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WEED COMMUNITIES OF DATE PALM IN EASTERN ARABIA

By

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مجتمعات الأعشاب الضارة في مزارع النخيل بشرق الجزيرة العربية

كمال حسين شلتوت و السيد فؤاد الحلواني

تهتم هذه الدراسة بتعريف ووصف مجتمعات الأعشاب الضارة في زراعات النخيل بواحة الاحساء بشرق الجزيرة العربية . تم تعريف ٣٣ مجتمع نباتي قسمت حسب طرز حياة نباتاتها السائدة ، إلى المجموعات الخمس التالية : الحشائشية الحولية ، العشبية الحولية ، الحشائشية المعمرة ، العشبية المعمرة ، ومجتمعات الشجيرات . تنمو المجتمعات الحولية تحت ظروف زراعية بالمزارع المخدومة ، بينما تنمو المجتمعات المعمرة ، وخاصة مجتمعات الشجيرات ،تحت ظروف تقشفية بالمزارع المهملة . أوضحت الدراسة أيضاً أن مجتمعات المزارع المخدومة تتميز بوفرة نوعية عالية وبعائد نوعي منخفض ، إذا ما قورنت بمجتمعات المزارع المهملة ، وقد نوقشت هذه النتيجة على ضوء نظرية الوسط .

Key Words: Diversity, Ordination, Phytosociology, Succession, Weed.

ABSTRACT

The present study deals with the recognition and description of the weed communities of date palm plantations in Al-Hassa Oasis, Eastern Arabia. Thirty three communities are recognized. They are classified, after the life forms of their leading dominant species, into the following five groups: annual grassy, annual herbaceous, perennial grassy, perennial herbaceous and shrubby communities. The annual communities thrive under segetal conditions (the cultivated farms), while the perennial ones, particularly the shrubby communities, thrive under ruderal conditions (neglected farms). The communities of cultivated farms are characterized by higher species richness and lower species turnover, as compared with those of neglected farms. This finding is discussed in relation to the theory of substrate heterogeneity.

INTRODUCTION

Palms are one of the economically most important groups of tropical plants, a major source of food and raw material that remains under-exploited; they certainly increase the chances of survival for people in tropical developing countries (Tomlinson, 1979). The gap between need and effort in the study of this important group of plants is still very evident.

Weeds represent a highly successful and biologically important component of the environment (e.g. arabale lands, range lands, forests, and aquatic bodies). This success of weeds is especially remarkable in view of the efforts directed towards their destruction. This very success warrants greater attention in order to understand the nature of weeds and to analyse interactions between crops, weeds and environment (Radosevich and Holt, 1984), and how to reduce their effects on our crops. The losses caused by weeds to agriculture are more than losses caused by all the pests put together (Sen, *et al,* 1984).

The present study aims at characterising and analyzing the weed communities of date palm plantations in Al-Hassa Oasis, the major date palm producer in Saudi Arabia (Khafaji, *et al,* 1986), with about 2 million date palms (Kadous, *et al,* 1983). This study aims to increase understanding of nature of the interactions between the date palms and weeds, and to evaluate the severity of weeds in this important crop.

Al-Hassa Oasis is situated in the Eastern Province of Saudi Arabia, about 60 km inland from the coast of the Arabian Gulf. This Oasis is L-shaped and slightly sloped to the north (about 30 km) and east (about 20 km) with the town of Al-Hofuf, 150 m above sea level (Fig. 1). East of the Oasis is the flat Al-Jafurah desert floor, sloping with a very small gradient towards the coastal plain of the Arabian Gulf. To the west, the escarpment of the Assumman plateau rises to about 270 m above sea level (Elprince, 1979). Geologically, Al-Hassa Oasis lies in the Eastern Sedimentary Basin that covering about 73% of Saudi Arabia. This basin includes the most important water forma-

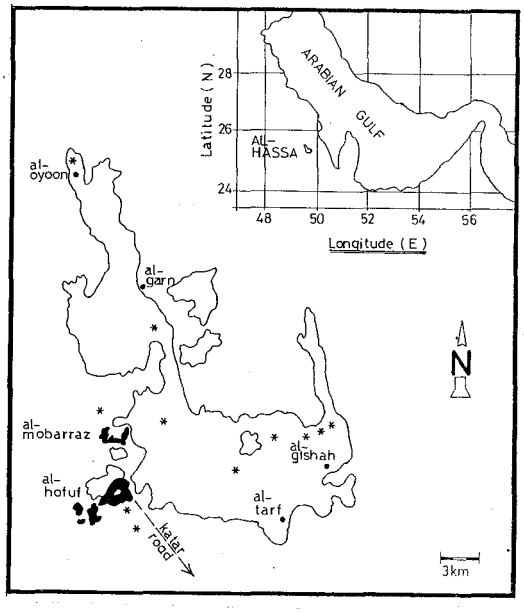

Fig. 1: Location map of the sample sites (*) in Al-Hassa Oasis.

