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THE SEGETAL VEGETATION OF VINEYARDS AND CROP FIELDS IN FRIULI-VENEZIA GIULIA (NE ITALY)

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Abstract: The segetal vegetation of vineyards and crop fields of Friuli-Venezia Giulia (NE Italy) was studied. 165 phytosociological relevés were analyzed by numerical classification and compared with those of Central European isoecic coenoses. Four associations were detected: the coenoses of vineyards and of weeded summer cultures of the plain and the hill belts, corresponding to those already described from Central Europe (*Geranio rotundifolii-Allietum vinealis* R. Tx. ex von Rochow 1966 and *Echinochloo-Setarietum pumilae* Felföldy 1942 corr. Mucina 1993, respectively), and the coenoses of weeded cultures of the mountain belt and of winter crop fields, described as new associations (*Galeopsido tetrahit-Galinsogetum* ass. nova and *Papaveretum apuli* ass. nova, respectively). A new subassociation of the *Echinochloo-Setarietum pumilae* is proposed, and the ecological concept of agroform is introduced. The results of this study indicate that the standardization of agronomic techniques has drastically reduced the biodiversity of these associations.

Introduction

The coenoses of vineyards and of crops (maize, soy-bean, potatoes, wheat and barley) are subjected to a very high anthropogenic pressure which changes continuously, due to the transition from artisan and semi-artisan techniques to an industrial agriculture. This has deeply modified the flora and vegetation of agroecosystems. The disappearance of many archaeophytes and the income and stabilisation of many neophytes represent very good examples of this phenomenon (Martini & Poldini 1995).

The standardization of agronomic techniques and the increased use of herbicides have drastically reduced the biodiversity of these ecosystems and the number of thermophilous species has strongly decreased. This is testified, for instance, by the disappearance of some syntaxa such as the *Polygono-Chenopodion polyspermi* alliance, described by Pignatti (1952) from the Venetian plain (Krippelová 1979). For this reason, it is necessary to reconsider the syntaxonomy of relevés from Friuli-Venezia Giulia. Nowadays it may be more appropriate to include them in the isoecic coenosis of Central Europe (*Geranio-Allietum* for vineyards of Rhine valley and *Echinochloo-Setarietum* for weeded crops of Central Europe). As a consequence, these coenoses have a very large distributional range that includes several biogeographical regions with different potential vegetations.

The weed communities of autumn-winter cereals (wheat and barley) and those of cultures of the mountain belt (potatoes and beans) are well differentiated; they are described for the first time in this paper.

When considering the strong floristic homogenization of agroecosystems, we adopted the syntaxonomical scheme proposed by Mucina (1993) that groups all the crop coenoses into a single class (*Stellarietea mediae*), rather than considering the coenosis of autumn-winter crops as belonging to the independent class of *Secalietea* (Oberdorfer 1993).

As already noted for other ecosystems (Chiapella Feoli & Poldini 1993; Poldini & Oriolo 1994), some of the relevés presented in this paper have a documentary value for vanishing plant communities.

Data and methods

165 phytosociological relevés regarding the main cultures of Friuli-Venezia Giulia have been considered. Karst relevés have been taken from Poldini (1989).

The relevés have been compared with those of vineyards of Slovenia (Vipava valley, Seljak 1989) and of Central Europe (Oberdorfer 1993; Wilmanns 1989), and with those of weeded crop fields from Italy [eastern Venetian plain (Lorenzoni 1963) and

Ferrara province (Gerdol & Piccoli 1979)], Slovenia (Vipava valley, Seljak 1989), Germany (Oberdorfer 1993), Croatia (Regula-Bevilacqua 1979) and Slovakia (Krippelová 1981).

Cover values have been converted according to van der Maarel (1979), and numerical data analysis has been carried out with Syn-Tax (Podani 1993) and Lagoli (Lagonegro & Feoli 1985) softwares.

The floristic nomenclature follows Ehrendorfer (1973), and the syntaxonomical one Mucina (1993), who refers to Ries (1992). Ecological indices have been desumed from Landolt (1977) and Poldini (1991). Data concerning pollination mechanisms has been drawn from Faegri & van der Pijl (1971), those concerning dispersion from Müller-Schneider (1986). Life forms and chorotypes have been taken from Poldini (1991).

Abbrevations in the tables are as follows: d = differential species of a part of an association; DAss = differential species of association; DAll = differential species of alliance; DO = differential species of order; O = order species; K = class species.

The concept of agroform

The evolution of cultivation techniques causes fast changes in the floristic composition and in the interspecific relationships within crop coenoses. These may change according to specific modifications of the cultivation techniques (for instance the passage from weeding to mulching) (Wilmanns 1989, 1991). In this respect we define as «agroform» of a crop coenosis the result of ecological modifications caused by agronomic techniques, provided that the connection with the original association is still evident.

In the crop associations of Friuli-Venezia Giulia three agroforms of vineyards (showing a transition from weeding to mulching or to mowing) and one of summer weeded crop fields (showing a very high use of herbicides) have been detected. Their description is given in the following chapters.

Syntaxonomical considerations

In order to define the syntaxonomical scheme of crop and vineyard associations of Friuli-Venezia Giulia, two of the most representative schemes were considered, that of Oberdorfer (1993), and that of Mucina (1993).

The scheme proposed by Oberdorfer (1993) is mainly based on Braun-Blanquet (1936). According to this scheme, crops and ruderal communities with annual cycle are divided into two different classes, *Secalietea* Br.-Bl. 1952 and *Chenopodietea* Br.-Bl. in Br.-Bl. *et al.* 1952. The first class includes associations of autumn-winter cereals (for instance barley and wheat), while the second one includes the other crop coenoses (mainly summer weeded crops and vineyards) in the order *Polygono-Chenopodietalia* (Tx. et Lohm. in Tx. 1950) J. Tx. in Lohm. *et al.* 1962, and the ruderal vegetation with annual cycle in the order *Sisymbrietalia* J. Tx. in Lohm. *et al.* 1962. On the contrary, the scheme proposed by Mucina (1993) refers to Tüxen's modification (Tüxen 1950) of Braun-Blanquet's scheme. It considers a single class, *Stellarietea mediae* R. Tx., Lohm. et Preis. in R. Tx 1950, subdivided in four orders: *Centaureetalia cyani* R. Tx., Lohm. et Preis. in R. Tx. 1950 for cultures of basic soils, *Chenopodietalia albi* R. Tx. (1937) 1950 for cultures of acid soils, *Sisymbrietalia* J. Tx. in Lohm. *et al.* 1962 for ruderal vegetation with annual cycle and, finally, *Eragrostietalia* J. Tx. ex Poli 1966 for cultures and ruderal associations with south-eastern European distribution.

The synthetic table (Tab. 1) highlights a substantial group of species, common to all the coenoses (*Chenopodium album*, *Veronica persica*, *Capsella bursa-pastoris*, *Cirsium arvense*, *Fallopia convolvulus*, *Stellaria media*, *Erigeron annuus*, *Sinapis arvensis*), that can be considered as characteristic of *Stellarietea*. This is in line with the fact that strong changes in agronomic techniques are levelling the floristic differentiation of the crop field associations (a valid example is the vanishing of many archaeophytes in wheat fields). Therefore, we think that Mucina's scheme fits better with the present situation in Friuli-Venezia Giulia, also because the only coenosis of *Centaureetalia* found in Friuli-Venezia Giulia (*Papaveretum apuli*) has a high presence of *Stellarietea* species.

We have introduced some significant changes to the original scheme of Mucina (1993):

a) the definition of *Centaureetalia* and *Chenopodietalia* orders seems to be more linked to the vegetation cycle than to soil characteristics. Therefore the spring-summer developing coenoses of vineyards and of summer weeded fields belong to *Chenopodietalia*, while the only association of autumn-winter cereals (*Papaveretum apuli*) belongs to *Centaureetalia*.

b) we placed the coenosis of Friuli-Venezia Giulia vineyards (*Geranio-Allietum*) into the *Chenopodietalia* order, not into the *Centaureetalia* order.

Tab. 1 - Synthetic table of syntaxonomic units present in Friuli-Venezia Giulia (frequency values).
1 = *Papaveretum apuli*; 2 = *Geranio-Allietum*; 3 = *Echinochloo-Setarietum*, Friuli cool variant;
4 = *Echinochloo-Setarietum*, Friuli warm variant; 5 = *Echinochloo-Setarietum xanthietosum*;
6 = *Echinochloo-Setarietum*, Karst warm variant; 7 = *Echinochloo-Setarietum*, Karst cool variant;
8 = *Galeopsido-Galinsogetum*.

		1	2	3	4	5	6	7	8
	Char. & diff. sp. (DAss1) ass. & all. (*Papaveretum apuli* and *Caucalidion*)								
	Papaver apulum	76							
	Avena fatua	59							
	Valerianella rimosa	35							
	Fumaria vaillantii	12							
	Valerianella eriocarpa	12							
	Ajuga chamaepitys	12							
	Ranunculus arvensis	88	9						
	Legousia speculum-veneris	82	9						
	Consolida regalis	65	6						
DAss1	Chaenorrhinum minus	29		6					
	Valerianella locusta	24	14						
DAss1	Silene vulgaris	47	3	13				8	4
DAss1	Oxalis fontana	41		6					4
	Diff. sp. order (*Centaureetalia*)								
	Centaurea cyanus	71							
	Raphanus raphanistrum	47							
	Buglossoides arvensis	41							
	Papaver argemone	24							
	Lolium temulentum	18							
	Rapistrum rugosum	12							
	Legousia hybrida	12							
DAss2	Anthemis arvensis	59	23						
DAss2	Veronica arvensis	53	31						
DAss2	Cerastium glomeratum	53	66						
	Aphanes arvensis	6	3						
	Arabidopsis thaliana	35	3						
	Papaver rhoeas	100	26					25	
	Fumaria officinalis	82	20					8	
DAss2	Alopecurus myosuroides	65	46					8	
	Myosotis arvensis	47	14						26
	Viola arvensis	47	6	6				8	
	Matricaria chamomilla	29			14				9
	Char. and diff. (DAss2) ass. and all. (*Geranio-Allietum* and *Fumario-Euphorbion*)								
	Calepina irregularis		63						
DAss2	Cerastium tenoreanum		57						
	Muscari racemosum		34						
	Allium vineale		31						
	Ornithogalum umbellatum		23						
	Valerianella carinata		11						
	Geranium rotundifolium		3						
	Thlaspi arvense		3						
DAss2	Crepis taraxacifolia	24	83						
K, Dass2	Lactuca serriola	35	63						
DAss2	Geranium dissectum	6	60						
K, DAss2	Bromus sterilis	24	49						

K, DAss2	Veronica hederifolia	18	34						4
DAss2	Muscari comosum	6	11						
	Char. & diff. sp. (DAss3) ass. (*Echinochloo-Setarietum*)								
K, DAss3	Amaranthus retroflexus	18	9	88	100	100	83	100	4
DAss3	Solanum nigrum			31	86	60	83	67	
d	Hibiscum trionum				14	40	100	17	
	Portulaca oleracea			19	71		33	8	
d	Amaranthus graecizans	6			14		67	50	
d	Bidens tripartita				14	100			39
d	Polygonum lapathifolium				43	100			
K, d	Xanthium italicum	12			14	80			
d	Bidens frondosa	6		6		60			
d	Lycopus europaeus					40			
	Diff. sp. ass. (DAss4) (*Galeopsido-Galinsogetum*)								
DAss4	Galeopsis tetrahit								65
DAss4	Galeopsis speciosa								48
DAss4	Aethusa cynapium								30
K, Dass4	Mentha arvensis	6						8	39
DAss4	Galinsoga ciliata			13					26
K, DAss4	Stachys palustris							25	39
DAss4	Galium aparine	29	9					17	70
	Char. & diff. sp. alleance (DAll3) (*Panico-Setarion*)								
K, DAll3	Digitaria sanguinalis	6	9	75	86	40	100	33	9
O2, DAll3	Setaria pumila	6		100	43	100	83	50	48
DO2, DAll3	Echinochloa crus-galli		9	88	100	100	33	42	13
	Chenopodium polyspermum			63	14	40		50	30
DAll3, d	Galinsoga parviflora	6		100	29			42	74
	Panicum miliaceum						17	8	4
	Char. & diff. sp. order (DO2) (*Chenopodietalia*)								
DO2	Euphorbia helioscopia	18	83	75	43	60	50	83	65
DO2	Sonchus oleraceus	18	49	63	43	60	67	58	74
DO2	Sonchus asper	18	40	19	14	60		50	
DO2	Lamium purpureum	12	37	44				33	57
	Sonchus arvensis		3	6				50	13
	Diplotaxis muralis		26	6			83	42	
	Erodium cicutarium		37				33	17	
	Lamium amplexicaule		14					8	
	Class species (*Stellarietea*)								
	Chenopodium album	94	3	100	100	100	100	92	100
	Veronica persica	76	100	44	29	20	83	67	26
	Capsella bursa-pastoris	76	71	81	14		17	83	74
	Cirsium arvense	29	71	13	29		67	58	43
	Fallopia convolvulus	65	14	38	14		33	83	83
	Polygonum persicaria	82	3	81	100		33	83	96
	Stellaria media	76	97	56			33	67	96
	Conyza canadensis	18	9	6		20	17	8	
	Erigeron annuus	53	37	31	57	60			17
	Senecio vulgaris	29	86		29	20	33	42	
	Vicia sativa (aggr.)	71	77			20	17	17	4
	Anagallis arvensis	76	14	6	14			17	
	Mercurialis annua	18	20	6				42	4
	Sinapis arvensis	41	6				33	33	9

Geranium molle	6	17				17	17	4
Brassica napus	12	20					8	9
Cardamine hirsuta	6	23	6					4
Geranium pusillum		3				17	17	4
Datura stramonium	12				40		8	
Oxalis corniculata	6		13					4
Geranium columbinum		23					8	13
Sherardia arvensis		3				17		4
Setaria viridis						67	42	26
Companions								
Agropyron repens	29	34	13	14	40	67	75	4
Calystegia sepium	94	51	88	57	100	33	42	65
Taraxacum officinale (aggr.)	12	94	63	57	60	67	67	26
Polygonum aviculare (aggr.)	76	3	25	14	60		58	9
Convolvulus arvensis	35	77	25	14		100	83	74
Artemisia vulgaris	24	11	6	43			8	4
Trifolium repens	24	14	31	14			8	17
Trifolium pratense	6	11	25			33	42	17
Daucus carota	29	14	13		20	17		13
Sorghum halepense	59		6	57	40	17	8	
Equisetum arvense	24		13	57	60		17	22
Plantago lanceolata	6	20	6			33	17	
Rumex crispus	18	54	19			17	17	
Plantago major	12	9	13		40		8	
Verbena officinalis	6		6	14	40		8	
Diplotaxis tenuifolia	6		6	14		33	17	
Rorippa sylvestris	29	6	6				8	
Potentilla reptans	18	11		14		33		
Galium mollugo	6	3				17		4
Lolium multiflorum	53	51					8	4
Rumex obtusifolius	18	40					17	4
Medicago lupulina	35		19			17	25	
Leucanthemum vulgare (aggr.)	6	3				17		9
Mentha spicata				14	20	17	8	
Arenaria serpyllifolia	59	20	6					
Arrhenatherum elatius	6	11						4
Glechoma hederacea	6		13					9
Medicago sativa	12	3					8	
Achillea millefolium	6					17		9
Mentha longifolia	71	29		14				
Silene alba	59	6						9
Cynodon dactylon		11	6			17		
Poa annua		46	13					17
Aristolochia clematitis		3				17	17	
Agrostis stolonifera		3	13			17		
Trifolium incarnatum /molinieri		20				17	25	
Leontodon hispidus		3				17	17	
Poa sylvicola	82	57						
Artemisia verlotorum	29	3						
Acalypha virginica			6	14				
Rubus caesius	18			14				
Prunella vulgaris						17		4
Conyza albida	24							
Ranunculus bulbosus		29						
Abutilon teophrasti					20			

Although this attribution is questionable, we wanted to put in evidence that this association lacks archaeophytic species, whereas species typical of weeded crops (*Lamium purpureum*, *Sonchus asper*, etc.) are frequent.

In addition to floristic criteria, we considered also structural (presence of bulbous geophytes), functional (presence of C4 plants) and chorological (presence of adventitious species) parameters for the definition of the coenoses.

Table 2 shows that geophytes reach their maximum value in *Geranio-Allietum*, while the highest values of neophytes and C4 species are found in *Echinochloo-Setarietum*; these two categories change together because most of successful neophytes are C4 plants. From Tab. 2 it is also evident that the vineyard vegetation has a low level of disturbance, as indicated by the scarce participation of neophytes. The dendrogram obtained from the cluster analysis of all relevés (Fig. 1) shows four main clusters, as follows:

Table 2 - Parameters used in the definition of coenoses (A = *Papaveretum apuli*; B = *Geranio-Allietum*; C = *Echinochloo-Setarietum*; D = *Galeopsido-Galinsogetum*). Values are weighed by frequency.

