean temperature 17.7-17.8 - 15.1-18.3ºC, yearly total precipitation 399.3-439.2-280.3-361.6 mm, mean duration of sunshine 7.0-8.0-7.5-7.0 h/day, respectively. To compare the different agroforestry applications, many pasture crops (*Agropyron cristatum, Agropyron intermedium, Bromus*

inermis, Medicago sativa, Onobrychis viciaefolia), medical crops (*Origanum onites, Salvia officinalis, Melissa officinalis, Caparis spinosa, Laurus nobilis)*, horticultural crops (*Pistacia terebinthus, Prunus amygdalus*) were grown alone or in combination with two different pines (*Pinus pinea*, *Pinus brutia*). The experimental design was a randomized complete block with 2 replications, each plot being 5 x 20 m = 100 m^2. All plots were surrounded with concrete blocks to collect eroded soil fractions and 210 l of barrels were placed at the bottom of the plots which were applied parallel to the slope (20-30%) of the experimental area. Original vegetation of the plots, except controls, were destroyed using bulldozer with ripper and research crops were sown or transplanted according to the conventional agronomical or forestry techniques on 15 th December 1996. 200 kg/ha ammonium sülfate and 150 kg/ha triple süper phosphate were applied as starting rate. The plants were evaluated according to the harvest times of crop materials in the plots, generally at the beginning or end of the growing season. Characteristics such as pine survival height and total cover, amount of soil losses (erosion) and economical aspect of crop alternatives were determined or calculated each year. All data were analized statisticaly and significant variations were tested using LSD values. Combinations of pasture crops and *Origanum onites* with *Pinus pinea* and *Pinus brutia* were chosen to discuss in this article.

Results and discussion

The results of the effect of some agroforestry applications on the rate of *Pinus* survival and height and total cover were presented in Table 1.

Table 1. Effect of some agroforestry applications on the rate of *Pinus* survival and height

Crop	*Pinus* survival (%)					*Pinus* height (cm)				
Alternatives (CA)	1997	1998	1999	2000	Mean	1997	1998	1999	2000	Mean
Pinus pinea	100	100	100	100	100	18.85	33.70	80.25	143.85	69.16
Pinus pinea + Origanum onites	100	100	100	100	100	15.80	32.40	62.90	105.80	54.23
Pinus pinea+ Pasture crops	25	63	50	50	47	11.00	19.80	28.90	42.75	25.61
Pinus brutia	79	86	95	95	89	10.00	18.00	44.45	93.75	41.55
Pinus brutia + Origanum onites	69	93	87	79	82	8.45	18.25	35.05	65.20	31.74
Pinus brutia+ Pasture crops	19	55	38	33	36	4.45	8.55	11.60	16.30	10.23
Mean	65	83	78	76	-	11.43	21.78	43.86	77.94	-
LSD (0.05)	Year (Y) Y: 3 CA: 4 CAxY:8					Y: 3.11 CA: 3.59 CAxY:7.18				

Pinus pinea transplanted alone had the highest rates of survival in each year and in average, and *Pinus brutia* transplanted alone followed it. When the *Pinus* tree seedlings were combined with pasture crops, the level of survival declined rapidly indicating the significance of stress of competition with legume and grass species in mixed cropping. The competitive pressure coming from the pasture crops were highest in first year on both *Pinus* type, being more effective on *Pinus brutia.* However the second year results were quite high, that's because new pine seedlings were transplanted in to the plots to replace dead material. The rate of survivals of *Pinus pinea*, and *Pinus brutia* in mixed cropping declined again in last two years.

There were significant differences among the crop alternatives with regard to plant height and *Pinus pinea* transplanted alone had the highest values, *Pinus brutia* followed it. There were also significant differences among the years and, as expected, *Pinus* height values increased gradually each year. *Pinus* + pasture crops mixtures had lowest *Pinus* heights in both alternatives, however *Pinus pinea* combined with pasture crops had much higher values than *Pinus brutia* mixed with pasture crops indicating again the superiority of *Pinus pinea* over *Pinus brutia* in terms of competitive ability with legumes and grasses mixed with pasture. *Pinus* height values also showed the negative

effects of pasture crops on the *Pinus* spp. and this might happen that competition for water, plant nutrition and solar radiation reduced the development of pines causing lower plant heights. Valerie and Chopin (2001) and Sulisburry and Ross (1992) also confirmed these result stating that herbaceous perennial plants had far more rapid growth than tree plants in early growing stages.

Table 2. Effect of some agroforestry applications on the cover and soil losses (erosion)

	Total cover(%)					Soil losses	Soil losses	Rate of
			Year (Y)			before application	4 years after application	soil losses controlled by application (%)
Crop Alternatives (CA)	1997	1998	1999	2000	Mean	(kg/ha)	(kg/ha)	
Pinus pinea	0.04	0.24	1.05	2.80	1.03	1700	595	65
Pinus inea + Origanum onites	4.43	15.69	15.76	29.53	16.35	1865	205	89
Pinus pinea+ Pasture crops	21.08	81.53	82.72	87.16	68.12	1780	40	98
Pinus brutia	0.01	1.22	1.89	7.51	2.66	1680	395	76
Pinus brutia + Origanum onites	2.31	16.91	18.00	29.60	16.71	1825	155	92
Pinus brutia+ Pasture crops	21.50	83.53	88.82	83.34	69.30	1865	38	98
Pasture	21.06	79.77	80.00	85.76	66.65	1745	37	98
					Control	815	345	58
Mean	10.06	39.84	41.18	46.53	-	1659	226	84
LSD (0.05)	Y: 3.11	CA: 1.71	CAxY:3.42					

Total cover values displayed significant variations among the crop alternatives in which *Pinus brutia +* pasture crops had almost highest values in each year except final year, and *Pinus pinea* + pasture crop mixtures and pasture alternative followed them. Considering the large population characteristics of the pasture vegetation, it may be concluded that these results were in accordance with the expectations. In addition to the local members of the original vegetation, many legumes and grasses which had been sown as new pasture crops for complimentary reasons for this vegetation, constructed an intensive crop cover above the soil. Moreover, same components proved to be highly successful by their rapid and aggressive growth habits under the ecological conditions of experimental area. It was obvious that pasture cops were the most effective partners of mixtures in terms of total crop cover characteristic and these grasses and legumes displayed the significant role of pasture crops in covering soil surface and controlling soil losses (Blackburn, 1994).

Pasture crops alternative alone or combined with *Pinus* spp. was the most successful application with regard to the soil conservation (Table 2). Highest soil losses were determined in *Pinus pinea* and *Pinus brutia* grown alone, former having highest amount of soil loss. Control plots which had already crop cover representing original vegetation had lowest amount of soil losses at the beginning, however this value decreased again after 4 years, probably due to the increasing intensity of crop cover which developed particularly under conservation in 4 years period (Baker *et al*., 1984; Valarie and Chopin, 2001).

Conclusions

According to the 4 year results of the experiment, it can be suggested that pasture crops, and partly its combinations with pine trees were the most successful alternatives in terms of soil conservation and economical aspect. However the negative influences of pasture crops on the growth performances of *Pinus* spp. were obvious. *Pinus pinea* seemed to have better performance than *Pinus brutia* and *Pinus* spp. + *Origanum onites* combinations were also promising choices for above mentioned purposes.

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