tions, starting with the Cambrian and including all the geological sequences ending in recent deposits with an average thickness of over 5000 m (Abd El-Rahman, 1986). Thus this Oasis is one of the largest irrigated areas in Saudi Arabia. Its cultivated areas (about 8000 ha, of which 5800 ha are cultivated with date palms) are supplied with well developed irrigation and drainage systems (Kadous *et al,* 1983). The climatic conditions of this Oasis are presented in (Table 1).

Table 1

Long term averages (1969-1979) of some metereological data of two stations in Eastern Saudi Arabia (after Kadous *et al,* 1983)

Station	Mean								
	Annual temp. (°C)		Summer temp. (°C)		Winter temp. (°C)		Annual R.H. %		Annual rainfall (mm/yr.)
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
Al-Hassa	33	20	44	28	20	11	60	20	109
Al-Qatif	31	21	43	29	21	11	96	51	76

METHODS

Seventy-nine stands were sampled in the date palm plantations in Al-Hassa Oasis so as to represent different situations of palm plantations, as well as their geographical distribution in this Oasis. Thus stands were sampled in 11 locations and on more than 36 farms (Fig. 1). Sampling was started in January 1990 and ended in March 1990. The following situations were taken into consideration:

1. The conditions of farm maintenance. We classified the farms into cultivated farms (i.e. well maintained farms) and neglected farms.
2. The density of palm plantations. Two density levels were subjectively recognized: low (spaced palms) and high (dense palms, where light penetration becomes strongly limiting).
3. The height of palms. The palms were visually classified into 3 classes according to their average height: small (< 4m), medium (4-8m), and large (> 8m).

In selecting each stand, a reasonable degree of habitat uniformity and weed cover homogeneity were ensured. The following records were made: list of the present species and their life forms, the first and second dominant species, and a visual estimate of the total weed cover (%). Samples from the recorded species were collected and prepared as herbarium specimens for checking their identification. The following references were consulted: Tackholm, (1974), Migahid, (1978), Collenette, (1985), Chaudhary and Akram, (1987), and Chaudhary, (1989). The specimens have been kept in Biology Department, King Faisal University, Al-Hassa, Saudi Arabia.

The percentage presence of the species in the stands representing each kind of date palm plantation was calculated, and the similarity index between each pair of stands was calculated according to the coefficient of (Sorensen, 1948). The similarity matrix was used to ordinate the stands according to the Wisconsin polar odination (Bray and Curtis, 1957). Species richness (alpha-diversity) for each stand was calculated as the average number of species per stand, and species turnover (beta-diversity) was calculated as the ratio between the total number of species recorded in each stand and its species richness (Pielou, 1975). The weed communities were determined according to the tabular comparison method (Muller-Dombois and Ellenberg, 1974) and named after the dominant species.

RESULTS AND DISCUSSION

The weed composition (96 species) of the recognized stands of date palm plantations in Al-Hassa Oasis indicates that 6 species attain high presence (> 50%). Five of them occur on both the cultivated and neglected farms, while the sixth (*Euphorbia densa)* occurs on the cultivated farms only (Table 2). On the other hand, 25 species are very rare (< 1%) and are restricted to one stand only. The total number of species recorded in the cultivated high density farms (49) is larger than that recorded on the cultivated low-density farms (39). The same is true regarding the total cover (65 and 57%, respectively). But taking into account the average number of species per stand (alpha diversity), this difference becomes negligible. Comparing cultivated and neglected farms, it is clear that the former has lower values of the total number of species and species turnover, but higher values of species richness and total cover. This can be interpreted in the following way. The neglected farms could be considered as transitional (ecotonic) zones between the arable (cultivated farms) and natural habitats, and hence they include, in addition to the arable weeds, some other species from ruderal and natural habitats. On the other hand, the higher species richness that characterizes the cultivated farms, indicates the higher diversity of the weed communities on these farms (see Pielou, 1969, 1975). Moreover, the lower species turnover of these communities shows that species replacement or biotic

Table 2

Weed composition (presence percentage) of the different situations of date palm plantations. The farms are classified into 3 classes, according to the average height of their palm trees, as follows: S-small (< 4m), M-medium (4-8m, L-large (> 8m), T-total.

