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SOME FEATURES OF IMPORTANT TAXA OF SOIL MESOFAUNA IN AN AFRO-MEDITERRANEAN COASTAL DESERT.

III. — SOIL MESOFAUNA UNDER DRY-FARMED OLIVE*

By

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INTRODUCTION

As a continuation of studies of populations of soil mesofauna in agro-ecosystems of the Mariut Region (GHABBOUR & SHAKIR 1982 a & b), this paper deals with orchards of dry-farmed olives. Olive cultivation was introduced in 1935 at Burg El-Arab and spread successfully along the coast (KASSAS 1972 and 1979). Estimations of the cultivated area vary from 7,000 frddans in 1965, according to the UNDP/FAO (1971) report (1 feddan=0.42 ha), to 2,000 feddans only in 1978 (EL-AZZOUNY 1979). The number of cultivated trees, according again to the UNDP/FAO (1971) report, was estimated at 300,000 in 1965, while according to an estimated density of 120/fed, (GARAD 1980), they may have been only 240,000 in 1978. However, a high-level decision was taken in 1977 to extend the introduction and cultivation of one million olive trees along the coast in a 5-year plan (AYYAD 1981), of which 60,000 were actually planted in 1979 (FATHI 1979). The rainfall requirement of the olive tree on this coast is 220-270 mm (EL-SHOURBAGY 1979), while consumptive water use was calculated as 3466 m^3/fed, thus leaving a potential area of 12,600 fed. for further cultivation (FATHI 1979). Although rainfall along the coast averages only 150 mm, cultivation is possible in depressions allowing run-on water from neighbouring slopes to reach the trees. They are cultivated in depressions of calcareous sandy loam to clay loam of pleistocens origin, with 15-40% clay, 20-80% silt, and 15-50% sand (ABDEL-KADER 1979). These depressions are mostly formed under lacustrine conditions. Cultivation of olives exploits those depressions mostly south of the Mariut Salt Marsh (see map given by GHABBOUR and SHAKIR 1982 a). The phenology of olive trees in this cosat was given by BARAKAT (1979) as : flowering in February, fruiting May, fruit maturity in September.

The litter of olive trees, essential as food for soil mesofauna, consists of leaves, flowers and fruits. Leaves may remain for more than 3 years on this evergreen tree, and when thay finally fall, they may have about 1% N (dry weight), but they may also fall prematurely due to deficiency in soil nitrogen or due to drought, and will then have the same N content of 1% (BARAKAT 1979). Final setting is 4-15% in desert farms of NW Egypt (EL-KHOLY et al 1978) so that relatively large amounts of non-setting flowers and fruits reach the soil. But on the other hand, most trees exhibit alternate bearing under this dry climate, and thus may produce reproductive organs every second year.

I.—MATERIAL AND METHODS

A) The sites

Two neighbouring dry-farmed olive orchards were chosen for the present study in the Burg El-Arab town area. The first is a farm owned by a local farmer (Haj Ali) and situated at about 3 km east of the town (plate I). Trees were planted on a slope south of the «third» ridge in the early 1950's, at distances of 4.5×5 m, thus with 450-470 trees/ha. The soil of this farm was described by GOMAA et al. (1978). The main characteristics are :

Plate I. Olive farm near rest house at Burg El Arab - Rain fed.

slope - almost flat,
parent material - calcareous marine deposits,
horizones, depth and description -

A_P	0-20 cm	dull yellow orange, loamy, sticky and plastic in wet, firm in moist, hard in dry, crumb structure, many medium roots, diffuse and smooth boundary, coarse sand 11%, medium sand 15%, fine sand 9%, silt 34%, clay 31%,
A_C	20-35 cm	bright yallowish brown, loamy sticky and plastic in wet, firm in moist, slightly hard in dry, massive structure, few fine roots, diffuse and smooth boundary, coarse sand 9%, medium sand 18%, fine sand 11%, silt 32%, clay 30%,
C	35-90 cm	yellowish brown, clay loam, sticky and plastic in wet, firm in moist, hard in dry, massive structure, coarse sand 8% medium sand 4% fine sand 11%, silt 31%, clay 46%.

The main agricultural practices affecting soil fauna in this farm are : ploughing in December and January (to allow for percolation of rain-water), weed clearing from March to July, fertilization with organic manure ($25m^3$/ha) and with superphosphate (250 kgm/ha). Leaf litter fall is throughout the year. The crop is collected in September and October.

The other farm is situated in a flat plain near the rest house of the Faculty of Science of Alexandria University at Burg El-Arab town. It is one of the oldest olive orchards in the area, established by the Horti-cultural Department of the Ministry of Agriculture in the mid-1930's; but it is now neglected and un-managed. The distances between trees in this farm are 6.0-6.25 X 6.0-6.25 m, with 270-290 trees/ha, i.e., it is less densely spaced than the Haj Ali farm. The soil of this farm is of the same formation as the HA farm, as described above, but since it is not tilled or weeded, its surface layer has hardened. At a depth of 50-60 cm a hard pan has developed in some places. Sheep and goats belonging to Bedouins graze freely on weeds and olive branches of this farm, and fertilize the soil with their egesta in the process.

B) Sampling and extraction of soil mesofauna

Sampling of the mesofauna of each of these two farms was carried five times, once for each season, from March 1977 to November 1978. The two farms overlap in four seasons. The Haj Ali (HA) farm was sampled in August and November 1977, and in March, May and November 1978. The Rest House (RH) farm was sampled in March, August and November 1977, and in January and April 1978. The autumn season is thus duplicated for the HA farm, while the spring season is duplicated for the RH farm. Extraction of soil mesofauna was by digging a 50 X 50 X 60 pit in the ground (10 for each season) along a random straight line within the farm, avoiding tree roots. All animals were hand-picked. The rest of the procedure, as well as determinations of moisture and organic matter content of soil samples, were described by GHABBOUR and SHAKIR (1982 a). Treatment of data was also explained in the same publication.

The degree of artificialization of the two olive farms, as conceived by LONG (1979) and LE FLOC'H (1981), ranges from 5.0 to 5.1, but the RH farm must be considered less artificialized because less intensive agricultural practices are applied there, so it will be given the value of 5.0/2 on the scale, and the AH farm will be given the value of 5.1 on the same scale.

II. — RESULTS

Tab. I gives results of soil moisture and soil organic matter analysis for the two olive farms. It is evident that the RH farm has higher moisture and higher organic matter, on the average, than the HA farm. This is probably due to the sloping surface of the latter farm. The hard pan in the RH farm may also help to conserve moisture at the depth of 60 cm, but sub-surface water is drained easily in the HA farm. Soil organic matter is higher in both farms in late winter and in spring, but it is also high in autumn in the RH farm. It appears therefore that weeds and egesta of grazing sheep and goats in the RH farm (for which the main activity season is late winter and spring), are more important as factors in raising levels of organic matter in soil than manure fertilization in the HA farm.

Tabs. II — V and Figs. 1 — 4 show the seasonal fluctuations in population desity (PD) and biomass (BM) of soil mesofauna under olive in the two farms. In the HA farm, Cicadidae are the only persistent taxon, while spiders and Tenebrionidae appeared in 4 seasons out

of 5. Earthworms, ticks, Pyrrhocoridae, Diptera, Mutilidae, Megachilidae, Scarabaeidae and Scydmaenidae, appeared in only one season. On the other hand, persistent taxa in the RH farm were Isopoda and Tenebrionidae. Only Formicidae were absent in one season. Taxa that appeared in just one season were Geophilomorpha, Gryllidae, Pyrrhocoridae, Pelecinidae, wasps, Scarabaeidae and Staphylinidae.

When arranged in descending order according to the annual PD average, the dominant taxa may be arranged in this order :

	HA		RH
Cicadidae	33.9%	Isopoda	44.6%
Pyrrhocoridae	22.9%	Pyrrhocoridae	14.9%
Tenebrionidae	13.1%	Formicidae	14.9%
Formicidae	8.2%	Tenebrionidae	8.4%
Spiders	6.8%	Spiders	4.1%
Earthworms	4.5%	Lepidoptera (l.)	3.0%
Staphylinidae	2.8%	Cicadidae	1.9%

In the case of BM, the seven dominant taxa are arranged in this order :

	HA		RH
Cicadidae	74.2%	Tenebrionidae	61.9%
Tenebrionidae	42.4%	Cicadidae	8.7%
Earthworms	4.4%	Scarabaeidae	8.6%
Pyrrhocoridae	1.9%	Lepidoptera (l.)	7.2%
Carabidae	1.3%	Isopoda	6.6%
Spiders	1.2%	Pyrrhocoridae	4.9%
Mutilidae	0.5%	Formicidae	0.8%

In order to resolve these differences, application of A.I.V. and R.I.V. (GHABBOUR and SHAKIR 1980) gives the following results (Figs. 5 and 6) :

	Haj Ali farm		Rest House farm	
	A.I.V.	R.I.V.	A.I.V.	R.I.V
Earthworms	2.5	13.9	—	—
Isopoda	—	—	4.6	71.3
Spiders	2.5	22.1	1.9	13.6
Pyrrhocoridae	2.2	27.7	2.8	23.2
Cicadidae	5.1	113.7	2.4	13.0
Lepidoptera (1.)	—	—	2.6	14.3
Formicidae	0.9	13.5	3.0	36.7
Tenebrionidae (a.)	4.3	67.1	3.7	49.0
Tenebrionidae (1.)	—	—	3.7	45.3
Scarabaeidae (a.)	—0.4	2.1	—1.0	2.0
Scarabaeidae (1.)	—	—	1.3	10.8
Carabidae (a.)	1.5	8.4	0.9	6.1
Staphylinidae (a.)	—0.2	6.1	0.0	4.5

It is thus evident that the order of the seven most important taxa on the A.I.V. scale in the HA farm, to take the dominant and sub-dominant taxa, are : Cicadidea, Tenebrionidae, earthworms, spirers, pyrrhocoridae, Carabidae and Formicidae. On the same scale, the seven taxa in the RH farm are : Tenebrionidae, Isopoda, Formicidae, pyrrhocoridae, Lepidoptera larvae and Cicadidae. It is noteworthy that we have here pairs or triplets of seemingly exchangeable groups : earthworms and Isopora, as well as Cicadidae, Lepidoptera larvae, and Formicidae. Tenebrionidae are dominant in the HA farm, but are much more important in the RH farm, where they are associated clearly with Scarabaeidae, as a response, no doubt, to the presence of egesta of domestic animals brought to graze in this farm. Isopoda and Lepidoptara larvae are also prominent in the fauna of the RH farm. This may be because of the rich weedy ground vegetation. The importance of Formicidae may be ascribed too to the rich seed output of this weedy vegetation, and to the ability of these ants to dig their burrows in the hardened soil, where other fossorial species find it hard to live in.

