THE SEGETAL PLANT COMMUNITIES OF PALESTINE*)

(with 1 fig., 1 map and 5 tables)

by

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I. General Remarks.

The East Mediterranean countries have often been referred to as the homeland of many weeds for which no primary habitat has as yet been found. In fact numerous widespread weeds are as „homeless" in the East Mediterranean countries as they are elsewhere. What is true is that the East Mediterranean countries have an exceedingly large number of weeds, among them many endemic weeds occurring also in non-segetal habitats. These weeds play an important part in the vegetation of these countries and are as old here as agriculture.

At present these countries are about to modernize their agricultural methods and the entire regimen of the local segetal vegetation may suddenly become radically altered before it is sufficiently known to the scientific world. This, as well as other practical and theoretical reasons, has impelled the author to summarize here observations and records collected on segetal vegetation during many years in Palestine.

In its phytogeographical position Palestine is a rich centre of segetal plants, a meeting place for weeds of boreal, subtropical and tropical origin, and a home for a number of East Mediterranean weeds. Observations during the past two decades have proved that the constitution of the local weed flora (particularly that of non-irrigated crops) is largely constant. There is also considerable evidence that the local segetal flora owes its existence to spontaneous migration processes rather than to introduction (intentional or unintentional) by man.

As for origin, the following categories have been distinguished within the local weed flora:

Obligatory weeds not found as yet outside segetal habitats. Many of them are rather widespread, e.g. Convolvulus arvensis, Vaccaria segetalis, Bupleurum subovatum, Galium tricorne, Sinapis arvensis, Lolium temulentum, Ridolfia segetum, Cichorium divaricatum, Raphanus Raphanistrum, Diplotaxis erucoides, Phalaris bulbosa, Phalaris paradoxa, etc. These are, undoubtedly, ancient plants which have lost their primary habitats during the long history of cultivation. Many of them are known from prehistoric times. They have been termed archeophytes (Rikli, 1903), as against epoekophytes or newcomers.

*) Received for publication 14-III-1950.

Another group of obligatory weeds are those endemic to Palestine or to Palestine and Syria, e.g. Galium uropetalum, Lathyrus gloeospermus, Alkanna galilaea, Salvia Eigii, Scandix palaestina, Astoma seselifolia, Bellevalia Warburgii, Tordylium palaestinum, Warburgina Faktorovskyi and many others. Among them is a series of plants very restricted in area, and the question whether these plants originated within the segetal habitat or in primary habitats later conquered by agriculture will long remain unanswered.

2. **Facultative weeds,** i.e. plants occurring both in segetal and primary habitats. Their number is fairly large and a few groups have been distinguished among them.

a. True facultative weeds, growing in segetal and in primary habitats and equally characteristic of both habitats. Such plants are Leontice Leontopetalum, Bongardia Chrysogonum, Allium Schuberti, Gundelia Tournefortii, Gladiolus atroviolaceus, Aristolochia Maurorum, Vicia angustifolia var. amphicarpa, Chorispora purpurascens, Malabaila Sekakul, Leopoldia eburnea, Cutandia memphitica, Tulipa sharonensis and many others. These species are associates of primary plant communities occurring in steppes and deserts adjacent to or remote from the cultivated areas. They no doubt originated in primary habitats and entered cultivated fields spontaneously.

In this regard it may be emphasized that the association of Eragrostis bipinnata - Centaurea procurrens segetale, growing on the sandy-clay soils of the Mediterranean Coastal Plain, and the Leopoldia eburnea - Lolium Gaudini association, growing on sandy loess of the W. Negev, harbour the greatest number of true facultatives still occurring in primary associations of the nearest vicinity. Apart from them the number of true facultatives occurring in other segetal plant associations is rather small.

b. Pseudo-facultative weeds. There is a large number of true segetals occurring also in „primary" habitats influenced by man, e.g. Crepis aspera, Rhagadiolus stellatus, Malcolmia crenulata, Plantago Psyllium, Ainsworthia trachycarpa, Avena sterilis, Cynodon dactylon, Medicago tuberculata, Senecio vernalis, Hypericum crispum and many others.

c. Relic weeds. These are typical non-segetals left by man in primary sites when bringing natural ground under cultivation. They are mostly deep-rooting shrubs which could not be eradicated by primitive modes of cultivation, such as Crataegus Azarolus (in Southern Judean Mountains and in Edom), Haloxylon articulatum, Anabasis Haussknechtii (in the loess soils of the Negev), Zizyphus Spina-Christi and Balanites aegyptiaca (in the oases of the Jordan Valley) and others. Single trees or shrubs of the primary vegetation are sometimes also intentionally left in the field to afford shade.

Some leading species of the most important weed associations came into the segetal habitats from habitats extremely different ecologically. Prosopis farcata, for instance, the most prominent hemicryptophytic weed of the Prosopidion farcatae, has its primary site on the banks of the Jordan, Euphrates and Tigris and also in the Dead Sea region salines. Eragrostis bipinnata, the leading species of the Mediterranean light soil weed association is at home in the Saharo-Sindian region and is confined there to savannah and saltland vegetation. Ononis leiosperma, the leading species of the Ononideto-Carthamion in the hill and mountains region has been found to grow within the subalpine tragacanthic vegetation of Mt. Hermon and Jebel Druze (Syria).

The phytosociological grouping of weed vegetation has as yet attracted little attention. True, phytosociological treatment of weeds calls for special methods and the ecological amplitude of weed communities is generally considerably greater than that of other land plant communities. But as already emphasized by BRAUN-BLANQUET (1932), phytosociological units of segetals can be well defined both floristically and ecologically, even though some experience is needed to grasp them.

In this country I have had opportunity to examine a series of segetal plant associations in various habitats and I came to the conclusion that these associations exhibit not only all the analytical and synthetic attributes required but also possess a considerable number of characteristic species not always and not easily found in many non-segetal associations.

Four alliances of segetal associations have been distinguished on non-irrigated lands. The alliance richest in species and characteristics is the Prosopidion farcatae, inhabiting alluvial and colluvial grounds of the Coastal Plain, the Upper Jordan Valley, the Plain of Esdraelon, etc. These areas comprise the most productive agricultural lands of Palestine. Next in importance is the Ononideto-Carthamion tenuidis occupying the Mediterranean lands of terra rossa and rendzina of the Hill and Mountain region from about 300 m. above sea level. Here cultivation is less mechanized and less intensive, confined to terraces and to patches amid areas of primary vegetation. The segetal vegetation here often also harbours few satellites of Mediterranean Batha associations. The third alliance is that of the Achilleion Santolinae confined to the Irano-Turanian loess and sandy-loess soils of the Northern and Western Negev. It is distinguished by a series of exclusive characteristic species. The fourth is the Eragrostion bipinnatae, occupying the sandy-clay soils of the Coastal Plain, which exhibits a long series of characteristic species not found in any other segetal association.

As moisture is in this country the most decisive factor for plant life, alterations in agrotechnical methods affecting the moisture regimen of the soil may introduce major changes in the floristic composition of the association. Methods of cultivation are therefore of supreme importance in the phytosociology of weeds. On the other hand, there is no marked difference in the weed composition of various field crops such as wheat, barley, oats, etc., grown in the same season and under the same method of cultivation.

In general it should be stressed that in regions with extreme seasons, such as the Mediterranean and particularly the East Mediterranean region, the summer aspect of the association (also on non-irrigated ground) is so different in its composition and ecology from the winter aspect that the question may arise whether we are justified in including these two aspects within the frame of a single association. They have nevertheless, been included here within the same association.

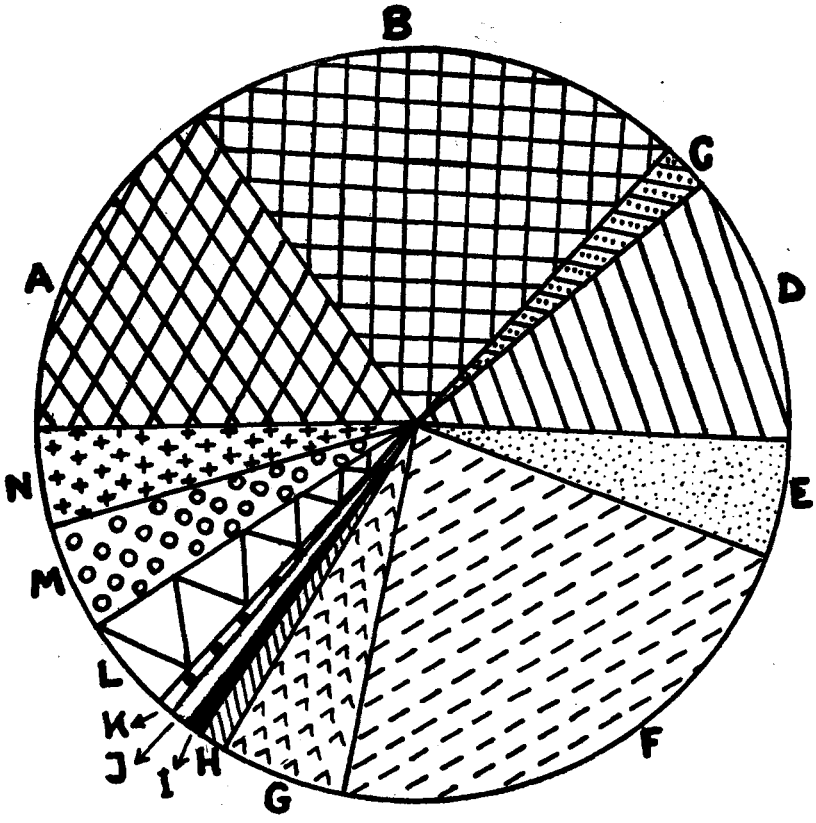
Too much emphasis should not be made of the great difference in the weed vegetation between irrigated and non-irrigated summer crops. The associations of irrigated summer crops, more closely related to ruderal plant associations, have not been considered here; they will be dealt with within the Ruderetalia on another occasion.

II. Phytogeographical analysis of the Palestine segetal flora.

The number of segetals occurring in Palestine, both obligatory and facultative, amounts to 458 species which makes 20,3 % of the total flora. This is rather high as compared with the extent of land under cultivation. The reasons for this wealth are manifold: first, the diversity of climatical and edaphical conditions in various regions of the country; second, the primitive method of cultivation still in use in large areas of this country, whereby weeds are poorly controlled; third, Palestine has to the East and South huge

steppes and deserts rich in therophytes, many of them with a wide ecological range and immense power of expansion. These plants no doubt penetrated the cultivated areas and found conditions here similar to those prevailing in the open steppe communities.

Plant geographically the weed flora constitutes a heterogenous entity. Apart from monoregionals, i.e. plants confined to a single region only, there are many bi- and pluriregionals among them. But pluriregionality is not necessarily a characteristic of segetals, as might be suggested. This is clearly seen from the following figures:



Diagramatic representation of the Phytogeographical Distribution of the Palestine Segetals.

