

## ASSOCIATIONS AND COMMUNITIES OF CEREAL CULTIVATIONS OF THE ŁUKOWSKA PLAIN PART II. ASSOCIATIONS OF HEAVY SOILS

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### Abstract

The paper is the second part of the work examining setal communities of the Łuków Plain. It presents a description of phytocenoses establishing in cereal crops on heavy soils. Only *Vicietum tetraspermae* were found in these habitats. Neither patches of *Consolido-Brometum* nor communities representing the alliance *Caucalidion lappulae* were encountered. Floristic and ecological diversity of *Vicietum tetraspermae* was due to 8 syntaxonomic units distinguished in the study area: 3 subassociations (*Vicietum tetraspermae typicum*, *V. t odontitetosum* and *V. t consolidetosum*) and 6 variants within *Vicietum tetraspermae typicum*. Patches of *Vicietum tetraspermae typicum* were the most frequent in the study area whereas the remaining sub-alliances were much more rare. Of particular interest were species-poor patches of *Vicietum tetraspermae typicum* dominated by *Vicia grandiflora* found in the Łuków area which are indicative of the degradation of this alliance.

**Key words:** weed communities, cereal cultivations, heavy soils, *Vicietum tetraspermae*, *Consolido-Brometum*

### INTRODUCTION

The paper is the second part of the work on weed communities establishing in winter cereals grown in the Łuków Plain (Równina Łukowska) region [1]. The first part, which also contains the description of the study area and methodology, presents the description of the following associations developing on light soils: *Arnoserido-Scleranthetum*, *Papaveretum argemones*, *Vicietum tetraspermae scleranthetosum* and *Vicietum tetraspermae typicum*, *Rhinanthus serotinus* variant.

The objective of this work is to present the structure, floristic composition and syntaxonomic diversity of *Vicietum tetraspermae* establishing in fertile habitats of the Łuków Plain.

### RESULTS

Systematics of the identified cereal associations

Class: *Stellarietea mediae* Tx., Lohm. et Prsg. 1950

Order: *Centauretalia cyani* R. Tx. 1950

Alliance: *Aperion spicae-venti* R. Tx. et J. Tx. 1960

1. Association: *Vicietum tetraspermae* (Krussem. et Vlieg. 1939) Kornaś 1950

a. Subassociation: *Vicietum tetraspermae typicum*

– typical variant

– variant with *Vicia grandiflora*

– variant with *Juncus bufonius*

– variant with *Oxalis fontana*

– variant with participation of characteristic species of *Panico-Setarion*

– variant with participation of characteristic species of *Polygono-Chenopodion polyspermi*

b. Subassociation: *Vicietum tetraspermae odontitetosum*

c. Subassociation: *Vicietum tetraspermae consolidetosum*

A total of 8 syntaxonomic units which reflect the floristic and ecological diversity of *Vicietum tetraspermae* were determined on the heavy soils of the Łuków Plain area. Moreover, the following 3 subassociations of this association were found (with their variants): *Vicietum tetraspermae typicum*, *Vicietum tetraspermae odontitetosum* and *Vicietum tetraspermae consolidetosum*.

*Vicietum tetraspermae typicum* was described on the basis of 109 phytosociological relevés. Floristic diversity within the sub-association, which reflects the habitat variation and agrotechnology applied, resulted

in the following 6 variants: typical, with *Vicia grandiflora*, with *Juncus bufonius*, with *Oxalis fontana*, with species of *Panico-Setarion* and with species of *Polygono-Chenopodion polyspermi*. Typical patches of *Vicietum tetraspermae typicum* (42 phytosociological relevés) were the most popular (Table 1). They established on soils developed from light and heavy loamy sand or silt formations with an underlying layer of light or medium loam. The patches were the floristically poorest communities on heavy soils. Although a total of 78 species were found, the average number of species per relevé, only 14, was small (8–22) because of a high share of sporadic species (78%).

*Vicia tetrasperma*, the characteristic species of the association, was one of the weeds which were dominant in the analysed patches. *Bromus secalinus* was much rarer in these phytocenoses although with quite high cover. *Vicia villosa* more frequently accompanied this association and its cover was higher compared with other cereal phytocenoses. On the contrary, *Polygonum lapathifolium* subsp. *pallidum* was completely absent. Apart from *Vicia tetrasperma*, *Apera spica-venti* and *Vicia hirsuta* dominated in typical patches of this sub-association. Moreover, locally, the following species were frequently found: *Matricaria maritima* subsp. *inodora*, *Anthemis arvensis* and *Centaurea cyanus* with high cover, and *Myosotis arvensis* and *Viola arvensis* with lower cover.