The seasonal relationship between PD and BM (x and y) is shown in Figs. 7 and 8. For the entire sampling period, this relationship could be expressed for the HA farm as such: $y = 994.1 + 20.9 \times$, $r = 0.24$, $n = 46$, p ... ns. The correlation coefficient of these two variables was significant at the 0.01-0.001 level in summer 1977, autumn 1977, and winter 1978 seasons. At the RH farm, the cumulative relationship for the entire sampling period may be expressed as such : $y=503.2+10.8$ X, $r = 0.33$, $n = 50$, $p < 0.05$. The correlation coefficient was significant for the autuman 1977 season only at the 0.01-0.001 level. When comparing seasonal regression lines shown in Figs. 7 and 8, it is clear that summer fauna in the HA farm tends to be very light-weight, while fauna of the following autumn and winter seasons tend to be more heavily-built. The same phenomenon can be observed in the RH farm for the same seasons. Cicadidae and Tenebrionidae appeared in autumn 1977 in both farms in large numbers and this accounts for the phenomenon. It is noteworthy that the RH farm, with higher moisture and richer in organic matter, had almost twice the PD of the RH farm, but a little more than half its BM. This is because lightweight groups, such as Formicidae and Isopoda, constitute the bulk of the fauna in the RH farm (60 %). In winter, when PD is at its lowest at the RH farm ($10/m^2$), ants constitute 73% of the population, but tenebrionid larvae, secluded in the soil, constitute 86% of the biomass. Isopoda were very few in this season, at their lowest density of $1.2/m^2$, but they were especially of heavy weight. an average 40.0 mgm/ind., against 3.0-8.0 mgm in the other seasons. The season of lowest PD in the HA farm was autumn 1977, which was dominated by Cicadidae, Tenebrionidae, and spiders (31, 15 and 31% respectively), but the same taxa constituted 19, 78 and 1% of the BM respectively. Thus it is clear that in the unfavourable seasons, certain «backbone» taxa tolerate the adverse conditions prevailing in the site and are not totally eliminated, and thus constitute the persisting facies of the population. It is notable that sand roaches, which are sand swimmers, did not appear in any of the two olive farms which have a hardened surface; they were replaced by other true fossorial taxa such as cicadas and wild bees. The late November rain in autumn 1978, which produced a surface moisture as high as 20%, resulted in the apparance of earthworms (Allolobophora caliginosa f. trapezoides), whose cocoons may be brought in the organic manure used in fartilization.

Table (I) : Dates of Sampling, Soil Moisture %, and Organic % (at 5 cm Depth), in the Dry-Farmed Olive Orchards of Haj Ali and Rest House.

Ecosystem and Site	SEASONS							
	Spring 1977	Summer 1977	Autumn 1977	Winter 1978	Spring 1978	Summer 1978	Autumn 1978	Annul Mean
Olive Haj-Ali Burg-El-Arab	—	12/8	18/11	17/3	18/5	—	30/11	
Soil Moisture %								
— 5 cm		4.40	5.62	12.60	3.64		20.11	9.27
— 30 cm		7.96	8.06	13.24	11.35		22.67	12.66
— 60 cm		11.68	11.51	18.77	11.15		19.65	14.55
Organic Matter %		1.17	0.99	1.66	1.50		1.19	1.30
Olive Rest House Burg-El-Arab	30/3	2/8	4/11	28/1	7—13/4	—	—	
Soil Moisture %								
— 5 cm	8.85	4.68	11.23	18.77	5.69			8.84
— 30 cm	18.46	12.61	15.63	18.09	12.51			15.46
— 60 cm	13.96	14.03	16.67	10.16	16.74			16.31
Organic Matter %	3.33	1.59	2.06	1.02	1.59			1.91

Table (II) : Seasonal Variation of Population Density (PD) per m^2 and Percentage of Total of Soil Mesofaunal Taxa Olive Haj Ali, Burg-EM-Arab.

Taxa of Soil Mesofauna		Summer 1977		Autumn 1977		Winter 1978		Spring 1978		Autumn 1978		Annual	
		PD	%	PD	%	PD	%	PD	%	PD	%	PD	%
Earthworms		—	—	—	—	—	—	—	—	3.20	19.05	0.64	4.46
Non-insect arthropods		1.20	6.24	2.00	38.46	—	—	2.50	11.36	0.80	4.76	1.30	9.06
Spiders		0.40	2.08	1.60	30.77	—	—	2.50	11.36	0.40	2.38	0.98	6.83
Ticks		0.40	2.08	—	—	—	—	—	—	—	-	0.08	0.56
Geophilomorpha		0.40	2.08	0.40	7.69	—	—	—	—	0.40	2.38	0.24	1.67
Insecta		18.00	93.76	3.20	61.54	8.50	100.00	19.50	88.64	12.80	76.19	12.40	86.48
Hemiptera		16.40	85.42	—	—	—	—	—	—	—	—	3.28	22.87
Pyrrhocoridae		16.40	85.42	—	—	—	—	—	—	—	—	3.28	22.87
Homoptera		0.80	4.17	1.60	30.77	6.00	70.59	9.50	43.18	6.40	38.10	4.86	33.89
Cicadidae		0.80	4.17	1.60	30.77	6.00	70.59	9.50	43.18	6.40	38.10	4.86	33.89
Diptera	(P)	—	—	—	—	0.50	5.88	—	—	—	—	0.10	0.70
Hymenoptera		0.80	4.17	0.40	7.69	—	—	5.50	25.00	0.40	2.38	1.42	9.90
Formicidae	(A)	—	—	0.40	7.69	—	—	5.50	25.00	—	—	1.18	8.23
Mutilidae	(A)	0180	4.17	—	—	—	—	—	—	—	—	0.16	1.12
Megachilidae	(A)	—	—	—	—	—	—	—	—	0.40	2.38	0.08	0.56
Coleoptera		—	—	1.20	23.08	2.00	23.53	4.50	20.45	6.00	35.71	2.74	19.11
Tenebrionidae	(A)	—	—	0.80	15.39	1.00	11.76	2.00	9.09	5.60	33.33	1.88	13.11
Scarabaeidae	(A)	—	—	—	—	—	—	—	—	0.40	2.38	0.08	0.56
Carabidae	(A)	—	—	0.40	7.69	0.50	5.88	0.50	2.27	—	—	0.28	1.95
Staphylinidae	(A)	—	—	—	—	0.50	5.88	1.50	6.82	—	—	0.40	2.79
Scydmaenidae	(A)	—	—	—	—	—	—	0.50	2.27	—	—	0.10	0.70
Total		17.20	100	5.20	100	8.50	100	22.00	100	16.80	100	14.34	100
Standard Error		16.11	—	1.79	—	2.44	—	9.62	—	5.39	—	3.21	—

A = Adult. L = Larvae. P = Pupae.

Notice : Prcentages in some cases do not always add up exactly to 100 because of rounding off.

Table (III) : Seasonal Variation of Biomass (BM) per m² Rnd Percentage of Total Biomass of Soil Mesofaunal Taxa Olive–Haj Ali, Burg—El–Arab.

Taxa of Soil Mesofauna		Summer 1977		Autumn 1977		Winter 1978		Spring 1978		Summer 1978		Annual	
		BM	%	BM	%	BM	%	BM	%	BM	%	BM	%
Earthworms		—	—	—	—	—	—	—	—	295.60	21.83	59.12	4.39
Non–insect arthropoas		15.60	5.69	7.60	0.65	—	—	63.75	2.06	13.20	0.97	20.03	1.49
Spiders		3.60	1.31	6.40	0.55	—	—	63.75	2.06	8.80	0.65	16.51	1.23
Ticks		7.60	2.77	—	—	—	—	—	—	—	—	1.52	0.11
Geophilomorpha		4.40	1.61	1.20	0.10	—	—	—	—	4.40	0.32	2.00	0.15
Insecta		258.40	94.31	1160.00	99.35	838.25	100.00	3034.00	97.94	1045.20	77.20	1267.20	94.12
Hcmiptera		128.00	46.72	—	—	—	—	—	—	—	—	25.60	1.90
Pyrrhocoridae		128.00	46.72	—	—	—	—	—	—	—	—	25.60	1.90
Homoptera		96.00	35.04	218.80	18.74	727.00	86.73	1325.00	42.77	811.20	59.91	635.60	47.21
Cicadidae		96.00	35.04	218.80	18.74	727.00	86.73	1325.00	42.77	811.20	59.91	635.60	47.21
Diptera	(P)	—	—	—	—	9.00	1.07	—	—	—	—	1.80	0.13
Hymenoptera		34.40	12.55	0.40	0.03	—	—	3.00	0.10	27.20	2 01	13.00	0.97
Formicidae	(A)	—	—	0.40	0.03	—	—	3.00	0.10	—	—	0.68	0.05
Mutilidae	(A)	34.40	12.55	—	—	—	—	—	—	—	—	6.88	5.01
Megachilidae	(A)	—	—	—	—	—	—	—	—	27.20	2.01	5.44	0.41
Coleoptera		—	—	940.80	80.58	102.25	12.20	1706.00	55.07	2206.80	15.77	591.17	43.91
Tenebrionidae	(A)	—	—	915.20	78.38	50.00	5.97	1694.00	54.68	193.60	14.30	570.56	42.38
Scarabaeidae	(A)	—	—	—	—	—	—	—	—	13.20	0.97	2.64	0.20
Carabidae	(A)	—	—	25.60	2.20	52.00	6.20	9.00	0.29	—	—	17.32	1.29
Staphylinidae	(A)	—	—	—	—	0.25	0.03	1.50	0.05	—	—	0.35	0.03
Scydmaenidae	(A)	—	—	—	—	—	—	1.50	0.05	—	—	0.30	0.02
Total		274.00	100	1167.60	100	838.25	100	3097.75	100	1354.00	100	1346.32	100
Strndard Error		144.55	—	721.00	—	310.00	—	1665.23	—	337.77	—	474.74	—

* See Table (II).