	A	B	C	D
Bulbous geophytes	0.001	0.038	0	0
Neophytes	0.082	0.005	0.180	0.085
C4 species	0.026	0.010	0.215	0.058

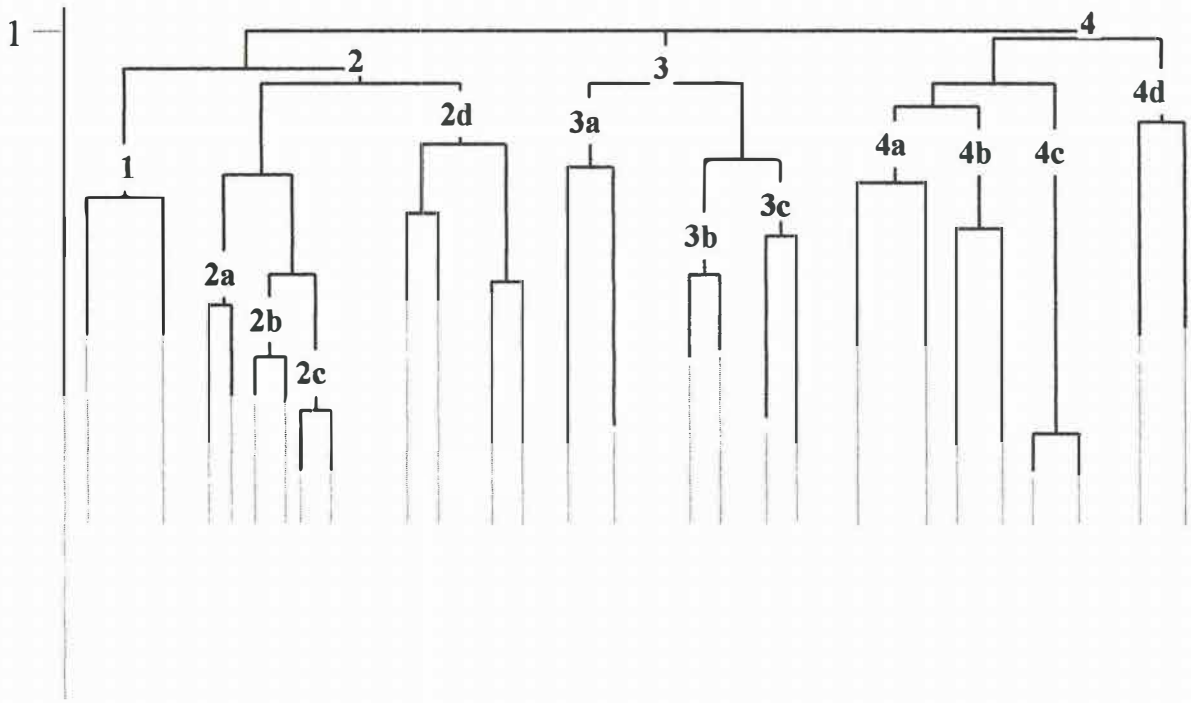


Fig. 1 – Simplified dendrogram of 165 phytosociological relevés (similarity ratio, complete linkage). 1 = relevés of autumn-winter crops (*Papaveretum apuli*); 2 = relevés of summer weeded crops of hills, valley bottoms, and plains; 2a = *Echinochloo-Setarietum*, Friulian cool variant; 2b = *Echinochloo-Setarietum*, Friulian warm variant; 2c = *Echinochloo-Setarietum xanthietosum*; 2d = *Echinochloo-Setarietum*, *Sorghum halepense* agroform; 3a = *Galeopsido-Galinsoghetum*; 3b = *Echinochloo-Setarietum*, Karstic cool variant; 3c = *Echinochloo-Setarietum*, Karstic warm variant; 4 = relevés of vineyards (*Geranium-Allietum*); 4a = *Geranio-Allietum*, typical form; 4b = *Geranio-Allietum*, *Taraxacum officinale* agroform; 4c = *Geranio-Allietum*, *Arrhenatherum elatius* agroform; 4d = *Geranio-Allietum*, *Agrostis stolonifera* agroform.

cluster 1 = relevés of autumn-winter cereals (*Papaveretum apuli*);
cluster 2 = relevés of weeded summer cultures of hills, valley bottoms and plain;
cluster 3 = relevés of weeded summer cultures of Karst and mountains;
cluster 4 = relevés of vineyards (*Geranio-Allietum*).

By following ecological and biogeographical considerations, relevés of cluster 2 can be ascribed to a Friuli sub-race of *Echinochloo-Setarietum*; these relevés can be further subdivided into a cool variant (cluster 2a), a warm variant (cluster 2b), a subassociation (cluster 2c, *xanthietosum*) and an agroform (cluster 2d). Similarly, relevés of cluster 3 can be ascribed to a Karstic sub-race of *Echinochloo-Setarietum*, with a warm variant (cluster 3c) and a cool one (cluster 3b), and to *Galeopsido-Galinsogetum* (cluster 3a). Cluster 4 groups all relevés of vineyards.

The synthetic table of all relevés belonging to clusters 2a,b,c,d and 3a,b,c is reported in Tab. 3. This matrix has undergone a hierarchical classification based on the complete link method, in order to clarify the syntaxonomy of weeded crop fields. The dendrogram is reported in Fig. 2.

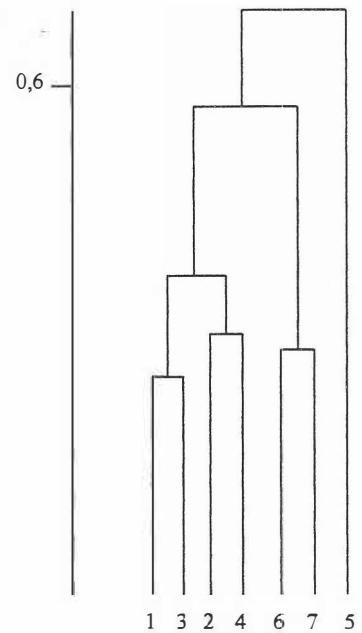


Fig. 2 – Dendrogram of weeded crop coenoses of Friuli – Venezia Giulia (similarity ratio, complete linkage). 1 = *Echinochloo-Setarietum*, Friulian cool variant; 2 = *Echinochloo-Setarietum*, Friulian warm variant; 3 = *Echinochloo-Setarietum xanthietosum*; 4 = *Echinochloo-Setarietum, Sorghum halepense* agroform; 5 = *Galeopsido-Galinsoghetum*; 6 = *Echinochloo-Setarietum*, Karstic cool variant; 7 = *Echinochloo-Setarietum*, Karstic warm variant.

Synoptic table of studied vegetation types

STELLARIETEA MEDIAE R. Tx., Lohm. et Preis. in R. Tx. 1950

CHENOPODIETALIA ALBI R. Tx. (1937) 1950

Veronico-Euphorbion Sissingh ex Passarge 1964 (syntax. syn.: ***Fumario-Euphorbion*** T. Müller in Görs 1966)

1) *Geranio rotundifolii-Allietum vineale* R. Tx. ex von Rochow 1951 (syntax. syn.: *Cerastio-Geranietum dissecti* Poldini 1980)

Panico-Setarion Sissingh in Westhoff *et al.* 1946

2) *Echinochloo-Setarietum pumilae* Felföldy 1942 corr. Mucina 1993 (syntax. syn.: *Panico-Polygonetum persicariae* Pignatti 1953; *Hibisco-Digitarietum sanguinalis* Poldini 1980; *Hibisco-Sorghetum halepensis* Poldini 1989 non Horvatic et Hodak 1960; *Oxalido - Chenopodietum* Sissingh 1950)
subass. *xanthietosum italici* subass. nova hoc loco

3) *Galeopsido tetrahit-Galinsogetum parviflorae* ass. nova hoc loco

CENTAUREETALIA CYANI R. Tx., Lohm. et Preis. in R. Tx. 1950

Caucalidion lappulae (R. Tx. 1950) von Rochow 1951

4) *Papaveretum apuli* ass. nova hoc loco

Associations

Ass.: ***Geranio rotundifolii-Allietum vineale*** R. Tx. ex von Rochow 1951 geogr. var. with *Cerastium tenoreanum*, geogr. var. nova hoc loco (Tab. 4).
Syntax. syn.: *Cerastio-Geranietum dissecti* Poldini 1980.
"The vegetation of vineyards"

Tab. 3 - Simplified comparison table of weeded coenosis of Friuli-Venezia Giulia (frequency values). 1 = *Echinochloo-Setarietum*, Friulian cool variant; 2 = *Echinochloo-Setarietum*, Friulian warm variant; 3 = *Echinochloo-Setarietum xanthietosum*; 4 = *Echinochloo-Setarietum, Sorghum halepense* agroform; 5 = *Echinochloo-Setarietum*, Karstic warm variant; 6 = *Echinochloo-Setarietum*, Karstic cool variant; 7 = *Galeopsido-Galinsogetum.*

		1	2	3	4	5	6	7
	Charac. and diff. (DAss1) species of ass. (*Echinochloo-Setarietum*)							
K,DAss1	Amaranthus retroflexus	88	100	100	91	83	100	4
DAss1	Solanum nigrum	31	86	60	78	83	67	
	Portulaca oleracea	19	71		5	33	8	
d2	Hibiscum trionum		14	40	5	100	17	
d2	Bidens tripartita		14	100	5			39
d2	Amaranthus graecizans		14			67	50	
d2	Bidens frondosa	6		60				
d2	Polygonum lapathifolium		43	100				
d2	Xanthium italicum		14	80				
d2	Lycopus europaeus			40				
	Charac. and diff. (DAss2) species of ass. (*Galeopsido-Galinsogetum*)							
DAss2	Galinsoga ciliata	13			5			26
DAss2	Galium aparine						17	70
K, Dass2	Mentha arvensis						8	39
K, DAss2	Stachys palustris						25	39
DAss2	Galeopsis speciosa							48
DAss2	Galeopsis tetrahit							65
DAss2	Aethusa cynapium							30
	Charac. and diff. (DAll) of all. (*Panico-Setarion*)							
K, Dall	Digitaria sanguinalis	75	86	40	82	100	33	9
DO, DAll	Echinochloa crus-galli	88	100	100	22	33	42	13
Dall	Setaria pumila	100	43	100	48	83	50	48
	Chenopodium polyspermum	63	14	40	8		50	30
DAll, DAss2	Galinsoga parviflora	100	29		73		42	74
	Panicum miliaceum					17	8	4
	Charac. and diff. (DO) species of ord. (*Chenopodietalia*)							
DO	Euphorbia helioscopia	75	43	60	49	50	83	65
DO	Sonchus oleraceus	63	43	60	22	67	58	74
DO	Sonchus asper	19	14	60	13		50	
DO	Lamium purpureum	44			9		33	57
	Diplotaxis muralis	6				83	42	
	Sonchus arvensis	6					50	13
	Erodium cicutarium					33	17	

Class species (*Stellarietea*)							
Chenopodium album	100	100	100	73	100	92	100
Veronica persica	44	29	20	26	83	67	26
Cirsium arvense	13	29		13	67	58	43
Capsella bursa-pastoris	81	14		59	17	83	74
Fallopia convolvulus	38	14		5	33	83	83
Polygonum persicaria	81	100		91	33	83	96
Erigeron annuus	31	57	60	30			17
Conyza canadensis	6		20	8	17	8	
Stellaria media	56			21	33	67	96
Senecio vulgaris		29	20	23	33	42	
Vicia sativa (aggr.)			20	5	17	17	4
Mercurialis annua	6			40		42	4
Geranium molle				5	17	17	4
Setaria viridis				14	67	42	26
Sinapis arvensis				5	33	33	9
Datura stramonium			40	18		8	
Papaver rhoeas						25	
Myosotis arvensis							26
Companions							
Agropyron repens	13	14	40	26	67	75	4
Calystegia sepium	88	57	100	87	33	42	65
Taraxacum officinale (aggr.)	63	57	60	22	67	67	26
Sorghum halepense	6	57	40	57	17	8	
Equisetum arvense	13	57	60	17		17	22
Polygonum aviculare	25	14	60	22		58	9
Convolvulus arvensis	25	14		52	100	83	74
Ranunculus repens	38		20	38	17	17	22
Diplotaxis tenuifolia	6	14		5	33	17	
Artemisia vulgaris	6	43		14		8	4
Trifolium repens	31	14		8		8	17
Daucus carota	13		20	9	17		13
Plantago major	13		40	5		8	
Mentha spicata		14	20	9	17	8	
Verbena officinalis	6	14	40			8	
Medicago lupulina	19			9	17	25	
Rumex crispus	19			5	17	17	
Trifolium pratense	25				33	42	17
Cynodon dactylon	6			27	17		
Plantago lanceolata	6				33	17	
Lythrum salicaria		14	20	5			
Potentilla reptans		14		9	33		
Trifolium incarnatum/molinieri					17	25	
Abutilon theophrasti			20				

Tab. 4 - *Geranio rotundifolii-Allietum vineale* R. Tx. ex von Rochow 1951 geogr. var. with *Cerastium tenoreanum* var. nova hoc loco

	Relevé number	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
	Altitude (x 10 m)	14	3	30	19	5	52	19	23	19	22	23	18	31	12	17	19	2	2	2	2	2	2	2	5	3	3	2	6	3	5	3
	Exposure							SO		NW			S																S		E	
	Slope (°)							10		20			10																20		20	
	Number of species (sporadic included)	28	21	25	27	34	17	25	35	25	28	28	23	32	17	31	48	42	41	31	33	30	27	26	23	19	26	32	24	26	25	29
	Charac. and diff. (DAss) spec. of ass. and all. (*Fumario-Euphorbion*)																**typical form**															
DAss	Geranium dissectum									1	+	+	+		1		+	1	+	+	+	+	1	+	r		2	1	3	+		
DAss K	Lactuca serriola		+			+		1	+							+	1	+		+	+		+	1	+	+	+	+	+	+	+	+
	Allium vineale					+			+	+		+					+	+	+										+	+		
DAss K	Bromus sterilis					2		1	2	2	3	1	3	3					2				1	+		+	2			+	+	
	Muscari racemosum				+				+		+						+		+						r				r		+	
DAss K	Veronica hederifolia	2	r	1		+		1	1	+		1	+	+					+													
DAss K	Veronica arvensis	+				+			+	+							+	+	r									1				
	Ornithogalum umbellatum									+					2		+		+		+							r				
DAss.	Fumaria officinalis	1					2										+		r	+												
DAss K	Anthemis arvensis															+	1		1					+				+				+
DAss	Valerianella locusta																+		1					1			1	1				
DAss	Muscari comosum	+															+	+														
	Valerianella carinata								+	2											+	+										
	Thlaspi arvense			1																												
	Geranium rotundifolium (Gagea villosa)																															
	Diff. spec. SE-alpine race																															
DAss	Crepis taraxacifolia	+	+	1			+	+	+	1	1	1	1	1	+	+	1	+	r	+	+		+		+		+	+	r	+	+	+
	Poa sylvicola	+			+				+			+				2	+	1	+	1	+	1	1	+			1	+		1	+	
	Rumex obtusifolius	+														1	+	+						+	r	+	+	+		+		1
	Vicia sativa (aggr.)	+			+	+		1	1	1	+	+		+		+	1	+	1	+	+		+	+	+	1	1	1			r	+
DAss	Cerastium glomeratum	+	+						+					+		+	+	+	+	+	+	1	+	+	+	1	1	1		+	1	1
	Lolium multiflorum		1	1	2	1					1	1	1					1	1						+	+		+	+	+	+	
	Rumex crispus			1	+			1	1	1	1	1	2	1		1	1	+	1	1	1	+	1	+								
d	Calepina irregularis				2				3	1	3	3	3	3	2					2	3	2	3	1	2	3	2	2	2	3	1	2
DAss	Cerastium tenoreanum	+				1			+	+	+			+					+	2	1	+		+	+	1	+	+	1	+		+
DAss	Alopecurus myosuroides					1											2	1		1		2	+	3	3	2	+	1		+		1
	Charac. and diff. (DO) spec. of ord. (*Chenopodietalia*)																															
DO	Euphorbia helioscopia		1	+	+		+	+	1		+	+		+			1	1	1	1	1	+	2	2	1	1	+	1	1	1	+	2
DO	Lamium purpureum			1					+	+	+		+		+		+		+				+				+					
DO	Sonchus oleraceus				+	+		+							+		+		r			1		+	+			+	+		+	+
DO	Sonchus asper		r															+		+	+	+					+	+	+	1	+	+
	Erodium cicutarium		+		+	1			+				+					+				+	+				1	+	1			1
	Diplotaxis muralis		+	+		+								+				+			+		+							+		
	Lamium amplexicaule						+	2			+	+											+									
	Echinochloa crus-galli											1				1	1															
	Digitaria sanguinalis																1				1											
	Amaranthus retroflexus																									+	+					+
	Sonchus arvensis																+															
	Class spec. (*Stellarietea*)																															
	Veronica persica	3	3	1	3	3	2	1	3	3	3	3	3	2	2	2	2	1	1	1	2	+	2	1	1	2	3	2	2	1	2	1
	Stellaria media	3	2	+	4	2	3	4	3	3	2	3	3	2	3	2	2	1	+	1	2	2	1	1	+		+	1	2	1	+	+
	Senecio vulgaris	+	r	+	+	1	1	+	+	+	+	+	+	+		+	1	+	r	1	+	2	+	r	r				+	+	r	+
	Cirsium arvense			2	2	1	2	1	1				1	1	1	2	1	2	1	2	1	2		+	1	1		1		1	1	+
	Capsella bursa-pastoris	+	1	+	+	1	1	1	+		+			+	+	1	1	+	r	+	2	+						+		+	r	+
	Erigeron annuus		+			+	+							+		+		+		+		+					+	1	+	+		+
	Cardamine hirsuta			1							+		+	+						+	+			r						+		
	Papaver rhoeas	+															+	+	r			+	+									r
	Geranium molle		r																1							r		+				
	Geranium columbinum				+	+		+	+		+						+															
	Brassica napus	+	+																		+			+			+	r				+
	Mercurialis annua				+												+											r	+		+	
	Bromus hordeaceus								+					+							+											
	Myosotis arvensis			+	+	+					+													+								
	Fallopia convolvulus	+				+	+	+				+																				
	Anagallis arvensis	+											+			+	+				+											
	Conyza canadensis					+		+									+															

Tab. 4 – Continued.