Monoregionals: A = Omni Mediterranean; B = East Mediterranean; C = West-, South- and North Mediterranean; D = Irano-Turanian; E = Saharo-Sindian; Biregionals: F = Mediterranean - Irano-Turanian; G = East-Mediterranean - Irano-Turanian; H = North and South Mediterranean - Irano-Turanian; I = Mediterranean - Saharo-Sindian; J = Irano-Turanian - Saharo-Sindian; K = Eurosibero-Boreoamerican - Mediterranean; Pluriregionals: L = Extratropical triregionals; M = Borealo - Tropicals; N = Subtropical - Tropicals.

1.	**Monoregionals**	
A	Omni-Mediterranean (incl. sub-Mediterranean)	71 species
B	East-Mediterranean (incl. sub-East-Mediterranean)	97 species
C	West-Mediterranean	1 species
	South-Mediterranean	3 species
	North-Mediterranean	5 species
D	Irano-Turanian	55 species
E	Saharo-Sindian	22 species
	Total of Monoregionals	255 species
2.	**Biregionals**	
F	Mediterranean — Irano-Turanian (incl. sub Med - Ir-Tur)	104 species
G	East Mediterranean — Irano Turanian (incl. sub E. Med — Ir-Tur)	25 species
H	North-Mediterranean — Irano-Turanian	3 species
I	Mediterranean — Saharo-Sindian	2 species
J	Irano-Turanian — Saharo-Sindian	3 species
	Total of Biregionals	141 species
3.	**Pluriregionals**	
K	Eurosibero - Boreoamerican — Mediterranean	2 species
L	Eurosibero - Boreoamerican — Mediterranean — Irano-Turanian	17 species
	Mediterranean — Irano-Turanian — Saharo-Sindian	2 species
N	Borealo-Tropical	22 species
	Mediterranean — Irano-Turanian — Tropical	7 species
	Mediterranean — Irano-Turanian — Saharo-Sindian - Tropical	2 species
	Tropical, South-Mediterranean-Tropical and Sub-Sudano-Deccanian	8 species
	Diverse	2 species
	Total of Pluriregionals	62 species
	Total number of species	458 species

The above figures show that the great majority (80 %) of the Palestine weeds belong to the Mediterranean and the adjacent Irano-Turanian regions. In the following I wish to mention some obligatory weeds of each group:

1. Omni- (or sub-) Mediterranean:

Adonis microcarpa
Ammi Visnaga
Bifora testiculata
Capnophyllum peregrinum
Chrysanthemum Myconis
Chrysanthemum segetum
Hypecoum grandiflorum
Lavatera trimestris
Linaria commutata
Medicago scutellata
Melilotus segetalis
Notobasis syriaca
Ornithogalum narbonense
Phalaris brachystachys
Phalaris bulbosa
Phalaris canariensis
Raphanus Raphanistrum
Ridolfia segetum
Scolymus maculatus
Securigera Securidaca
Silene gallica
Silene muscipula
Silene nocturna
Teucrium spinosum
Thesium humile

2. East- (or sub-East-) Mediterranean:

Astoma seselifolium
Bellevalia Warburgii
Cachrys goniocarpa
Carthamus tenuis
Centaurea Verutum
Convolvulus palaestinus
Cynara syriaca
Euphorbia arguta
Euphorbia cybirensis
Exoacantha heterophylla
Leontice Leontopetalum
Medicago Blancheana
Medicago galilaea
Medicago rotata
Molucella laevis
Onosma giganteum
Salvia pinnata
Silene crassipes
Silene damascena
Specularia pentagonia
Tordylium aegyptiacum

3. South-Mediterranean:

Daucus aureus
Ononis hirta
Silene aegyptiaca

4. Mediterranean (or sub-Mediterranean) - Irano-Turanian:

Ammi majus
Anchusa azurea
Asperula arvensis
Beta vulgaris
Brassica nigra
Bupleurum subovatum
Calepina irregularis
Cichorium pumilum
Coronilla scorpioides
Chrozophora tinctoria
Euphorbia falcata
Fumaria parviflora
Galium tricorne
Geropogon glabrum
Gladiolus segetum
Glaucium corniculatum
Haplophyllum Buxbaumii
Heliotropium europaeum
Lathyrus erectus
Leopoldia comosa
Linaria Elatine
Linaria spuria
Malvella Sherardiana
Melilotus indicus
Ononis leiosperma
Phalaris paradoxa
Polygonum Bellardi
Rapistrum rugosum
Scandix Pecten Veneris
Scorpiurus sulcata
Silene conoidea
Sinapis alba
Sinapis arvensis
Vaccaria segetalis
Valerianella coronata
Vicia angustifolia

5. East-Mediterranean (or sub-East-Mediterranean) - Irano-Turanian:

Bellevalia macrobotrys
Bongardia Chrysogonum
Bupleurum Fontanesii
Campanula strigosa
Centaurea iberica
Cephalaria syriaca
Coriandrum sativum
Erucaria myagroides
Euphorbia aleppica
Ornithogalum brachystachys
Scandix iberica
Tragopogon longirostre
Valerianella vesicaria
Vinca herbacea
Vogelia apiculata

6. Irano-Turanian (or sub-Irano-Turanian):

Achillea Santolina
Alhagi Maurorum
Aristolochia Maurorum
Astragalus oocephauls
Bellevalia longipes
Bunium elegans
Carthamus glaucus
Convolvulus stachydifolius

TABLE I.

Scolymeto-Prosopidetum farcatae.

No. of record	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	Degree of presence
Sub.-ass.	typicum							Carthametosum						subhydrophilum																								
Area in m²	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Coverage of weeds	20%	30-40%	100%	60%	30-40%	70%	20%	–	–	60%	–	–	100%	70%	25%	20%	70%	70%	20%	10%	10%	10%	75%	80%	75%	100%	80%	25%	–	–	–	–	75%	75%	30%	10%	10%	
Charact. species of Association and Adliance																																						
Prosopis farcata	2–3	+–3	2–3	2–3	2–7	1–2	2–2	2–2	1–2	+	.	2–2	4–2	.	2–2	2–2	4–2	2–2	2–2	.	2–2	+	3–2	2–2	+	2–2	+	+	2–2	2–2	2–3	.	2–2	1–2	1–2	1–2	+	V
Alhagi Maurorum	.	.	.	.	.	.	.	.	.	.	.	.	.	1–2	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	1–2	2–2	+	2–2	.	.	I
Cynara syriaca	.	+	3–2	2–2	+	+	.	+	1–2	3–2	1–2	1–2	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	II
Phlomis pungens	1–2	.	+	+	+	+	+	+	+	+	.	.	.	1–1	1–1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Centaurea Verutum	+	.	.	.	.	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Alkanna galilaea	.	.	.	+	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Cachrys goniocarpa	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Bupleurum Fontanesii	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
Euphorbia cybirensis	.	.	.	.	2–1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	+	.	.	.	I
Exoacantha heterophylla	.	.	.	.	.	.	.	+	.	.	.	.	.	1–2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
Onosma auriculatum	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Scandix palestina	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Stachys Zoharyana	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Lathyrus gloeospermus	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Differential species																																						
Euphorbia falcata	+	+	+	+	+	.	.	+	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	II
Daucus aureus	1–2	+	+	+	+	+	.	.	.	.	.	+	+	1–2	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	II
Ammi Visnaga	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	+	1	.	.	+	1	+	+	II
Ononis hirta	+	.	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Ammi majus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	.	.	.	.	.	.	.	1	+	.	.	.	I
Teucrium spinosum	.	.	.	+	.	+	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Capnophyllum peregrinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	I
Tetragonolobus Requieni	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Brassica nigra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Charact. species of Suborder Triticetalia orientalia																																						
Convolvulus betonicifolius	+	+	+	+	+	+	+	+	+	+	+	+	.	1–1	1–1	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
Euphorbia arguta	+	+	+	1–1	.	.	1–1	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.	.	.	.	+	.	.	.	.	II
Cephalaria syriaca	+	.	.	+	.	+	+	+	+	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	2–1	.	.	.	.	II
Anthemis pseudocotula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	+	+	+	1–1	+	+	2–1	+	+	•	•	•	•	•	•	•	II
Anchusa strigosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	1–2	+	+	+	+	+	.	.	.	.	.	.	.	.	.	II
Allium Schuoerti	+	+	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Carthamus glaucus	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	+	.	+	+	1–1	.	.	.	.	.	.	.	.	.	.	I
Salvia syriaca	.	.	.	.	+	.	+	1–2	.	.	3	.	+	.	1	.	.	.	.	.	.	.	2–1	.	+	1–1	+	.	.	.	.	.	.	.	.	.	.	I
Tordylium aegyptiacum	.	.	.	.	.	1–1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Molucella laevis	.	.	.	+	.	+	.	.	.	.	.	.	.	2–1	1–1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Heliophyllum crassipes	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Ornithogalum narbonense ssp. brachystachys	.	.	.	+	+	1–1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Medicago rotata	.	+	.	1–1	+	.	.	.	.	.	.	.	.	.	1–1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Carthamus tenuis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	1–1	+	.	.	I
Bellevalia trifoliata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Gundelia Tournefortii	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Tetragonolobus palaestinus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	.	.	.	.	+	.	.	.	.	I
Malcolmia crenulata	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Charact. species of Order (Secalinetalia) and Class (Rudereto-Secalinetea)																																						
Scolymus maculatus	1–2	2–2	1–2	1–2	.	.	2–1	+	2–2	1–1	1–1	1–1	+	1–1	1–1	.	.	+	+	.	.	.	.	+	+	.	.	.	+	+	+	+	+	+	+	.	.	IV
Bupleurum subovatum	+	1–1	.	+	+	.	+	+	+	.	.	.	2–1	2–1	1–1	.	+	+	+	+	+	+	+	+	.	+	.	.	+	+	1–1	+	.	.	.	+	+	III
Convolvulus arvensis	+	+	+	+	+	1–1	1–1	+	+	+	.	.	2–1	2–1	1–1	.	.	.	+	.	.	+	+	.	.	.	.	+	.	.	+	.	+	.	.	+	+	III
Rapistrum rugosum	+	+	.	+	+	+	.	.	.	.	+	.	.	.	+	.	.	.	+	.	+	.	.	.	+	.	+	1–1	.	3–1	3–1	+	+	+	.	+	+	III
Sinapis arvensis	+	+	+	+	+	1–1	.	1–1	+	.	.	1–1	.	.	.	+	.	.	+	.	.	+	+	+	.	1–1	.	.	.	+	.	.	+	.	.	.	+	III
Vaccaria segetalis	+	.	.	+	.	.	+	+	.	.	+	.	.	.	.	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.	1–1	.	.	.	.	.	.	II
Vicia narbonensis	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	+	1–1	+	.	+	.	+	+	1–1	+	+	.	+	.	.	.	.	+	.	.	.	.	II
Galium tricorne	+	+	+	.	1–1	1–1	1–1	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	+	.	+	.	.	.	+	+	.	II
Phalaris brachystachys	.	.	.	+	.	.	+	.	.	.	+	+	.	.	.	+	.	+	.	+	+	.	.	+	.	.	+	.	+	.	.	+	.	+	+	.	.	II
Lavatera trimestris	.	+	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	+	.	+	.	.	+	+	.	.	.	.	II
Cichorium pumilum	.	.	+	.	.	+	.	.	.	.	+	.	1–1	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	+	1–1	.	.	.	+	.	+	+	II
Melilotus indicus	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	.	.	.	.	+	+	+	.	.	.	.	II
Ridolfia segetum	+	.	.	.	.	.	.	.	.	.	.	+	.	1–1	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	+	1–1	+	.	.	II
Ranunculus arvensis	.	+	+	.	.	1–1	+	.	.	.	.	.	.	1–1	1–1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	+	II
Anchusa azurea	+	.	+	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Geropogon glabrum	.	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	+	.	+	.	.	II
Chrozophora tinctoria	+	2–2	+	+	.	.	2–2	.	.	.	+	.	1–1	1–2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Anagallis coerulea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2–1	+	+	.	.	+	+	+	+	.	+	1–1	+	+	+	.	+	.	.	.	.	II
Centaurea hyalolepis	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	(+)	(+)	+	+	+	+	.	.	.	+	.	.	.	.	.	II
Cynodon dactylon	.	.	.	.	.	.	.	.	.	.	.	2–3	.	.	1–2	+	+	.	.	.	1–1	1–2	+	2–2	+	.	.	.	.	.	.	+	.	.	.	.	.	II
Scabiosa prolifera	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	2–1	+	+	.	+	.	+	+	.	.	.	.	II
Beta vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	+	.	.	.	+	.	.	+	.	.	.	+	.	+	+	II
Erucaria myagroides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	II
Hymenocarpus circinatus	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	.	.	+	+	.	.	.	.	II
Senecio vernalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	+	.	+	.	.	.	+	.	.	.	+	.	.	.	.	II
Scorpiurus muricatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	II
Trifolium resupinatum	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	.	+	+	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.	II
Phalaris bulbosa	.	.	.	.	.	+	.	.	1–2	.	+	.	+	1–2	1–2	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	I
Ph. paradoxa	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	+	.	.	I
Gladiolus segetum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	+	I
Hypericum crispum	.	.	.	.	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Lolium temulentum	.	.	.	.	.	.	.	.	.	.	.	2–2	.	.	.	.	+	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Linaria Elatine	.	1–1	.	.	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Convolvulus pentapetaloides	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Coronilla scorpioides	+	+	.	.	.	+	.	.	.	1–1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	I
Linaria halepensis	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Malvella Sherardiana	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Verbascum sinuatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	+	+	.	.	+	.	.	.	+	.	.	.	.	.	I
Adonis microcarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	I
Eruca sativa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	I
Chrysanthemum coronarium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	I
Fumaria densiflora	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	.	.	.	.	.	.	.	I
Rhagadiolus stellatus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	I
Centaurea iberica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	+	.	.	I
Sinapis alba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Euphorbia Peplus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	I
Ranunculus trachycarpus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	2–1	2–1	.	.	+	+	I
Lolium rigidum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	.	.	+	+	.	+	.	.	.	I
Medicago tuberculata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	.	.	.	.	.	+	.	.	.	.	I
Sonchus oleraceus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	I
Antirrhinum Orontium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	+	.	.	.	.	I
Medicago hispida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	+	+	.	.	.	.	I
Trifolium purpureum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	+	.	.	I