Table (IV) : Seasonal Variation of Population Density (PD) per m2 and Percentage of Total of Soil Mesofaunal Taxa, Olive Rest House, Burg-El-Arab.

Taxa of Soil Mesofauna		Spring 1977		Summer 1977		Autumn 1977		Winter 1978		Spring 1978		Annual	
		PD	%	PD	%	PD	%	PD	%	PD	%	PD	%
Non-insect arthropnds													
Isopoda		29.50	88.06	2.00	6.76	20.50	64.06	1.20	11.54	5.50	21.15	11.74	44.64
Spiders		—	—	2.40	8.11	0.50	1.56	—	—	2.50	9.62	1.08	4.11
Geophilomorpha		—	—	—	—	1.00	3.13	—	—	—	—	0.20	0.76
Insecta													
Orthoptera		—	—	—	—	—	—	—	—	0.50	1.92	0.10	0.38
Gryllidae		—	—	—	—	—	—	—	—	0.50	1.92	0.10	0.38
Hemiptera		—	—	19.60	66.22	—	—	—	—	—	—	3.92	14.90
Pyrrhocoridae		—	—	19.60	66.22	—	—	—	—	—	—	3.92	14.90
Homoptera		—	—	—	—	—	—	—	—	2.50	9.62	0.50	1.90
Cicadidae		—	—	—	—	—	—	—	—	2.50	9.62	0.50	1.90
Lepidoptera	(L)	—	—	0.40	1.35	2.00	6.25	—	—	1.50	5.77	0.78	2.97
Hymenoptera		2.00	5.97	—	—	4.00	12.50	7.60	73.08	8.50	32.69	4.42	16.81
Formicidae	(A)	2.00	5.97	—	—	1.50	4.69	7.60	73.08	8.50	32.69	3.92	14.90
Pelecinidae	(A)	—	—	—	—	1.00	3.13	—	—	—	—	0.20	0.76
Wasps		—	—	—	—	0.50	1.56	—	—	—	—	0.10	0.38
Indet.	(A)	—	—	—	—	1.00	3.13	—	—	—	—	0.20	0.76
Coleoptera		2.00	5.97	5.20	17.57	4.00	12.50	1.60	15.38	5.00	19.23	3.56	13.54
Tenebrionidae	(A)	2.00	5.97	—	—	3.00	9.38	—	—	1.00	3.85	1.20	4.56
	(L)	—	—	0.40	1.35	0.50	1.56	1.20	11.54	3.00	11.54	1.02	3.88
Scarabaeidae	(A)	—	—	0.40	1.35	—	—	—	—	—	—	0.08	0.30
	(L)	—	—	0.80	2.70	—	—	—	—	—	—	0.16	0.61
Carabidae	(A)	—	—	—	—	0.50	1.56	0.40	3.85	1.00	3.85	0.38	1.44
Staphylinidae	(A)	—	—	3.60	12.16	—	—	—	—	—	—	0.72	2.74
Total		33.50	100	29.60	100	32.00	100	10.40	100	26.00	100	26.30	100
Standard Error		9.17	—	2.31	—	1.82	—	1.68	—	0.86	—	0.70	—

Table (V) : Seasonal Variation of Biomass (BM) per m^2 and Percentage of Total Biomass of Soil Mesofaunal Taxa, Olive Rest House, Burg-El-Arab.

Taxa of Soi Mesofauna		Spring 1977		Summer 1977		Autumn 1977		Winter 1978		Spring 1978		AnnualW	
		BM	%	BM	%	BM	%	BM	%	BM	%	BM	%
Non-insect arthropods													
Isopoda		104.50	12.19	9.20	1.38	61.00	5.07	48.00	12.06	44.00	4.88	53.34	6.62
Spiders		—	—	3.60	0.54	3.00	0.25	—	—	11.00	1.22	3.52	0.44
Geophilomorpha		—	—	—	—	15.50	1.27	—	—	—	—	3.10	0.38
Insecta													
Orthoptera		—	—	—	—	—	—	—	—	3.00	0.33	0.60	0.07
Gryllidae		—	—	—	—	—	—	—	—	3.00	0.33	0.60	0.07
Hemiptera		—	—	198.80	29.78	—	—	—	—	—	—	39.76	4.93
Pyrrhocoridae		—	—	178.80	29.78	—	—	—	—	—	—	39.76	4.93
Homoptera		—	—	—	—	—	—	—	—	352.00	39.00	70.40	8.74
Cicadidae		—	—	—	—	—	—	—	—	352.00	39.00	70.40	8.74
Lepidoptera	(L)	—	—	109.60	16.42	150.00	12.46	—	—	29.00	3.21	57.72	7.16
Hymenoptera		4.50	0.53	—	—	6.75	0.56	5.60	1.41	22.50	2.49	7.87	0.98
Formicidae	(A)	4.50	0.53	—	—	1.25	0.10	5.60	1.41	22.50	2.49	6.77	0.84
Pelecinidae	(A)	—	—	—	—	1.50	0.12	—	—	—	—	0.30	0.04
Wasps		—	—	—	—	2.00	0.17	—	—	—	—	0.40	0.05
Indet.		—	—	—	—	2.00	0.17	—	—	—	—	0.40	0.05
Coleoptera		748.00	87.28	346.40	51.89	968.00	80.38	344.40	86.53	441.00	48.86	569.56	70.68
Tenebrionidae	(A)	748.00	87.28	—	—	490.50	40.73	—	—	39.00	4.32	255.50	31.70
	(L)	—	—	5.20	0.78	475.00	39.44	343.60	86.33	394.00	43.60	243.56	30.22
Scarabaeidae	(A)	—	—	3.20	0.48	—	—	—	—	—	—	0.64	0.08
	(L)	—	—	344.80	51.65	—	—	—	—	—	—	68.76	8.56
Carabidae	(A)	—	—	—	—	2.50	0.21	0.80	0.20	8.00	0.89	2.26	0.28
Staphylinidae	(A)	—	—	3.20	0.48	—	—	—	—	—	—	0.64	0.08
Total		857.00	100	667.60	100	1204.25	100	398.00	100	902.50	100	805.87	100
Standard Error		165.80	—	44.96	—	57.34	—	82.05	—	51.86	—	19.53	—

Table (VI) : Matrix of SORENSEN'S similarity coefficients between seasons (presence or absence of taxa, qualitative), in the lower left hand corner, and matrix of GLEASON's similarity coefficients between seasons (quantitative presence of taxa), using A.I.V., in the upper right hand corner.

(A) Olive Haj Ali, Burg–El-Arab.

	Summer 1977	Autumn 1977	Winter 1978	Spring 1978	Autumn 1978
Summer 1977		34	22	23	31
Autumn 1977	50		67	70	63
Winter 1978	18	54		57	49
Spring 1978	31	77	67		53
Autumn 1978	46	61	33	43	

(B) Olive, Rest House, Burg–El–Arab.

	Spring 1977	Summer 1977	Autumn 1977	Winter 1978	Spring 1978
Spring 1977		16	82	47	43
Summer 1977	18		33	19	36
Autumn 1977	43	42		46	61
Winter 1978	57	33	53		54
Spring 1978	50	47	70	62	

Table (VII) : Arrangement of soil mesofauna taxa in the dryfarmed olive orchards of Haj Ali and Rest House at Burg El-Arab, according to the Index of Species Abundance proposed by ROBERTS and HSI (1979).

Serial No.	Taxon	I.S.A. Haj Ali	I.S.A. Rest House
1	Earthworms	6.0	—
2	Isopoda	—	1.0
3	Spiders	5.0	5.0
4	Ticks	14.0	—
5	Geophilomorpha	9.0	12.0
6	Gryllidae	—	16.5
7	Pyrrhocoridae	2.0	2.5
8	Cicadidae	1.0	9.0*
9	Lepidoptera (l.)	—	7.0
10	Diptera (p.)	11.5	—
11	Formicidae	4.0	2.5*
12	Pelecindae	—	12.5
13	Mutilidae	10.0	—
14	Wasps	—	16.5
15	Magachilidae	14.0	—
**	Hymenoptera (indet.)	—	12.0
16	Tenebrionidae (a.)	3.0	4.0
17	Tenebrionidae (l.)	—	6.0
18	Scarabacidae (a.)	14.0	10.0
19	Scarabaeidae (l.)	—	15.0
20	Carabidae (a.)	8.0	14.0
21	Staphylinidae (a.)	7.0	8.0
22	Scydmaenidae (a.)	11.5	—

* Difference significant at $p > 0.01$ level for PD.

