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Relative Transpiration of the Old and Young Leaves of Some Macchie Elements

By

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With 6 Figures

Introduction

The Bosphorus divides the mainland of Turkey into two parts; the European part comprising 23957,5 square kilometers and much longer Asiatic part comprising 751100,0 square kilometers. The latter is commonly known as Anatolia and is further subdivided into six divisions, namely: East, West, North, South, South-East and Central Anatolia (Fig. 1). Physically most of Anatolia consists of plateau, rising steadily towards the east and bounded on north and south by steep mountain ranges. Due to the different geographical, geological and climatic contrasts we come across different vegetation zones in Anatolia. By far the most conspicuous of these are the macchies or maquis (Fig. 2).

The macchies in general are a characteristic natural mediterranean plant community (Fig. 3) formed by dense, sometimes impenetrable, thickets of tall shrubs, 2 meters or more in height, with stiff densely twiggy branches and small dark evergreen leathery leaves (POLUNIN & HUXLEY 1967: 9—11). They cover much of the mediterranean territory of Turkey below 1000—1200 meters.

The nature of macchies has been a subject of controversy since long, but latest investigations; on the west anatolian macchies by PEŞMEN 1968; have shown that they are of secondary nature formed after the destruction of forest through various biotic agencies, Studies on the water economy of these macchie formations, for the purpose of reforestation, is thus of immense importance to Turkey.

Keeping the above facts in view, the present investigation comprises the studies on the transpirational behaviour of some of these macchie

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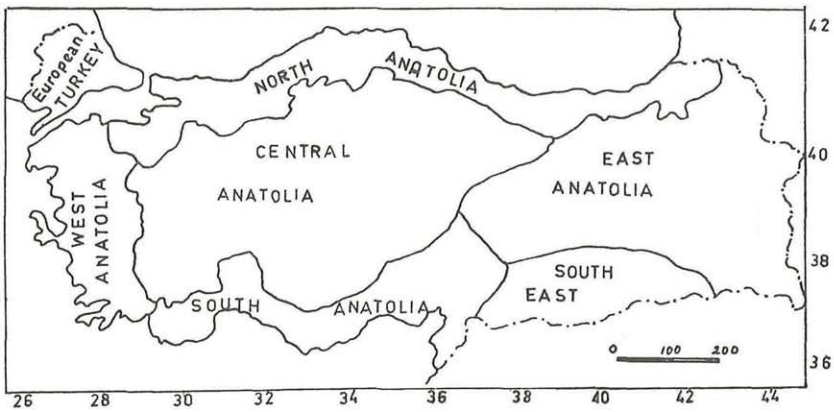

FIG.1. GEOGRAPHICAL DIVISIONS WITHIN TURKEY

elements, when supplied with water, under identical conditions. The following species were selected: *Cistus creticus*, *Cistus salviifolius*, *Myrtus communis* var. *melanocarpa* and *Myrtus communis* var. *leucocarpa* vis-a-vis *Nerium oleander* and *Platanus orientalis* which occupy moist localities in degraded macchies.

Methods

The transpiration measurements on the species of *Cistus* and *Myrtus* varieties were made by determining the loss of weight of twigs in water.