Euphorbia lanata	Phlomis pungens
Gladiolus atroviolaceus	Prosopis farcata
Gundelia Tournefortii	Salvia syriaca
Hyoscyamus reticulatus	Smyrniopsis cachroides
Malva aegyptia	Teucrium parviflorum

7. Borealo-Tropical:

Amaranthus graecizans	Digitaria sanguinalis
Amaranthus lividus	Eragrostis megastachya
Amaranthus retroflexus	Portulaca oleracea
Convolvulus arvensis	Stellaria media

We shall not list the other groups here. Mention may, however, be made of some weeds limited to Syria and Palestine which are not found outside the segetal habitats. These are: Astoma seselifolium, Astragalus macrocarpus, Astragalus oocephalus, Bellevalia longipes, Cachrys goniocarpa, Carthamus tenuis, Centaurea Verutum, Cynara syriaca, Delphinium, rigidum, Exoacantha heterophylla, Scandix palaestina, Silene damascena, Stachys arabica, etc.

Still more interesting are weeds endemic to Palestine only. These are: Adonis palaestina, Lupinus palaestinus, Vicia esdraelonica, Lathyrus gloeospermus, Convolvulus palaestinus, Salvia Eigii, Alkanna galilaea, Leopoldia eburnea, Linaria joppensis, Galium uropetalum, Anthemis cornucopiae, Astragalus bersabeensis, etc.

III. The segetal plant Communities of Palestine.

The segetal vegetation of Palestine must, no doubt, be classed with the Rudereto-Secalinetea Br. Bl. (1936).[1]) It can scarcely, however, be included within the Order Secalinetalia as described and characterized by BRAUN-BLANQUET (1931) for Europe and W. Mediterranean. This is because the East Mediterranean segetal communities harbour a long series of local characteristic weeds playing a most important part in the segetal vegetation. This is a sufficient reason to class the East Mediterranean segetal associations under a particular suborder of the Secalinetalia which I would propose to term Triticetalia orientalia.

This suborder comprises in Palestine 4 alliances well based floristically and ecologically, each equivalent to the Secalinion Br.-Bl. (1931) later subdivided by TüXEN (1937) into Secalinion medioeuropaeum and S. mediterraneum. The establishment of these new alliances for the local segetal vegetation seems necessary as it is impossible to widen the frame of the Secalinion to such an extent as to include therein also all the segetal associations of the East Mediterranean countries. It is sufficient to mention in this regard that at least 170 species of segetal plants of this country are not represented in the West Mediterranean countries. The alliances are:

1. Prosopidion farcatae segetale occupying heavy soils of the Coastal Plain and intermountain valleys, mainly within the Mediterranean territory.

2. Ononideto-Carthamion tenuidis, confined to the terraces and plateaux of the Mediterranean hills and mountains.

[1]) The author followed the principles and methods of phytosociological research of the Zürich-Montpellier school. For details the reader is referred to Braun-Blanquet (1928).

3. Achilleion Santolinae, confined to the loess and sandy loess soils of the Irano-Turanian Northern and Western Negev.

4. Eragrostion bipinnatae, confined to the sandy clay soils of the Mediterranean Coastal Plain.

Although these units are well distinguished from one another ecologically and floristically, they are spatially connected with one another by transitions. All the alliances are confined to non-irrigated or only occasionally and slightly irrigated lands, of both winter and summer crops.

1. The **Prosopidion farcatae segetale.**

It comprises the only association:

Scolymeto-Prosopidetum farcatae (= Prosopidetum farcatae Eig. 1946).

This is one of the most important associations among the segetal vegetation of Palestine, Syria and to some extent of N. Iraq. In Palestine it occupies large areas of the Mediterranean lowlands and partly also the adjacent Plains of the Irano-Turanian territory in the Jordan Valley. These areas have been cultivated since ancient times and are considered the main granary of the country. They are governed by a mild rainy winter and a dry and hot summer. The amount of annual precipitation is not under 400 mm. for the great part of the area and its monthly distribution is sufficient to support winter and summer crops without or almost without irrigation.

The entire area is characterized by deep soils of various origin, such as highly calcareous rendzinas, transported terra rossa, basalt soils, alluvial loams with obvious hydropedical features, etc. All of them are designated by their heavy texture, and medium or high capacity of retaining moisture at a certain depth during the entire year.

Floristically the Scolymeto-Prosopidetum is richest in species. Nearly 200 species have been listed in the 62 records collected of this association. Many of them are common wides, others are East Mediterranean obligatory weeds and a considerable number of them are characteristic species of this association (see Table), among them half a dozen endemic to Palestine.

Of the perennial dominants the following may be mentioned: Prosopis farcata, Alhagi Maurorum, Convolvulus arvensis, Convolvulus betonicifolius, Cynodon dactylon, Sorghum halepense, Phalaris bulbosa. Among the annual noxious weeds are Phalaris paradoxa, Rapistrum rugosum, Cephalaria syriaca, Lolium temulentum, Ridolfia segetum, Ammi Visnaga, Bupleurum subovatum, Galium tricorne, etc.

In accordance with its wide range of climatical and edaphical requirements a few subassociations, well characterized by a number of plants, have been readily distinguished in this association. The typical subassociation occupies the greatest part of the area; the subassociation subhydrophyllum is confined to more heavy soils sometimes inundated in winter while the subassociation Carthametosum glauci is found almost exclusively on highly calcareous soils of the „Lissan Marl" in the Beth-Shean Valley and the Upper Jordan Valley. A few other subassociations have been distinguished, among them the subassociation transiens (transitional between Prosopidetum and Carthametum on rendzinas of the Western Foot Hill region) and subassociation depauperatum (at the southern terminus of the Prosopidetum in the Shefela). The latter two and other minor variations of this association have not been included in our table.

As to periodicity there is no marked resting period for this association during the whole year. The early autumn is the germination period of most winter annuals. In early winter a few widespread and very common segetals and ruderals such as Senecio vernalis, Calendula arvensis, Fumaria tenuiflora, F. micrantha, Thlaspi perfoliata, Capsella Bursa pastoris, Erodium moschatum, E. cicutarium, etc. occupy the field. Then the late winter and spring flora appears, amounting to over a hundred species, all annuals except a few hemicryptophytes such as Convolvulus arvensis, C. betonicifolius, Cachrys goniocarpa, Aristolochia Maurorum, Vinca herbacea, etc., and some geophytes of the genera Bellevalia, Allium, Ornithogalum, Helicophyllum, etc. From early summer to autumn the field is occupied by a few dominant species. The earliest to appear are Scolymus maculatus, Centaurea Verutum, Ammi Visnaga, Eryngium creticum, Haplophyllum Buxbaumii. Somewhat later in the season Prosopis and Alhagi blossom, with them Cynara syriaca, Chrozophora tinctoria, Linaria Elatine, Linaria commutata, various Heliotropia, Euphorbia lanata, Euphorbia aleppica (still in flower), Malvella Sherardiana, Alkanna galilaea and others. The group of species belonging to the summer aspect is of peculiar ecological significance- some of them have exceedingly deep roots (up to 15 m. or more in Prosopis).

Unfortunately the late summer plants have for technical reasons not been fully noted in the following records and their occurrence is much more frequent than recorded here.

Apart from the species listed in table I a large number of companions and characteristics of class, order and suborder have not been noted except in one, two or three records. These species are fully recorded here (number of records in brackets):

Species observed in three records:

Acanthus syriacus (1, 23, 24), Ainsworthia trachycarpa (23, 24, 25), Alopecurus myosuroides (24, 25, 31), Chrysanthemum segetum (32, 33, 35), Hippocrepis bisiliqua (30, 31, 33), Koeleria phleoides (24, 31, 32), Linum pubescens (25, 32, 33), Notobasis syriaca (7, 16, 19), Plantago Lagopus (32, 33, 34), Plantago Psyllium (23, 25, 30), Silene rubella (25, 28, 32).