** Not shown in Fig. 9.

The breakdown of the fauna into functional groups, based on annual averages, shows the following pattern :

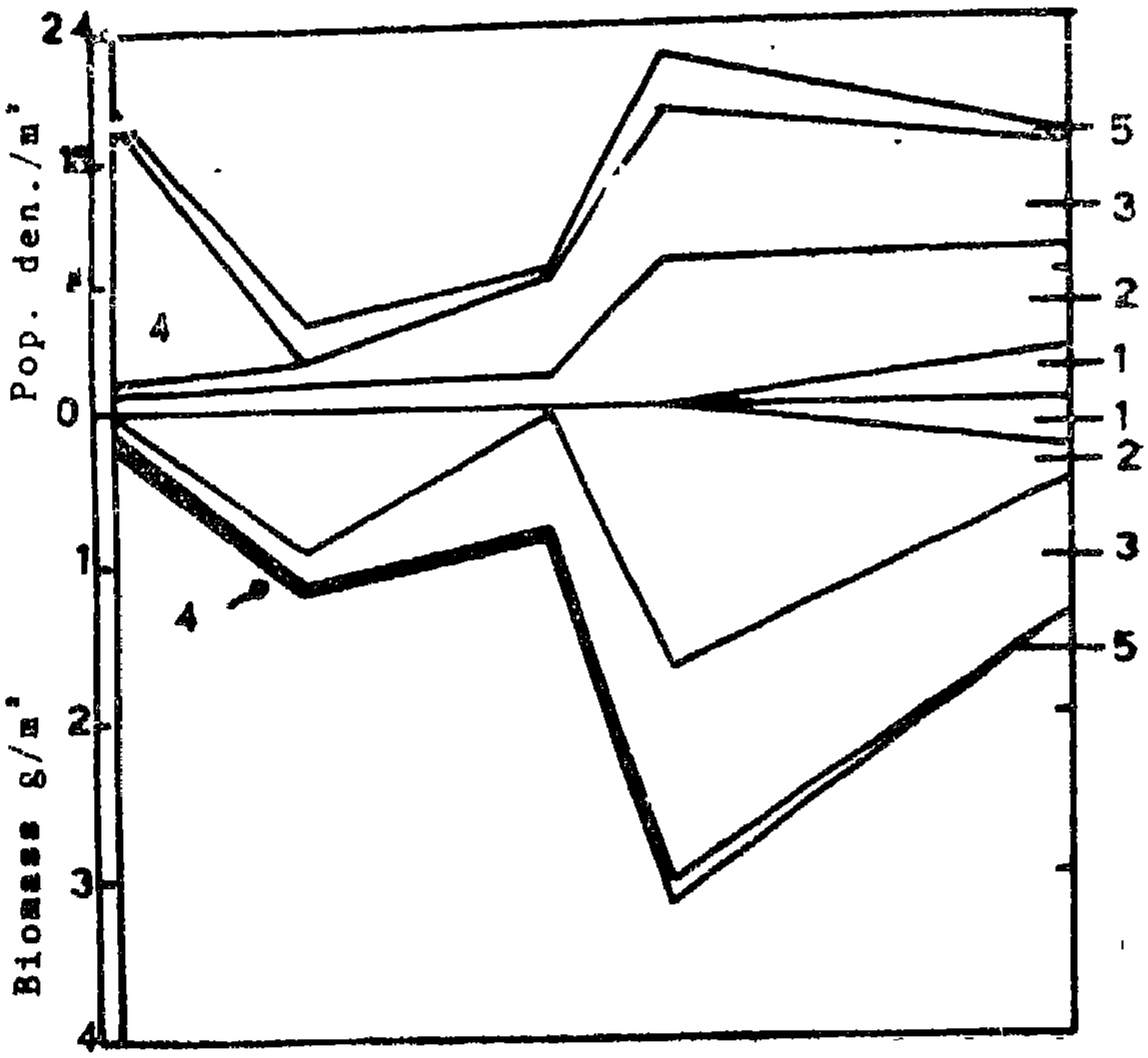
	HA		RH farm	
	PD/m²	BM,mgm/m²	PD/m²	BM,mgm/m²
Detritivores	4.5	647.8	18.9	560.9
Grazers (pests)	8.2	662.7	5.4	235.4
Predators	1.6	35.8	1.9	9.6
(as %)	12.6	3.9	7.8	1.2

Thus predators are much more common, in relation to their ptey population, at the HA farm, which has however a lower average prey density, but a higher prey biomass, than at he RH farm. The BM of predators is also proportional to the BM of prey.

III. — DISCUSSION

As was previously shown for two fig farms (GHABBOUR and SHAKIR 1982 b), the overall seasonal occurrence of taxa is not the same in the two olive farms. Although both are on the same soil formation, are under the same tree crop (old enough to reach stability), with minimal agricultural practices, yet there are subtle differences between the two farms which greatly affect the soil mesofauna. In general, the hardened soil allows for the establishment of large populations of truly fossorial species such as: cicadas, ants, wild bees, tenebrionids, but other differences, such as tree density, tillage, grazing by sheep and goats, among other things, determine secondary differences in community struture and species composition. Sand-swinmming species such as sand roaches did not appear here. Where a dense litter layer is formed by a rich ground weedy cover, isopods, lepidopterous larvae, and gryllids, are present. Differencees in PD and BM of taxa are shown in Fig. 9 on a log scale, where both qualitative and quantitative differences can be easily observed. In the densely spaced HA farm (450-470 trees/ha), ticks and earthworms could appear in response to the specially favourable micro-climatic conditions, less exposed to direct sunlight effects. The HA farm has a higher proportion of phytophages, due to the abundance of cicadas. The present study confirms the results of the study on fig farms, viz., that extensive seasonal sampling reveals taxa unexpected from single season sampling. Pyrrhocoridae, for example, appeared abundantly in both farms, but only in summer.

Olive, Haj Ali, Burg El-Arab



1- Earthworms, 2- Other detritivores,
3- Cicadas, 4- Pests, 5- Predators

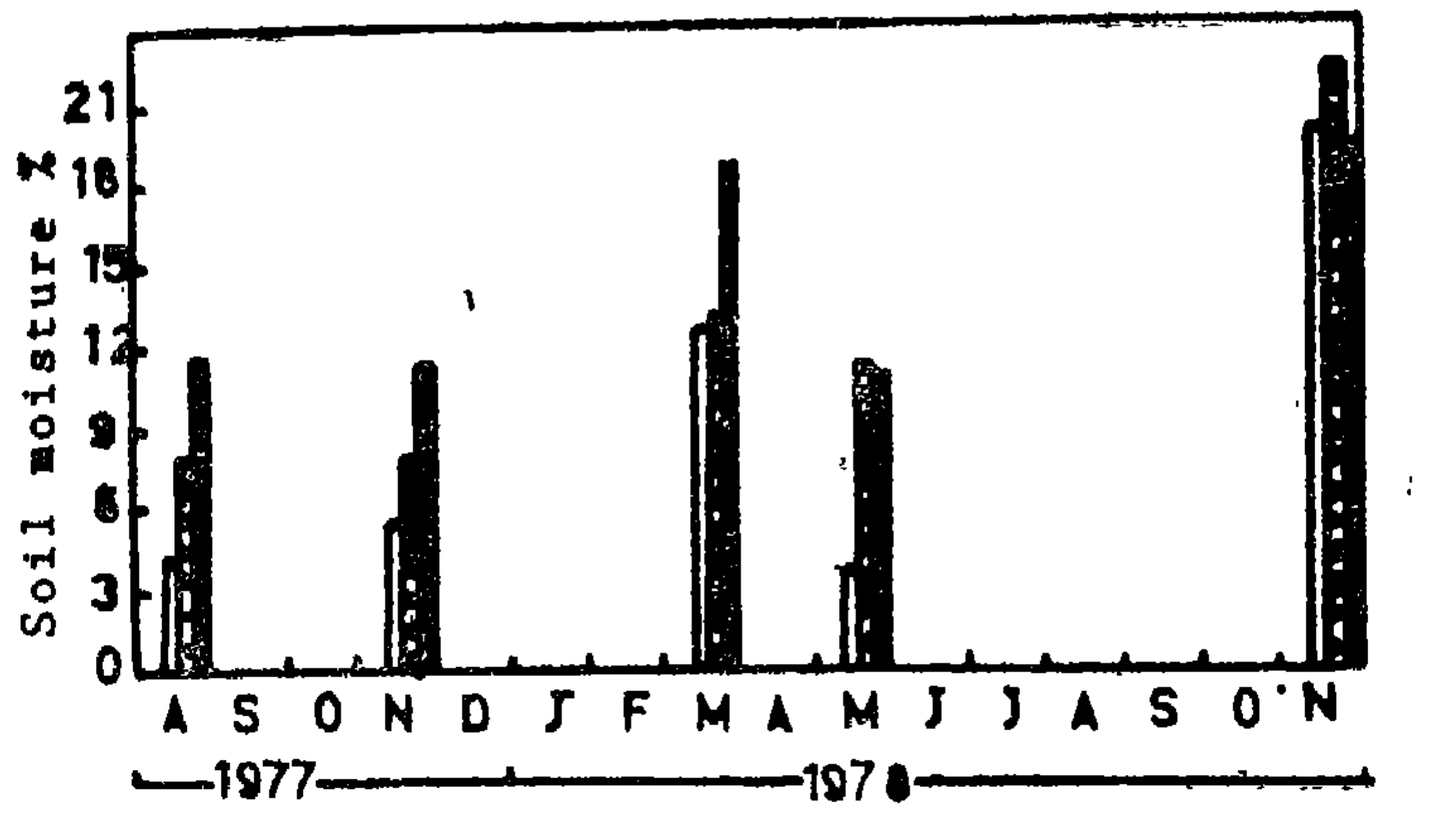
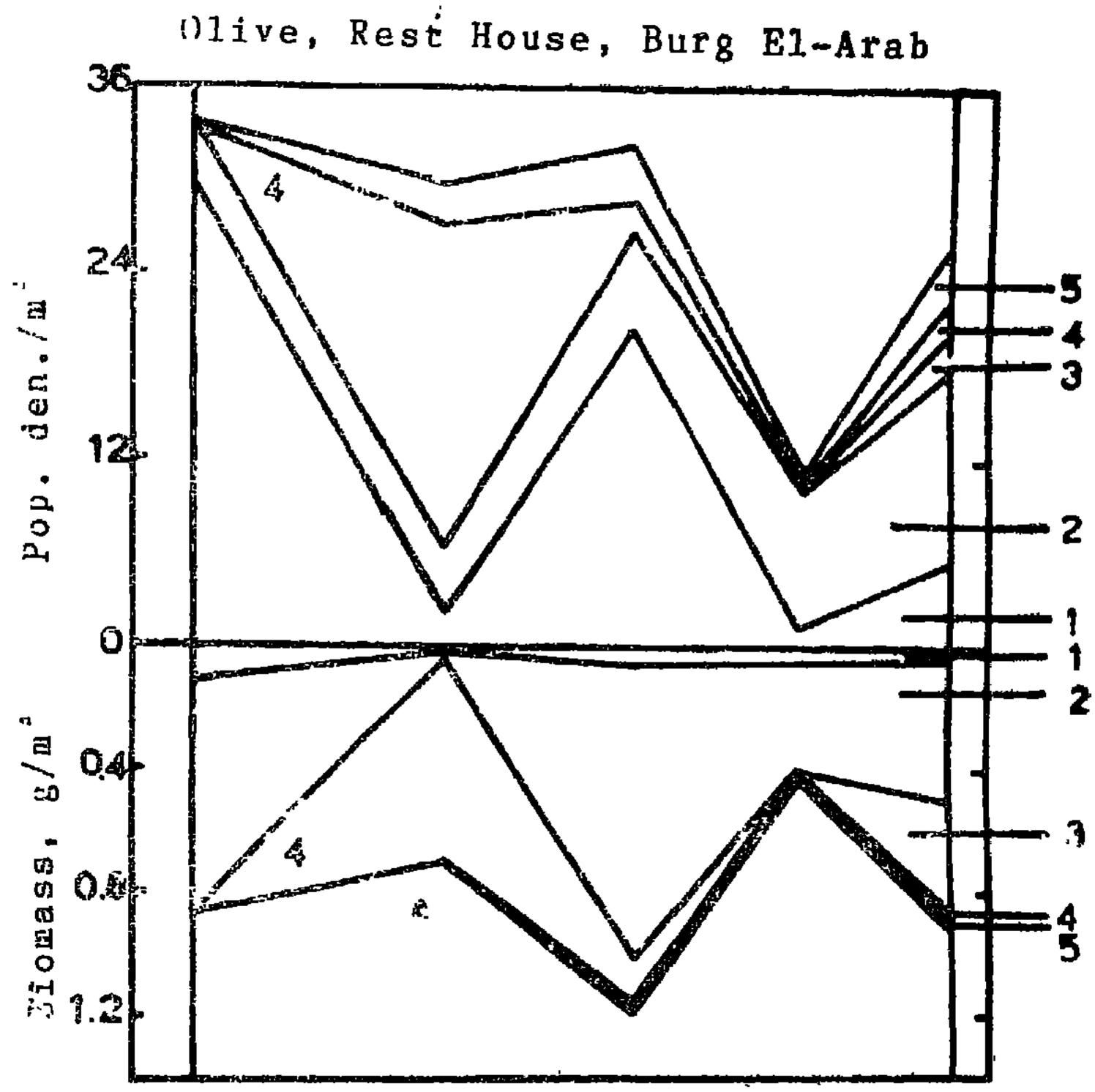