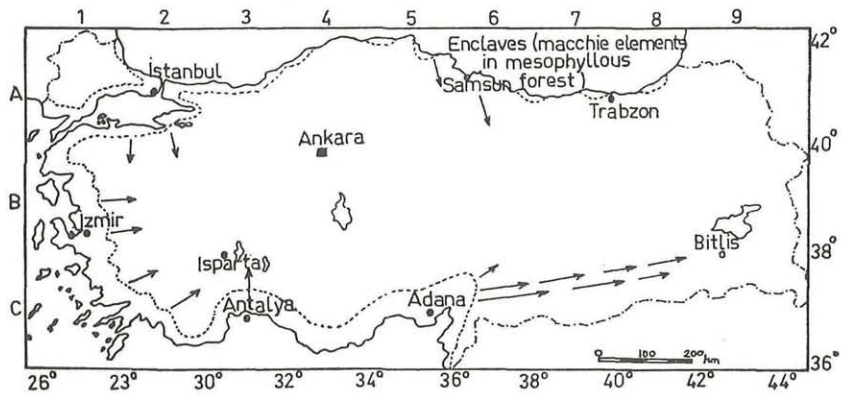

FIG.2. DISTRIBUTION OF MACCHIES IN TURKEY

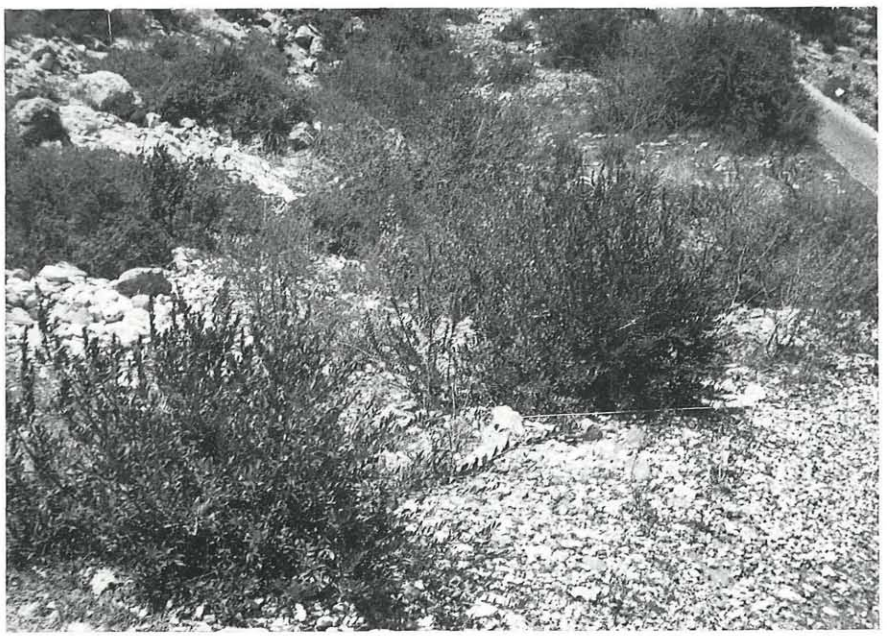

Fig. 3. A general view of the Macchie from Western Anatolia.

Similar measurements for *Nerium oleander* and *Platanus orientalis* were performed on their leaves only. Shoots were cut under water in the field and brought to the laboratory, where their dust and other adhering particles were washed out. The latter were then placed overnight in dark humid chambers. The transpiration measurements were conducted by placing the shoots or the leaves, as the case may be, in flat bottomed conical fiasks covered by a thin layer of paraffin oil, to prevent any loss of moisture by evaporation. Leaf area was measured by a Planimeter and evaporation by Pichi Evaporimeter. The relative humidity was recorded by a hygrometer. The young shoots used were 3—4 months old whereas the old shoots used were 10—12 months old. Transpiration and all other measurements were started at 0700 hours in the morning and terminated at 1900 hours in the evening.

Results and Discussion

The daily course of transpiration corresponds very much to the concomitant environmental parameters being almost non-existant before sunrise and after sunset and reaching a maximum at midday except in *Platanus orientalis* (Fig.: 4a, b; 5a, b). The maximum transpiration rate attained by the young and the older leaves of various species are given in tables (1 and 2). A comparison of the results given in tables 1 and 2 shows that these species differ greatly in their transpiration intensity. This is in accordance with the view put forth by KRAMER 1959 that the rate of transpiration per unit of plant tissue varies greatly among the species in the same environment, among individual plants and even among different leaves on the same plant.