Species observed in two records:

Asteriscus aquaticus (23, 33), Astragalus hamosus (28, 32), Avena sterilis (26, 34), Bromus japonicus (34, 35), Calendula arvensis (23, 24), Erodium malacoides (26, 33), Euphorbia exigua (28, 32), Falcaria vulgaris (33, 35), Fumaria micrantha (30, 33), Hedypnois cretica (25, 33), Lavatera cretica (28, 33), Onobrychis squarrosa (26, 30), Ononis leiosperma (7, 31), Scandix Pecten Veneris (23, 24), Silybum Marianum (27, 32), Sorghum halepense (11, 16), Trifolium tomentosum (26, 32), Trigonella arabica (28, 33), Trigonella spinosa (29, 32), Uropermum picroides (24, 31), Valerianella coronata (25, 32).

Species observed in one record:

Aegilops speltoides (35), Andropogon annulatus (32), Anthemis melanolepis (34), Astragalus macrocarpus (23), Atriplex Halimus (26), Bongardia Chrysogonum (8), Brachypodium distachyum (25), Bromus alopecurus (34), Bromus macrostachys (26), Bromus scoparius (26), Campanula strigosa (31),

Caucalis leptophylla (23), Chenopodium murale (31), Convolvulus Dorycnium (23), Convolvulus stachydifolius (31), Crepis aspera (28), Cressa cretica (35), Echium italicum (25), Eremostachys laciniata (26), Filago germanica (25), Heliotropium europaeum (31), Helminthia echioides (34), Hirschfeldia incana (24), Hordeum bulbosum (35), Hordeum ithaburense (26), Hordeum marinum (35), Inula viscosa (35), Lagoecia cuminoides (34), Lathyrus Aphaca (24), Lathyrus marmoratus (24), Linaria micrantha (31), Lythrum flexuosum (25); Malva nicaeensis (29), Melilotus sulcata (24), Mercurialis annua (28), Orobanche sp. (29), Pisum elatior (24), Pulicaria arabica (34), Rumex pulcher (34), Salvia cognata (23), Salvia Horminum (26), Scandix iberica (26), Scrophularia xanthoglossa (23), Silene fuscata (29), Solanum nigrum (31), Trifolium campestre (33), Trifolium lappaceum (29), Valerianella vesicaria (32), Vicia angustifolia (31), Vinca herbacea (3).

Location and environment of records:

Rec. 1. Esdraelon Plain, Merhavia, heavy basalt soil; wheat field.
Rec. 2. Ibidem, 5 km. S. of Afule, basalt soil intermingled with lime; wheat field.
Rec. 3. Ibidem, 1 km. S. of Afule, soil as above; field fallow for one year.
Rec. 4. Ibidem, between Jenin and Afule, plain, deep terra rossa.
Rec. 5. Lower Galilee, between Moledeth and Kumi, basalt soil; fallow field.
Rec. 6. Ibidem, between Sarona and Kafr Kama, basalt soil; field ploughed for summer crops but not sown.
Rec. 7. Ibidem, Sarona, black basalt soil; wheat field.
Rec. 8. Ibidem, between Kafr Kama and Meshkha; all as above.
Rec. 9. Ibidem, between Ain-Dor and Mt. Tabor; all as above.
Rec. 10. Esdraelon Plain, 2—3 km. S. of Merhavia, terra rossa; fallow wheat field.
Rec. 11. Lower Galilee, 5 km. S.W. of Meshkha, shallow and stony basalt soil; field of Durrah (Sorghum vulgare), details not noted.
Rec. 12. Ibidem, env. of Suk el Khan, basalt soil not ploughed for one year.
Rec. 13. Ibidem, near Kafr Kama, plain deep basalt soil; fallow field.
Rec. 14. Ibidem, badly grown maize field, soil as above.
Rec. 15. Ibidem at a certain distance from above, well grown maize field.
Rec. 16. Eastern shore of Lake Kinnereth, env. of Ain Gev, alluvial plain, grayish white calcareous soil, alfalfa field scantily irrigated in winter.
Rec. 17. Ibidem, „Lissan Marl" soil, slight and somewhat moist depression.
Rec. 18. Ibidem, between Ain-Gev and Samrah, conditions as above.
Rec. 19. Upper Jordan Valley, Kerak near Degania, „Lissan Marl" soil, slightly irrigated in winter; wheat field.
Rec. 20. Ibidem, environs of Kinnereth settlement, grey basalt-calcareous transported soil, wheat field scantily irrigated in winter.
Rec. 21. Ibidem, near Degania Beth, all as above.
Rec. 22. Ibidem, 2 km. East of Beith Zera, grayish-white highly calcareous „Lissan Marl" soil, fallow field.
Rec. 23. Ibidem, between Massada and Shaar Hagolan, grey calcareous soil, fallow plot near wheat field.
Rec. 24. Beth-Shean Valley, env. of Nevei-Eithan, white grayish-calcareous, Lissan Marl soil, fallow plot near wheat field scantily irrigated in winter.
Rec. 25. Ibidem, 1,5 km. N. of Favarneh, calcareous soil ploughed for winter crops but not sown.
Rec. 26. Ibidem, Maoz, soil as above, plot fallow for one year, non-irrigated.
Rec. 27. As above, wheat field scantily irrigated in winter.
Rec. 28. Ibidem, 1 km. N. of Favarneh, calcareous heavy soil, fallow plot ploughed but not sown, near a wheat field scantily irrigated.
Rec. 29. Esdraelon Plain, between Afule and Ain-Harod, basalt soil, plot fallow for a few years.
Rec. 30. Ibidem, near Shata, deep basalt soil, field fallow for a few years.
Rec. 31. Ibidem, field of irrigated forage crops not ploughed after last harvest.
Rec. 32. Beth-Shean Valley, 1 km. N. of Samrieh, irrigated heavy soil.
Rec. 33. Ibidem, n. Favarneh, calcareous heavy soil, fallow plot.
Rec. 34. Sharon Plain, n. Hedera, deep heavy soil, fallow plot.
Rec. 35. Plain of Acre, NE. of Sabinia, heavy soil cracked in summer.

TABLE II.

Association of Ononis leiosperma-Carthamus tenuis.

No. of record	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Degree of presence
Area in m²	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Coverage of weeds	25%	20%	30%	25%	60%	50%	20%	10%	20%	20%	30%	20%	20%	50%	30%	40%	—	30%	80%	80%	100%	
Charact. species of Association and Alliance																						
Bupleurum nodiflorum	+	.	+	+	1—1	+	1—1	+	.	+	1—1	.	.	.	+	.	.	.	1—1	+	+	III
Campanula strigosa	.	+	.	.	+—1	+	+	+	+	.	.	.	+	.	.	+	.	.	+	+	+	III
Astoma sessilifolia	.	.	+	+	1—1	1—1	+	.	.	.	+	.	+	.	.	.	.	.	1—1	1—1	1—1	III
Cerastium dichotomum	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	II
Asperula arvensis	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	+	+	II
Silene longipetala	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Gladiolus atroviolaceus	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	+	+	.	I
Calepina irregularis	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I
Linum mucronatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1—2	+	1—2	I
Silene crassipes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	I
Preferentials																						
Ononis leiosperma	1—3	1—3	1—3	(+)	1—2	+	+	+	1—2	2—3	1—3	1—3	(+)	.	+	+	(+)	(1-2)	2—2	2—3	+	V
Carthamus tenuis	+	2—2	2—2	1—2	2—2	3—2	1—2	+	1—2	.	.	+	+	+	+	1—2	1—2	1—2	2—2	1—1	2—2	V
Bongardia Chrysogonum	.	.	.	+	+	+	+	.	.	.	+	+	.	.	1—1	.	.	.	+	+	+	III
Vicia angustifolia var. amphicarpa	.	.	.	+	.	.	.	1—1	.	+	.	.	.	.	.	.	.	.	+	+	+	II
Leontice Leontopetalum	.	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	II
Specularia pentagonia	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	+	.	+	+	.	II
Charact. species of Suborder Triticetalia orientalia																						
Tetragonolobus palaestinus	.	+	+	.	+	.	.	+	.	.	.	+	+	+	+	.	.	+	+	.	+	III
Convolvulus betonicifolius	+	1—1	+	+	+	+	+	.	.	.	1—1	.	+	.	.	+	.	.	1—1	1—1	2—1	III
Cephalaria syriaca	.	.	.	+	+	+	+	1	.	.	+	.	.	+	.	+	.	.	+	+	.	III
Trifolium campestre	.	.	.	.	.	.	.	+	+	+	.	+	+	.	.	2—1	.	+	+	+	+	III
Anthemis melanolepis	.	.	.	+	+	.	.	+	.	+	.	+	.	+	.	.	+	.	+	+	.	III
Malcolmia crenulata	.	.	.	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	+	.	+	II
Aristolochia Maurorum	.	.	.	.	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	+	+	II
Anthemis pseudocotula	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	2—1	1—1	+	II
Medicago Blancheana	.	.	+	+	.	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	II
Onobrychis squarrosa	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	+	+	II
Trifolium formosum	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	.	.	.	+	.	II
Gundelia Tournefortii	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	I
Zizyphora capitata	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	I
Pterocephalus involucratus	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	I
Euphorbia aleppica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	I
Warburgina Faktorovskyi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	I
Cephalaria joppensis	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	.	.	I
Charact. species of Order (Secalinetalia) and Class (Rudereto-Secalinetea)																						
Bupleurum subovatum	1—1	+	+	+	+	+	1—1	+	.	+	+	+	.	.	+	1—1	1—1	1—1	+	+	+	V
Vaccaria segetalis	1—1	+	+	1—1	+	+	.	+	.	.	1—1	+	1—1	+	.	1—1	.	.	+	+	+	IV
Lolium temulentum	.	.	+	+	.	1—1	+	+	2—2	1—1	+	+	+	+	1—1	+	.	.	+	.	1—2	IV
Galium tricorne	.	+	+	+	+	+	.	+	.	.	+	.	+	.	2—1	.	+	.	1—1	+	+	IV
Hypericum crispum	+	.	+	+	1—1	+	.	+	+	+	.	.	.	.	.	.	+	+	+	+	+	IV
Cynodon dactylon	.	.	+	.	+	.	+	.	1—2	1—2	+	.	+	.	+	.	+	.	+	1—2	+	III
Papaver Rhoeas	+	.	.	+	+	+	.	.	+	.	.	.	+	+	+	+	+	.	.	+	+	III
Convolvulus arvensis	+	+	+	.	.	+	.	.	1—2	.	1—1	1—1	.	1—1	2—2	1—1	.	+	.	.	.	III
Scorpiurus muricata	.	.	+	+	+	+	.	+	+	+	.	.	.	.	+	+	.	.	.	+	.	III
Cichorium pumilum	.	.	+	+	+	+	.	.	+	.	.	.	+	.	+	.	+	.	1—1	+	+	III
Senecio vernalis	+	.	+	.	1—1	+	+	+	1—1	.	.	.	.	.	.	.	+	+	1—1	+	.	III
Rhagadiolus stellatus	+	.	+	+	.	.	.	.	.	.	+	+	+	+	+	.	.	.	+	+	+	III
Sinapis arvensis	+	+	.	+	+	.	+	.	.	.	+	.	.	.	.	+	+	.	+	+	.	III
Coronilla scorpioides	.	.	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.	+	+	+	+	III
Geropogon glabrum	.	.	+	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	+	+	.	II
Koeleria phleoides	.	.	.	.	+	.	.	+	+	.	.	.	.	+	.	.	.	.	+	+	+	II
Phalaris bulbosa	.	.	.	.	+	.	+	+	.	1—2	+	.	.	.	2—2	.	.	.	+	+	.	II
Ranunculus arvensis	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	.	.	+	+	.	+	II
Phalaris paradoxa	.	.	.	+	.	+	.	.	.	.	.	.	.	+	+	.	1—2	1—2	.	.	+	II
Phalaris brachystachys	.	.	.	+	1—1	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	II
Anagallis coerulea	.	.	.	.	+	.	+	.	+	.	.	.	+	.	.	.	.	.	+	+	+	II
Rapistrum rugosum	+	.	.	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	II
Anchusa azurea	.	.	.	+	.	+	.	.	.	.	1—2	.	.	.	.	.	.	.	+	+	.	II
Ridolfia segetum	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	II
Medicago orbicularis	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	II
Notobasis syriaca	.	.	.	+	.	+	+	.	.	+	.	.	.	.	.	+	.	.	+	.	.	II
Haplophyllum Buxbaumii	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	I
Silene inflata	.	.	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Ononis pubescens	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	+	I
Lolium rigidum	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	+	I
Chrozophora tinctoria	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	I
Scolymus maculatus	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	I
Scolymus hispanicus	.	.	.	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	+	.	I
Chrysanthemum Coronarium	+	.	.	.	.	.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	I
Filago spathulata	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	I
Medicago hispida	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	+	.	.	.	I
Hymenocarpus circinatus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	I
Hedypnois cretica	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	I
Centaurea hyalolepis	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	I
Reseda alba	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	I
Medicago tuberculata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	.	.	I
Lathyrus Ochrus	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	I
Euphorbia Helioscopia	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	I
Polygonum Bellardi	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	I
Silene muscipula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	I
Companions																						
Eryngium creticum	.	+	.	+	1—1	+	1—1	+	+	.	+	.	.	.	.	.	.	.	+	+	+	III
Avena sterilis	.	.	.	.	.	.	.	+	.	+	(+)	.	+	.	+	.	+	+	+	+	+	III
Plantago Psyllium	.	.	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	+	+	III
Crepis aspera	.	.	+	.	.	+	.	+	+	.	.	.	.	.	+	.	.	.	+	+	1—1	II
Bromus alopecurus	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	II
Aegilops variabilis	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	+	I
Pimpinella cretica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	I
Trifolium tomentosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	I