32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62					
5	15	17	18	1	15	13	2	2	24	2	2	24	3	12	13	13	11	12	13	5	2	2	1	2	1	26	25	24	2	2					
					S							S	W							S															
					5							20	10							15															
26	30	41	26	23	33	32	14	19	18	32	26	30	18	18	18	19	17	21	19	25	18	28	21	28	32	38	24	27	21	21	Typical associat.			Total	
				Taraxacum officinale **agroform**									*Arrhenatherum elatius* **agroform**							*Agrostis stolonifera* **agroform**											**Pr.**	**Fr.**	**Cl.**	**Pr.**	**Fr.**
1	r	1		3	1				2	r	+	1								+	1				+						21	58	IV	30	48
+	+	+		+								+																			22	61	V	24	39
	+		+		+	2			1		+	+								2	3	+			2	+	2				11	31	II	22	35
		1	+					r												+									+		17	47	III	20	32
r	+	+	+			2														+		+		+	1						12	33	II	17	27
r					+	+																	+			r					12	33	II	16	26
	+	+	r	1																						r	+				11	31	II	14	23
		+	r	1		2																1						+			8	22	II	12	19
	+	r			+																										7	19	I	8	13
		1	2																												8	22	II	8	13
																															5	14	I	5	8
		1																													4	11	I	4	6
																															4	11	I	4	6
																															1	3	I	1	2
			3																												1	3	I	1	2
1	+	1				1		r	1	r		+									+	r			+	1	+				29	81	V	39	63
+		+	+	2	2	1	1	2	2	2	1	1								1		2	3	2	2	3	1	1			20	56	III	37	60
+		+	+				1	1	+		+	+	1	1	1	+	+	1	+	1	+	+	1	+		+		+		1	14	39	II	34	55
+	+	+	1		+																+			+	+	1					27	75	IV	32	52
+	+	+		3		+		1	+	1										+					+	1	r				23	64	IV	32	52
	1	2	2				+	1	1	1	+	1									+	1	1		1	1		2			18	50	III	30	48
	+				1					+																	+		+		19	53	III	23	37
	1																														22	61	IV	22	35
	2	+																		+											20	56	III	21	34
+	2	3							1		+																				16	44	III	18	29
1	1	1	+	1	+	+					+	+										+			r	r			r		29	81	V	38	61
+	+	+		2	1	1	1	+	+	+	+	+	+	+	+			1			+	1	1	1	+	+					13	36	II	32	52
+	+	+	+		+	+			+	1		r									+			1							17	47	III	24	39
1		+	r				+			r	+	+														+					14	39	II	19	31
	1																														13	36	II	13	21
		+																													9	25	II	9	15
																															5	14	I	5	8
					1																										3	8	I	4	6
		r																													3	8	I	3	5
																															3	8	I	3	5
																															1	3	I	1	2
1	1	1	1	2	1	1	1		+	1	1	2			1	+		+	+	1	+	+	1	1	1	+			+		35	97	V	55	89
1	+	+	+	1	3	1	2	1	+	+		1	1	+	1	1	+			+			2	1		+		+			34	94	V	52	84
+	r	+		+	1		1	+	+	r		+								+											30	83	V	38	61
+		r			+	+				+	+																			1	25	69	IV	30	48
+	r	+			+	1		r		+																					25	69	IV	29	47
	+				1	1	+	+		r	+									1			+		+	1	+	+			13	36	II	25	40
										+														+	+	r					8	22	II	12	19
	1	r																								r					9	25	II	10	16
+	r			1																		1	+	+							6	17	I	10	16
		1	+			+						+																			8	22	II	10	16
					1																										7	19	I	8	13
	+		+																												7	19	I	7	11
				1																+						1		+			3	8	I	7	11
				+																											5	14	I	6	10
					+																										5	14	I	6	10
																															5	14	I	5	8
						+																									3	8	I	4	6

Tab. 4 – Continued.

	Geranium pusillum											+																				
	Ranunculus arvensis	+		+														+														
	Legousia speculum-veneris	+				+																										
	Malva neglecta																+						2									
	Sherardia arvensis																		r													
	Solanum nigrum																															
	Aphanes arvensis																		+													
	Consolida regalis	1																					+									
	Sinapis arvensis	1		+																												
	Viola arvensis					1													r													
	Chenopodium album																															
	Polygonum persicaria															+																
	Differerential spec.																															
	of agroform							+																								
	Plantago major											+		+				+														
	Trifolium pratense								+			+																				r
	Trifolium repens															+		+	+		+							r				
	Lolium perenne								+																							
	Diff. spec. of *Agrostis stolonifera* agroform																															
	Potentilla reptans							+				1		1		+																
	Ranunculus repens									+	+							+														
	Agrostis stolonifera																														+	
	Bellis perennis																												+			
	Cerastium holosteoides																															
	Dactylis glomerata																															
	Rumex acetosella																															
	Diff. spec. of *Arrhenath. elatius* agroform																															
	Plantago lanceolata			+	+	+				+		+						+											+			
	Arrhenatherum elatius								1	1									+	+												
	Silene alba					+											+															
	Galium mollugo																		+													
	Achillea millefolium																															
	Prunella vulgaris																															
DO	Setaria pumila																															
	Geranium pyrenaicum																															
	Companions																															
	Taraxacum officinale (aggr.)		+	1	+	+	+		1	1	1	2	2	1	+	+	+	+	+	+	+	+	+	+	+		+	+	+	1	+	+
	Convolvulus arvensis	1	r	1	1	1	1			+	+	+	1	1	+	2	2	2	+	+	1	2	1	+	+	+					+	
	Agropyron repens	+														3	3	1	2		1	1			+			+		1	1	
	Poa annua		1			+			1	3		1	3	1	+			1					+		1	+				2	3	3
	Calystegia sepium	+	+				+	+	+	+	+		+			1	1	1	+	1	1	1				+		+				
	Ranunculus bulbosus			+	+	1		+	+	1		+	+	+	+																	
	Mentha longifolia								1							1	1	+	+	1	+	+										+

Charact. and diff. (D) species: *Allium vineale*, *Cerastium tenoreanum* (D), *Geranium dissectum* (D), *Crepis taraxacifolia* (D), *Calepina irregularis*, *Geranium rotundifolium*, *Muscari comosum* (D), *M. racemosum*, *Ornithogalum umbellatum*, *Valerianella carinata*, *Cerastium glomeratum* (D), *Thlaspi arvense*, *Lactuca serriola* (D), *Veronica hederifolia* (D), *Bromus sterilis* (D) and *Gagea villosa* (very rare in Friuli-Venezia Giulia). Moreover, it is possible to consider as differential species *Alopecurus myosuroides*, *Fumaria officinalis*, *Valerianella locusta*, *Anthemis arvensis* and *Veronica arvensis*, which derive from *Centaureetalia* (because of similar growth time).

Floristic composition. This is the agrocoenosis with the highest number of bulbous geophytes (*Allium vineale, Muscari racemosum, M. comosum* and *Ornithogalum umbellatum*), because of the absence of tilling works until late spring. For the same reason this association is particularly rich in spring therophytes, such as *Geranium dissectum* (which can form thick carpets), *G. molle, G. rotundifolium, G. columbinum, G. pusillum, Cerastium tenoreanum* and *C. glomeratum. Stellaria media* and *Veronica persica* are always present with the highest cover values, while *Calepina irregularis* is sometimes absent, whereas sometimes it dominates the relevés.

Syntaxonomy. The vegetation of vineyards of Karst and Collio was described by Poldini (1980, 1989) with the name of *Cerastio-Geranietum dissecti.* At that time the author had already put in evidence the strong differentiation from the isoecic coenosis of

Tab. 4 – Continued.

				1	+	3																									1	3	I	4	6	I
																															3	8	I	3	5	I
	+																														3	8	I	3	5	I
						2																									2	6	I	3	5	I
						+																							r		1	3	I	3	5	I
															+	+		+													0	0		3	5	I
						+																				+					1	3	I	3	5	I
																															2	6	I	2	3	I
																															2	6	I	2	3	I
																															2	6	I	2	3	I
																		+													1	3	I	2	3	I
																															1	3	I	1	2	I
					+			+	+	+	+			1	+		+	+	+			+			+	+	+		+	r	3	8	I	19	31	II
+						1			+				+					+	1		+		+	+	+	1	1	+		+	4	11	I	17	27	II
					+			+		+	1	1		+			+			2		1	+								5	14	I	15	24	II
										1				+	+	1	+	+	+			1		+	1				2		2	6	I	13	21	II
+					1					+	1	1								+	2	1	+	+	+	+		1	1	3	4	11	I	18	29	II
					1	+		+		+	1	1									+	r	+			+	1	1	2	3	3	8	I	17	27	II
										2	1	+								2	1	2	1	3	1	1	3	2	3		1	3	I	14	23	II
				3			+			r	+									+	+	+	1	+	+						1	3	I	11	18	I
						+		+																+	+	+	r	+			0	0		7	11	I
										r	+											+				r		+	+	+	0	0		7	11	I
																										1	+	1			0	0		3	5	I
				1	+	+							1	2	2	2	1	1	1	1	+			+	+	+	+	+			7	19	I	24	39	II
											+		4	4	4	4	4	3	2	r				1	1	+	+	2			4	11	I	18	29	II
													+	1	1	1	+	+	1					+		+					2	6	I	11	18	I
													2	2	1	1		1	1			+			+		+	2			1	3	I	11	18	I
						1							1		1	2	2	2	2						+		+	1			0	0		10	16	I
													+	+	1	2	1	1							1				+		0	0		8	13	I
													1	1	1	2	1	1	1												0	0		7	11	I
													+	1	1	1			+												0	0		5	8	I
+	+	r	r	1	1	4	2	1	2	1	1	2	+	+	2	1	1	1	3	1	1	2	2	2	+	1			+	+	33	92	V	58	94	V
		+	+			+						+	1	1		2	1	1	1												27	75	IV	35	56	III
+										+		r								1			+	+	1	1	2	+		1	12	33	II	22	35	II
				1			1	1	1	1	1									+											16	44	III	23	37	II
	+	+								+																+				+	18	50	III	21	34	II
				1									1	+			+		+			r		+							10	28	II	17	27	II
			+							+		+										+		1	+						10	28	II	15	24	II

Central Europe (*Geranio-Allietum*). In this respect, we faced the problem of differentiating between geographical race and association. Data analysis is not useful to detect the shifting point between these two *syntaxa*, and it is therefore necessary to evaluate both the biogeography and the potential vegetation of the survey area (Poldini *et al.* 1996). The potential vegetation (as synonym of the synphytosociological term «head association») of Friuli-Venezia Giulia is represented by mature oaks woods: *Seslerio-Quercetum petraeae* (Poldini 1964 n.n.) Poldini 1982, *Carici umbrosae-Quercetum petraeae* Poldini ex Marincek 1994, *Asparago tenuifolii-Quercetum roboris* (Lausi 1966) Marincek 1994 (basionym: *Querco-Carpinetum boreo-italicum* Pignatti ex Lausi 1966). These woods are particularly rich in species with submediterrenean - SE European distribution. Such a strong characterization could suggest that the coenosis of Friuli-Venezia Giulia vineyards belongs to an independent association. Nevertheless, we observed that, when anthropogenic pressure is very high, the same association («tail association») develops from different head associations (Géhu 1996).

Table 5 shows the main differences between the vineyard vegetation of Friuli-Venezia Giulia and that of Central Europe. The community occurring in Friuli-Venezia Giulia is characterized by several thermophilous elements, such as *Alopecurus myosuroides, Calepina irregularis, Calystegia sepium, Cerastium tenoreanum, Crepis taraxacifolia, Geranium dissectum, Poa sylvicola, Rumex*

Tab. 5 – Simplified, synthetic table of Centro-European *Geranio-Allietum* and of the SE-Alpine race (frequency values). A = data from Oberdorfer (1993); B = data from Wilmanns (1989); C = data from Tab. 4.

	A	B	C
Species of ass. and all. (*Veronico-Euphorbion*)			
Allium vineale	70	75	40
Bromus sterilis	20	50	53
Fumaria officinalis	54	25	18
Geranium rotundifolium	21	44	8
Lactuca serriola	22	75	60
Muscari racemosum	51	56	35
Ornithogalum umbellatum	23	31	28
Valerianella carinata	2	13	10
Veronica arvensis	13	25	28
Cerastium glomeratum	4		60
Gagea villosa	16	13	
Geranium dissectum	17		63
Thlaspi arvense	6		5
Veronica hederifolia		88	33
Allium oleraceum	14		
Allium scordoprasum		13	
Alopecuros myosuroides			40
Anthemis arvensis			20
Calepina irregularis			55
Cerastium tenoreanum			58
Crepis taraxacifolia			78
Lolium multiflorum			45
Muscari comosum			10
Poa sylvicola			50
Valerianella locusta			13
Ord. (*Chenopodietalia*) species			
Euphorbia helioscopia	78	19	80
Lamium amplexicaule	30	6	18
Lamium purpureum	89	100	33
Solanum nigrum	61	13	10
Sonchus arvensis	15	6	5
Sonchus asper	81	19	38
Sonchus oleraceus	91	19	48
Echinochloa crus-galli	27		10
Erodium cicutarium	29		40
Euphorbia peplus	33		
Class (*Stellarietea*) species			
Amaranthus retroflexus	19	19	15
Capsella bursa-pastoris	25	13	75
Chenopodium album	35	19	10
Cirsium arvense	56	38	68
Conyza canadensis	13	19	8
Geranium pusillum	11	13	3
Mercurialis annua	52	81	23
Papaver rhoeas	9	6	28
Senecio vulgaris	84	56	85
Stellaria media	80	88	98
Veronica persica	64	94	100
Anagallis arvensis	16		18
Fallopia convolvulus	1		18
Geranium columbinum	15		20
Malva neglecta	17		5
Setaria viridis	21		8
Sinapis arvensis	20		5
Cardamine hirsuta		31	20
Vicia sativa (aggr.)		19	75
Brassica napus			18
Diplotaxis muralis			25
Erigeron annuus			33
Companions			
Agropyron repens	41	25	38
Convolvulus arvensis	41	69	80
Galium aparine	10	25	8
Lolium perenne	4	25	5
Poa annua	22	69	40
Polygonum aviculare (aggr.)	15	19	3
Taraxacum officinale	91	94	88
Diplotaxis tenuifolia	1	25	
Lapsana communis	14		3
Ranunculus repens	26		13
Veronica polita	58	6	
Calystegia sepium			48
Mentha longifolia			25
Ranunculus bulbosus			25
Rumex crispus			48
Rumex obtusifolius			35
Trifolium incarnatum/molinieri			23

crispus, and *Vicia sativa / angustifolia*. With the exception of *Calepina irregularis,* these species are not exclusive of vineyards, but penetrate from surrounding habitats. They can be considered as the geographical differentials of a Southeastern Alpine race of *Geranio-Allietum*. The ecological-structural meaning of the high frequency of spring bulbous geophytes, which distinguishes this agrocoenosis from the others, has been considered particularly important and has led us to include the relevés of Friuli-Venezia Giulia into *Geranio-Allietum*.

At higher syntaxonomical levels, the attribution of this coenosis is evident; *Geranium dissectum* and *Fumaria officinalis* show adherence to the alliance *Veronico-Euphorbion*. Since *Geranio-Allietum* is the only known association of this alliance in Friuli-Venezia Giulia, alliance and association species coincide. *Sonchus oleraceus, S. asper, Euphorbia helioscopia, Lamium purpureum, L. amplexicaule, Diplotaxis muralis* and *Erodium cicutarium* show adherence to *Chenopodietalia*.

Centaureetalia species are particularly frequent in these relevés. This depends on the growth time of *Geranio-Allietum* (spring) when also the autumn-winter cultures have their maximum blooming. *Stellarietea* species are very numerous. Among them, *Veronica persica, Stellaria media, Senecio vulgaris, Cirsium arvense, Capsella bursa-pastoris* and *Erigeron annuus* are the most frequent.

Variability. It is low, although the relevés come from areas with strong pedological differences (karstic «terre rosse», flysch and gravels). A certain differentiation (floristic rather than ecological) exists between relevés of the Collio hills near Gorizia (*Alopecurus myosuroides*) and those from the Karst plateau near Trieste (*Ranunculus bulbosus* and *Trifolium incarnatum/molinieri*, maybe once used as fodder plants).

Agroforms. The variety of cultivation techniques in viticulture has a strong influence on vineyard coenoses. It is therefore possible to identify three agroforms that are often more frequent than the typical association.

— *Taraxacum officinale* agroform (Tab. 4, rels. 36-44): it occurs in vineyards characterized by light tilling once or twice a year, combined with mulching between the rows and the use of desiccatives beneath the rows. Sometimes *Taraxacum officinale* dominates these vineyards, because its roots, rich of reserve material and buds, make it resistant to mulching and tolerant to the use of desiccatives and to occasional tap-root fragmentation caused by harrowing, which may even foster its propagation (Wilmanns 1991). In this agroform all species of *Geranio-Allietum* are well represented, especially *Geranium dissectum*.

— *Agrostis stolonifera* agroform: it occurs in vineyards characterized by the absence of tilling (Tab. 4, rels. 52-62); it spreads on heavy clay soils with high water table, such as those of the springs area («risorgive»). The weeds control is made by mulching, which helps the spreading of creeping perennial herbs (*Potentilla reptans, Agrostis stolonifera* and *Ranunculus repens*, etc.) or of plants with tap-roots (*Taraxacum officinale*). Among the differential species of *Geranio-Allietum, Allium vineale* reaches high cover values, because, in absence of tilling, it forms large tufts.

— *Arrhenatherum elatius* agroform (Tab. 4, rels. 45-51): it occurs in vineyards where soil tilling is replaced by mowing and natural manuring. Besides *Arrhenatherum elatius*, other species of *Arrhenatherion* dominate this agroform, such as *Galium mollugo, Silene alba* and *Plantago lanceolata.* Therefore, the characteristic species of vineyards almost disappear, being replaced by perennial herbs.

The two first agroforms correspond to those described by Wilmanns (1989, 1991) from the Rhine valley.

Life forms. This association, in its typical aspect, shows a high percentage of geophytes (11.3%), although therophytes dominate (67.0%) and the percentage of hemicryptophytes is also high (21.4%). The increase in hemicryptophytes in the agroforms is caused by the reduction of soil tilling, replaced by mowing and the use of desiccatives.

Chorotypes. The low percentage of adventitious species is noteworthy; this fact confirms that vineyards are scarcely disturbed cultures. The high percentage of euromediterranean species (26.6%) and the presence of stenomediterranean ones (0.6%) well arrange with the Mediterranean gravitation of the SE-Alpine race of *Geranio-Allietum*; these chorotypes decrease in agroforms where species with European distribution (more resistant to disturbance) prevail.

Pollination and dispersal. There are some differences between the typical association and its agroforms. Autogamy and entomophily are progressively substituted by anemophily, proceeding from the association to its agroforms. In *Geranio-Allietum*, due to ground tilling, autogamy is very important; in fact this strategy guarantees quick self-fecundation of species (Faegri & van der Pijl 1971)

and fructification before the next tilling. In the agroforms with *Agrostis stolonifera* and *Arrhenatherum elatius* the mowing favours the spreading of anemophilous *Gramineae*. The agroform with *Taraxacum officinale* is a transition coenosis, because of the co-presence of tilling and mulching.