Fig. 1. Seasonal variation in density and biomass of ditritivores, grazers (phytophages) and predators, among the mesofauna sampled in the Haj Ali farm. Earthworms and cicadas are shown separately. Soil moisture content as % at 3 depths during the sampling period are also shown.



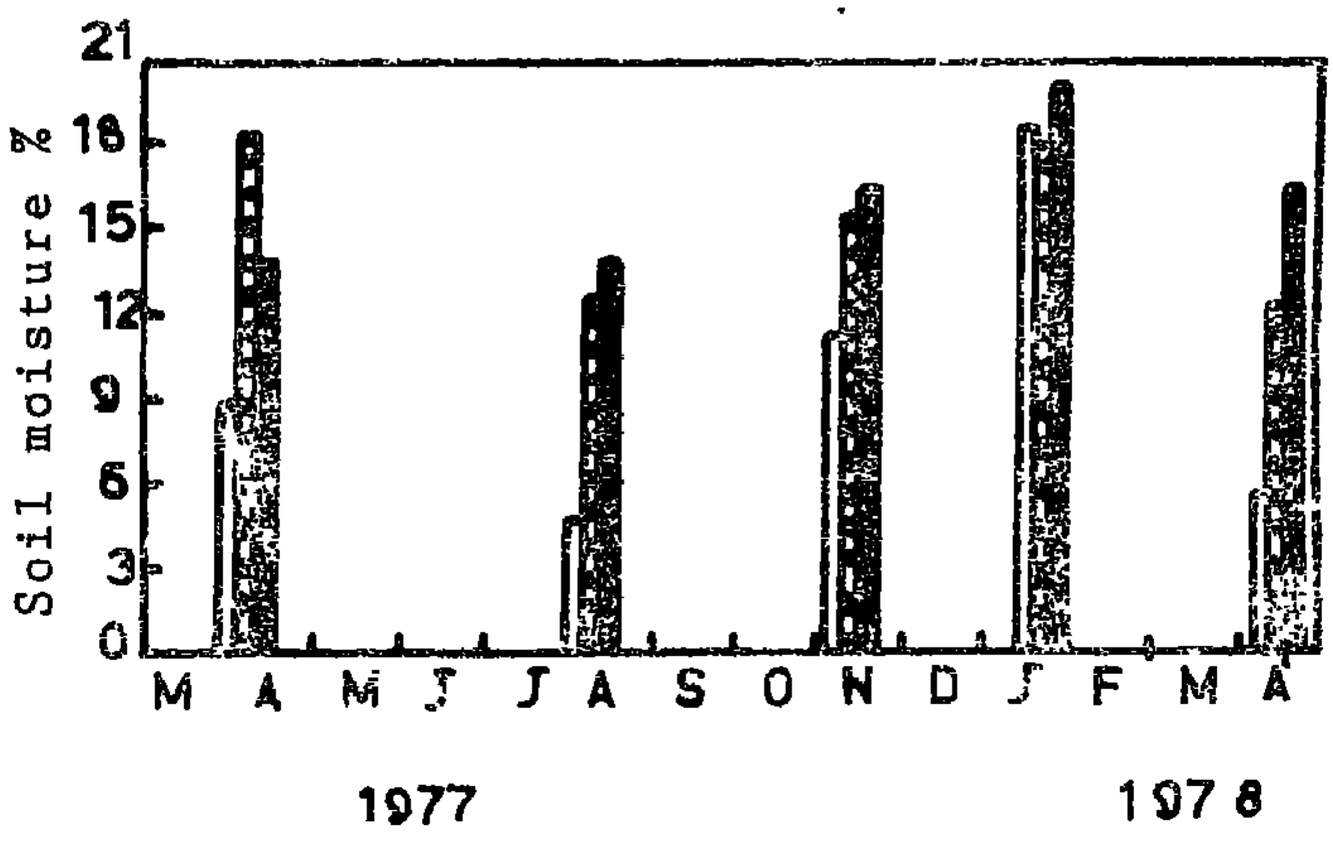


Fig. 2. Same as in Fig. 1, for the Rest House olive farm at Burg El-Arab. Isopoda and cicadas are shown separately.

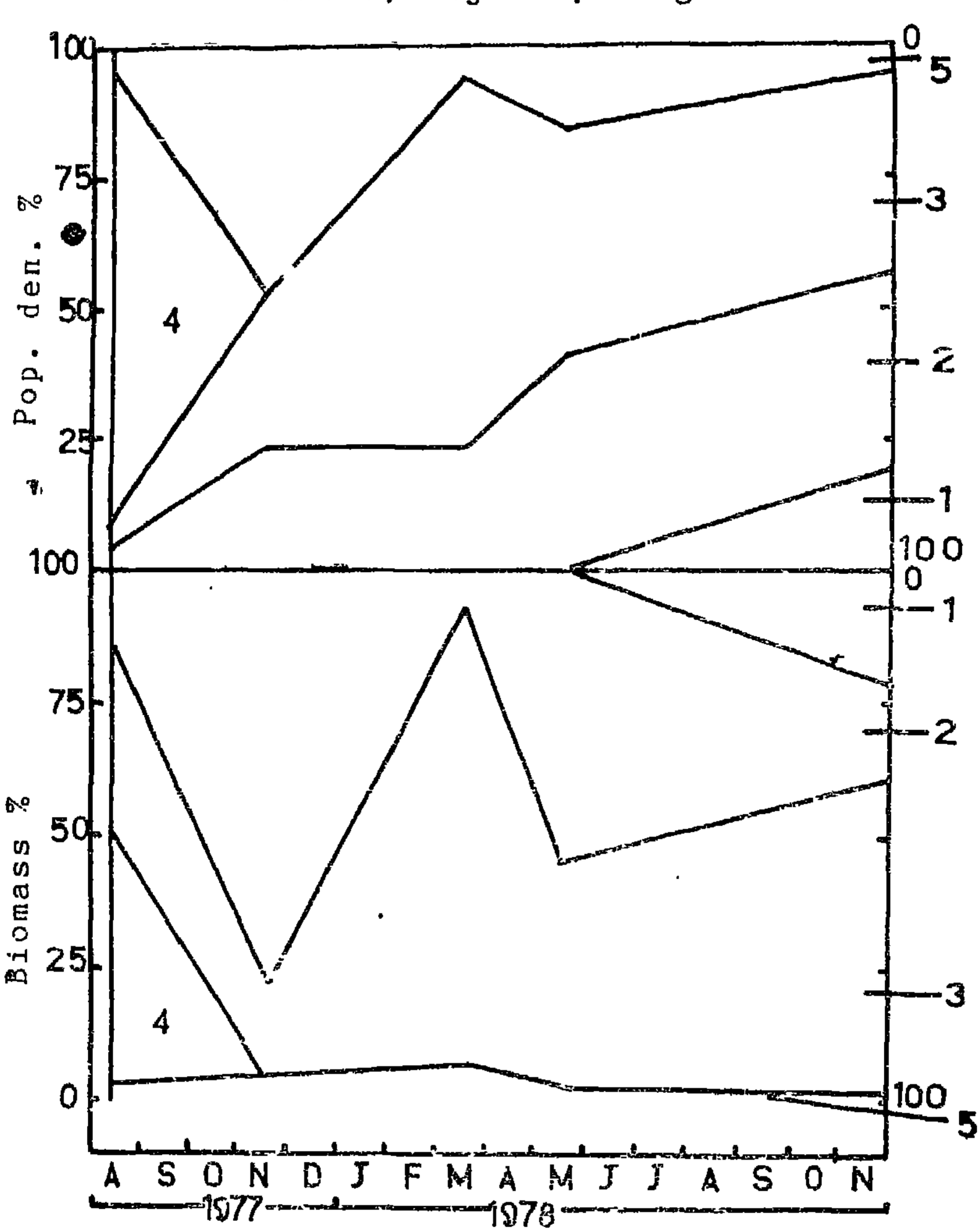


Fig. 3. Seasonal variation of faunistic groups shown in Fig. 1, expressed as %.