Rec. 36. Sharon Plain, n. Kfar Vitkin, heavy somewhat moist soil near river, vetch-barley field.
Rec. 37. Ibidem, as in above, but plot 500 m. far away from river.

2. The **Ononideto-Carthamion tenuidis.**

This alliance is nearest the Prosopidion but is well distinguished from it both ecologically and floristically. While the Prosopidion is confined to deep heavy lowland soils the Carthamion comprises the weed vegetation of the hills and mountain region mainly from 300 m. above S.L. where the soil is exceedingly poor, shallow and mostly stony, with primitive agriculture. It is characterized by a number of exclusive and preferential species as well as by the absence of many species characteristic of the Prosopidion.

The Carthamion no doubt comprises a number of associations widespread throughout the hilly districts of the NE countries but as yet the following only has been more or less adequately studied:

The **association of Ononis leiosperma — Carthamus tenuis (Eig 1946).**

Widely distributed over the hills and mountains of Palestine's Mediterranean territory. Although including some minor variants it is more or less homogeneous in composition in the whole area examined. It is confined to the districts of terra rossa and white-grayish highly calcareous rendzina, mostly with truncated profiles and stony texture. Agriculture on these lands is often limited to terraces and patches unfit for mechanized methods of cultivation. Crop rotation, if practised, is mostly biennial. The main winter crops are wheat or barley while the main summer crops are durrah (Sorghum annuum) or sesame.

Floristically this association differs from all other local segetal associations by a number of characteristic species, though it has a great number of class- and order characteristics in common with the Prosopidetum. As in the latter the total number of species is rather high; most of them show only low presence.

While the winter aspect is dominated by a large number of widespread East-Mediterranean and Omni-Mediterranean weeds, the summer aspect is rather poor in species. Among the latter, Ononis leiosperma, Carthamus tenuis, Chrozophora tinctoria, Linaria Elatine, Heliotropium villosum are most striking. Ononis leiosperma is a seasonally dimorphic hemicryptophyte with a rosette of mesomorphic leaves in winter and lang thorny flowering shoots bearing small leaflets in summer. Carthamus is a summer annual densely covering huge areas of the cultivated hillsides with its grey colour. The presence of the species of the summer aspect is considerably higher than marked in the table (no. II).

Species (incl. companions, characteristics of class, order and suborder) observed only in one or two records have not been included in the table. Here is a list of them (number of record in brackets).

Species observed in two records:

Ainsworthia trachycarpa (19, 20), Bellevalia flexuosa (19, 21), Beta vulgaris (17, 18), Bifora testiculata (19, 20), Bromus macrostachys (19, 21), Bupleurum Fontanesii (17, 18), Calendula arvensis (8, 14), Carthamus glaucus (10, 12), Centaurea iberica (6, 7), Daucus Broteri (8, 21), Daucus maximus (17, 20), Elymus Delileanus (19, 20), Erucaria myagroides (8, 9), Galium hierosolymitanum (5, 19), Hippocrepis bisiliqua (9, 19), Hischfeldia incana (14, 21), Melilotus indica (14, 15), Plantago cretica (19, 21), Poterium spinosum (8, 21), Poterium verrucosum (19, 20), Salvia syriaca (10, 19), Scabiosa

prolifera (1, 3), Scandix Pecten Veneris (15, 19), Scrophularia Peyroni (8, 10), Silene conoidea (6, 21), Sinapis alba (18, 21), Tordylium aegyptiacum (1, 18), Trifolium purpureum (6, 20), Trifolium stellatum (10, 19), Veronica syriaca (11, 20), Vogelia apiculata (12, 13).

Species observed in one record:

Acanthus syriacus (3), Ammi Visnaga (17), Anchusa aegyptiaca (1), Anchusa hybrida (19), Anchusa strigosa (9), Artedia squamata (16), Arum palaestinum (11), Avena barbata (5), Bromus sp. (14), Caucalis leptophylla (21), Caucalis tenella (21), Daucus aureus (10), Erodium cicutarium (8), Evax contracta (19), Falcaria vulgaris (12), Hordeum ithaburense (3), Inula viscosa (15), Lactuca Scariola (11), Lagoecia cuminoides (19), Lamium amplexicaule (8), Lathyrus annuus (6), Lathyrus Aphaca (8), Medicago scutellata (18), Melilotus sulcata (14), Ochtodium aegyptiacum (14), Scorzonera palaestina (19), Securigera securidaca (9), Silybum Marianum (1), Thesium humile (9), Tolpis virgata (21), Trifolium resupinatum (19), Trifolium spumosum (10), Trifolium xerocephalum (9), Urospermum picroides (9), Valerianella vesicaria (5).

Location and environment of records:

Rec. 1. Lower Galilee, Plain near Wadi Hamam (S. of Migdal), shallow stony soil, lentil field.
Rec. 2. Samaria, between Mt. Heteri and Bath Shlomo, rendzina soil, vetch field.
Rec. 3. NE. of Jerusalem, grayish white calcareous soil, wheat field.
Rec. 4. Judean Mountains, E. of Kiryath Anavim, terra rossa, lentil field.
Rec. 5. Ibidem, between Motza and Kiryath Anavim, stony plain terra rossa, fallow plot.
Rec. 6. Ibidem, n. Suba, grayish white soil, plot fallow for one year.
Rec. 7. Jerusalem, env. of Sanhedria, stony terra rossa.
Rec. 8. Lower Galilee, between Afule and Nazareth, dark grey calcareous, somewhat stony soil, wheat field.
Rec. 9. Ibidem, between Nazareth and Tiberias, n. Kafr Kama, compact white calcareous stony soil, barley field.
Rec. 10. Upper Galilee, between Kadesh and Malkieh, deep stony terra rossa, barley field.
Rec. 11. Ibidem, S. of Gush Halab, basalt soil covered with basalt and limestone boulders, wheat field.
Rec. 12. Ibidem, between Gush-Halab and Saasa, terra rossa transported in an intermountain valley, wheat field.
Rec. 13. Ibidem, 1,5 km. E. of Hurfesh, intermountain valley, terra rossa, wheat field.
Rec. 14. Ibidem, between Tarshiha and Pekiin, white marly and stony soil, wheat field.
Rec. 15. Ibidem, between Sukhmata and Pekiin, grayish white marly and stony soil.
Rec. 16. Ibidem, at a distance of one km. from above, dark stony terra rossa at foot of mountain, wheat field.
Rec. 17. Samaria, env. of Dalia, rendzina soil with stony surface, rye field.
Rec. 18. Ibidem, 1 km. N. of Dalia, rendzina soil, rye field.
Rec. 19. Judean Mountains, above Ain-Karem, field fallow for one year, stony terra rossa.
Rec. 20. Ibidem, Jerusalem terraces sloping the Matzleva Valley, terra rossa, wheat field fallow the second year.
Rec. 21. Ibidem, between Jerusalem and Malha, terra rossa, wheat field fallow for the second year.

3. The **Achilleion Santolinae.**

This alliance is confined to the Negev of Palestine and is one of the outstanding features of this region. It characterizes extensive agricultural areas of Irano-Turanian and Saharo-Sindian territories, where the mean annual

precipitation barely reaches 200 mm. Another feature is the strong fluctuation in the rainfall from year to year. Agriculture accordingly is very unstable here.

Edaphically this alliance accupies two more or less well defined soil varieties, viz. the loess and the sandy loess soils. Both are eolian in origin but differ from one another in their moisture retention capacity.

As seen from the table this alliance is distinguished from all other local alliances by series of characteristic species (exclusives, differentials and regionals) as well as by a number of desert companions. The total number of species is rather small.

The alliance comprises two associations: the Achilleetum Santolinae and the association of Leopoldia eburnea — Lolium Gaudini. The former is confined to loess soil in N. Negev, the latter to loessy sands. Both develop under desert conditions and none has a well developed summer aspect.

The **Achilleetum Santolinae (Eig, 1946)**

It covers vast stretches in the loess region of the N. Negev where agriculture is semi-nomadic and mainly confined to winter crops. According to edaphical variations (amount of $CaCO_3$, stoniness, depth of soil layer, etc.) this associations has been subdivided into three subassociations (Zohary-Feinbrun 1942) but for lack of sufficient data I prefer not to record them in the following table.