Sinecology. The coenosis develops at the beginning of spring in vineyards where artisan cultivation techniques are used. The absence of tilling until late spring is essential for the survival of the coenosis, which would be destroyed by early tilling, because it is formed mainly by spring flowering plants. The light ploughing at the beginning of June determines the closure of the seasonal cycle of the association. During summer harrowing is carried out to keep under control the summer species of *Stellarietea* (especially *Setaria viridis*, *Erigeron annuus*, *Amaranthus retroflexus* and *Mercurialis annua*).

This association develops on «terre rosse», silts, clays, and gravels; these soils are not heavily modified by viticulture, since it needs only light manuring.

The altitude ranges from sea level to 350-400 m (Collio hills and Karst plateau).

Synchorology. The presence of *Geranio-Allietum* has been reported in Germany, Austria, North-Eastern Italy and Slovenia.

Ass.: ***Echinochloo-Setarietum pumilae*** Felföldy 1942 corr. Mucina 1993 geogr. var. with *Calystegia sepium*, geogr. var. nova hoc loco (Tab. 6).

Syntax. syn.: *Panico-Polygonetum persicariae* Pignatti 1953, *Hibisco-Digitarietum sanguinalis* Poldini 1980, *Hibisco-Sorghetum halepensis* Poldini 1989 non Horvatic et Hodak 1960; *Oxalido-Chenopodietum* Sissingh 1950

"The vegetation of weeded summer cultures of the plain and of the hill belts"

Charact. and diff. (D) species: *Amaranthus retroflexus* (D), *Solanum nigrum* (D), *Portulaca oleracea* and *Calystegia sepium*.

Floristic composition. This association is dominated by *Setaria pumila, Digitaria sanguinalis, Echi-nochloa crus-galli, Amaranthus retroflexus, Polygonum persicaria, Euphorbia helioscopia, Chenopodium album, C. polyspermum, Convolvulus arvensis* and *Sonchus oleraceus*. *Portulaca oleracea, Solanum nigrum, Capsella bursa-pastoris* and *Taraxacum officinale* are often present, but with low cover values.

Syntaxonomy. In the attempt to attribute the relevés of Friuli-Venezia Giulia, we first considered two associations already described for weeded crops: *Panico-Polygonetum* Pign. 1953 (Pignatti 1952), surveyed in the eastern Venetian plain, and *Echinochloo-Setarietum pumilae* Felföldy 1942 corr. Mucina 1993, present in Central Europe (Mucina 1993), and we compared synthetic tables of weeded cultures of northern Italy (Gerdol & Piccoli 1979; Lorenzoni 1963; Poldini 1989) with those of Central Europe (Krippelová 1981; Regula-Bevilacqua 1979; Seljak 1989; Oberdorfer 1993) by means of numerical analysis. The classification (Fig. 3) shows that the relevés from Ferrara separate at a high level (0.63 of dissimilarity), while the cluster of relevés from the Venetian plain join the group of associations of Central Europe at a lower level of similarity (0.54). Hence all the examined relevés have been gathered into a single coenosis. Due to nomenclatural priority, the correct name is *Echinochloo-Setarietum*, whereas the binomial *Panico-Polygonetum* and *Oxalido-Chenopodietum* are syntaxonomic synonyms.

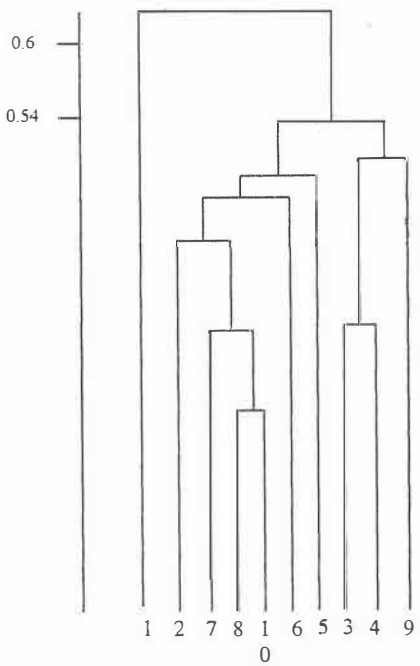


Fig. 3 – Dendrogram of weeded crops of Europe, obtained by classification of synthetic tables (similarity ratio, mean linkage). 1 = *Panico-Polygonetum* (Italy, Ferrara, Gerdol & Piccoli 1979); 2 = *Setario-Galinsogetum* (Croatia, Regula-Bevilacqua 1979); 3 = *Setario-Galinsogetum* (Slovakia, Krippelová 1981); 4 = *Oxalido-Chenopodietum* (Slovakia, Krippelová 1981); 5 = *Panico-Polygonetum* (Italy, Eastern Venetian plain, Lorenzoni 1963); 6 = *Oxalido-Chenopodietum* (Italy, Eastern Venetian Plain, Lorenzoni 1963); 7 = *Setario-Galinsogetum* (Slovenia, Seljak 1989); 8 = *Oxalido-Chenopodietum* (Slovenia, Seljak 1989); 9 = *Setario-Galinsogetum* (Germany, Oberdorfer 1993); 10 = relevés from Friuli – Venezia Giulia.

Although the eastern Venetian plain and Central Europe belong to different biogeographical regions with different «head associations» (see Syntaxonomy of *Geranio-Allietum*), it is also true that coenoses of weeded cultures are subject to a levelling anthropogenic pressure.

The attribution of this association to the *Panico-Setarion* alliance is due to the high participation of species of the tribe *Panicoideae* (*Setaria pumila*, *Digitaria sanguinalis* and *Echinochloa crus-galli*), of *Galinsoga parviflora* and *Chenopodium polyspermum*. The framing in *Chenopodietalia* is justified by the presence of *Sonchus oleraceus*, *S. asper*, *Lamium purpureum* and *Euphorbia helioscopia*. *Chenopodium album*, *Capsella bursa-pastoris*, *Erigeron annuus*, *Stellaria media*, *Fallopia convolvulus*, *Veronica persica* and *Setaria viridis* show adherence to the *Stellarietea* class.

Variability. Because of its very large geographical distribution, *Echinochloo-Setarietum* exhibits a certain variability. In Friuli-Venezia Giulia a Southeastern-Alpine race is present, which is characterized by some thermophilous species such as *Calystegia sepium*, *Euphorbia helioscopia*, *Polygonum persicaria* and *Chenopodium polyspermum*. This SE-Alpine race is not homogenous; on the basis of biogeographical considerations, it is possible to segregate two sub-races (Fig. 4):

a) Karstic sub-race (Tab. 6, rels. 46-63), distinguished by: *Veronica persica*, *Agropyron repens*, *Cirsium arvense*, *Amaranthus graecizans*, *Diplotaxis muralis*, *Erodium cicutarium*, *Trifolium incarnatum/molinieri* and *Stachys palustris*;

b) Friuli sub-race (Tab. 6, rels. 1-23), distinguished by the absence, or the negligible presence, of Karstic differential species.

Within the two sub-races, parallel ecological responses to changes in temperature and in soil moisture can be observed. We can therefore identify a cool variant and a warm one of each subrace. The cool variants are differentiated by *Galinsoga parviflora*, *Stellaria media*, *Fallopia convolvulus*, *Lamium purpureum* and *Trifolium pratense*, while the warm ones by *Sorghum halepense* and *Hibiscus trionum*. In the Karst the cool variant is found at the bottom of dolines, while the warm one is found in the south-exposed terraced cultures; the warm variant has already been described as a race of *Hibisco-Sorghetum halepensis* Horvatic et Hodak 1960 by Poldini (1989), who framed it in the Mediterranean alliance *Diplotaxidion* Br.-Bl. 1936. According to the new results, this alliance is excluded from Friuli-Venezia Giulia. In Friuli, the cool variant is found at the bottom of pre-Alpine valleys and on the Friulian hills, while the warm one is found in the plain.

Subassociation. One new subassociation has been detected:

xanthietosum italici subass. nova, holotypus Tab. 6 rel. 24 (Tab. 6, rels. 24-28). This subassociation has been recorded in the crop fields of reclaimed areas of Friuli, where the soil texture limits the water flow, increasing the soil moisture. It is differentiated by *Polygonum lapathifolium* (which completely replaces *P. persicaria*), *Bidens tripartita*, *B. frondosa*, *Xanthium italicum* and *Lycopus europaeus*. These

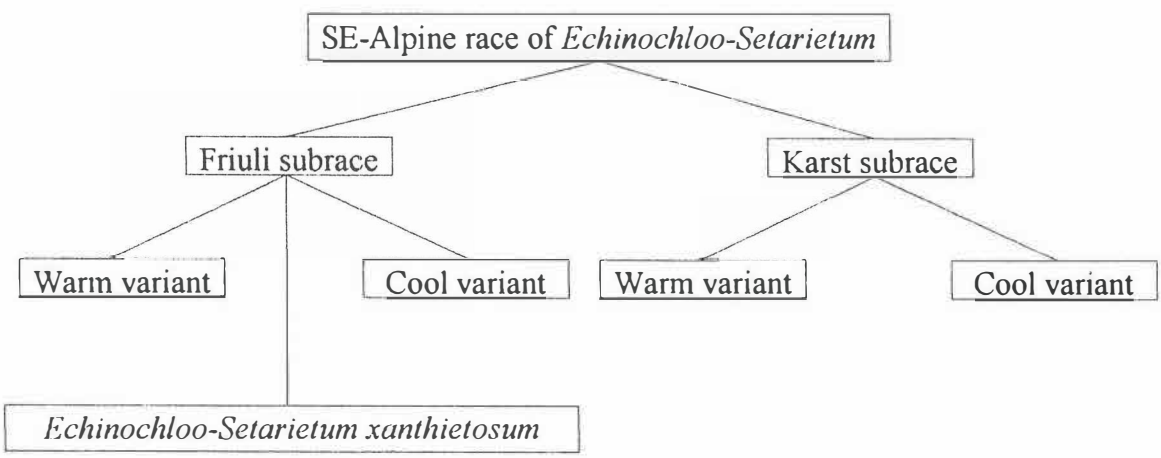
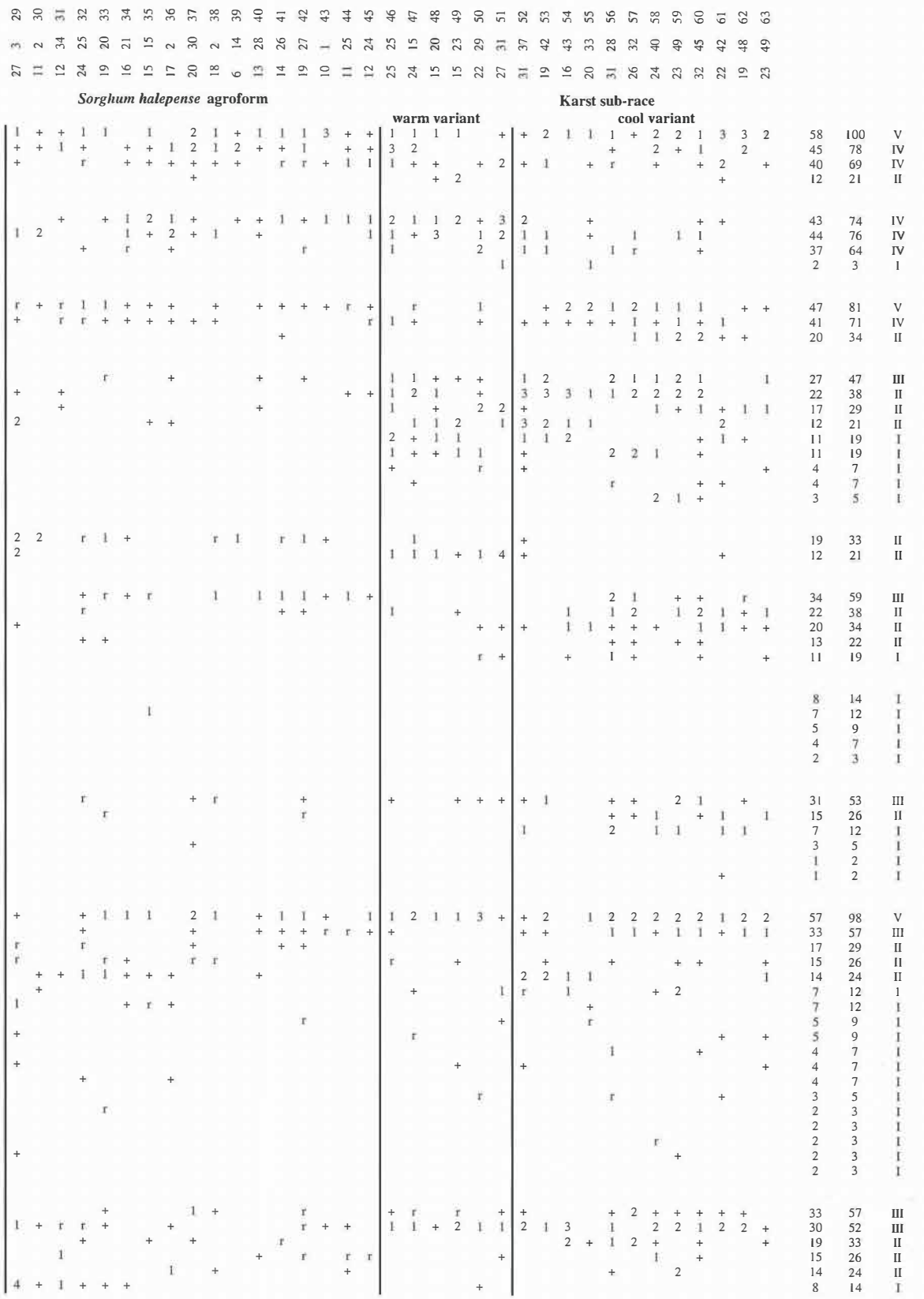


Fig. 4 – Variability of *Echinochloo-Setarietum*.

Tab. 6 – *Echinochloo-Setarietum pumilae* Felfoldy 1942 corr. Mucina 1993 geogr. var. with *Calystegia sepium* var. nova hoc loco.

	Releves n°	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
	Altitude (x10m)	40	37	35	40	30	30	39	43	35	2	5	6	34	34	28	26	3	1	1	1	1	11	2	1	1	1	30	30
	Total n. of species (spor. incl.)	18	21	23	18	20	18	19	15	22	9	13	27	13	19	14	21	19	11	19	10	17	19	16	19	21	16	22	17
	Char. & diff. (DAss) sp. of ass.																												
DAss	Amaranthus retroflexus		1	+	1	+	1	2	1	1	1	1	1		2	2	2	2	2	1	1	1	1	1	1	+	+	+	+
DAss	Calystegia sepium	2	2	+	2	1	+	+		1	+	+	+	+	1		+	2	+		1		+		1	+	1	1	1
DAss	Solanum nigrum				+		+		r	+		+						+		1	1	1	+	+	1	1	1		
	Portulaca oleracea										3	1	+					+	1	1		+	r						
	Char. & diff. (DAll) sp. alleance																												
DAll	Digitaria sanguinalis	+	+		2	1	3		+		r	1	1		1	1	+	2	1	1		1	1	1		+	+		
DAll	Setaria pumila	2	2	1	2	1	+	2	2	2	+	1	1	1	1	1	2	1					1	+	1	+	1	1	1
DAll	Echinochloa crus-galli	+	1			+	+	2	2	4	+	+	2	2	+	1	1	2	2	2	1	2	1	1	1	1	+	2	2
DAll	Panicum miliaceum																												
	Diff. sp. SE-alpine race																												
K	Polygonum persicaria	+	1	+	+	1	1	2	1	1		1	1	+			+	r	1	2	2	2	2	1					
DO	Euphorbia helioscopia	1	1	+	1	+		1	+	r				+	+	+	+			+		r	+		+		+		+
DAll	Chenopodium polyspermum	2	2	1	+	+	1	2	2	+	+							+							+				1
	Diff. sp. Karst subrace																												
K	Veronica persica	+	1	+	+					+			+				+	+		+					r				
	Agropyron repens															+	+			r							+		+
K	Cirsium arvense				1									r								+	+						
K	Setaria viridis																												
	Amaranthus graecizans																	+											
O	Diplotaxis muralis		+																										
O	Erodium cicutarium																												
	Trifolium incarnatum\ molinieri																												
	Stachys palustris																												
	Diff. sp. warm variant																												
	Sorghum halepense																1			+	+	+	+					+	+
	Hibiscus trionum																	+							+	+			
	Diff. sp. cool variant																												
DAll	Galinsoga parviflora	3	3	4	2	2	4	3	3	3	4	2	2	1	3	1	1	+		+									
K	Stellaria media	2		1	2	1	2	2	3	1							1												
K	Fallopia convolvulus	+	1	2			+	1	+									r											
DO	Lamium purpureum	+	2	+	1	+	1						r																
	Trifolium pratense			+				+		+			r																
	Diff. sp. subass. (*xanthietosum*)																												
K	Polygonum lapathifolium																		r	+			r		1	1	+	1	2
	Bidens tripartita																							1	1	2	2	2	2
K	Xanthium italicum																							1	+	+	+	1	
	Bidens frondosa		+																							+		+	1
	Lycopus europaeus																								+	+			
	Char. & diff. (DO) sp. Chenopodietalia																												
DO	Sonchus oleraceus	2	2	1	+		r	1	2	1					+		+	+		+		r					+	+	+
DO	Sonchus asper					r				+							r		r						+	+			r
	Sonchus arvensis														r														
	Galinsoga ciliata	2															r												
	Euphorbia peplus												r																
	Lamium amplexicaule																												
	Class species																												
	Chenopodium album	1	2	2	2	1	1	3	2	1	1	1	1	+	2	1	1	3	2	1	1	1	+	+	+	1	1	+	1
	Capsella bursa-pastoris	1	1	+			+	+	1	+		+	+	+	+	+	1			+									
	Erigeron annuus			+		+									+	+	+	+				+	+	+	r	+		+	
	Senecio vulgaris																	r		r									r
	Mercurialis annua											1																	
	Sinapis arvensis																												
	Datura stramonium																									+	+		
	Conyza canadensis														+													+	
	Vicia sativa (aggr.)																											+	
	Anagallis arvensis												+											r					
	Geranium molle																												
	Oxalis fontana												+															+	
	Geranium pusillum																												
	Cardamine hirsuta					r																							
	Oxalis corniculata		+					+																					
	Viola tricolor			r																									
	Brassica napus																												
	Acalypha virginica												1											+					
	Companions																												
	Taraxacum officinale	+	+	+		+	+	1		+			+	+		+		+			+		r	r	+		+	+	
	Convolvulus arvensis			1		+			1	+									+										
	Polygonum aviculare						1			+			r		+									+		+	+		1	
	Ranunculus repens			+	1	+		1					+	+														1	
	Equisetum arvense				r												+			+	1	+		r		1		1	1
	Cynodon dactylon													r															

Tab. 6 - Continued.



species, except *Polygonum lapathifolium* (typical of cultures), come from neighbouring humid, nitrophilous habitats. This subassociation is similar to the *Polygono-Xanthietum italici* Pirola & Rossetti 1974 which has been described from the eutrophic, disturbed gravel-bed of the Reno river, near Bologna (Pirola & Rossetti 1974), and to *Polygono-Bidentetum* (W. Koch 1926) Lohm. 1950, a ruderal association of *Bidentetea tripartiti* Tx., Lohm. et Prsg. 1950 (Regula-Bevilacqua 1979).