Olive, Rest House, Burg El-Arab

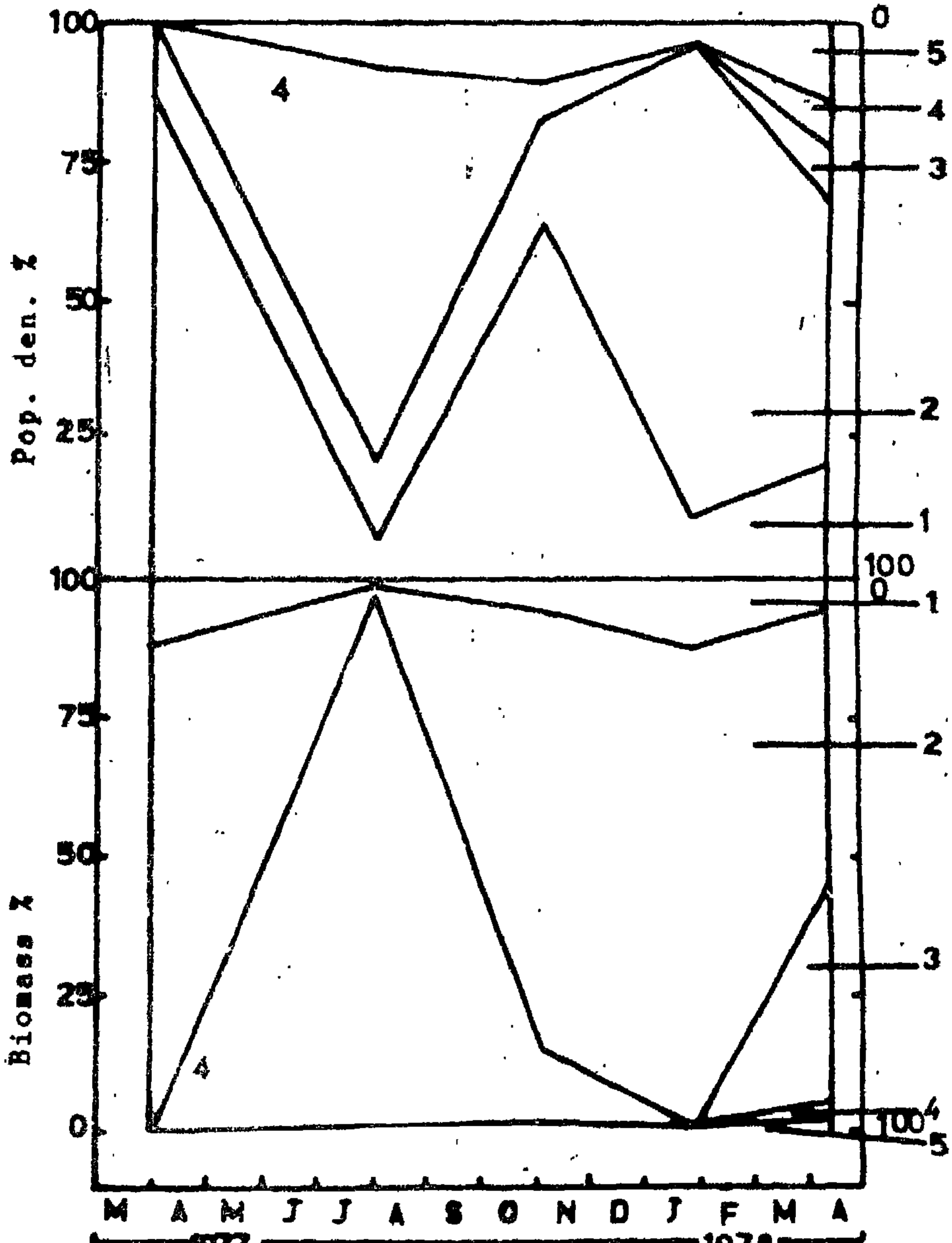


Fig. 4. Seasonal variation of faunistic groups shown in Fig. 2, expressed as %.

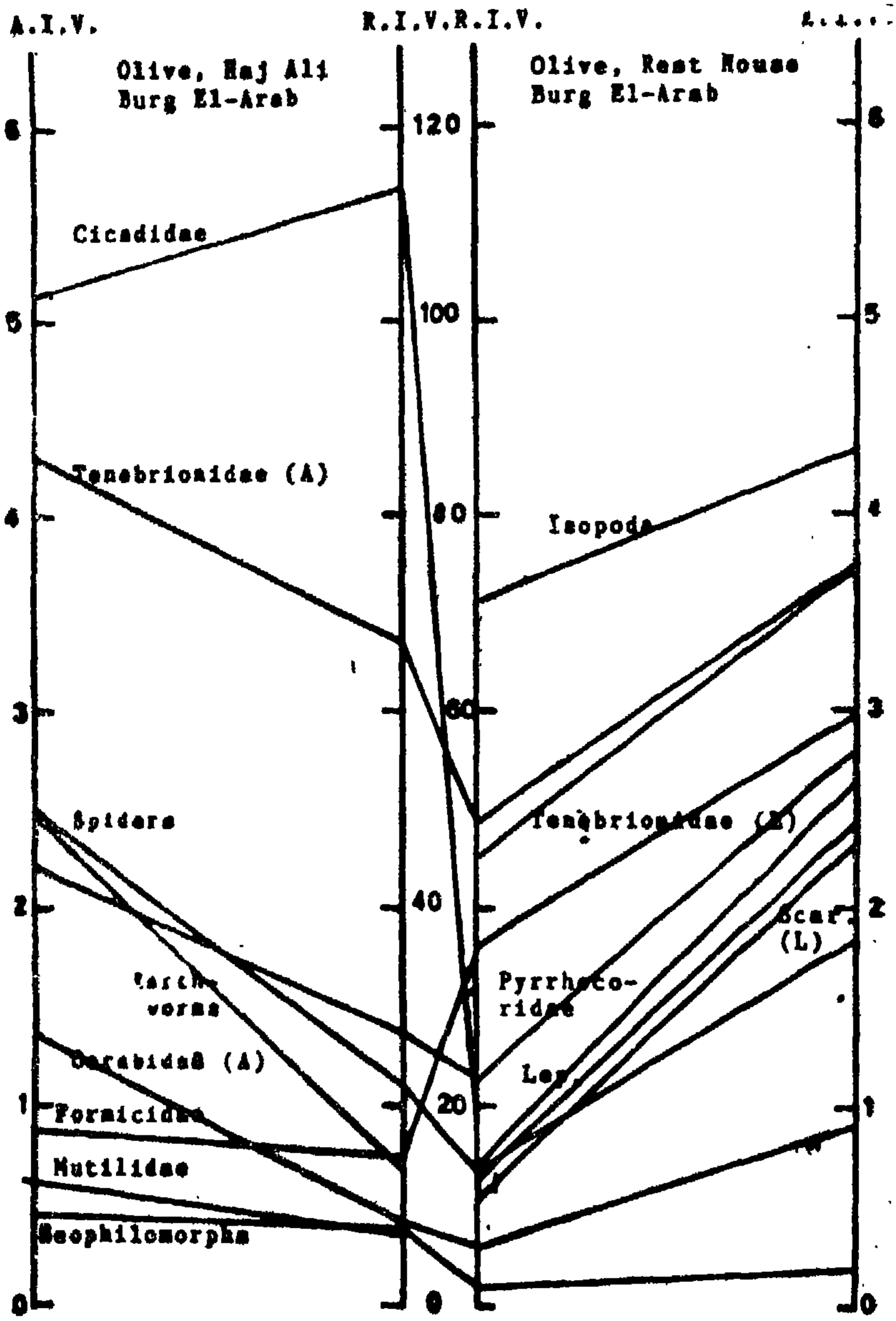


Fig. 5. Position of taxa on the A.I.V. and R.I.V. scales, excluding those with A.I.V. less than 0, at the dry-farmed olive orchards of Haj Ali and Rest House.