As a whole, the association comprises many desert weeds alongside Mediterranean and polychorus weeds. To the former belong Achillea Santolina, Glaucium corniculatum, Hyoscyamus reticulatus, Leopoldia longipes, Bellevalia Eigii, Malabaila Sekakul, etc. To the non-desert weeds belong Thesium humile, Phalaris, Brachypodium, Koeleria, etc.

Table III. Achilleetum Santolinae
(Percentage of presence)

Characteristic species of the association

93	Achillea Santolina	17	Vicia narbonensis var. serrata
60	Glaucium corniculatum	13	Malabaila Sekakul
47	Salvia lanigera	10	Pithuranthos tortuosus
43	Hyoscyamus reticulatus	10	Ixiolyrion montanum
33	Leopoldia longipes	7	Gypsophila porrigens
33	Malva aegyptia	7	Linaria floribunda
27	Onopordon alexandrinum	7	Astragalus kahiricus
20	Salvia spinosa	7	Anabasis Haussknechtii
20	Launea tenuiloba	3	Tulipa amblyophylla
20	Linaria albifrons	3	Pisum humile
20	Bellevalia Eigii	3	Vicia monantha
17	Bupleurum subovatum var. heterophyllum	3	Lathyrus pseudocicera

Characteristic species of alliance (Achilleion Santolinae).

67	Plantago albicans	7	Astragalus peregrinus
67	Trigonella arabica	3	Coronilla repanda
43	Astragalus alexandrinus	3	Argyrolobium uniflorum
20	Scleropoa memphitica	3	Astragalus annularis
7	Linaria ascalonica		

Characteristic species of suborder (Triticetalia orientalia).

37 Gundelia Tournefortii
33 Anthemis pseudocotula
27 Leontice Leontopetalum
17 Erucaria Boveana
13 Centaurea hyalolepis
13 Eryngium creticum
10 Ifloga spicata
7 Allium Ampeloprasum
7 Hippocrepis unisiliquosa
7 Gladiolus atroviolaceus
7 Linaria joppensis
7 Silene longipetala
3 Caucalis tenella
3 Cephalaria syriaca
3 Convolvulus Dorycnium
3 Eremostachys laciniata
3 Helicophyllum crassipes
3 Onobrychis squarrosa
3 Carthamus tenuis

Characteristic species of order (Secalinetalia) and class (Rudereto - Secalinetea)

50 Thesium humile
37 Cynodon Dactylon
23 Koeleria phleoides
23 Anagallis coerulea
20 Convolvulus althaeoides
13 Leopoldia comosa
13 Silene colorata
13 Phalaris brachystachys
13 Filago spathulata
13 Coronilla scorpioides
10 Brachypodium distachyum
10 Hypericum crispum
10 Chrozophora tinctoria
7 Phalaris paradoxa
7 Galium tricorne
7 Plantago Psyllium
7 Hordeum murinum
7 Scorpiurus muricatus?
7 Hymenocarpus circinatus
7 Asteriscus aquaticus
7 Ammi majus
7 Orobanche cernua
7 Plantago Lagopus
7 Vaccaria segetalis
3 Polygonum equisetiforme
3 Fumaria micrantha
3 Sinapis arvensis
3 Convolvulus arvensis
3 Malvella Sherardiana
3 Lotus villosus
3 Calendula arvensis
3 Cnicus benedictus
3 Antirrhinum Orontium
3 Papaver hybridum
3 Herniaria cinerea
3 Lolium rigidum
3 Trifolium campestre

Desert wides

33 Peganum Harmala
20 Reseda decursiva
17 Schismus calycinus
17 Matthiola livida
13 Senecio coronopifolia
10 Adonis dentata
7 Torularia torulosa
7 Trigonella stellata
7 Gastrocotyle hispida
3 Reboudia pinnata
3 Astragalus callichrous
3 Linaria Haelava
3 Calendula aegyptiaca

Accidentals (mainly relic weeds, all perennials)

33 Asphodelus microcarpus
10 Pallenis spinosa
10 Verbascum fruticulosum
7 Alkanna strigosa
7 Anchusa strigosa
7 Lycium europaeum
3 Gypsophila Rokejeka
3 Heliotropium rotundifolium

3 Thymelaea hirsuta	3 Bellevalia desertorum
3 Astragalus sanctus	3 Marrubium Alysson
3 Urginea maritima	3 Verbascum eremobium
3 Scrophularia xanthoglossa	3 Lactuca orientalis
3 Anagyris foetida	3 Verbascum sinuatum
3 Ajuga Iva	3 Dianthus multipunctatus

Of this association 30 records have been collected from the following localities:

Rec. 1. Negev, 10 kms. N. of Bersheva, field on slope of a hill.
Rec. 2. Negev, 18 kms. N. of Bersheva, wheat field, loess soil.
Rec. 3. Negev, 18 kms. NW. of Bersheva and 2 kms. E. of Bir-Abu-Mansur, plain, wheat field.
Rec. 4. Negev, 5 kms. SW. of Kaufakha, loess soil, fallow field.
Rec. 5. Negev, 6 kms. S. of Tel-Abu-Hureira, between Gaza and Bersheva.
Rec. 6. Negev, 5 kms. N. of Sheikh Nuran, loess soil, barley field.
Rec. 7. Negev, 12 kms. NE. of Bersheva, loess soil.
Rec. 8. Negev, 20 kms. N. of Bersheva, loess soil covered with pebbles, wheat field.
Rec. 9. Negev, 17 kms. NW. of Bersheva, env. of Bir-Abu-Mansur, typical loess soil, wheat field.
Rec. 10. Negev, 5 kms. S. of Bir-Abu-Mansur and 15 kms. NW. of Bersheva, compact wheat field.
Rec. 11. Negev, 5 kms. N. of Bir Abu Iraquia, about 14 kms. NW. of Bersheva, wheat field, typical loess soil.
Rec. 12. Negev, about 5 kms. NW. of Bersheva, compact loess soil typical of the Bersheva district, field.
Rec. 13. Negev, 7 kms. W. of Bersheva, loose loess soil, barley field; general coverage of weeds 20 %.
Rec. 14. Negev, about 12 kms. W. of Bersheva, fallow field; general coverage of weeds 60 %.
Rec. 15. Negev, 1½ kms. W. of Bersheva, light coloured loess soil, barley field; general coverage together with crop 60 %.
Rec. 16. 24 kms. NW. of Bersheva, 2—3 kms. N. of Khan-el-Far, loess soil.
Rec. 17. Negev, about 16 kms. SE. of Wadi Shalala, on the road between Gaza and Bersheva, loess soil, edge of a barley field, loess strewn with pebbles.
Rec. 18. Negev, about 15 kms. SE. of Wadi Shalala, on the road between Gaza and Bersheva, loess soil, barley field.
Rec. 19. Negev, about 18 kms. SW. of Bersheva, loess soil, barley field.
Rec. 20. Negev, about 20 kms. SW. of Bersheva, loess soil, barley field.
Rec. 21. Negev, env. of Khan-Abu-Sugheiban, about 14 kms. W. of Bersheva, loess soil, barley field.
Rec. 22. Negev, about 6 kms. NE. of Ain-esh-Shalala, between Khan-Yunis and Berheva, loess soil, barley field.
Rec. 23. Negev, about 13 kms. W. of Bersheva, typical loess, barley field.
Rec. 24. Negev, about 3 kms. E. of Bersheva, loess soil, wheat field.
Rec. 25. Negev, 13 kms. S. of Gaza, on the road to Rafah, loess plain, barley field.
Rec. 26. Eastern Negev, env. of Wadi Shalala, on the road between Gaza and Bersheva, loess soil, barley field.
Rec. 27. Negev, about 11,5 kms. NE. of Bersheva, typical loess soil.
Rec. 28. Negev, 1 km. of the crossroads Gaza - Bersheva - Immara, loess plain, fringes of barley field; general coverage 70 %.
Rec. 29. Negev, env. of Abassan, loess soil, barley field.
Rec. 30. Negev, about 16 kms. E. of Bersheva, env. of Khirbet-el-Vaten, loess soil in a Wadi, poor barley crop.

Association of Leopoldia eburnea - Lolium Gaudini
(ZOHARY and FEINBRUN, 1942)

This association is well developed in the N.W. corner of the Negev on loess soil covered by a sand layer. The annual rainfall does not exceed 150 mm. and in certain years not even 100 mm. Nevertheless agriculture is carried

on here without irrigation. Winter crops generally consist of wheat and barley, summer crops of durrah and melons.

The Leopoldia - Lolium association is distinguishable from all other segetal associations of the country by many characteristic species, some of them (e.g. Leopoldia eburnea, Artemisia monosperma, Colchicum Ritchii, Atractylis flava, Trisetum glumaceum) also occur in the psammophilous, nonsegetal vegetation of the vicinity, classed by EIG (1939) under Retametalia arenaria sinaica. The main association of this order is the Artemisietum monospermae sinaicum.

In fields fallow for one or more years the Leopoldia - Lolium association assumes the form of grass steppe dominated by Lolium Gaudini, Aegilops bicornis, Cutandia memphitica, Cynodon dactylon, etc. Where cultivation is abandoned for a longer period the Artemisietum monospermae occupies the area.

As an association growing on sandy soil it has certain species in common with the psammophilous association of Eragrostis bipinnata - Centaurea procurrens segetale of the Mediterranean Coastal Plain.

Table IV. The association of Leopoldia eburnea — Lolium Gaudini
(Percentage of presence)

Characteristic (regional or differential) species of the assoc.

(many of them also characteristic of primary associations of the Retametalia arenaria sinaica, **Eig** 1939)

67 Lolium Gaudini	13 Colchicum Ritchii
60 Linaria ascalonica	13 Anthemis sp.
53 Leopoldia eburnea	13 Erodium pulverulentum
53 Aegilops bicornis	7 Dipcadi erythraeum
47 Ononis serrata	7 Atractylis flava
40 Artemisia monosperma	7 Helianthemum sessiliflorum
40 Astragalus annularis	7 Trisetum glumaceum
40 Hippocrepis bicontorta	7 Vulpia inops
20 Coronilla repanda	

Characteristic species of alliance (Achilleion Santolinae)

73 Cutandia memphitica	7 Astragalus peregrinus
47 Plantago albicans	7 Launea tenuiloba
47 Trigonella arabica	7 Linaria albifrons
27 Adonis dentata	7 Malva aegyptia
20 Argyrolobium uniflorum	7 Orobanche sp.
20 Astragalus alexandrinus	7 Vicia peregrina
13 Bupleurum semicompositum	

Species occuring also in the assoc. of Eragrostis bipinnata - Centaurea procurrens segetale

47 Lotus villosus	47 Ifloga spicata
33 Orlaya maritima	13 Ornithopus compressus
20 Corynephorus articulatus	7 Trigonella cylindracea
20 Linaria joppensis	7 Cutandia philistea

Characteristic species of suborder (Triticetalia orientalia)

7 Helicophyllum crassipes
7 Leontice Leontopetalum

Characteristic species of order (Secalinetalia) and class (Rudereto - Secalinetea).