The diurnal march of transpiration exhibits three distinct levels in different species (Fig. 6a, b). The highest level of transpiration rate on the basis of unit leaf area in both young as well as old leaves is shown by the species of *Cistus*, the median level by the species of *Myrtus* and *Platanus* and the lowest by *Nerium oleander* (Fig. 6a). On the basis of fresh weight the maximum is shown by the species of *Cistus*, medium by *Platanus orientalis* and the lowest by the species of *Myrtus* and *Nerium* (Fig. 6b). This clearly shows that the xerophytic species like *Cistus creticus* and *Cistus salviifolius* can transpire more when supplied with water as compared to the moisture loving species of *Platanus*, *Nerium* and *Myrtus*. The latter supports the findings of MAXIMOVA (cf. PARKER 1968; KRAMER 1959) that xerophytes did not transpire less than mesophytes but may transpire more under humid soil conditions.

The results of transpirational studies also show that the new leaves have not attained their full power of transpiration when they have reached

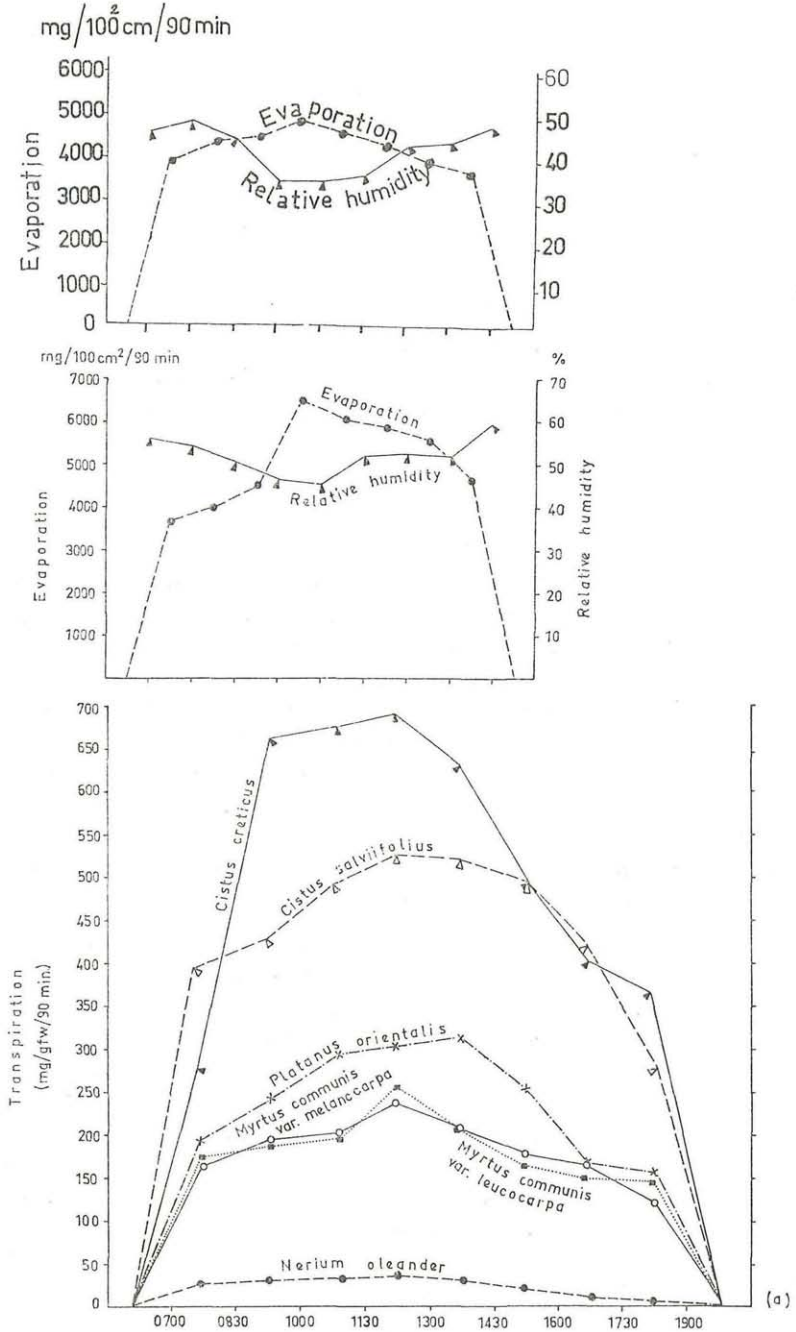

Fig. 4a. Daily transpiration curves of the macchie elements with concomitant environmental parameters (March and November). Young leaves.