Species	Cultivated Farms								T	Neglected Farms				Total Veg.
	High density				Low density					Low density				
	S	M	L	T	S	M	L	T		S	M	L	T	
Sampled stands	4	14	21	39	7	4	6	17	56	17	2	4	23	79
Total Cover (%)	70	56	70	65	46	60	68	57	63	47	82	71	54	56
Total species	21	38	32	49	26	21	25	39	60	62	15	9	68	96
Species richness	11	10.9	10.9	10.9	10.7	9.3	11.2	10.5	10.8	10.2	12	3.3	9.2	10.3
Species turnover	2.0	3.5	3.0	4.5	2.4	2.3	2.3	3.5	5.5	6.3	1.3	3.0	7.7	9.7
Constant species (presence > 50%)														
Sonchus oleraceus	100	79	100	95	100	100	100	100	96	53	100	—	48	84
Cynodon dactylon	100	79	95	90	100	50	83	82	87	59	100	25	48	76
Convolvulus arvensis	75	93	80	85	71	50	83	71	80	53	100	—	39	68
Melilotus indica	100	79	57	56	86	25	33	53	64	53	100	—	39	57
Phragmites australis	75	57	43	51	29	25	33	29	45	82	50	25	78	54
Euphrobia densa	25	79	100	87	—	75	67	41	71	—	—	—	—	52
Intermediate species (presence > 10-50%)														
Reichardia tingitana	—	57	80	62	43	50	67	53	59	29	—	—	22	49
Setaria verticillata	25	36	71	56	43	75	83	28	57	6	100	—	13	44
Phoenix dactylifera	25	50	48	46	29	50	17	29	41	29	100	—	30	38
Dactyloctenium aegyptium	25	21	43	33	43	50	50	47	37	41	—	—	30	35
Chenopodium murale	50	29	48	41	43	50	67	53	45	6	50	—	9	34
Angallis arvensis	—	21	67	41	14	—	50	24	37	6	100	—	13	30
Malva parviflora	100	29	19	31	71	25	50	63	38	6	—	—	4	28
Imperata cylindrica	—	21	43	28	—	25	17	12	25	24	—	50	26	25
Launaea nudicaulis	50	29	5	18	71	25	—	35	23	35	—	—	26	24
Setaria viridis	50	29	14	23	71	—	—	39	25	18	—	—	13	22
Chenopodium glaucum	—	7	—	3	43	25	50	41	14	12	100	—	17	15
Stellaria media	—	29	5	13	—	75	50	15	20	—	—	—	—	14
Plantago lanceolata	—	21	33	26	—	—	—	—	18	—	—	—	—	13
Portulaca oleracea	25	21	—	10	29	—	33	24	14	6	50	—	9	13
Rare species (presence < 1-10%)														
Flaveria trinervia	25	7	14	13	—	—	33	12	13	—	50	—	4	10
Amaranthus graecizans	75	—	—	8	29	—	—	12	9	12	—	—	9	9
Bassica eriophora	—	—	—	—	—	—	17	6	2	35	—	—	26	9
Cyperus conglomeratus	25	7	5	8	14	—	50	24	13	—	—	—	—	9
Picris sulphurea	—	29	5	13	—	25	—	6	9	12	—	—	9	9
Polypogon monospeliensis	25	29	5	15	—	—	—	—	11	—	—	—	—	8
Suaeda monoica	—	—	—	—	—	—	—	—	—	24	—	50	26	8
Anethum graveolens	—	7	10	8	—	50	—	12	9	—	—	—	—	6
Conyza linifolia	—	—	5	3	—	25	17	12	5	12	—	—	9	6
Cressa cretica	25	—	—	3	14	—	—	6	4	12	—	25	13	6
Ricinus communis	—	—	24	13	—	—	—	—	9	—	—	—	—	6
Suaeda volkensii	—	14	—	5	14	—	—	—	7	—	—	50	9	6
Zygophyllum coccineum	—	—	—	—	—	—	—	—	—	29	—	—	22	6
Aeluropus lagopoides	—	—	—	—	—	—	—	—	—	24	—	—	17	5
Brassica arabica	—	—	19	13	—	—	—	—	7	—	—	—	—	5
Conzya bovei	—	14	—	5	—	—	—	—	4	12	—	—	9	5
Echinochloa colonum	—	—	—	—	—	—	—	6	2	18	—	—	13	5
Hordeum leporinum	—	—	—	—	—	—	—	—	—	24	—	—	17	5
Launaea capitata	—	—	—	—	—	—	—	—	—	24	—	—	17	5
Rumex dentatus	—	—	19	13	—	—	—	—	4	—	—	—	—	5
Suaeda aegyptiaca	25	—	—	3	—	—	17	6	4	12	50	—	9	5