Agroform. One agroform has been defined:

— *Sorghum halepense* agroform (Tab. 6, rels. 29-45): it is typical of intensive cultivation with use of heavy ploughing and high input of herbicides and of mineral manure. The relevés are characterized by very low cover and strong quantitative modification of the interspecific relationships (Ferrari *et al.* 1979). The permanence of association differential species assures the link with the typical coenosis.

Life forms and chorotypes. Therophytes prevail, and, in the Friuli subrace, they reach the highest value among the studied coenoses (73.1%). Geophytes are scarce; only in the *Sorghum halepense* agroform (15.1%) and in the Karst subrace (14.8%) their value is significant, due to the presence of *Sorghum halepense* (Friuli) and of *Agropyron repens* (Karst).

The most frequent chorotypes are Cosmopolitan, adventitious and palaeotemperate.

Synecology. *Echinochloo-Setarietum* is present in weeded summer cultivation, such as maize, soy-bean, and, to a lesser degree, potatoes. After sowing, these cultures undergo weeding and hoeing, but nowadays weeds are mainly controlled by the use of herbicides.

Nowadays the maize cultures can produce a biomass of 450-500 q ha^{-1} in 100-200 days. Maize exploits at best the modern techniques of manuring, irrigation, etc., but it is very sensitive to weed competition. This is due to its inability to recover from damages caused by the development of weeds, because of its short growth season. Moreover, it is the only cereal sowed in rows, and for this reason it is not able to express the typical spatial competitivity of *Gramineae*. In Friuli-Venezia Giulia, this susceptibility is enhanced by low spring temperatures, which delay the early growth stages. Nevertheless, maize cultivation has become an easy task, thanks to the use of triazinic herbicides (Cassani 1986). Their intensive and extensive use have selected some resistant weeds. As we can observe from the phytosociological relevés, in this particular ecosystem some species are now very frequent and widespread, as they have become resistant (*Amaranthus retroflexus*, *Chenopodium album* and *Solanum nigrum*) or tolerant (monocots such as *Echinochloa crus-galli*, *Digitaria sanguinalis* and *Sorghum halepense*) to triazinic compounds (Pollastro 1989). Infestation by these species is very dangerous to maize, because most of them belong to the same family (*Gramineae*) and are therefore very competitive. Moreover, except *Chenopodium album* and *Solanum nigrum*, they are C4 plants (as maize). Under favourable environmental conditions, C4 species are known to be very competitive against C3 species (Baker 1972, Collins & Jones 1985). Moreover, since triazinic substances operate on photosynthesis, C4 weeds take further advantage of their alternative CO_2 assimilation pathway, and can survive to these herbicides (Gutierrez *et al.* 1974).

Indeed, an overgrowth of weeds soon after sowing would seriously hamper the development of any crop. From an agronomic point of view, the damage is greater when the weed coenosis develops at the same time as the crop plant. Conversely, the growth of weeds at the end of July, when maize and soy-bean dominate, is usually tolerated and the crop coenosis consequently reaches its maximum development only in late summer (second half of August). It is then destroyed by the harvest in late August-early September (potatoes) or at the end of October-beginning of November (maize and soy-bean). This tilling calendar allows most of the weeds to fructify, thus increasing the soil seed-bank responsible for the spring renovation of the coenosis. Fragmented roots and underground organs, and weed-seeds contained in stable manure (artisan fields) also contribute considerably to such process.

The species which dominate *Echinochloo-Setarietum* (*Amaranthus retroflexus, Digitaria sanguinalis, Echinochloa crus-galli, Setaria pumila, S. viridis, Sorghum halepense*) are almost all C4, and thus need high temperature for their peculiar metabolism.

The association mainly occurs on basic soils, from gravels to silt and clay but also on the «terre rosse» of the Karst plateau.

The altitude ranges from sea level to 350-400 m. In Friuli the warm form reaches 100-150 meters, being replaced by the cool form at higher altitudes.

Synchorology. This association occurs in Central Europe but it is also present south of the Alps and in the Italian and Slovenian Karst; the southern limit of

Tab. 7 – *Galeopsido tetrahit – Galinsogetum parviflorae* ass. nova hoc loco

	Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23			
	Altitude (x 10 m)	40	42	55	60	73	95	92	71	59	69	47	60	61	60	71	69	82	56	117	36	74	76	64			
	Number of species (spor. incl.)	20	20	20	26	19	21	19	17	19	16	18	19	21	24	19	22	20	19	27	26	25	16	28			
	Diff. sp. of ass.																								**Pr**	**Fr**	**Cl.**
	Galium aparine				+	1	1	+	2	+	1	1	2	1	+	+	3	2	1			+			16	70	IV
	Galeopsis tetrahit		+	1	+	+	1	+		1					1	2	3	3	3	I		1	+		15	65	IV
	Galeopsis speciosa		1	1			+	1		1	2	1	1	1					+	1					11	48	III
K	Mentha arvensis			1			3	1	1					1				1		+		+		+	9	39	II
K	Stachys palustris	+		+						2	+	2	+	1					+			1			9	39	II
	Aethusa cynapium		1	+	r						+								r	+		1			7	30	II
	Galinsoga ciliata																	2	2		3	4	4	3	6	26	II
	Char. & diff. (DAll) sp. of all. (*Panico-Setarion*)																										
DAll	Galinsoga parviflora	3	3	2	2	4	3	2	1	4	3	3	3	5	2	2	2	1							17	74	IV
DAll	Setaria pumila	1	1	1	2	+						+	1		1				+		1			+	11	48	III
	Chenopodium polyspermum			+						+					+	+	+				+	+			7	30	II
DAll	Echinochloa crus-galli				+																2			+	3	13	I
DAll	Digitaria sanguinalis	+																			1				2	9	I
DAll	Panicum miliaceum	+																							1	4	I
	Char. & diff. (DO) sp. of order (*Chenopodietalia*)																										
DO	Sonchus oleraceus	+		1	1	r	1	1	2	2	+		1	+	1	+		+	1		1	+			17	74	IV
DO	Euphorbia helioscopia	+	r		2	+		+	r	1			r		1		+	+		+	1		+	+	15	65	IV
DO	Lamium purpureum				1	1	+	1	1			r	r		+	r	+			1		+		+	13	57	III
	Sonchus arvensis				+		1							+											3	13	I
	Class species (*Stellarietea*)																										
	Chenopodium album	2	3	3	1	2	1	+	3	2	2	1	1	1	1	1	1	2	2	1	1	1	1	+	23	100	V
	Polygonum persicaria	1	2	1	1	2	1		1	1	2	2	4	2	1	1	1	1	+	1	+	+	1	1	22	96	V
	Stellaria media	2	2	2	1	3	3	3	2	3	2	2	2		2	2	3	2	2	3	2	+	1	+	22	96	V
	Fallopia convolvulus	1	1	1	2	3	1	+	2	1	1	1	2	+	2	2	2	1	2			+			19	83	V
	Capsella bursa-pastoris	1	+	+	+		1	+		+	+	r		+	1	+	+	+		+	1		+		17	74	IV
	Cirsium arvense							+				1	1	+	1	1		1	1		1	+			10	43	III
	Veronica persica		r		+	1									+					+	1				6	26	II
	Setaria viridis				1	+				+				1					+			+			6	26	II
	Myosotis arvensis						+	1						+				+		+		+			6	26	II
	Erigeron annuus													+							+		+	+	4	17	I
	Geranium columbinum				+	+																+			3	13	I
	Matricaria chamomilla				r											r									2	9	I
	Brassica napus																r			1					2	9	I
	Sinapis arvensis																			+	+				2	9	I
	Geranium pusillum	+																							1	4	I
	Oxalis fontana	1																							1	4	I
	Oxalis corniculata			+																					1	4	I
	Sherardia arvensis								r																1	4	I
	Geranium molle														+										1	4	I
	Cardamine hirsuta																r								1	4	I
	Veronica hederifolia																			+					1	4	I
	Vicia sativa (aggr.)																					+			1	4	I
	Mercurialis annua																						+		1	4	I
	Companions																										
	Convolvulus arvensis	+		1	2	2	+	2	1	1		1	1		1	1	+	1			2	1	+		17	74	IV
	Calystegia sepium		1	1			1		2	1		1	1	1	2	2	1	1	1		2			+	15	65	IV
	Bidens tripartita	r	1	+							r				1		2	+	1		+				9	39	II
	Taraxacum officinale (aggr.)				+		+			+					+		+				+			6	26	II
	Equisetum arvense	2				+		+							+						2				5	22	II
	Ranunculus repens		1														1		+		1			+	5	22	II

its distribution is yet unknown.

Ass.: ***Galeopsido tetrahit-Galinsogetum parviflorae*** ass. nova hoc loco (Tab. 7).
"The vegetation of weeded summer cultivation of the mountains"

Holotypus: Tab. 7 rel. 10.
Diff. species: *Galium aparine, Galeopsis tetrahit, G. speciosa, Mentha arvensis, Stachys palustris, Galinsoga ciliata* and *Aethusa cynapium.*
Floristic composition. The coenosis is dominated by *Galinsoga parviflora*, although it is sometimes entirely replaced by the congeneric *G. ciliata*. *Sonchus oleraceus, Chenopodium album, Polygonum persicaria, Stellaria media* and *Fallopia convolvulus* are very frequent and show high cover values. There are also interesting penetrations of *Galeopsis speciosa* and *G. tetrahit* from the edge of the surrounding woods.
Syntaxonomy. The syntaxonomical framing of the relevés has been rather problematic. Although the floristic link with *Echinochloo-Setarietum* is evident, most of the *Panicoideae* species (differentials of that association) are missing. Due to their C4 metabolism, they are not able to grow (or are not competitive) in mountain climate. Friuli relevés have been compared with *Galinsogeto-Portulacetum* Br.-Bl. 1949 (Braun-Blanquet 1949; Pedrotti 1959a, 1959b), described for the Central Alps, where the cultivation of autumn-winter cereals is possible thanks to the continental climate, with spring and summer less rainy and warmer than in Carnia. The floristic compositions of the two coenoses are significantly different, and they cannot be referred to the same association. The floristic differences are due to the coexistence of *Centaureetalia* and *Chenopodetalia* species in the Central Alps association. Therefore we prefer to consider the Carnic relevés as a new, independent association with the name of *Galeopsido tetrahit-Galinsogetum parviflorae*.

This association has to be referred to the *Panico-Setarion* alliance for the presence of *Galinsoga parviflora*, *Setaria pumila* and *Chenopodium album*. Among *Chenopodietalia* species *Sonchus oleraceus*, *Euphorbia helioscopia* and *Lamium purpureum* are the most frequent; among the *Stellarietea* ones *Chenopodium album*, *Polygonum persicaria*, *Stellaria media*, *Capsella bursa-pastoris* and *Fallopia convolvulus*.
Life forms and chorotypes. Therophytes are dominant (71.4%), followed by hemicryptophytes (20.6%) and geophytes (8.1%).

Because of the particular climatic conditions in which this coenosis occurs, large distribution chorotypes dominate; among these, Cosmopolitan (32.6%), eurasiatic (20.7%) and circumboreal (12.5%) are the best represented. For the same reason, the frequency values of eurymediterranean (1.9%) and steno-mediterranean species (0.3%) are very low, whereas those of adventitious (14.2%) and palaeotemperate (12.6%) are similar to the other coenoses studied in this paper.
Synecology. The association has been found in small fields near villages in cool mountain valleys, especially in Carnia. These fields are mainly cultivated with potatoes and beans (sometimes in the same plot of land) and, due to the excessive altitude, maize is only seldom present. This is a rare example of artisan agriculture, where the few tilling works consist in a single hoeing operation before sowing and in a light weeding during the growth period. In the potato fields, harvest is at the end of September, while bean fields do not undergo further tilling. The soil is left to rest till the next sowing. These fields hardly exceed 300 m^2.

Galeopsido-Galinsogetum occurs in peculiar ecological conditions, in areas with high rainfalls (1600-2500 mm per year), from 400 to 1100 m on sea level, on rendzinas and brown soils, with a high input of organic matter (manuring).
Synchorology. So far, this association has been recorded only in weeded fields of the mountains of Friuli.

Ass.: ***Papaveretum apuli*** ass. nova hoc loco (Tab. 8)
"The vegetation of autumn-winter cereals of the plains of Veneto and Friuli"

Holotypus: Tab. 8, rel. 3.
Charact. and diff. species (D): *Papaver apulum*, *Oxalis fontana* (D).
Floristic composition. The coenosis is dominated by *Centaureetalia* (*Papaver rhoeas, Fumaria officinalis, Centaurea cyanus, Alopecurus myosuroides* and *Anthemis arvensis*) and by *Caucalidion* (*Ranunculus arvensis, Legousia speculum-veneris, Avena fatua* and *Consolida regalis*) species. *Chenopodium album, Polygonum persicaria, Calystegia sepium* and *Poa sylvicola* are almost always present.
Syntaxonomy. The framing of this association was problematic. Pignatti (1952) found in the Venetian plain an association which was identified as *Alchemillo arvensis-Matricarietum* R. Tx. 1937. The

same author, following Tuxen's scheme (Tuxen 1950) for Central Europe, placed it in the alliance *Scleranthion annui* (Kreuseman et Vlieger 1939) Sissingh in Westhoff *et al.* 1946 (which includes acid soil coenoses), although he noted the absence of alliance species, replaced by differential species of *Caucalidion* (which includes basiphilous associations). In this respect Pignatti admitted the existence of one or more basiphilous associations of *Caucalidion*, but did not formally distinguish them (Ferro 1990). In this paper a new association is therefore described with the name of *Papaveretum apuli*.

Ranunculus arvensis, Avena fatua, Legousia speculum-veneris and *Consolida regalis* show the adherence to *Caucalidion, Papaver rhoeas, Fumaria officinalis, Centaurea cyanus, Alopecurus myosuroides* and *Veronica arvensis* to *Centaureetalia*, while the presence of *Chenopodium album, Polygonum persicaria, Lactuca serriola* and *Anagallis arvensis* supports the framing in *Stellarietea.*

Life forms and chorotypes. Therophytes are the most frequent life form (67.3%), but the percentage of hemicryptophytes is also high (25.5%).

Among the studied coenoses, *Papaveretum apuli* shows the highest value of stenomediterranean (6.5%) and eurymediterranean (22.9%) species. The remarkable percentage of neophytes (12.2%) underscores the level of anthropogenic disturbance of this association.

Synecology. This coenosis develops in cultures of autumn-winter cereals and is therefore characterized by the presence of spring therophytes. These species must fructify before the harvest in June.

The soil texture is heterogeneous: it varies from gravel to silt and clay; the soils mainly derive from calcareous substrata. This coenosis occurs below 100-150 m on sea level.

Synchorology. So far, this association has been detected only in Friuli-Venezia Giulia, but it is probably present in the whole of the Venetian plain.

Conclusions

The continuous adjustment of the segetal flora to the changing cultural techniques causes high instability in the floristic composition of the coenoses. Therefore, in the characterization of these plant communities, we privileged some ecological-structural characters (life form / growth form, and species with C4 metabolism) which remain constant.

The crop field and vineyard vegetation of Friuli-Venezia Giulia can be ascribed to four associations. This situation, due to the great changes in cultivation techniques, does not coincide with that described about 40 years ago by Pignatti (1952) and Lorenzoni (1963). Among the associations described at that time, *Panico-Polygonetum* is still valid as a well defined geographical race of *Echinochloo-Setarietum*. In Friuli-Venezia Giulia the variability of this coenosis is very high, and it is possible to identify two geographical sub-races (Karst and Friuli), two ecological-altitudinal forms, one subassociation on drained soils (*xanthietosum italici*) and one agroform in fields with a strong use of herbicides (with *Sorghum halepense*). In the same way *Cerastio-Geranietum dissecti*, described by Poldini (1980), is considered here as a geographical race of *Geranio-Allietum,* containing three different agroforms (with *Taraxacum officinale*, with *Agrostis stolonifera* and with *Arrhenatherum elatius*) induced by different cultivation techniques. Other two coenoses of autumn-winter cereals fields and of small weeded fields of the mountain belt are here described for the first time. They are, respectively, *Papaveretum apuli* and *Galeopsido tetrahit-Galinsogetum parviflorae*.