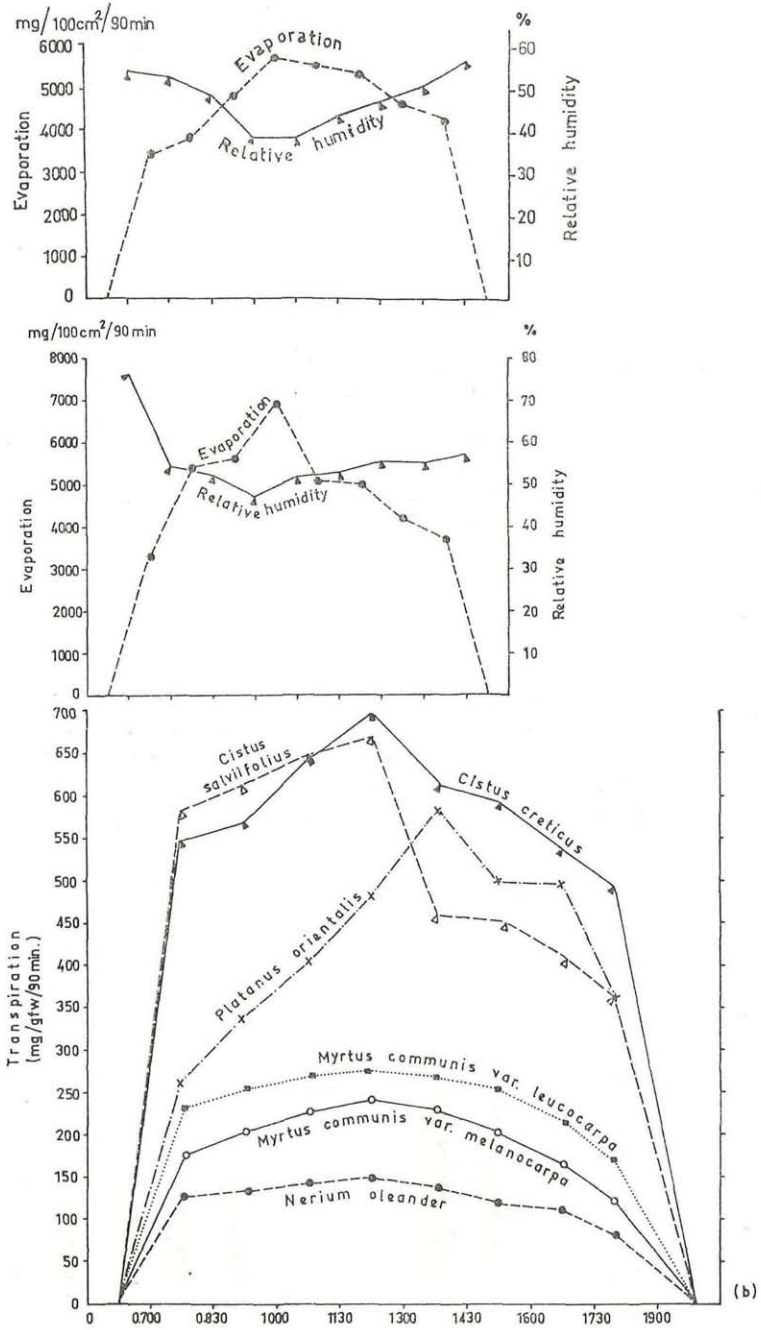

Fig. 4b. Daily transpiration curves of the macchie elements with concomitant environmental parameters (March and November 1968). Old leaves.