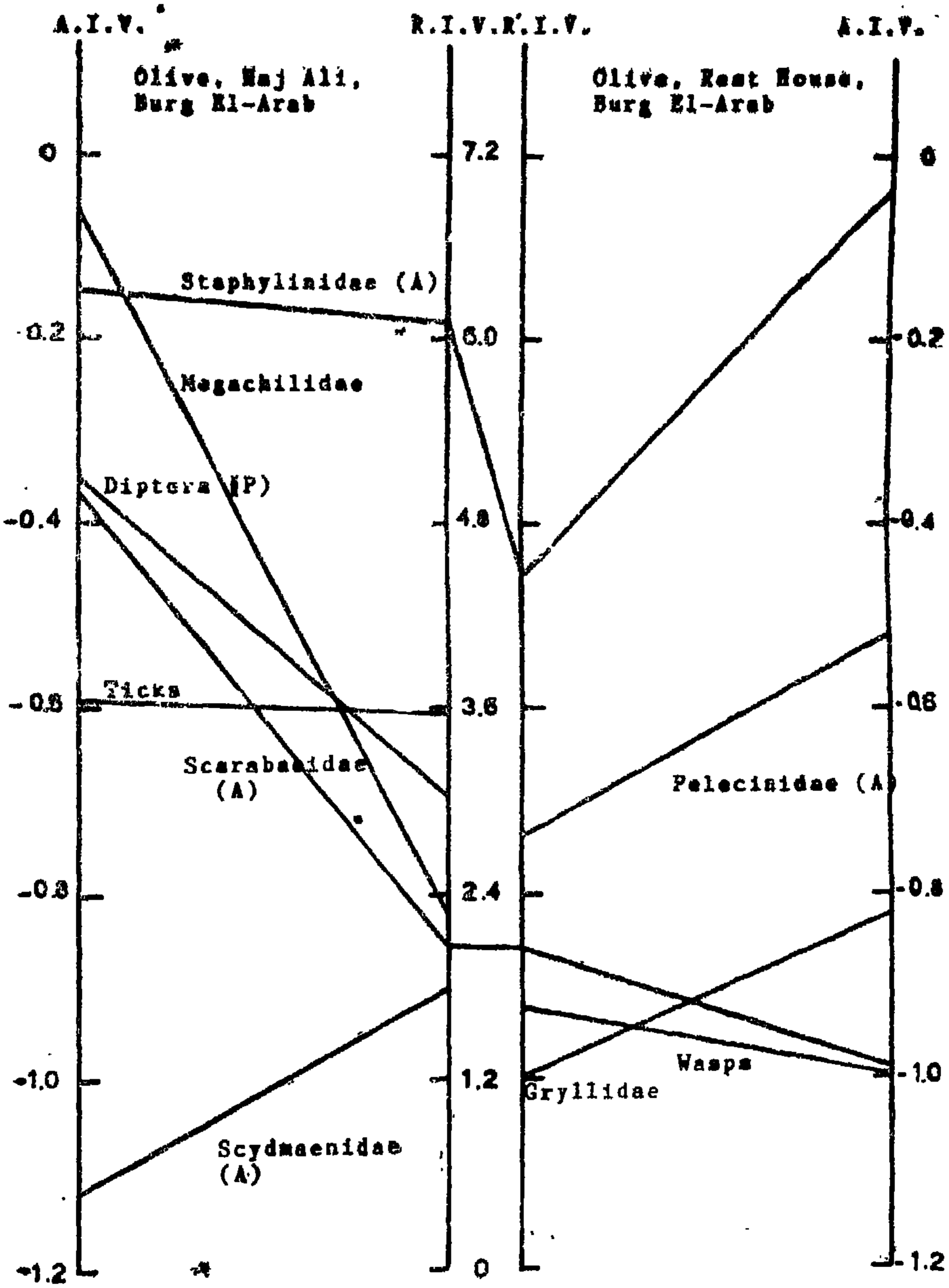


Fig. 6. Position of taxa with an A.I.V. less than O, on the A.I.V, and R.I.V. scales, for the two olive orchards.

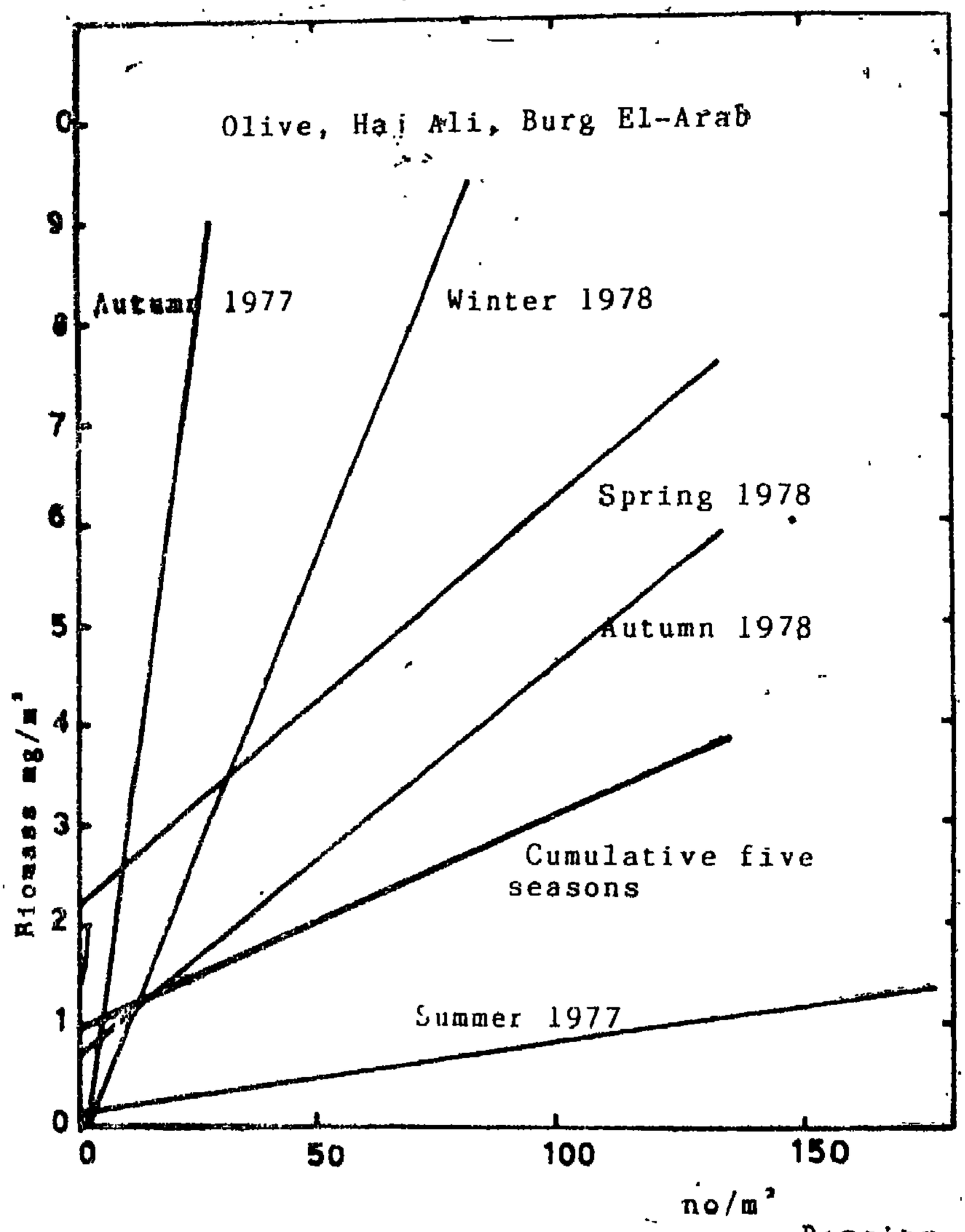


Fig. 7. Regression lines for population density and biomass of soil mesofauna in different seasons, Haj Ali farm.

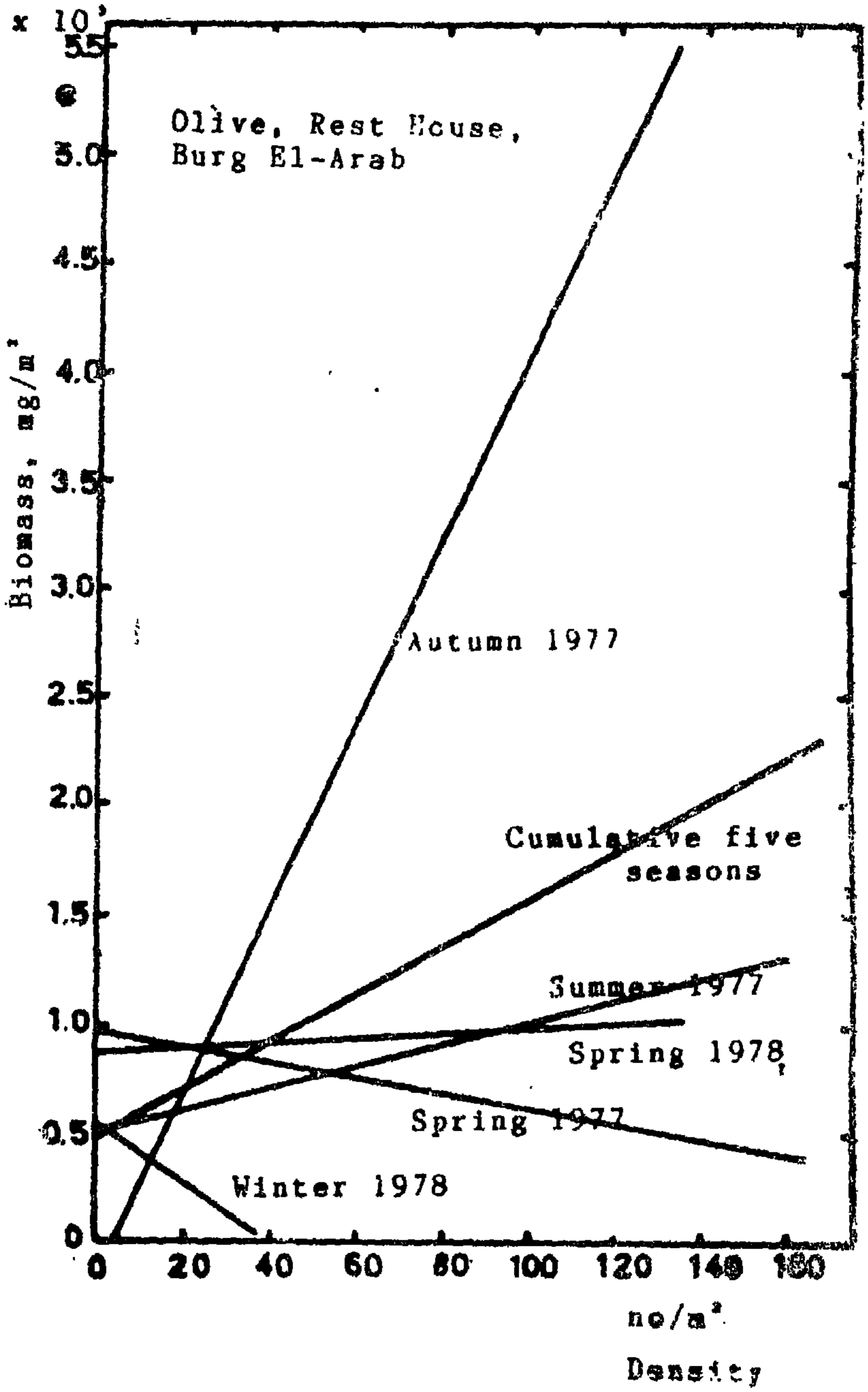


Fig. 8. Same as in Fig. 7, for the Rest House orchard.