Appendix

Tab. 4 - Geranio rotundifolii-Allietum vineale

Localities: 1: Spessa di Cividale 9946/1 (UD); 2: Villanova di Farra 0047/3 (GO); 3: Sgonico 0248/3 (TS); 4: Samatorza 0248/1 (TS); 5: Pliskovica 0349/1 (SLO); 6: Bonetti 0147/3 (GO); 7: Sales 0248/3 (TS); 8: Dutovlje 0248/2 (SLO); 9: Godnje 0349/1 (SLO); 10: ibidem; 11: ibidem; 12: ibidem; 13: Tomaj 0348/3 (SLO); 14: Kreplje 0348/3 (SLO); 15: near Rocca Bernarda 9946/1 (UD); 16: Moimacco (near Villa Puppi) 9946/1(UD); 17: Felettis (Palmanova) 0045/1 (UD); 18: Virco 0144/1 (UD); 19: Moraro 0047/3 (GO); 20: between Mossa and Capriva 0047/3 (GO); 21: Corona (Mariano del Friuli) 0046/2 (GO); 22: Villanova di Farra 0047/3 (GO); 23: Moraro 0047/3 (GO); 24: Capriva del Friuli 0047/1 (GO); 25: Villanova di Farra 0047/3 (GO); 26: ibidem; 27: Moraro 0047/3 (GO); 28: Capriva del Friuli 0047/1 (GO); 29: Savogna d'Isonzo 0147/1 (GO); 30: between Lucinico and Giasbana 0047/2 (GO); 31: between Villanova and S. Lorenzo 0047/2 (GO); 32: Lucinico 0047/3 (GO); 33: Corno di Rosazzo 0046/2 (UD); 34: Gagliano di Cividale 9946/2 (UD); 35: Cividale 9946/2 (UD); 37: Campeglio (Faedis) 9846/2 (UD); 38: Orzano (Remanzacco) 9946/3 (UD); 39: Varmo 0143/2 (UD); 40: Vendoglio 9845/1 (UD); 41: Buttrio 9744/3 (UD); 42: Sterpo 0044/3 (UD); 43: between Ariis and Torsa 0144/2 (UD); 44: Faedis 9846/1 (UD); 45: Tauriano 9843/3 (PN); 46: ibidem; 47: ibidem; 48: ibidem; 49: ibidem; 50: ibidem; 51: ibidem; 52: Capriva del Friuli 0047/1 (GO); 53: Torsa 0144/2 (UD); 54: Iutizzo (Codroipo) 0043/4 (UD); 55: S. Pietro di Varmo 0043/4 (UD); 56: Sevegliano 0045/3 (UD);57: Muzzana del Turgnano

Tab.8 - *Papaveretum apuli* ass. nova hoc loco

	Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Pr.	Fr.	Cl.
	Altitude (x 10 m)	6	6	4	23	9	11	2	25	10	10	8	11	2	1	1	9	24			
	Number of species (spor. incl.)	31	30	37	37	36	41	35	32	31	39	40	29	19	30	36	37	46			
	Char. & diff. (DAss) sp. ass.																				
	Papaver apulum	+	+	1	+	+			1	+	2	1	+			+	2	2	13	76	IV
K, DAss	Oxalis fontana		+	+	1	+							+			+	+		7	41	III
	Char. & diff. (DAll) sp. all. (*Caucalidion*)																				
	Ranunculus arvensis	+	+	1	+	1	2	+	2	+	+	1	+		+		+	2	15	88	V
	Legousia speculum-veneris			1	+	+	+	+	2	+	3	1	+		2	+	1	1	14	82	V
	Consolida regalis	1	+	+	+	+	+		+		3	1					+	+	11	65	IV
	Avena fatua	+	+	1			1	1	+	2	+				+	+			10	59	III
DAll	Silene vulgaris		+		+	+	+				+	1	1		+				8	47	III
	Valerianella rimosa									+	+	+	+				+	+	6	35	II
DAll	Chaenorrhinum minus				+			+			+						+	+	5	29	II
DAll	Valerianella locusta			2					+			+					+		4	24	II
	Valerianella eriocarpa	+														+			2	12	I
	Fumaria vaillantii			+								+							2	12	I
	Ajuga chamaepitys											1	+						2	12	I
	Char. & diff. (DO) sp. ord. (*Centaureetalia*)																				
DO	Papaver rhoeas	1	2	2	+	1	+	+	1	1	4	3	1	2	2	2	3	2	17	100	V
DO	Fumaria officinalis	+	+	1	1	1	+	1	1	+	1	+				+	+	1	14	82	V
	Centaurea cyanus	2	1	4	1	+	+	2	4	1	2		3					1	12	71	IV
DO	Alopecurus myosuroides	+	+	1				3	2	1	2	2	1		+	3			11	65	IV
DO	Anthemis arvensis	+	2	1		+		+	1	1	1	2	1						10	59	III
DO	Veronica arvensis			+	+	+					+	+	+		+		+	+	9	53	III
	Cerastium glomeratum				+	+	+				1	1	1	+			1	+	9	53	III
DO	Viola tricolor	3		+	+	+			1	+	1	1							8	47	III
DO	Myosotis arvensis	+		+			+	+	+	+	+							+	8	47	III
	Raphanus raphanistrum				1	1		+	+	2	+						+	1	8	47	III
	Buglossoides arvensis	+	1			1	2			2		+	+						7	41	III
	Arabidopsis thaliana					+		+			2	+					+	1	6	35	II
DO	Matricaria chamomilla			+				+								4	+	2	5	29	II
	Papaver argemone				+		+	+							+				4	24	II
	Lolium multiflorum						1	1	2										3	18	I
	Legousia hybrida	+	+																2	12	I
	Rapistrum rugosum													+	+				2	12	I
	Aphanes arvensis			1															1	6	I
	Class species (*Stellarietea*)																				
	Chenopodium album	+	4	+	+	1	+	+	+	+	+	+		2	+	+	2	2	16	94	V
	Polygonum persicaria		+		1	+	+	+	1	+	+	+		2	1	3	+	+	14	82	V
	Capsella bursa-pastoris	+	+	1	1	+	+	+	1				+	+		+	+	+	13	76	IV
	Anagallis arvensis	+	+	+	1		+	+	+		+			+	+	+	1	+	13	76	IV
	Veronica persica	+	+	1	1	1	+				+	1		+	+	+	1	+	13	76	IV
	Stellaria media	+		+	+	1	+	+	+	+		1		+	+	1		+	13	76	IV
	Vicia sativa		+	+	+	+	1		1	1	+	+	+		+	+			12	71	IV
	Fallopia convolvulus	2		+		1	1	+	+	+	1	1		1				1	11	65	IV
	Erigeron annuus					2	+		+		+	1	2		+		1	1	9	53	III
	Sinapis arvensis			+	+	1	+		1	2					+				7	41	III
	Lactuca serriola			+							1	+				2	2	3	6	35	II
	Senecio vulgaris	+										+				1	+	1	5	29	II
	Cirsium arvense		+	+			+			1						1			5	29	II
	Bromus sterilis					+	1	+									+		4	24	II
	Mercurialis annua	+		+														+	3	18	I
	Sonchus oleraceus	+													+	1			3	18	I
	Amaranthus retroflexus			+													+	1	3	18	I
	Euphorbia helioscopia				+							+						+	3	18	I
	Sonchus asper				+												+	+	3	18	I
	Veronica hederifolia					+		+		+									3	18	I
	Conyza canadensis					+			+						+				3	18	I

Tab.8 - Continued.

Brassica napus		+		1													2	12	I
Xanthium italicum							+		1								2	12	I
Datura stramonium								+								+	2	12	I
Lamium purpureum						+										+	2	12	I
Geranium dissectum			+														1	6	I
Geranium molle			+														1	6	I
Mentha arvensis					1												1	6	I
Muscari comosum						+											1	6	I
Euphorbia falcata											1						1	6	I
Setaria pumila												+					1	6	I
Oxalis corniculata													+				1	6	I
Amaranthus graecizans														1			1	6	I
Euphorbia peplus														+			1	6	I
Cardamine hirsuta															+		1	6	I
Digitaria sanguinalis															1		1	6	I
Galinsoga parviflora																+	1	6	I
Companions																			
Calystegia sepium	2	1		1	1	+	1	1	1	+	1	1	2	+	1	1	1	16	94	V
Poa sylvicola			+	1	2	2	2		1	2	2	1	1	2	1	1	1	14	82	V
Polygonum aviculare	1		+	1	1	+	+	1	1	1			1	1	+		+	13	76	IV
Mentha longifolia	+	+		+	1	1	1		+	+	+			+	+		+	12	71	IV
Sorghum halepense	+	1	+	+						+	1	+			1	1	2	10	59	III
Silene alba	+	+					+	+	+	+	1	1	1		1			10	59	III
Arenaria serpyllifolia		1				+	+			1	+	1		+	1	+	+	10	59	III
Lolium multiflorum	1	+		1					2	1		1			+	1	1	9	53	III
Medicago lupulina		+				+					+	+			+		+	6	35	II
Convolvulus arvensis			+			1				+				1	1		1	6	35	II
Artemisia verlotorum	1					+	+	1							+			5	29	II
Daucus carota				+	+	+					2			1				5	29	II
Agropyron repens				1	1		+						2	+				5	29	II
Ranunculus arvensis						+	+				+		+				1	5	29	II
Rorippa sylvestris						+		+				+			1		+	5	29	II
Galium aparine							+		+					+	+	+		5	29	II
Trifolium repens		+		1									+	1				4	24	II
Artemisia vulgaris				+							2	1					2	4	24	II
Conyza albida						+				+						1	1	4	24	II
Crepis taraxacifolia						+				+		2				2		4	24	II
Equisetum arvense													1	2	+	+		4	24	II

0144/4 (UD); 58: Colloredo di Montalbano 9844/2 (UD); 59: Buttrio 9744/3 (UD); 60: Nimis 9745/4 (UD); 61: S. Croce 0248/3 (TS); 62: ibidem.

Sporadic species: *Daucus carota:* + (1), + (15), + (17), + (19), r (35), + (37), + (48), + (56), + (59); *Urtica dioica:* + (28), + (37), + (43), 1 (45), 3 (50), 1 (51), 4 (54), + (56), r (60); *Trifolium incarnatum/molineri:* 1 (4), 1 (7), + (8), + (10), + (11), + (12), + (13); *Arenaria serpyllifolia:* + (13), + (17), + (20), r (24), r (26), + (31), r (35); *Cynodon dactylon:* + (13), 1 (17), r (26), + (34), 1 (43); *Raphanus landra:* + (16), + (17), + (19), + (22), 1 (34), 2 (35); *Lamium maculatum:* + (10), + (21), + (22), + (36), + (62); *Clematis vitalba:* r (15), + (16), + (49), + (50), + (62); *Artemisia vulgaris:* + (18), + (21), 1 (26), 1 (32), + (49); *Ajuga reptans:* + (38), + (55), + (58), + (59), + (60); *Crepis foetida:* + (3), + (4), + (20), + (21); *Galium aparine:* + (5), + (12), r (23), r (58); *Ranunculus acris:* + (15), r (44), + (55), + (60); *Polygonum aviculare:* + (1), + (48), + (50); *Brassica rapa:* 1 (4), + (10), + (21); *Cerastium pumilum:* + (6), 2 (14), r (61); *Galium lucidum:* + (15), 1 (37), + (38); *Medicago sativa:* r (35), + (52), + (56); *Pastinaca sativa:* + (39), 2 (51), + (60); *Glechoma hederacea:* + (44), + (54), 1 (57); *Anthoxanthum odoratum:* + (58), + (59), + (60); *Picris hieracioides:* + (39), 1 (47); *Cardaria draba:* 1 (4), + (13); *Malva sylvestris:* + (5), + (44); *Poa pratensis:* + (86), + (62); *Sisymbrium officinale:* + (10), + (34); *Rorippa sylvestris:* + (13), 1 (16); *Allium ampeloprasum:* 1 (14), r (44); *Aristolochia clematitis:* + (16), + (62); *Sambucus ebulus:* + (16), + (54); *Leucanthemum vulgare:* + (17), + (56); *Artemisia verlotorum:* 1 (19), + (61); *Ranunculus sardous:* 1 (21), + (31); *Capsella rubella:* + (29), 1 (36); *Silene vulgaris:* + (34), + (60); *Holcus lanatus:* + (37), + (58); *Verbena officinalis:* + (45), + (46); *Crepis capillaris:* + (48), + (51); *Veronica chamaedrys:* 1 (54), 1 (60); *Brachypodium sylvaticum:* + (61), + (62); *Carex pairae* 1 (61), + (62); *Rubus caesius:* r (61), + (62); *Linaria vulgaris:* + (3); *Bromus madritensis:* + (4); *Erophila verna:* + (5); *Vicia hirsuta* + (8); *Plantago media:* + (13); *Medicago minima:* + (13); *Trifolium campestre:* + (13); *Inula salicina:* + (15); *Tussilago farfara:* + (15); *Ononis spinosa:* + (16); *Solanum dulcamara:* + (16); *Leontodon hispidus:* + (17); *Sanguisorba minor:* r (18); *Arabidopsis thaliana:* + (19); *Bromus molliformis:* + (19); *Ranunculus parviflorus:* + (23); *Cirsium vulgare:* + (28); *Fragaria vesca:* + (28); *Lapsana communis:* + (34); *Senecio inaequidens:* + (34); *Tragopogon orientalis:* + (34); *Lotus corniculatus:* + (37); *Saponaria officinalis:* + (37); *Hypochoeris radicata:* + (38); *Cerastium brachypetalum:* + (40); *Carex hirta* + (42); *Euphorbia*

lathyris: r (42); *Aegopodium podagraria:* + (44); *Buphthalmum salicifolium:* + (44); *Hypochoeris glabra:* + (52); *Valeriana officinalis:* + (52); *Pimpinella major:* + (57); *Cruciata laevipes:* + (59); *Allium sphaerocephalon:* 1 (61); *Avena barbata:* 1 (61); *Medicago lupulina:* r (62); *Eupatorium cannabinum:* 1 (62).

Tab. 6 - Echinochloo-Setarietum pumilae

Localities: 1: Enemonzo 9543/3 (UD); 2: Villa Santina 9543/4 (UD); 3: Esemon di Sotto 9543/3 (UD); 4: Formeaso 9544/3 (UD); 5: Socchieve 9643/1 (UD); 6: Enemonzo 9543/3 (UD); 7: Esemon di Sopra 9543/3 (UD); 8: Esemon di Sopra 9543/3 (UD); 9: Terzo 9544/3 (UD); 10: Subida (Cormons) 0046/2 (GO); 11: Moraro 0047/3 (GO); 12: Capriva del Friuli 0047/3 (GO); 13: Terzo 9544/3 (UD); 14: Esemon di Sotto 9543/3 (UD); 15: Cavazzo 9644/1 (UD); 16: Amaro 9644/2 (UD); 17: Manzano 0046/1 (UD); 18: Gorgo (Latisana) 0244/1 (UD); 19: Gorgo (Latisana) 0244/1 (UD); 20: Gorgo (Latisana) 0244/1 (UD);21: Latisana 0144/3 (UD); 22: Perteole 9945/1 (UD); 23: Flambruzzo 0144/1 (UD); 24: Marano 0245/1 (UD); 25: Aquileia 0246/1 (UD); 26: S. Giorgio di Nogaro 0145/3 (UD); 27: Preval (Cormons) 0047/1 (GO); 28: ibidem; 29: Fagagna 9844/4 (UD); 30: Tolmezzo 9544/3 (UD); 31: Terzo 9544/3 (UD); 32: Gemona 9744/2 (UD); 33: ibidem; 34: Artegna 9744/4 (UD); 35: Flambruzzo (Rivignano) 0144/1 (UD); 36: Romans d'Isonzo 0146/2 (UD); 37: Terzo 9544/3 (UD); 38: Fagagna 9844/4 (UD); 39: Maiano 9844/1 (UD); 40: Terzo 9544/3 (UD); 41: Cavazzo 9644/1 (UD); 42: ibidem; 43: Gemona 9744/2 (UD); 44: Cavazzo 9644/1 (UD); 45: Codroipo 0043/1 (UD); 46: Pliskovica 0349/1 (SLO); 47: Ferletti 0147/3 (GO); 48: Medeazza 0247/2 (TS); 49: Sales 0248/3 (TS); 50: S. Michele 0147/1 (GO); 51: Pliskovica 0349/1 (SLO); 52: Medeazza 0247/2 (TS); 53: Dutovlje 0349/1 (SLO); 54: Lokev 0349/1 (SLO); 55: Villanova di Farra 0047/3 (GO); 56: Grozzana 0349/3 (TS); 57: ibidem; 58: Basovizza 0349/1 (TS); 59: Percedol 0248/3 (TS); 60: S. Canziano 0349/2 (SLO); 61: Rupinpiccolo 0248/4 (TS); 62: ibidem; 63: Sgonico 0248/3 (TS).

Sporadic species: *Medicago lupulina:* r (5), + (9), + (14), + (29), r (37), + (46), r (52), + (54), + (55); *Trifolium repens:* + (2), + (5), + (13), + (14), + (15), r (23), + (40), + (66); *Artemisia vulgaris:* r (15), r (18), + (21), + (22), r (32), + (33), + (37), r (55); *Diplotaxis tenuifolia:* r (6), 1 (20), + (29), + (48), + (50), + (25); *Rumex crispus:* + (12), r (15), 1 (16), + (32), + (50), r (52), + (54); *Plantago major:* r (3), + (6), + (25), + (27), + (32), + (57); *Daucus carota:* r (3), + (14), + (27), + (29), r (38), + (46); *Mentha spicata:* + (22), + (25), + (34), 1 (38), + (47), r (55); *Plantago lanceolata:* r (12), + (47), + (51), + (57), + (66); *Verbena officinalis:* + (12), r (21), r (24), r (25), + (55); *Potentilla reptans:* r (21), + (29), + (36), 1 (47), 2 (52); *Vicia sepium:* + (7), + (9), r (30), r (43); *Rumex obtusifolius:* r (29), + (34), 2 (54), 1 (58); *Silene vulgaris:* r (1), r (14), r (55); *Agrostis stolonifera:* + (7), r (15), 1 (51); *Rubus caesius:* r (22), 1 (38), 1 (39); *Lythrum salicaria:* r (21), + (28), r (36); *Aristolochia clematitis:* + (51), + (53), 1 (66); *Poa annua* + (3), + (12); *Glechoma hederacea:* r (5), 1 (12); *Rorippa sylvestris:* + (11), 1 (52); *Arenaria serpyllifolia:* + (14), r (33); *Cirsium vulgare:* r (16), r (39); *Heliotropium europaeum:* + (29), r (52); *Armoracia rusticana:* 1 (5); *Chaenarrhinum minus:* r (14); *Mentha longifolia:* + (21); *Cichorium intybus:* r (23); *Abutilon theophrasti:* + (26); *Polygonum mite:* + (27); *Picris hieracioides:* + (29); *Helianthus tuberosus:* + (30); *Aegopodium podagraria:* + (31); *Hypericum perforatum:* r (33); *Lysimachia nummularia:* r (36); *Sambucus ebulus:* + (37); *Vicia cracca:* r (37); *Brassica nigra:* r (38); *Picris echioides:* + (38); *Crepis rhoeadifolia:* + (46); *Nicandra physalodes:* + (47); *Chondrilla juncea:* r (50); *Achillea millefolium:* + (51); *Centaurea weldeniana:* r (51); *Galium mollugo:* + (51); *Leucanthemum vulgare:* r (51); *Prunella vulgaris:* + (51); *Misopates orontium:* r (52); *Stachys annua:* + (53); *Lolium multiflorum:* + (57); *Medicago sativa:* 1 (57); *Euphorbia falcata:* + (63).