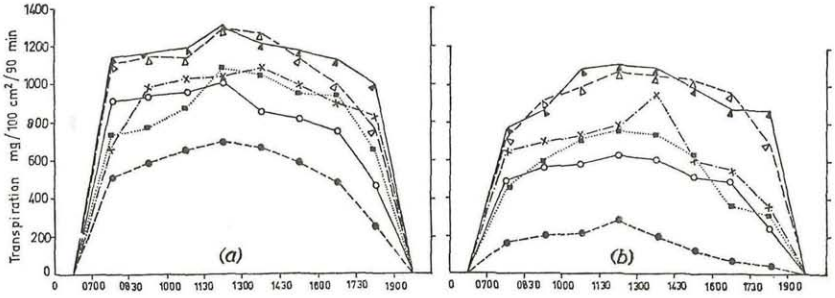

Fig. 5. Diurnal changes in the transpiration rate of old leaves (a) and young leaves (b). ●: *Nerium oleander*, ○: *Myrtus communis* var. *melanocarpa*, ■: *Myrtus communis* var. *leucocarpa*, ×: *Platanus orientalis*, △: *Cistus salviifolius*, ▲: *Cistus creticus*.

the area of maturity. This fact is not wholly a result of the imperfect development in the thickness of leaves, for when the transpiration ratios are referred, not to the equal area of leaves, but to equal weights, the older leaves often maintain their position as the more active in transpiration. This is evidently shown by the data presented in table 3 below.

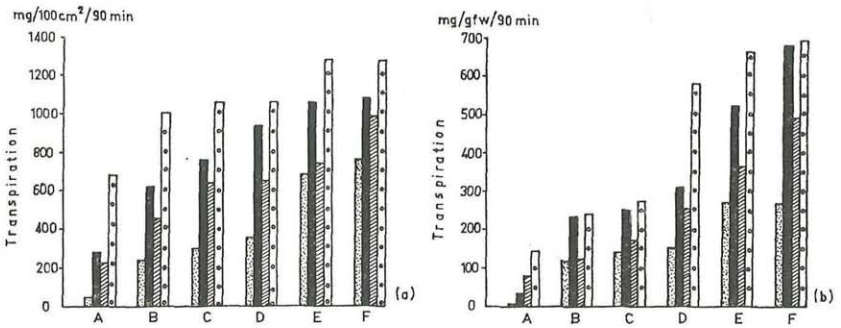

Fig. 6. Comparison of mean maximum (▬ ▭) and mean minimum (▤ ▨) transpiration intensity of different species. (▤ ▬) Young leaves. (▭ ▨) Old leaves

A : Nerium oleander.
B : Myrtus communis var. melanocarpa.
C : Myrtus communis var. leucocarpa.
D : Platanus orientalis.
E : Cistus salviifolius.
F : Cistus creticus.

Table 1

Transpiration of Young Leaves

Date	Species	Time	Transpiration		Evaporation	Time	% Relative Humidity
			mg/gfw/90 min	mg/100 cm²/90 min	mg/100 cm²/90 min		
17/3/'68	*Nerium oleander*	0700—0830	28	177	3700	0700	56.1
		0830—1000	30	208	4000	0830	54.3
		1000—1130	34	211	4500	1000	50.9
		1130—1300	36	286	6500	1130	46.4
		1300—1430	32	204	6100	1300	45.1
		1430—1600	21	133	5900	1430	52.0
		1600—1730	11	72	5600	1600	52.8
		1730—1900	8	52	4700	1730	51.7
						1900	59.9
17/3/'68	*Myrtus communis* var. *melanocarpa*	0700—0830	165	483	3700	0700	56.1
		0830—1000	194	569	4000	0830	54.3
		1000—1130	201	589	4500	1000	50.9
		1130—1300	238	635	6500	1130	46.4
		1300—1430	208	612	6100	1300	45.1
		1430—1600	176	519	5900	1430	52.0
		1600—1730	165	486	5600	1500	52.8
		1730—1900	121	256	4700	1730	51.7
						1900	59.9
17/3/'68	*Myrtus communis* var. *leucocarpa*	0700—0830	174	476	3700	0700	56.1
		0830—1000	187	593	4000	0830	54.3
		1000—1130	196	721	4500	1000	50.9
		1130—1300	255	769	6500	1130	46.4
		1300—1430	206	744	6100	1300	45.1
		1430—1600	164	623	5900	1430	52.0
		1600—1730	148	363	5600	1600	52.8
		1730—1900	146	311	4700	1730	51.7
						1900	59.9