100 Cynodon Dactylon
33 Anagallis coerulea
20 Malva parviflora
13 Filago spathulata
13 Plantago Psyllium
7 Astragalus boeticus
7 Brachypodium distachyum
7 Bromus scoparius
7 Gladiolus segetum
7 Hedypnois cretica
7 Hypericum crispum
7 Plantago Lagopus
7 Polygonum equisitiforme
7 Thesium humile

Desert wides

13 Senecio coronopifolia
7 Linaria Haelava

Companions and accidentals

40 Trifolium tomentosum
33 Hedypnois cretica
27 Asphodelus tenuifolius
13 Lathyrus marmoratus
13 Ononis reclinata
7 Arisarum vulgare
7 Asphodelus microcarpus
7 Silene colorata

Location and environment of the records:

Rec. 1. Negev, env. of Dangur, sandy loess plain; general coverage 100 %.
Rec. 2. Negev, env. of Dangur, loess soil covered with sand, barley field.
Rec. 3. Negev, about 10 kms. SE. of Rafah, loess soil covered with sand, fallow field.
Rec. 4. Southwestern Negev, 63 kms. SE. of Gaza, sandy loess soil, fallow field.
Rec. 5. Negev, 31 kms. S. of Gaza, undulating plain, loess soil covered with a deep layer (70 cm.) of compact sand, fallow fields.
Rec. 6. Negev, env. of Tsealim, at Wadi Shenek, sandy loess soil, field fallowed; general coverage 70 %.
Rec. 7. Negev, about 6 kms. N. of Bir-Shenek, loess soil covered with sand.
Rec. 8. Southwestern Negev, km. 54 SE. of Gaza, 7 kms. SE. of Abu Kishta, sandy loess soil — transition between sandy loess and loess soil.
Rec. 9. Southwestern Negev, 5 kms. SE. of Abu Kishta, sandy loess plain, field fallowed probably for 2—3 years; general coverage 80 %.
Rec. 10. Southwestern Negev, 1 km. of Abu Mahinane, sandy loess soil.
Rec. 11. Southwestern Negev, undulating plain, compact sandy loess, rather deep sand.
Rec. 12. Negev, about 10 kms. NW. of El Khalasa (Halutza), sandy loess soil, barley field; general coverage 20 %.
Rec. 13. Negev, km. 29 between Gaza and Rafa, sandy loess soil, little developed barley fields.
Rec. 14. Southwestern Negev, km. 68,5 SE. of Gaza, sandy loess soil, fallow field; general coverage 75 %.
Rec. 15. Negev, env. of Tseàlim at the Wadi Shenek, sandy loess plain; general coverage 70 %.

4. The Eragrostion bipinnatae (EIG, 1939)

This alliance has been fully described by EIG from the Coastal Plain of Palestine. Among others it comprises the association of Eragros-

tis bipinnata - Centaurea procurrens and the Ormenidetum mixtae. Both are confined to sandy clays and are syngenetically connected.

They have been recorded by EIG from fields fallow for 1-2 (Ormenidetum) or several years (Eragrostis - Centaurea). My examinations on the same area were confined to sown fields actually under barley or vetch and barley cultivation. EIG established his Ormenidetum mainly on the absence of Eragrostis and the strikingly high coverage of certain species also present in the Eragrostis - Centaurea association. The records collected by me in sown fields are in their composition clearly transitional between the Eragrostis - Centaurea association and the Ormenidetum and cannot be considered other than as a segetal subassociation of the former.

Table V. The association of Eragrostis bipinnata - Centaurea procurrens segetale

(Percentage of presence)

Characteristic species of the association

91	Eragrostis bipinnata	27	Tulipa sharonensis
82	Centaurea procurrens	18	Lupinus angustifolius
64	Brassica Tournefortii	18	Lupinus Termis
36	Ornithopus compressus	9	Silene gallica
36	Reseda orientalis		

Characteristic species of the alliance

64	Lupinus palaestinus	9	Allium telavivense

Characteristic species of suborder Retametalia (Eig 1939)

100	Ormenis mixta	36	Lotus villosus
82	Spergula arvensis	27	Crepis aculeata
73	Maresia pulchella	27	Polycarpon tetraphyllum
73	Medicago littoralis	18	Anchusa aggregata
64	Rumex occultans	9	Crucianella herbacea
45	Rumex bucephalophorus	9	Ifloga spicata
45	Anthemis leucanthemifolia	9	Corrigiola littoralis
36	Emex spinosus		

Characteristic species of suborder Triticetalia

9	Tetragonolobus palaestinus		

Characteristic species of order (Secalinetalia) and class (Rudereto - Secalinetea)

91	Senecio vernalis	9	Convolvulus arvensis
91	Raphanus Raphanistrum	9	Galium tricorne
55	Cynodon Dactylon	9	Hypericum crispum
55	Papaver Rhoeas	9	Euphorbia Helioscopia
45	Stellaria media	9	Medicago hispida
45	Anagallis coerulea	27	Scorpiurus muricatus
36	Poa exilis	27	Polygonum equisetiforme
36	Hymenocarpus circinatus	27	Vicia angustifolia
18	Malva parviflora	27	Trifolium resupinatum
9	Lathyrus Gorgonii	18	Lamium amplexicaule

18 Sonchus oleraceus
9 Fumaria micrantha
9 Medicago Murex
9 Lathyrus Ochrus
9 Geranium molle
9 Malva nicaeensis
9 Astragalus boeticus
9 Cyperus rotundus
9 Daucus littoralis

Companions

18 Lathyrus marmoratus
9 Biscutella didyma
9 Trifolium clypeatum
9 Lolium rigidum
9 Aegilops variabilis

Accidentals

18 Arisarum vulgare

The Eragrostis - Centaurea association as a whole, which at present occupies vast stretches of the sandy clay soils in the Coastal Plain is no doubt a secondary vegetation unit which has established itself after the Quercus ithaburensis climax association was wiped out by man. The Eragrostis association has obviously no syngenetical relation with the local Quercus forest climax.

Eragrostis bipinnata is a Saharo-Sindian species growing primarily in savannas of the Central Sahara (MAIRE 1940) and also in marshy habitats of the extreme deserts of the Negev (ZOHARY 1945).

The records of this subassociation were collected from the following localities:

Rec. 1. Sharon Plain, between Kfar Vitkin and Natanya, sandy-clay soil, barley and vetch field; general coverage 90 %, coverage of weeds 10 %.
Rec. 2. Sharon, between Gan-Haim and Beth-Lid, sandy-clay soil, barley field; general coverage 50 %, coverage of weeds 5 %.
Rec. 3. Sharon Plain, km. 90,5 on the road Petah-Tikva-Haifa, env. of Gan-Haim, sandy-clay soil, barley field; general coverage 80 %, coverage of weeds 5—10 %.
Rec. 4. Env. of Even Yehuda and Natanya, sandy-clay soil, barley field; general coverage 70 %, coverage of weeds 5 %.
Rec. 5. Env. of Even Yehuda, about 76,5 kms. on the road Petah-Tikva-Haifa, sandy-clay soil, oat and vetch field; general coverage 80 %, coverage of weeds 10 %.
Rec. 6. Sharon Plain, env. of Even Yehuda, km. 76 on the road Petah Tikva-Haifa, sandy-clay soil, pea field; general coverage 70 %; coverage of weeds 5 %.
Rec. 7. Sharon Plain, env. of Ramatayim, typical sandy clay soil, barley field; general coverage 80 %.
Rec. 8. Sharon Plain, env. of Raanana, sandy clay soil, oats and vetch field; general coverage 80 %, coverage of weeds 25 %.
Rec. 9. Sharon Plain, between Tel Zur and Kadimah, sandy clay soil, barley field; general coverage 90 %, coverage of weeds 10 %.
Rec. 10. Sharon Plain, env. of Kadimah, light terra rossa, barley field.
Rec. 11. Sharon Plain, 1 km. N. of Beth-Lid, light soil, barley field; general coverage 80 %, coverage of weeds 10—15 %.

IV. Syngenetical remarks.

The five associations considered in this paper comprise almost the entire segetal vegetation of non-irrigated fields in Palestine. They are based on ecological and floristical pecularities and therefore readily distinguishable from one another. Future more detailed analysis may nevertheless subdivide

these associations into minor units according to edaphical variations of areas occupied by them.

Sufficient evidence exists that the gross floristical make-up of this association has not changed for centuries. This is because agriculture and mode of cultivation too have not changed in this country for ages. What is subject to steady change is the coverage of the individual species within the association. As a matter of fact, each year has its dominant weeds which give the landscape its specific coloration. There are „years" of Chrysanthemum Coronarium, of Papaver Rhoeas, of Anchusa italica, of Ridolfia segetum, Rapistrum rugosum, Avena sterilis, Phalaris paradoxa, etc. This domination of certain weeds in certain years is no doubt the result of the specific climate of the year. Although it is as yet impossible to reveal the particular reason responsible for each variation in dominance, it is clear that minute deviations from the „normal" hydrothermic regime of the year may produce striking changes in the species mosaic of the associations. This, however, scarcely leads to elimination of certain species from the association.

As ecological and partly also phytogeographical units these segetal associations possess high indicator significance. For instance, Prosopis and other leading associates of the Prosopidetum are reliable indicators of deep heavy loams, the most productive lands of the country. The Ononis - Carthamus association points to shallow stony and generally poor mountainous soils. In the Coastal Plain of the Mediterranean territory Eragrostis bipinnat,a and many of its associates indicate light sandy-clay soil most suitable for Citrus groves, whereas in the Negev the limits of Achillea Santolina coincide roughly with the boundaries of the loess soil area.

As to the syngenetical relations of the segetal associations the following must be mentioned:

1. **The Scolymeto-Prosopidetum** occupies the most ancient agriculture districts of the country. These fertile lands were no doubt cultivated in prehistoric times. For long periods natural vegetation has been exterminated so completely that at present no direct evidences can be found as to the climax or its successional stages in this area. From the remains of vegetation still existing on unsown hills bordering these plains, one may, however, suggest the following arboreal climaxes for the various districts of this association. The Mediterranean Coastal Plain is the climax area of Ceratonieto-Pistacietum Lentisci. In the interior plains the climax is Zizyphetum Loti (Beth Shean Valley), Pistacietum atlanticae (Kinnereth Valley) and Quercetum ithaburense (in the Dan Valley and in the Plain of Yavneel, etc.).

The re-establishment of the climax vegetation or its successional seres on abandoned fields has never been observed in these areas. Fields fallow for several years are still in a weedy stage and dominated by Prosopis or Alhagi, etc. which are not greatly affected by changes in the soil constitution caused by fallowing. Owing to their tremendous subterranean shoots these plants are extraordinarily resistant in competition with the newly returning plants of primary vegetation.