Table 2 Contd.

Species	Cultivated Farms								T	Neglected Farms				Total Veg.
	High density				Low density					Low density				
	S	M	L	T	S	M	L	T		S	M	L	T	
Beta vulgaris	—	—	—	—	29	25	—	18	5	—	—	—	—	4
Astragalus hauarensis	—	—	—	—	—	—	—	—	—	18	—	—	13	4
Cornulaca monocantha	—	—	—	—	—	—	—	—	—	18	—	—	13	4
Cuscuta campestris	—	—	—	—	29	—	—	12	4	6	—	—	4	4
Oligomeris linifolia	—	—	—	—	—	—	—	—	—	18	—	—	13	4
Plantago lagopus	—	—	10	15	—	—	—	—	4	6	—	—	4	4
Sporobolus spicatus	—	—	—	—	—	—	—	—	—	18	—	—	13	4
Spergularia marina	—	7	—	3	14	—	—	6	4	6	—	—	4	4
Ammi visnaga	—	14	—	5	—	—	—	—	4	—	—	—	—	3
Anabasis setifera	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Chenopodium sp.	50	—	—	5	—	—	—	—	4	—	—	—	—	3
Cistanche phelypaea	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Frankenia pulverulenta	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Heliotropium bacciferum	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Heliotropium digynum	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Juncus rigidus	—	—	—	—	—	—	—	—	—	—	—	50	9	3
lasiurus hirsutus	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Lolium rigidum	—	14	—	5	—	—	—	—	4	—	—	—	—	3
Lolium perenne	—	—	—	—	14	—	—	6	2	6	—	—	4	3
Panicum turgidum	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Pennisetum divisum	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Plantago ovata	—	—	—	—	—	—	—	—	—	6	50	—	9	3
Ranunculus muricatus	—	7	5	5	—	—	—	—	4	—	—	—	—	3
Salsola baryosma	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Samolus valerandi	—	14	—	5	—	—	—	—	4	—	—	—	—	3
Savigyna parviflora	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Stipagrostis ciliata	—	—	—	—	—	—	—	—	—	12	—	—	9	3
Suaeda vermiculata	—	7	5	5	—	—	—	—	4	—	—	—	—	3
Zizyphus spinachristi	—	7	—	3	—	—	—	—	2	6	—	—	4	3
Eleusine compressa	—	—	—	—	—	—	—	—	—	12	—	—	9	3

Very rare species (presence < 1%)

Aeluropus littoralis, Agrophyllum montasiri, Alhagi maurorum, Aizoon canariense, Aster squamatus, Astragalus tribuloides, Convolvulus pilosellaefolius, Corchorus olitorius, Cynanchum acutum, Eleusine indica, Heliotropium europaeum, Launaea mucronata, Lippia nodiflora, Lotus halophilus, Phalaris minor, Polygonum bellardii, Rumex vesicarius, Salsola imbricata, Salsola Volkensii, Salsola vermiculata, Schismus barbatus, Sonchus asper, Spergularia diandra, Tamarix nilotica and *Tamarix passerinoides.*

change is smaller than in the weed communities of the neglected farms (Whittaker, 1972, Wilson and Shmida, 1984). This may be related to the habitat heterogeneity of the neglected farms which have characteristics of both the arable and natural habitats.