Tab. 7 - Galeopsido tetrahit-Galinsogetum parviflorae

Localities: 1: Socchieve 9543/3 (UD); 2: S. Pietro di Zuglio 9544/1 (UD); 3: Cercivento 9443/3 (UD); 4: Ampezzo 9542/4 (UD); 5: Avaglio (Lauco) 9543/3 (UD); 6: Forni Avoltri 9442/2 (UD); 7: Ravascletto 9443/3 (UD); 8: between Liariis and Clavais (Ovaro) 9543/1 (UD); 9: Magnanins (Ravascletto) 9443/3 (UD); 10: Lenzone (Ovaro) 9543/1 (UD); 11: Cella (Ovaro) 9543/1 (UD); 12: Lenzone (Ovaro) 9543/1 (UD); 13: Liariis (Ovaro) 9543/1 (UD); 14: Oltris (Ampezzo) 9542/4 (UD); 15: between Trava and Avaglio (Lauco)9543/3 (UD); 16: Osais (Val Pesarina) 9442/2 (UD); 17: Pesariis 9442/4 (UD); 18: Cercivento 9443/3 (UD); 19: Sauris di sotto 9542/1 (UD); 20: Villa Santina 9543/2 (UD); 21: Paularo 9444/3 (UD); 22: Mersino sup. (M. Matajur) 9847/3 (UD); 23:Malga Vidoni (M. Chiampon) 9745/1 (UD).

Sporadic species: *Poa annua:* + (7), + (10), + (17), 1 (20); *Trifolium pratense:* + (13), + (21), + (22), + (23); *Trifolium repens:* + (4), + (13), + (22), + (23); *Daucus carota:* + (10), + (12), + (23); *Aegopodium podagraria:* + (16), + (19), + (23); *Silene alba:* r (2); + (19); *Polygonum aviculare:* + (4), + (8); *Urtica dioica:* + (4), 1 (23); *Nepeta cataria:* + (5), + (15); *Lamium album:* + (6), + (16); *Glechoma hederacea:* + (11), + (20); *Myosoton aquaticum:* 1 (11), 1 (12); *Leucanthemum vulgare:* + (19), + (22); *Phalaris canariensis:* + (1); *Artemisia vulgaris:* r (2); *Lamium maculatum:* + (2); *Rumex obtusifolius:* + (6); *Myosotis sylvatica:* r (8); *Atriplex tatarica:* r (13); *Galium lucidum:* + (14); *Geranium pyrenaicum:* + (15); *Agropyron repens:* 1 (19); *Lathyrus pratensis:* + (19); *Ranunculus acris:* + (19); *Silene vulgaris/vulgaris:* + (19); *Vicia hirsuta:* r (19); *Vicia sepium:* + (19); *Dactylis glomerata:* + (20); *Arrhenatherum elatius:* + (21); *Borago officinalis:* + (21); *Euphorbia lathyris:* + (21); *Lotus corniculatus:* + (22); *Centaurea nigrescens:* + (23); *Crepis capillaris:* + (23); *Galium mollugo:* + (23); *Holcus lanatus:* + (23); *Lolium multiflorum:* 1 (23); *Malva neglecta:* + (23); *Prunella vulgaris:* + (23); *Veronica chamaedrys:* + (23).

Tab. 8 - Papaveretum apuli

Localities: 1: Lucinico 0047/3 (GO); 2: Farra d'Isonzo 0047/3 (GO); 3: Gradisca 0147/1 (GO); 4: S. Vito di Fagagna 9944/4 (UD); 5: Mereto di Tomba 9944/3 (UD); 6: Orzano (Remanzacco) 9946/2 (UD); 7: Palmanova 0045/4 (UD); 8: Fagagna 9844/4 (UD); 9: Cerneglons 9954/2 (UD); 10: Udine 9945/2; 11: Udine Sud 9945/2 (UD); 12: Premariacco 9946/2 (UD); 13: Cervignano 0146/4 (UD); 14: Carlino (Marano) 0145/3-0245/1 (UD); 15: Torviscosa 0145/4 (UD); 16: Pradamano 9945/2 (UD); 17: Cicconicco di Fagagna 9844/3 (UD);

Sporadic species: *Potentilla reptans:* + (1), 1 (13), 1 (14); *Rumex crispus:* + (1), + (6), 1 (15); *Reseda lutea:* + (4), + (10), + (12); *Rumex obtusifolius:* 1 (8), + (9), 1 (11); *Rubus caesius:* + (13); + (14), + (15); *Medicago sativa:* 2 (4), 3 (6); *Ajuga genevensis:* + (5), 1 (11); *Plantago major:* + (6), 1 (9); *Helianthus tuberosus:* 1 (7), 1 (14); *Cerastium holosteoides:* + (10), + (17); *Taraxacum officinale:* 1 (10), + (17); *Saxifraga tridactylites:* + (11), + (16); *Acinos arvensis:* + (11), + (12); *Fagopyrum tataricum:* 1 (1); *Achillea millefolium:* 1 (2); *Melilotus officinalis:* + (2); *Trifolium pratense:* + (2); *Vicia cracca:* + (2); *Aphanes arvensis:* 1 (3);

Bifora radians: + (3); *Lithospermum officinale:* 4 (3); *Diplotaxis tenuifolia:* + (4); *Fallopia dumetorum:* 1 (4); *Galium mollugo:* + (4); *Arrhenatherum elatius:* + (5); *Glechoma hederacea:* + (5); *Myosoton aquaticum:* + (5); *Rumex acetosa:* + (5); *Bidens frondosa:* 1 (7); *Geum urbanum:* + (7); *Brassica oleracea:* + (8); *Humulus lupulus:* + (9); *Oxalis acetosella:* + (9); *Hypochoeris radicata:* + (10); *Senecio inaequidens:* 1 (10); *Galium lucidum:* 1 (11); *Plantago lanceolata:* 1 (11); *Saponaria officinalis:* 1 (11); *Verbena officinalis:* + (11); *Aegopodium podagraria:* 2 (13); *Equisetum ramosissimum:* + (14); *Festuca arundinacea:* + (14); *Plantago media:* 1 (14); *Lysimachia vulgaris:* + (15); *Dactylis glomerata:* + (16); *Erophila verna:* + (16); *Leucanthemum vulgare:* + (16); *Trifolium campestre:* + (16); *Crepis foetida:* 1 (17); *Rumex conglomeratus:* + (17).

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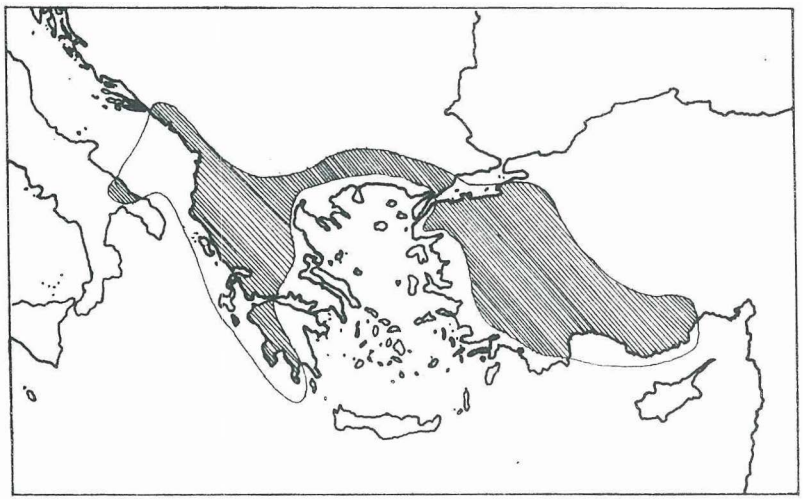

Fig. 1 - Distribuzione geografica di *Quercus trojana* Webb.
Geographic distribution of Quercus trojana *Webb.*

Area di studio

Sotto il profilo bioclimatico l'area pugliese interessata dai fragneti (Fig. 2) rientra, secondo la classificazione proposta da Rivas-Martinez *et al.* (1991), nel tipo mesomediterraneo subumido inferiore. Infatti sulla base dei diagrammi ombrotermici (Fig. 3), relativi alle stazioni termopluviometriche ricadenti all'interno dell'areale del fragno, si rileva che le temperature medie annue sono comprese fra 14°C e 16°C, mentre le precipitazioni medie annue vanno da circa 600 mm a 700 mm. *Quercus trojana* nel territorio pugliese si insedia normalmente su terre rosse mediterranee originatesi da calcari miocenici, dove forma boschi puri o talora misti a *Quercus ilex* L. e *Q. virgiliana* (Ten.) Ten., o più raramente a *Q. cerris* L. e *Q. calliprinos* Webb.

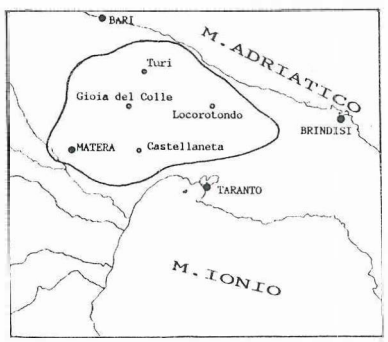

Fig. 2 - Areale di *Quercus trojana* Webb in Puglia (da Maselli 1940, modif.).
Distribution of Quercus trojana *in Puglia (from Maselli 1940, modified).*

Risultati e Discussione

Sulla base della loro composizione floristica, esigenze ecologiche e correlazioni dinamiche, i boschi a *Quercus trojana* presenti nelle Murge pugliesi mostrano un chiaro carattere termofilo. Infatti in queste formazioni sono presenti numerose sclerofille arboree, arbustive e lianose come *Quercus ilex, Phillyrea latifolia, Rubia longifolia, Rosa sempervirens, Lonicera implexa, Pistacia lentiscus, Viburnum tinus, Ruscus aculeatus*, ecc. che normalmente si accompagnano ad altri elementi termofili decidui come *Pyrus amygdaliformis, Calicotome infesta, Lonicera etrusca, Fraxinus ornus, Quercus virgiliana*, e *Pistacia terebinthus*.

Nel loro complesso questi fragneti, rientranti nella fascia climacica del *Quercion ilicis*, si insediano su substrati calcarei a quote comprese tra i 100 e i 500 m, dove costituiscono un tipo di vegetazione climacica molto peculiare ed esclusiva in Italia di quest'area pugliese. Abbastanza ricco e ben rappresentato è il contingente di specie appartenenti alla suddetta alleanza e alla relativa classe *Quercetea ilicis*. Oltre alle specie legnose sopracitate, si rinvengono pure numerosi altri elementi di questi *syntaxa*, come *Cyclamen repandum, Carex distachya, Asparagus acutifolius, Viola dehnhardtii, Luzula forsteri, Poa sylvicola, Tamus communis, Carex hallerana*. Per la caratterizzazione floristica dei suddetti *syntaxa* ci si è attenuti soprattuto al lavoro di revisione di *Quercetea ilicis* effettuato da Rivas Martinez (1975) e Brullo & Marcenò (1985).

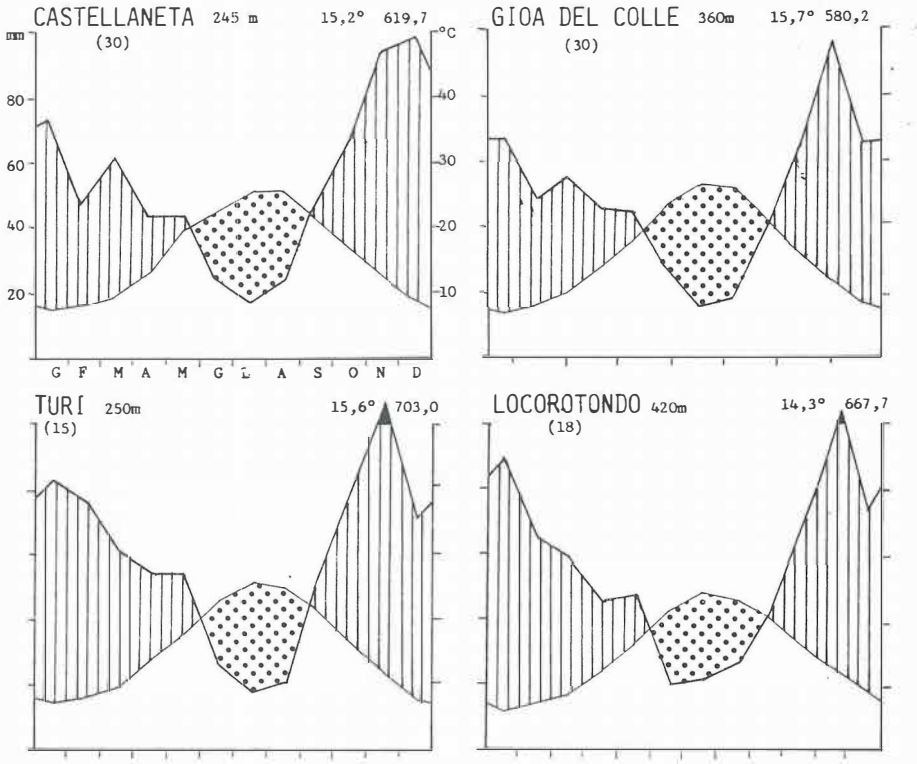

Fig. 3 - Diagrammi ombrotermici di alcune stazioni delle Murge Pugliesi. I dati di Castellaneta e Gioia del Colle sono stati tratti da Bianco *et al.* (1988); quelli di Turi e Locorotondo da Bianco (1961a).

Climatic diagrams of selected localities in the Murge (Puglia). Data from Bianco et al. *(1988) (Castellaneta and Gioia del Colle), and from Bianco (1961a) (Turi and Locorotondo).*

L'appartenenza di questa formazione all'alleanza *Quercion ilicis* era già stata evidenziata da Chiesura Lorenzoni *et al.* (1971) e successivamente confermata da Lorenzoni e Chiesura Lorenzoni (1987), che in particolare attribuiscono le cenosi in oggetto ad un *Quercetum trojanae n.n.*, in seno al quale differenziano varie subassociazioni.

In effetti, i fragneti delle Murge pugliesi si differenziano abbastanza bene floristicamente dalle altre formazioni boschive del *Quercion ilicis*, oltre che per la dominanza di *Quercus trojana*, anche per la presenza di alcuni elementi abbastanzi rari e significativi nel territorio italiano, esclusivi o quasi di queste formazioni. Si tratta in particolare di *Euphorbia apios* e *Potentilla detommasii*, specie entrambe del Mediterraneo nord-orientale, qui abbastanza diffuse e frequenti, come pure di *Arum apulum,* un raro endemismo pugliese. Queste specie nel loro complesso permettono di differenziare una nuova associazione, proposta come *Euphorbio apii-Quercetum trojanae* (*holotypus*: ril. 11, Tab. 1).

In situazioni microclimatiche e pedologiche più mesiche i boschi a *Q. trojana* della Puglia si arricchiscono in specie dei *Quercetalia pubescentis-petraeae* e dei *Querco-Fagetea*, fra cui in particolare *Buglossoides purpureo-coerulea, Silene italica, Euonymus europaeus, Poa sylvicola, Brachypodium sylvaticum, Quercus cerris, Fraxinus ornus.* Queste specie permettono di differenziare un aspetto più mesofilo proposto come subass. *poetosum sylvicolae* (*holotypus* ril. 10, Tab. 1), che si distingue abbastanza bene dal tipo anche sotto il profilo ecologico.