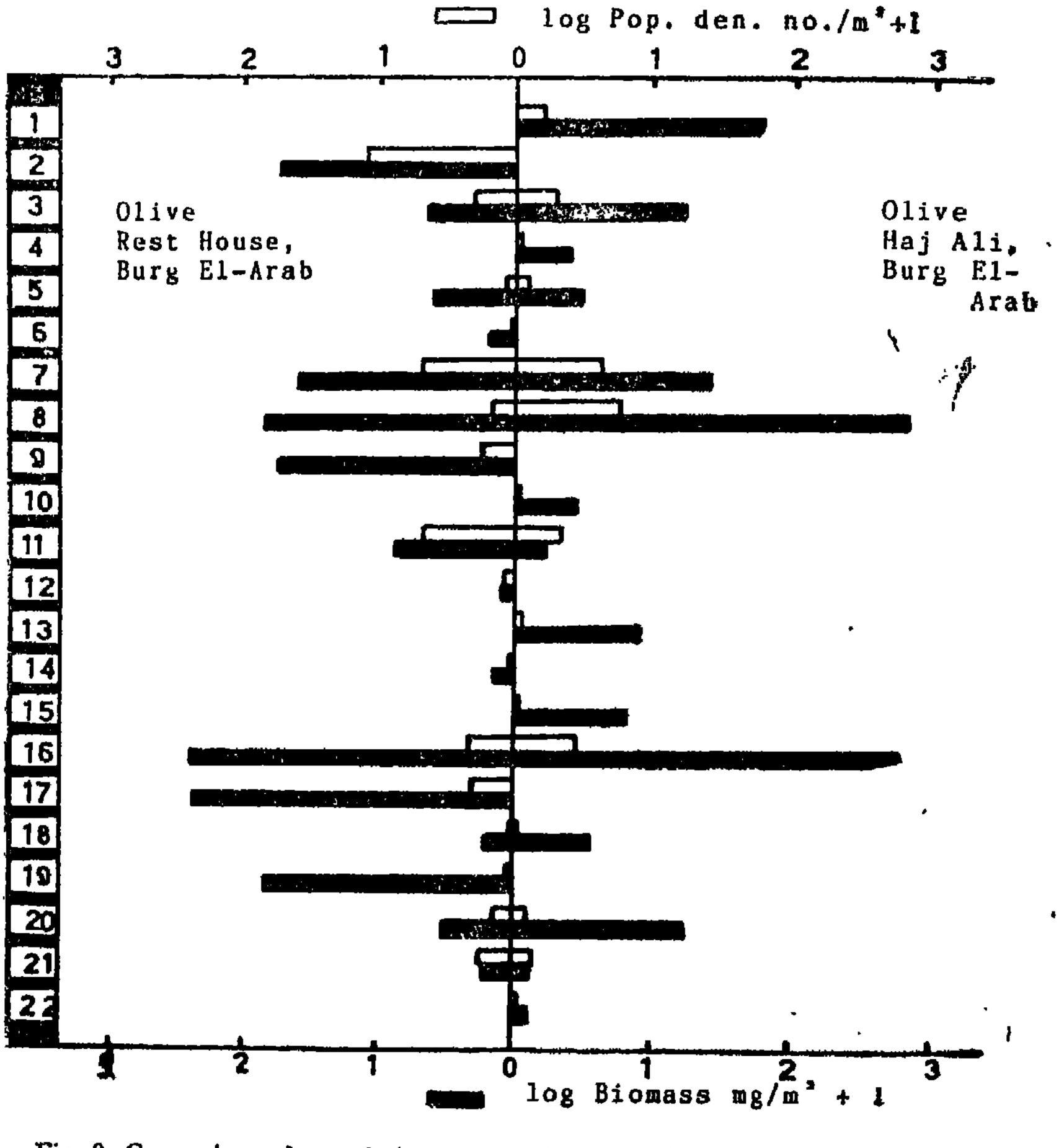


Fig. 9. Comparison of population density (open bars) and biomass (closed bars) of the 22 taxa appearing in the Haj Ali and Rest House olive orchards, on the log scale. Arrangement of taxa is in the order as in Tab. VII

The use of SORENSEN's andGLEASON's similarity coefficients between seasons (Tab. VI), based on A.I.V., shows that summer season is least similar to other season in both farms. The highest similarity is observed between spring and autumn seasons in both farms. This phenomenon repeats what was observed in the fig farms. The overall similarity between the two farms is 57%, which is much less than the similarity between the two fig farms of the previous study (GHABBOUR and SHAKIR1982 b). Application of the Index of Species Abundance (I.S.A.), as proposed by ROBERTS and HSI (1979), gives the order shown in Tab. VII. It is to be noted that the smaller figures on the I.S.A. scale denote greater abundance. The diversity indiees based on R.I.V. are 0.78 (SIMPSON) and 0.71 (SHANNON-WIENER), and based on A.I.V. they are 0.81 (SIMPSON) and 0.81 (SHANNON-WIENER), for the HA farm. For the RH farm these values are:0.76, 0.76, 0.83, and 0.85 respectively.

Since a difference in tree density from 450-470/ha in the HA farm to 270-290/ha in the RH farm has resulted in a drastic change in the soil mesofaune, notably a significant reduction of cicadas and a tendency towards more xeric conditions, it would be logical to expect that the soil mesofauna of newly established orchards will be more similar to the fauna of the RH farm rather than the HA farm. This is because the tree density recommended by GARAD (1980) is 280-290/ha, as in the RH farm. If the new orchards are to be tilled regularly and effectively and grazing animals will not be allowed in, as is usually the case, taxa associated with weeds (Isopoda, ants Lepidoptera larvae), and taxa associated with animal egesta, will not be significantly present. The weed flora of olive orchards in the coast is known to be especially impoverished due to careful cutting and ploughing (IMAM 1979). However, certain taxa, like Pyrrhocoridae, might still be expected to make their appearance. Such taxa may well be ubiquitous in the area.

IV. — CONCLUSIONS

In the previous study on fig farms, it was found that differences in soil structure, the number of manure applications, and gains from run-on rain-water, may account for the observed diffeences in faunistic composition and population variables. In the present study on rain-fed olive farms, differences of slope, tree density, ground cover, and introduction of grazing animals, are the chief causes that can be suggested to account for differences in the populations of soil mesofauna. While some taxa are characteristically common to both farms which were chosen for this investigation, e.g., cicadas, some others are associated with the higher inputs of organic matter in the older and neglected Rest House farm. This organic matter input comes from two sources : the litter of a dense weedy cover, attracting isopods and Lepidopteera, and sceds attracting, ants, or from egesta of domestic animals, attracting tensbrionids and scarabaeids. The high similarity between spring and autumn seasons, shown in dry-farmed figs as well as olives, indicates that these two transitional seasons provide the opportunity for several taxa to flourish simultaneously, taking advantage of the more clement climatic conditions, relief from excessive heat as they emerge from summer, or from excessive cold as they emeerge from winter.

ACKNOWLEDGEMENTS

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SUMMARY

A survey of soil mesofauna in two rain-fed olive orchards in the Mariut Region, in the vicinity of Burg El-Arab town, 48 km west of Alexandria, was carried out in 1977-1978. The two farms are situated in a depression of calcareous loamy soil. One is about 30 years old, the Haj Ali (HA) with 450-470 trees/ha, and the other, Rest House (RH) is more than 45 years old with 270-290 trees/ha. Population density in the HA farm varied from 5.2 to 22.0/m², with an annual average of 14.3/m², and varied in the RH farm from 10.4 to 33.5/m², with an annual average of 26.3/m². Biomass of alcohol preserved specimens varried at the HA farm 274.0 to 3097.8 mgm/m², with an annual average of 1346.3mgm/m², and varied in the RH farm from 398.0 to 1204.3 mgm/m², with an annual average of 805.9 mgm/m². The dominant taxon in the HA farm was Cicadidae, followed by Tenebrionidae, earthworms and spiders. At the RH farm, the dominant taxon was Tenebrionidae, followed by Isopoda, ants and Pyrrhocoridae. Predators were more abundant at the HA farm, although their prey population was at a lower density (but higher biomass) than at the RH farm. In this particular pair of dry-farmed olive, differences of slope, tree density, ground cover, and introduction of grazing animals, are suggetsed to account for differences in community structure of mesofauna populations.

Résumé

Sur quelques paramètres définissant les populations de la mésofaune du sol dans agrosystèmes de la région de Mariut, Egypte. III. — Dans deux plantations non irriguées d'oliviers.

Un échantillonnage de la mésofaune du sol de deux plantations à sec d'oliviers, dans la dépression au sud de la troisième crête, près du village de Burg El-Arab, à 48 km à l'ouest d'Alexandrie, a été, effectué durant la période 1977-1978. La densité annuelle de la population dans une d'elles (dite Haj Ali) passait de 5,2 à 220/m², avec un moyenne annuelle de 14,3/m², tandis que la biomasse (des individus préservés en alcool) passait de 274,0 à 3 097,8 mgm/m², avec une moyenne annuelle de 1 346,3 mgm/m². Pour l'autre plantation (dite Rest House), les valeurs correspondantes sont : 10,4 - 33,5 - 26,3 pour la densité, et 398,0 - 1 204,3 - 805,9 pour la biomasse. Le taxon dominant dans HA était les cicadides, suivi par les ténébrionidés, les vers de terre, et les araignées. Le taxon dominant dans RH était les ténébrionidés, suivi par les cloportes, les fourmis, et les pyrrhocoridés (hémiptères). Les prédateus représentent une plus importante densité et biomasse dans HA, malgrès que leurs proies ont une basse densité, mais une biomasse assez importante.

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* This paper is dedicated to Prof. M. Kassas, eminent Egyptian ecologist and teacher of generations of Egyptian ecologists, in honour of his seventieth birthday.