The two-dimensional polar ordination (Bray and Curtis, 1957) indicates clear segregation between the cultivated and neglected farms, on the basis of the degree of similarity among their weed composition. On the other hand, the total species range of the neglected farms occupies an intermediate position between that of the cultivated farms and that of the whole vegetation (Fig. 2). This indicates that the weed flora, and consequently the weed community, is closely related to the degree of farm maintenance. Similar conclusions regarding the type of crops, were reached by (Streibig, 1979) in his study in Denmark, and Shaltout and

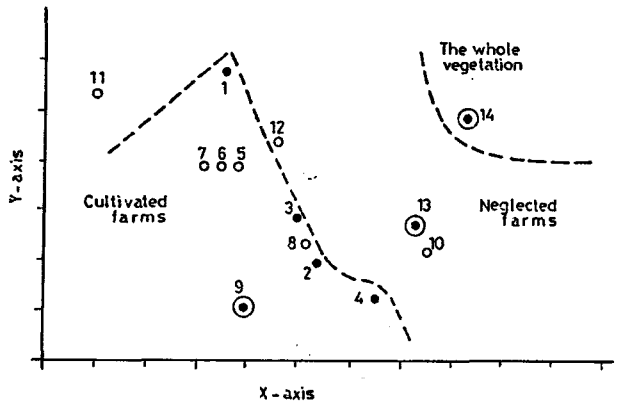

Fig. 2: Two dimensional polar ordination (Brays and Curtis, 1957) of the different date Palm stands based on their weed composition (●) High density, (○) Low density, (●) Total.

El-Fahar (in press) in their study in the Nile Delta region of Egypt.

The weed spectrum shows that the percentage of annual species is lower under cultivated, high-density plantations (63%) than in those of low density (74%). The reverse is true regarding

the perennial species (Table 3). On the other hand, the cultivated farms are characterized by a higher proportion of annuals (67%) and a lower proportion of perennials (31%) as compared with the neglected farms (50% and 47%, respectively). In general, the annual herbs made a larger contribution than do the annual grasses on the cultivated farms, and vice versa on the neglected farms. On the other hand, the woody life forms (shrublets, shrubs and trees) made a considerable contribution to the weed vegetation of the neglected farms (23%) as compared with that of the cultivated farms (13%). With regard to the vegetation as a whole, the percentage of annuals (54%) exceeds that of perennials (44%).

Table 3

Weed spectrum (%) of the different stands of date palm plantations. The farms are classified into 3 classes, according to the average height of their palm trees, as follows: S-small (< 4m), M-medium (4-8m), L-large (> 8m), T-total.

Species	Cultivated Farms								T	Neglected Farms				Total Veg.
	High density				Low density					Low density				
	S	M	L	T	S	M	L	T		S	M	L	T	
Annuals														
Grasses	19	16	16	12	15	10	12	15	15	11	7	—	10	10
Herbs	48	45	53	51	46	62	64	59	52	40	67	—	40	44
Total	67	61	69	63	61	72	76	74	67	51	74	—	50	54
Perennials														
Grasses	14	11	13	8	15	14	16	13	8	16	1	33	15	14
Herbs	14	13	9	12	12	9	4	8	10	10	1	11	9	9
Shrublets	—	5	3	4	—	—	—	—	3	3	—	23	6	6
Shrubs	—	8	3	11	4	—	—	—	9	15	—	33	16	14
Trees	5	2	3	2	4	5	4	3	2	2	1	—	1	1
Total	33	39	31	37	35	28	24	24	31	46	3	100	47	44
Parasites	—	—	—	—	5	—	—	2	2	2	—	—	3	2
Total No. of species	21	38	32	49	26	21	25	39	60	62	15	9	58	96

The relatively high contribution of annuals in the weed communities of the cultivated farms may be related to their short life cycles (sometimes a few weeks) that enable them to resist the instability of the agro-ecosystems. They also have the ability to set seeds without the need for a visiting pollinator (Baker, 1974) and this facilitates continuity of their life cycle. On the other hand, the considerable contribution of the woody species in the weed communities of the neglected farms can be related to the successional trend observed on these farms towards the desert climax.

Thirty three plant communities were identified according to their dominant species and, in addition two characteristic (differential) species. Thirteen of them could be considered as dominant communities (represented by at least 3 stands) and the others (20) are less important (18 of them are represented by one stand only). They were classified into 5 groups according to the life forms of their dominant species of the dominant communities (Table 4), two are fully represented on the neglected farms *(Phragmites australis, Zygophyllum coccineum)*, one has comparable occurrences on the cultivated and neglected farms *(Imperata cylindrica)*, and seven are fully represented on the cultivated farms. The following is the list of the less important communities (20):