2. **The Ononis leiosperma - Carthamus tenuis association** covers cultivated lands of the Mediterranean hill and mountain region. Agriculture here, though not less ancient than in the lowlands, has always been considerably less intensive than in plains and valleys because of the difficulties involved in mountain cultivation (clearing, terracing etc.). Consequently, many remnants of primary vegetation were left outside and inside of cultivation plots clearly indicating local climax vegetation and its successional march. Although the association of Ononis - Carthamus is more or less homogeneous throughout the entire area the climax vegetation of the latter consists of three different associations of forest and mâquis, viz.: the asso-

ciation of Quercus calliprinos - Pistacia palaestina (mostly on terra rossa from 300 m. above S.L.), the association of Quercus ithaburensis - Styrax officinalis (on dark rendzina of Lower Galilee and Ephraim Mountains) and the association of Pinus halepensis - Hypericum serpyllifolium (on light highly calcareous rendzinas).

Freshly cleared lands in the above areas still harbour a series of Batha and Garigue and even Mâquis components (relic weeds), mostly but not entirely disappearing with time. The reestablishment of climax vegetation on abandoned fields seems to be here considerably easier and faster than in the Prosopidetum for the following reasons:

a. cultivation here does not introduce considerable changes in soil constitution, b. the dominant weeds are less resistant in competition with the returning pioneers of the primary vegetation, c, the plants needed for revegetation of the direlict plots are present in the vicinity.

Observation has revealed that during the first 3-4 years after the field has been abandoned the segetal vegetation is still dominant on the plot, but a series of semiruderal or semisteppe hemicryptophytes, such as Carlina involucrata, Echinops Blancheana, Tolpis virgata, etc. readily enter the association. During a further period of 4-5 years Poterium or other pioneers of the Batha associations (Poterietum, Thymetum, Calycotometum, Cistetum, etc.) occur here as the first more stable stage of the successional sere leading to the climax vegetation.

Since segetal vegetation continues to exist several years after cultivation has stopped and only then passes slowly into permanent successional associations, one may perhaps consider the Ononis - Carthamus association or certain variants of it as an initial stage of the secondary successional sere in the entire mountain area of Palestine. At this juncture the assumption may be given that many of these plants, at present confined to segetal habitats only, might have played an important part in the colonization of newly formed land through erosion, spill, etc. even before man appeared. In fact, many segetals are first to occupy freshly denuded or bare areas in several parts of the country.

3. **The Eragrostis bipinnata - Centaurea procurrens association,** confined to the sandy clay lands of the Coastal Plain, covers the climax area of Quercetum ithaburense arenarium, which differs from other varieties of the same association by the presence of certain psammophilous associates. This forest type, which at the end of the last century still occupied continuous areas in the Sharon Plain, has been almost entirely devastated and replaced by the Eragrostis - Centaurea association and its many variants.

It is at present impossible to trace the syngenetical lines of the above Quercetum ithaburense but small patches of Calycotometum, Poterietum, Cistetum, Thymetum, etc., scattered in the area give clear evidence that these associations are no doubt successional stages leading to the Quercetum. On the other hand the Eragrostis - Centaurea association, was never linked syngenetically with the above forest climax. In fact Eragrostis, the leading and dominant species of the association, is a Saharo-Sindian saltland or Savannah plant which could by no means occupy the Mediterranean territory before the land was laid bare through destruction of the primary climax by man. In this regard Eragrostis resembles Prosopis and a few other associates of the Prosopidetum which are strangers to the Mediterranean forest climax territory.

As to the re-establishment of the climax vegetation, I had no opportunity to observe the recapture of the land by local successional stages, even on plots abandoned by man for ten or more years. This is presumably because

Eragrostis with its extensive subterranean shoot and root system is most aggressive and cannot readily be suppressed by the pioneers of local dwarf shrub vegetation.

From the above it seems that the difficulties in regeneration of the original vegetation in this and in other cases must be ascribed to the vigor of the dominant occupants which preserve their supremacy long after optimal life conditions have ceased to exist on the spot.

4. **Achilleetum Santolinae** covers the loess lands of the N. Negev Plain. This area, although subject to a steppe climate, has been cultivated for many centuries. Agriculture is most primitive but so extensive that no spot has been found unploughed throughout the entire Plain. Primary vegetation can therefore hardly be traced within the area. From what has been observed in similar edaphic and climatic conditions in southern Transjordan and in the hills adjacent to the loess plain, however, the climax vegetation of the area in question must be a certain variant of Artemisietum Herba-albae.

As to the syngenetical relations between the Achilleetum and Artemisietum the following must be emphasized: side by side with typical widespread weeds and desert wides the Achilleetum harbours a considerable number of annual and perennial species also found in the Artemisietum. Such are Salvia lanigera, Plantago albicans, Astragalus alexandrinus, etc.

Achillea, the leading species of this association, was no doubt codominant in the original Artemisietum of the area in question. It could maintain itself under segetal conditions because its subterranean shoots readily withstand ploughing, while Artemisia, with its very shallow roots, has been removed easily from the area through continuous cultivation. One comes thus to the conclusions that the Achilleetum still preserves many species of that type of Artemisietum which originally existed in the area. The re-establishment of the climax associations — the Artemisietum — in abandoned fields seems thus to be easy and rather immediate.

5. **The association of Leopoldia - Lolium** is limited to a desert area dominated by the vegetation of the Retametalia arenaria sinaica (EIG 1939), which comprises among others a particular association, the Artemisietum monospermae. Very few widespread and typical weeds occur in this association. Apart from some desert wides, it contains a considerable number of characteristic species, most of them occuring also in the Artemisietum monospermae of adjacent dunes and sandfields, though in quite different proportions. The climax association is here very easily restored, since a part of it is already included within the segetal association.

In spite of the above features the Leopoldia — Lolium association, as described above, is a constant segetal association of nonirrigated winter crops growing under Saharo-Sindian conditions.

SUMMARY.

1. A phytosociological analysis of Palestine's weed vegetation of non-irrigated agriculture has revealed the existence of five plant associations well defined by floristic, ecological and phytogeographical characteristics.
2. These associations belong to four alliances which together constitute a particular suborder of the Secalinetalia Br. Bl.
3. A phytogeographical analysis of the weed flora has revealed the great proportion of East-Mediterranean and Irano-Turanian species among the segetals of Palestine.
4. A series of obligatory weeds occuring in Mediterranean Palestine recur as components of primary associations in the neighbouring steppes and deserts, whence they obviously came to the segetal habitat.

5. A series of other obligatory weeds endemic to Palestine or to Palestine and Syria have as yet not been found in primary habitats.
6. There is some evidence for the assumption that many widespread weeds at present not found in primary habitats are to be considered components of „new-land" associations, i.e. pioneer associations colonizing bare lands formed through denudation or spill etc. These plants have no doubt existed ever since and with the artificial formation of new land by man have occupied the segetal habitats as permanent sites.
7. While certain segetal associations (Prosopidetum, Eragrostis - Centaurea association) continue to exist on the spot long after cultivation has ceased and so to delay the return of primary vegetation, other associations (Ononis - Carthamus association, Achilleetum, Leopoldia - Lolium association) readily disappear from abandoned fields and clear the way for local climax vegetation or seral associations preceding the climax.

ACKNOWLEDGEMENT.

This work was carried out within the framework of a research project on weeds sponsored and supported by the Research Council of Israel to which the author is greatly indebted.

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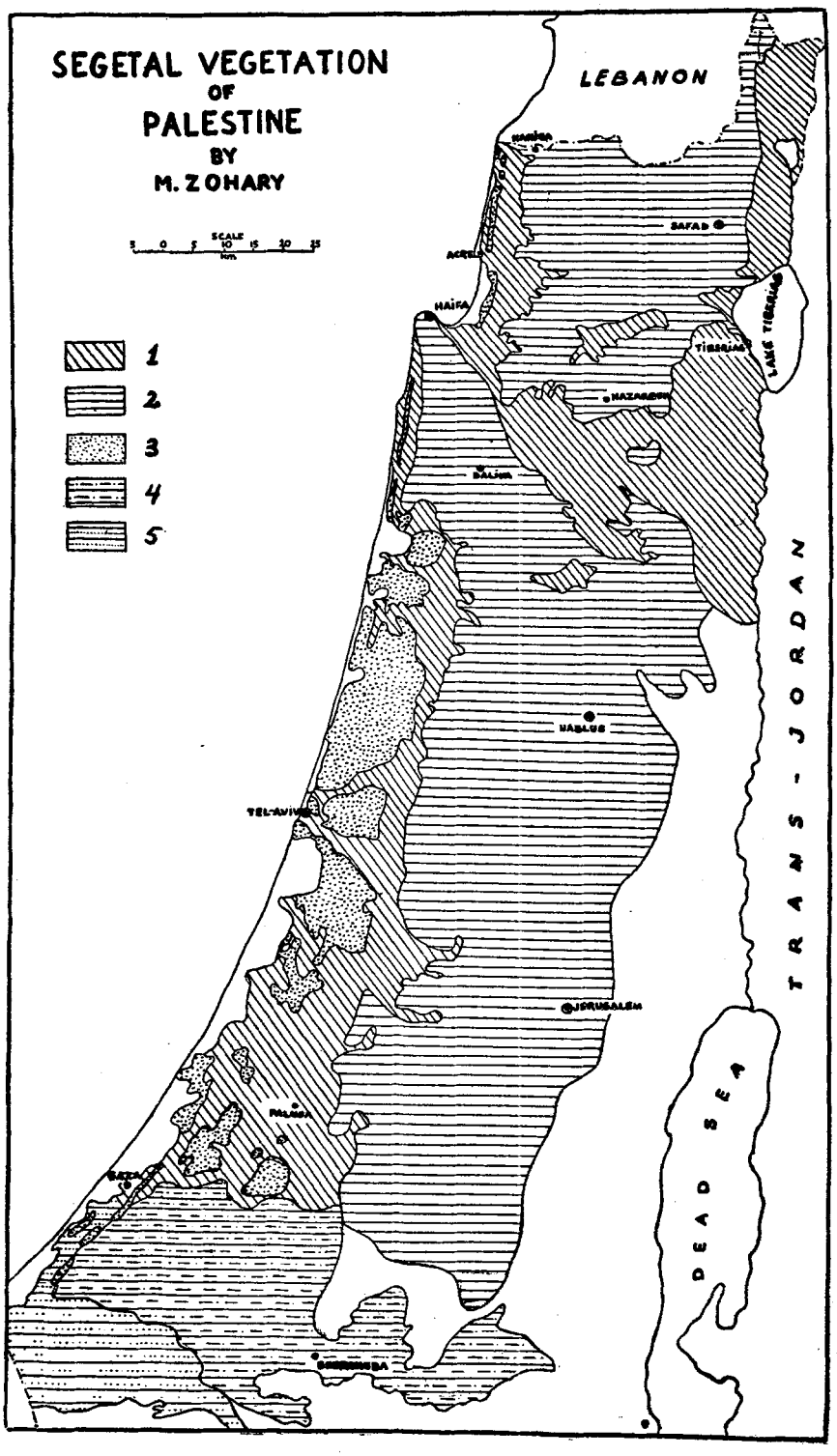

LEGEND

1 = Region of Prosopidion farcatae segetale.
2 = Region of Ononideto-Carthamion tenuidis.
3 = Region of Eragrostion bipinnatae.
4 = Region of Achilleetum Santolinae.
5 = Region of assoc. of Leopoldia eburnea — Lolium Gaudini.