Table 1
Continued

Date	Species	Time	Transpiration		Evaporation	Time	% Relative Humidity
			mg/gfw/90 min	mg/100 cm²/90 min	mg/100 cm²/90 min		
21/3/'68	*Platanus orientalis*	0700—0830	193	655	3900	0700	45.5
		0830—1000	240	706	4300	0830	48.2
		1000—1130	293	738	4400	1000	44.8
		1130—1300	302	772	4800	1130	34.9
		1300—1430	313	956	4600	1300	34.9
		1430—1600	253	613	4300	1430	36.1
		1600—1730	165	557	3900	1600	43.7
		1730—1900	157	366	3700	1730	44.3
						1900	48.7
21/3/'69	*Cistus salviifolius*	0700—0830	393	718	3900	0700	45.5
		0830—1000	428	918	4300	0830	48.2
		1000—1130	491	991	4400	1000	44.8
		1130—1300	525	1067	4800	1130	34.9
		1300—1430	520	1048	4600	1300	34.9
		1430—1600	493	1023	4300	1430	36.1
		1600—1730	418	946	3900	1600	43.7
		1720—1900	275	694	3700	1730	44.3
						1900	48.7
21/3/'68	*Cistus creticus*	0700—0830	275	772	3900	0700	45.5
		0830—1000	661	878	4300	0830	48.2
		1000—1130	674	1094	4400	1000	44.8
		1130—1300	689	1098	4800	1130	34.9
		1300—1430	629	1092	4600	1300	34.9
		1430—1600	493	985	4300	1430	36.1
		1600—1730	399	875	3900	1600	43.7
		1730—1900	363	873	3700	1730	44.3
						1900	48.7

Table 2

Transpiration of Old Leaves

Date	Species	Time	Transpiration		Evaporation	Time	% Relative Humidity
			mg/gfw/90 min	mg/100 cm²/90 min	mg/100 cm²/90 min		
17/11/'68	*Nerium oleander*	0700—0830	126	504	3300	0700	77.0
		0830—1000	134	585	5400	0830	54.1
		1000—1130	141	656	5600	1000	52.5
		1130—1300	149	694	7000	1130	47.2
		1300—1430	138	661	5100	1300	52.0
		1430—1600	119	586	5000	1430	52.9
		1600—1730	111	479	4200	1600	55.7
		1730—1900	83	259	3700	1730	55.3
						1900	57.4
17/11/'68	*Myrtus communis* var. *melanocarpa*	0700—0830	175	907	3300	0700	77.0
		0830—1000	203	936	5400	0830	54.1
		1000—1130	227	955	5600	1000	52.5
		1130—1300	241	1012	7000	1130	47.2
		1300—1430	229	856	5100	1300	52.0
		1430—1600	203	808	5000	1430	52.9
		1600—1730	166	749	4200	1600	55.7
		1730—1900	123	461	3700	1730	55.3
						1990	57.4
17/11/'69	*Myrtus communis* var. *leucocarpa*	0700—0830	233	725	3300	0700	77.0
		0830—1000	256	766	5400	0830	54.1
		1000—1130	268	869	5600	1000	52.5
		1130—1300	279	1064	7000	1130	47.2
		1300—1430	268	1055	5100	1300	52.0
		1430—1600	256	946	5000	1430	52.9
		1600—1730	216	936	4200	1600	55.7
		1730—1900	172	654	3700	1730	55.3
						1900	57.4