Sulla base di osservazioni personali inedite e di dati di letteratura (Agostini 1967, Macchia 1987, Bartolo *et al.* 1985, De Marco & Caneva 1985, Brullo *et al.* 1987), nel territorio pugliese l'associazione in oggetto viene sostituita in situazioni più xeriche dall'*Oleo - Quercetum virgilianae* Brullo 1984, che in genere è legato a un clima di tipo termomediterrano subumido inferiore, o dal *Thymo-Pinetum halepensis* De Marco & Caneva 1985 quando si passa al termomediterraneo secco superiore. In situazioni microclimatiche più

Tab. 1 - *Euphorbio apii - Quercetum trojanae*

Numero del rilievo	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Quota (m)	320	320	320	310	310	310	420	450	440	440	450	450	430	380	360
Superficie (m^2)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Copertura arborea (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Copertura arbustiva (%)	40	40	30	50	50	40	60	60	70	50	50	50	50	60	60
Copertura erbacea (%)	40	30	30	50	30	50	60	60	50	60	60	70	70	70	60
Specie caratteristiche di associazione															
Quercus trojana Webb	4	5	5	4	5	5	5	5	5	5	5	5	5	3	4
Euphorbia apios L.	1	1	2	1	1	+	2	1	1	2	1	1	1	2	1
Potentilla detommasii Ten.	.	+	.	+	1	.	.	+	2	1	1	1	+	1	2
Arum apulum (Carano) Bedalov	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Specie differenziali di subassociazione															
Poa sylvicola Guss.	.	.	.	.	.	.	2	1	1	2	2	2	2	3	2
Euonymus europaeus L.	.	.	.	.	.	.	.	+	1	2	2	1	1	1	2
Buglossoides purpurocaerulea (L.) Johnst.	1	+	.	.	.	+	1	.	.	2	2	2	1	2	1
Brachypodium sylvaticum (Hudson) Beauv.	.	.	.	.	.	.	2	1	2	2	2	2	3	.	.
Geum urbanum L.	.	.	.	.	.	.	.	+	1	1	1	1	+	.	+
Galium odoratum (L.) Scop.	.	.	.	.	.	.	+	1	+	1	+	.	.	.	.
Fraxinus ornus L.	.	.	.	.	.	.	.	1	1	1	+	.	.	.	.
Quercus cerris L.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2
Specie caratteristiche di *Quercion ilicis* e di *Quercetea ilicis*															
Rubia longifolia Poiret	1	2	2	2	1	1	.	2	2	2	2	1	1	1	1
Rosa sempervirens L.	1	1	+	+	.	1	.	1	1	1	2	2	2	2	2
Carex distachya Desf.	1	1	+	1	+	.	.	1	+	1	1	1	1	3	2
Pyrus amygdaliformis Vill.	1	1	+	1	+	.	.	+	2	1	2	1	1	.	1
Asparagus acutifolius L.	1	2	+	2	2	2	.	.	.	.	2	1	1	1	1
Quercus virgiliana (Ten.) Ten.	1	1	.	+	.	1	1	.	.	1	1	1	1	2	2
Phillyrea latifolia L.	1	+	1	1	+	1	2	1	1	+	1	.	.	.	.
Lonicera etrusca Santi	.	.	+	1	+	.	.	1	1	1	1	1	+	1	1
Quercus ilex L.	2	1	1	2	2	1	1	+	1	.	.	.	.	.	.
Cyclamen repandum Sibth. et Sm.	1	+	1	.	+	.	.	.	.	2	1	1	1	+	.
Viola dehnhardtiiTen.	+	+	.	+	.	+	.	.	.	.	1	1	+	+	+
Calicotome infesta (C.Presl) Guss.	1	.	+	2	1	1	.	2	1	1	.	.	.	.	.
Ruscus aculeatus L.	.	.	.	.	.	.	.	.	1	1	1	2	1	1	+
Tamus communis L.	.	.	.	.	.	.	2	1	2	1	1	1	.	.	.
Lonicera implexa Aiton	.	.	.	.	.	.	1	2	1	.	.	.	1	1	.
Luzula forsteri (Sm.) DC.	+	.	+	1	+	.	.	.	.	.	.	.	.	+	.
Pistacia lentiscus L.	.	.	.	.	.	.	3	2	2	.	.	.	.	.	.
Pistacia terebinthus L.	.	.	.	.	.	.	.	.	.	.	1	2	1	.	.
Viburnum tinus L.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.
Carex hallerana Asso	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.
Pulicaria odora (L.) Reichenb.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.
Altre specie															
Ranunculus neapolitanus Ten.	2	1	1	1	.	1	1	1	1	2	1	1	2	1	+
Crataegus monogyna Jacq.	1	+	1	1	.	+	1	1	2	1	1	1	1	1	2
Dactylis glomerata L.	1	.	+	1	.	2	2	1	1	2	2	2	2	2	2
Geranium sanguineum L.	1	.	+	1	1	2	1	+	+	.	1	1	+	1	+
Silene italica (L.) Pers.	+	1	+	1	1	+	1	.	.	.	1	2	1	2	2
Allium subhirsutum L.	+	+	+	1	1	+	.	.	1	+	1	+	+	.	.
Hedera helix L.	1	+	.	.	1	.	.	2	1	1	2	2	2	2	1
Stachys cfr. salviifolia Ten.	1	+	.	+	1	+	1	.	.	.	+	+	+	+	+
Carex serrulata Biv.	+	.	+	1	+	+	.	.	+	.	+	.	+	1	+
Crepis leontodontoides All.	1	+	.	+	+	.	2	.	.	.	+	1	.	1	1
Rubus ulmifolius Schott	1	+	+	1	2	1	.	3	.	.	.	.	.	1	2
Euonymus europaeus L.	.	.	.	.	.	.	.	+	1	2	2	1	1	1	2
Crepis vesicaria L.	.	.	.	.	.	.	2	1	1	+	1	1	+	.	1
Anthoxanthum odoratum L.	1	+	.	+	.	.	.	.	.	.	1	1	1	1	+
Arabis hirsuta (L.) Scop.	.	.	.	.	.	.	+	+	+	+	1	1	1	.	+
Teucrium chamaedrys L.	+	+	.	+	.	+	.	.	.	.	+	.	+	1	+
Prunus spinosa L.	.	.	.	.	.	.	.	1	1	1	1	+	.	2	2
Anemone hortensis L.	.	.	.	.	.	.	.	+	1	.	1	+	1	+	+
Festuca rubra L.	.	.	+	2	+	.	1	.	.	.	.	.	.	2	1
Asphodelus microcarpus Salzm. et Viv.	.	.	.	.	.	.	2	.	.	.	+	1	1	2	+
Cistus monspeliensis L.	1	1	+	1	+	.	2	.	.	.	.	.	.	.	.
Sanguisorba muricata Gremli	.	.	.	+	.	.	.	.	1	+	1	1	+	.	.
Silene latifolia Poiret	.	.	.	.	.	.	.	.	+	.	+	1	1	+	+
Cistus eriocephalus Viv.	1	+	.	.	.	+	.	1	+	.	.	.	.	.	.
Dorycnium hirsutum (L.) Ser.	1	+	+	.	.	.	1	.	.	.	.	.	.	.	.
Silene vulgaris (Moench) Garcke	.	.	.	.	.	.	1	1	+	.	+	.	.	.	.
Galium verum L.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	1
Leontodon tuberosus L.	.	.	.	.	.	.	+	.	.	.	.	.	+	1	+

fresche e umide, come il fondo di valloni o versanti bene ombreggiati, in genere si insediano leccete mesofile del *Quercion ilicis* riferibili in massima parte al *Pistacio-Quercetum ilicis* Brullo & Marcenò 1985. Nell'estrema punta salentina, limitatamente alle aree più interne, interessate da un bioclima termomediterraneo subumido superiore, la formazione climatofila è rappresentata dall' *Arbuto-Quercetum calliprini* Brullo *et al.* 1987. Abbastanza diffuse lungo le stazioni costiere della Puglia sono inoltre le formazioni dell' *Oleo-Ceratonion*, appartenenti per lo più al *Myrto-Lentiscetum* (Molinier 1954 em. O. Bolos 1962) Rivas Martinez 1975.

Da osservazioni personali inedite, nei processi di degradazione, legati soprattutto al taglio, incendio e pascolo, l'*Euphorbio apii-Quercetum trojanae* tende ad essere sostituito, in seguito alla distruzione dello strato arboreo ed arbustivo, da garighe del *Cisto-Ericion* Horvatić 1958, che a loro volta, con l'accentuarsi dei fenomeni di erosione del suolo, lasciano il posto a praticelli effimeri del *Thero-Brachypodion* Br.-Bl. 1925.

Sulla base dei dati di letteratura, boschi a *Quercus trojana* sono stati segnalati nella Penisola Balcanica da Horvat *et al.* (1974), che riportano per la Macedonia un *Quercetum trojanae* Em 1958 em. Horvat 1959 attribuito all' *Ostryo-Carpinion orientalis* Horvat (1954) 1958, alleanza dei *Quercetalia pubescentis* Br.-Bl. 1932. Questa associazione, per la presenza e in genere abbondanza di *Carpinus orientalis, Ostrya carpinifolia, Sorbus aria, Acer obtusatum, Quercus pubescens, Fraxinus ornus, Coronilla emeroides, Buxus sempervirtens, Cornus mas, Festuca heterophylla, Campanula trachelium, Polygonatum odoratum*, ecc., come pure per le sue esigenze ecologiche, mostra un marcato carattere mesofilo e pertanto si differenzia nettamente dall'associazione pugliese. Altre associazioni a *Quercus trojana*, ascritte sempre all' *Ostryo-Carpinion orientalis*, sono state segnalate per varie località dell'ex Yugoslavia. Si tratta in particolare del *Quercetum pubescenti-macedonicae* Horvat 1936 *n.n.*, *Quercetum trojanae hercegovinicum* Stefanović 1962 *n.n.*, *Quercetum trojanae montenegrinum* Blečić & Lakusić 1975 *n.n.*, *Quercetum macedonicae* Em in Horvat 1950 *n.n.* (cfr. Horvat 1936, 1950, Fukarek & Fabijanić 1968, Stefanović & Fabijanić 1969, Em 1969). Queste associazioni non possono essere comparate dal punto di vista floristico con quella pugliese in quanto i vari autori citano semplicemente il nome dell'associazione senza fornire rilievi o elenchi floristici. E' comunque da ritenere probabile che boschi termofili a *Quercus trojana* affini a quelli pugliesi, rientranti anch'essi nel *Quercion ilicis* siano presenti anche nei territori balcanici e anatolici, soprattutto nelle stazioni collinari più meridionali.

Appendice 1

Rill. 1-6: Tra Putignano e Alberobello (Bari), 8.5.84; ril. 7 Bosco delle Pianelle (Taranto), 7.5.1992; rill. 8-10: Martinafranca (Taranto), 7.5.1992; rill. 11-13: Alberobello (Bari), 7.5.1992; rill.14-15 Gioia del Colle (Bari), 7.5.1992.

Appendice 2

Specie sporadiche di Tab. 1 - Ril. 1: *Asperula aristata* L. Fil., *Briza maxima* L., *Hippocrepis varia*, *Oryzopsis miliacea* (L.) Asch. et Schweinf., *Pimpinella anisoides* Briganti, *Stachys arenaria* Vahl, *Thesium italicum* DC. Ril. 2: *Briza maxima* L., *Hippocrepis varia*, *Stachys arenaria* Vahl, *Thesium italicum* DC. Ril. 3: *Asperula aristata* L. Fil., *Pimpinella anisoides* Briganti, *Stachys arenaria* Vahl, *Saxifraga bulbifera* L. Ril. 4: *Geranium purpureum* Vill., *Lolium perenne* L., *Prunella vulgaris* L., *Saxifraga bulbifera* L. Ril. 6: *Briza maxima* L., *Geranium purpureum* Vill., *Lolium perenne* L., *Saxifraga bulbifera* L. ril: 7: *Cistus salviifolius* L., *Orchis morio* L., *Orchis papilionacea* L. Ril. 8: *Cistus salvifolius* L., *Festuca heterophylla* Lam., *Pteridium aquilinum* (L.) Kuhn Ril. 9: *Festuca heterophylla* Lam., *Pteridium aquilinum* (L.) Kuhn, *Platanthera chlorantha* (Custer) Rchb. Ril. 11: *Clinopodium arundanum* Boiss. Ril. 12: *Bromus erectus* Hudson, *Clinopodium arundanum* Boiss., *Hordeum bulbosum* L., *Ornithogalum comosum* L. Ril. 13: *Clinopodium arundanum* Boiss., *Festuca heterophylla* Lam., *Ornithogalum comosum* L.; *Pimpinella peregrina* L. Ril. 14: *Elaeoselinum asclepium* (L.) Bertol., *Galium aparine* L., *Ornithogalum comosum* L., *Pimpinella peregrina* L., *Quercus calliprinos* Webb, *Silene otites* (L.) Wibel, *Eryngium campestre* L., *Origanum heracleoticum* L. Ril. 15: *Pimpinella peregrina* L., *Quercus calliprinos* Webb, *Silene otites* (L.) Wibe, *Elaeoselinum asclepium* (L.) Bertol., *Galium aparine* L., *Thapsia garganica* L. *Genista sp.*, *Rhamnus oleoides* L.

Riassunto

In questo lavoro vengono esaminati i boschi calcicoli caratterizzati dalla dominanza di *Quercus trojana* presenti in Puglia. Dal punto di vista fitosociologico questa formazione rientra nel *Quercion ilicis,* alleanza dei *Quercetea ilicis,* localizzandosi nel territorio delle Murge a 100-500 m di quota. Si tratta di un'associazione climatofila legata a un bioclima di tipo mesomediterraneo subumido inferiore, la quale viene proposta come *Euphorbio apii-Quercetum trojanae.* Ne vengono esaminate la composizione floristica, l'ecologia, la distribuzione e le correlazioni sindinamiche.

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fresche e umide, come il fondo di valloni o versanti bene ombreggiati, in genere si insediano leccete mesofile del *Quercion ilicis* riferibili in massima parte al *Pistacio-Quercetum ilicis* Brullo & Marcenò 1985. Nell'estrema punta salentina, limitatamente alle aree più interne, interessate da un bioclima termomediterrraneo subumido superiore, la formazione climatofila è rappresentata dall' *Arbuto-Quercetum calliprini* Brullo *et al.* 1987. Abbastanza diffuse lungo le stazioni costiere della Puglia sono inoltre le formazioni dell' *Oleo-Ceratonion*, appartenenti per lo più al *Myrto-Lentiscetum* (Molinier 1954 em. O. Bolos 1962) Rivas Martinez 1975.

Da osservazioni personali inedite, nei processi di degradazione, legati soprattutto al taglio, incendio e pascolo, l'*Euphorbio apii-Quercetum trojanae* tende ad essere sostituito, in seguito alla distruzione dello strato arboreo ed arbustivo, da garighe del *Cisto-Ericion* Horvatić 1958, che a loro volta, con l'accentuarsi dei fenomeni di erosione del suolo, lasciano il posto a praticelli effimeri del *Thero-Brachypodion* Br.-Bl. 1925.

Sulla base dei dati di letteratura, boschi a *Quercus trojana* sono stati segnalati nella Penisola Balcanica da Horvat *et al.* (1974), che riportano per la Macedonia un *Quercetum trojanae* Em 1958 em. Horvat 1959 attribuito all' *Ostryo-Carpinion orientalis* Horvat (1954) 1958, alleanza dei *Quercetalia pubescentis* Br.-Bl. 1932. Questa associazione, per la presenza e in genere abbondanza di *Carpinus orientalis, Ostrya carpinifolia, Sorbus aria, Acer obtusatum, Quercus pubescens, Fraxinus ornus, Coronilla emeroides, Buxus sempervirtens, Cornus mas, Festuca heterophylla, Campanula trachelium, Polygonatum odoratum*, ecc., come pure per le sue esigenze ecologiche, mostra un marcato carattere mesofilo e pertanto si differenzia nettamente dall'associazione pugliese. Altre associazioni a *Quercus trojana*, ascritte sempre all' *Ostryo-Carpinion orientalis*, sono state segnalate per varie località dell'ex Yugoslavia. Si tratta in particolare del *Quercetum pubescenti-macedonicae* Horvat 1936 *n.n.*, *Quercetum trojanae hercegovinicum* Stefanović 1962 *n.n.*, *Quercetum trojanae montenegrinum* Blečić & Lakusić 1975 *n.n.*, *Quercetum macedonicae* Em in Horvat 1950 *n.n.* (cfr. Horvat 1936, 1950, Fukarek & Fabijanić 1968, Stefanović & Fabijanić 1969, Em 1969). Queste associazioni non possono essere comparate dal punto di vista floristico con quella pugliese in quanto i vari autori citano semplicemente il nome dell'associazione senza fornire rilievi o elenchi floristici. E' comunque da ritenere probabile che boschi termofili a *Quercus trojana* affini a quelli pugliesi, rientranti anch'essi nel *Quercion ilicis* siano presenti anche nei territori balcanici e anatolici, soprattutto nelle stazioni collinari più meridionali.

Appendice 1

Rill. 1-6: Tra Putignano e Alberobello (Bari), 8.5.84; ril. 7 Bosco delle Pianelle (Taranto), 7.5.1992; rill. 8-10: Martinafranca (Taranto), 7.5.1992; rill. 11-13: Alberobello (Bari), 7.5.1992; rill.14-15 Gioia del Colle (Bari), 7.5.1992.

Appendice 2

Specie sporadiche di Tab. 1 - Ril. 1: *Asperula aristata* L. Fil., *Briza maxima* L., *Hippocrepis varia, Oryzopsis miliacea* (L.) Asch. et Schweinf., *Pimpinella anisoides* Briganti, *Stachys arenaria* Vahl, *Thesium italicum* DC. Ril. 2: *Briza maxima* L., *Hippocrepis varia, Stachys arenaria* Vahl, *Thesium italicum* DC. Ril. 3: *Asperula aristata* L. Fil., *Pimpinella anisoides* Briganti, *Stachys arenaria* Vahl, *Saxifraga bulbifera* L. Ril. 4: *Geranium purpureum* Vill., *Lolium perenne* L., *Prunella vulgaris* L., *Saxifraga bulbifera* L. Ril. 6: *Briza maxima* L., *Geranium purpureum* Vill., *Lolium perenne* L., *Saxifraga bulbifera* L. ril: 7: *Cistus salviifolius* L., *Orchis morio* L., *Orchis papilionacea* L. Ril. 8: *Cistus salvifolius* L., *Festuca heterophylla* Lam., *Pteridium aquilinum* (L.) Kuhn Ril. 9: *Festuca heterophylla* Lam., *Pteridium aquilinum* (L.) Kuhn, *Platanthera chlorantha* (Custer) Rchb. Ril. 11: *Clinopodium arundanum* Boiss. Ril. 12: *Bromus erectus* Hudson, *Clinopodium arundanum* Boiss., *Hordeum bulbosum* L., *Ornithogalum comosum* L. Ril. 13: *Clinopodium arundanum* Boiss., *Festuca heterophylla* Lam., *Ornithogalum comosum* L.; *Pimpinella peregrina* L. Ril. 14: *Elaeoselinum asclepium* (L.) Bertol., *Galium aparine* L., *Ornithogalum comosum* L., *Pimpinella peregrina* L., *Quercus calliprinos* Webb, *Silene otites* (L.) Wibel, *Eryngium campestre* L., *Origanum heracleoticum* L. Ril. 15: *Pimpinella peregrina* L., *Quercus calliprinos* Webb, *Silene otites* (L.) Wibe, *Elaeoselinum asclepium* (L.) Bertol., *Galium aparine* L., *Thapsia garganica* L. *Genista sp.*, *Rhamnus oleoides* L.

Riassunto

In questo lavoro vengono esaminati i boschi calcicoli caratterizzati dalla dominanza di *Quercus trojana* presenti in Puglia. Dal punto di vista fitosociologico questa formazione rientra nel *Quercion ilicis,* alleanza dei *Quercetea ilicis,* localizzandosi nel territorio delle Murge a 100-500 m di quota. Si tratta di un'associazione climatofila legata a un bioclima di tipo mesomediterraneo subumido inferiore, la quale viene proposta come *Euphorbio apii-Quercetum trojanae.* Ne vengono esaminate la composizione floristica, l'ecologia, la distribuzione e le correlazioni sindinamiche.

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