Community group	Cultivated farms	Neglected farms
I. Annual herbaceous	*Rumex dentatus*	*Flaveria trinerva*
	Brassica arabica	*Oligomeris linifolia*
	Picris sulphurea	*Plantago ovata*
	Plantago lagopas	—
	Portulaca oleracea	—
	Ranunculus muricatus	—
	Sonchus oleraceous	
II. Perennial herbaceous	*Plantago lanceolata*	*Cressa cretica*
	Samolus valerandi	—
III. Annual grassy	*Dactyloctenium aegyptium*	—
IV. Perennial grassy	—	*Aeluropus lagopoides*
		Eleusine compressa
V. Shrubby	—	*Suaeda volkensii*
		Anabasis setifera
		Salsola baryosma
		Suaeda monoica

The community types identified in the present study have a successional trend from arable and weed communities to natural communities via the ruderal weed communities. This trend is as follows:

1. Communities (mostly annual) fully represented on the

Table 4

General characteristics of the dominant weed communities in the palm plantations of Al-Hassa Oasis. The values between brackets are the percentage presence of the characteristic species of each community within the palm stands. N-number of the sampled stands, Cu-cultivated farms (%), Ng-neglected farms (%), CO-average cover (%), TS-total species, SR-species richness, ST-species turnover.

Community Type		Characteristic species	N	Cu	Ng	CO	TS	SR	ST
		I. Annual herbaceous communities							
Euphorbia densa	*Convolvulus arvenis* (100%)	*Reichardia tingitana* (75%)	8	100	0	69	19	10.1	1.8
Stellaria media	*Euphorbia densa* (100%)	*Setaria verticillata* (100%)	5	100	0	72	25	10.6	2.4
Melilotus indica	*Chenopodium glaucum* (75%)	*Malva parviflora* (75%)	4	75	25	58	29	12.7	2.3
Anagalis arvensis	*Melilotus indica* (100%)	*Setaria verticillata* (100%)	3	67	33	78	20	10.7	1.9
Chenopodium murale	*Anagalis arvensis* (67%)	*Malva parviflora* (67%)	3	100	0	73	20	11.0	1.8
		II. Perennial herbaceous communities							
Convolvulus arvenis	*Cynodon dactylon* (100%)	*Sonchus oleraceous* (80%)	5	100	0	28	24	9.0	2.7
		III. Annual grassy communities							
Setaria viridis	*Dactyloctenium aegyptium* (100%)	*Melilotus indica* (100%)	4	100	0	70	23	13.0	1.8
Setaria verticillata	*Euphorbia densa* (100%)	*Chenopodium murale* (75%)	4	100	0	57	15	9.2	1.6
Polypogon monspeliensis	*Phragmites australis* (100%)	*Launaea nudicaulis* (67%)	3	100	0	46	17	11.3	1.5
		IV. Perennial grassy communities							
Phragmites australis	*Aeluropus lagopoides* (60%)	*Sporobolus spicatus* (60%)	5	0	100	48	23	8.6	2.7
Cynodon dactylon	*Convolvulus arvensis* (100%)	*Setaria verticillata* (80%)	5	80	20	66	29	11.0	2.6
Imperata cylindrica	*Convulvulus arvensis* (100%)	*Melilotus indica* (80%)	5	60	40	84	26	11.6	2.2
		V. Shrubby communities							
Zygophyllum coccineum	*Tamarix nilotica* (100%)	*Bassia eriophora* (100%)	3	0	100	26	26	14.7	1.8

cultivated farms.

2. Communities with a common occurrence on both the cultivated and neglected farms. The most important of them are the perennial grassy communities *(Cynadon dactylon, Imperata cylindrica).*
3. Communities (mostly shrubby) fully represented on the neglected farms.

Their leading dominant species are not truely weeds, but their occurrence reflects the developmental change towards the natural vegetation. The dominance of these shrubby species in natural habitats in many regions of Saudi Arabia supports this conclusion (e.g. Vessey-Fitzgerald, (1957), Migahid and El-Sheikh, (1977), Younes *et al,* (1983), El-Sheikh, *et al,* (1985), El-Shourbagy, *et al,* (1987). It is of interest to mention that most of the leading dominant species in the communities on neglected farms are halophytic (e.g. *Zygophyllum coccineum, Suaeda volkensii, Anabasis setifera, Salsola baryosma, Suaeda monoica*) and this will lead to increase in the salinity hazard. Under these conditions, these arable lands will be lost in the near future and their reclamation will be very expensive.

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