Table 2
Continued

Date	Species	Time	Transpiration		Evaporation	Time	% Relative Humidity
			mg/gfw/90 min	mg/100 cm²/90 min	mg/100 cm²/90 min		
21/11/'68	*Platanus orientalis*	0700—0830	259	659	3500	0700	55.3
		0830—1000	338	980	3900	0830	54.1
		1000—1130	405	1025	4900	1000	49.7
		1130—1300	482	1027	5800	1130	39.9
		1300—1430	585	1069	5600	1300	39.5
		1430—1600	497	981	5400	1430	44.3
		1600—1730	496	891	4700	1600	47.9
		1730—1900	363	829	4300	1730	51.1
						1900	57.0
21/11/'68	*Cistus salviifolius*	0700—0830	582	1101	3500	0700	55.3
		0830—1000	612	1138	3900	0830	54.1
		1000—1130	647	1147	4900	1000	49.7
		1130—1300	668	1284	5800	1130	39.9
		1300—1430	459	1260	5600	1300	39.5
		1430—1600	453	1120	5400	1430	44.3
		1600—1730	409	991	4700	1600	47.9
		1730—1900	362	747	4300	1730	51.1
						1900	57.0
21/11/'68	*Cistus creticus*	0700—0830	545	1122	3500	0700	55.3
		0830—1000	567	1157	3900	0830	54.1
		1000—1130	653	1191	4900	1000	49.7
		1130—1300	699	1289	5800	1130	39.9
		1300—1430	614	1212	5600	1300	39.5
		1430—1600	592	1162	5400	1430	44.3
		1600—1730	538	1131	4700	1600	47.9
		1730—1900	493	998	4300	1730	51.1
						1900	57.0

Table 3

Transpiration Ratios

Species	Equal areas (o—n)	Equal weights (o—n)
Nerium oleander	3.29	5.00
Myrtus communis var. *melanocarpa*	1.61	1.06
Myrtus communis var. *leucocarpa*	1.52	1.32
Platanus orientalis	1.39	1.78
Cistus salviifolius	1.18	1.18
Cistus creticus	1.20	1.12

The transpiration measurements on the plants cited above appear to indicate the following conclusions:

1. Leaves of the species studied transpire more for equal areas when 10—12 months old than they do when they have just reached their maximum area i. e. 3—4 months old.

2. Transpiration for equal weights of old leaves is more active than for young leaves.

3. Xerophytes may not necessarily transpire less than mesophytes when supplied with water.

4. Water economy studies are of first and the foremost importance for the reforestation of macchies.

Summary

The subject of water relations of plants has gained a lot of importance during the past few years. The world wide interest in this subject is accentuated by increasing sensitivity to the seriousness of dwindling water supplies in arid regions. Transpirational studies constitute one of the aspects in this field of research. The present studies, as such, embody investigations concerning the transpirational behaviour of some economically important plants growing in macchies; one of the dominant formations in Turkey. The observations show that the species studied differ greatly in the longevity of their leaves. Transpiration for equal weights of leaves is generally more active for older than younger leaves. The leaves of most of the species studied transpire more for equal areas when older.

Zusammenfassung

In den letzten Jahren wurden über die Kenntnis der Zusammenhänge zwischen Pflanze und Wasser große Fortschritte erzielt. Das weltweite Interesse an diesem Thema beruht vor allem auf dem schwierigen Versorgen mit Wasser in den Trockengebieten der Erde. Daher gehören Transpirationsstudien zu den dringendsten Arbeiten. Die in der Türkei sehr verbreitete

Macchie erlaubte es, bestimmte, ökonomisch wichtige Pflanzen auf breiter Grundlage vergleichend zu untersuchen. Die Ergebnisse zeigten, daß die Arten sich mit Bezug auf das Alter ihrer Blätter sehr verschieden verhalten. Ältere Blätter gleichen Gewichtes transpirieren im allgemeinen lebhafter als jüngere. Auch im gleichen Areal transpirieren die älteren Blätter der meisten Arten viel mehr als die jüngeren.

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