Locally, patches of *Vicietum tetraspermae typicum* dominated by *Vicia grandiflora*, which were described as a variant with this species, were encountered on the western outskirts of Łuków and along the road to Stoczek Łukowski. The variant was described based on 11 phytosociological relevés in which only 56 species were found (Table 1). The number of species per relevé ranged between 14 and 25, 19 on average. The weed cover in the analysed patches was very high. Apart from the above-mentioned *Vicia grandiflora*, the phytocenoses had a high share of *Apera spica-venti* and *Centaurea cyanus*. Moreover, *Vicia villosa* and *Vicia tetrasperma* were a permanent component with high cover, as well as *Viola arvensis* and *Myosotis arvensis*, whose cover was lower, however. Other frequent species, with locally higher cover, included: *Anthemis arvensis*, *Stellaria media*, *Matricaria maritima* subsp. *inodora*, *Veronica arvensis* and *Geranium pusillum*. These phytocenoses established on leached brown soils and lessive soils originating from loams or light and heavy loamy sands with an underlying layer of light loam, classified as a very good rye complex, good rye complex or good wheat complex of agricultural land

suitability. They were very disturbed habitats located close to buildings and a railway line, within the town limits or in the immediate proximity of the town.

The wet variant of *Vicietum tetraspermae typicum* was described on the basis of 25 plant patches establishing on lessive soils and degraded black earths representing rye complexes (5 and 4), a poor wheat complex (3) and cereal-fodder complexes (8 and 9). A total of 115 species occurred in these phytocenoses (Table 1). They were floristically abundant communities with 12 to 35 species per relevé, 26 on average. Of the characteristic species, *Vicia tetrasperma* occurred on a large scale in the analysed patches whereas other species were less frequent and their cover was lower. The patches were also dominated by *Apera spica-venti* and characterised by a large group of hygrophilous species, with a permanent occurrence of *Juncus bufonius* (high cover) and *Gnaphalium uliginosum* (lower cover). Other species, for example: *Mentha arvensis*, *Polygonum hydropiper*, *Plantago intermedia*, *Gypsophila muralis*, were less frequently found. Other numerous species included: *Vicia hirsuta* (high cover), *Vicia angustifolia*, *Stellaria media*, *Myosotis arvensis*, *Viola arvensis*, *Veronica arvensis* and locally *Matricaria maritima* subsp. *inodora*.

*Vicietum tetraspermae typicum*, the variant with *Oxalis fontana*, was distinguished based on 11 phytosociological relevés (Table 1). Such phytocenoses established mainly in spring cereals in moderately fertile habitats which were sufficiently or excessively wet, with near-neutral pH. Their soils were as follows: lessive soils, leached brown soils as well as degraded and proper black earths classified as cereal-fodder complexes (8 and 9) and a very good rye complex (4). The phytocenoses were floristically quite rich, with an average number of species per relevé of 24 (15–33) and a total of only 73 species. *Vicia tetrasperma* was a permanent component of these communities but its cover was not high whereas *Vicia villosa* was found only occasionally. More frequent species included *Bromus secalinus* and *Polygonum lapathifolium* subsp. *pallidum*. Apart from *Oxalis fontana*, other permanent species included *Vicia angustifolia* and *Viola arvensis* whereas *Myosotis arvensis*, *Fallopia convolvulus*, *Anthemis arvensis* and *Matricaria maritima* subsp. *inodora* were frequent components. By contrast, *Apera spica-venti* was a relatively rare species. A numerous group of hygrophilous species occurring in these habitats, *Mentha arvensis* and *Ranunculus repens* being the most popular, is indicative of an excess of moisture.

Table 1  
*Vicietum tetraspermae* (Krusem et Vlieg. 1939). Part. I

Association	<i>Vicietum tetraspermae</i>							
Subassociation	typicum							
Variant	typical		with <i>Vicia grandiflora</i>		with <i>Juncus bufonius</i>		with <i>Oxalis fontana</i>	
Number of relevés	42		11		25		11	
	5, 4		5, 4, 2		5, 4, 3, 8, 9		4, 8, 9	
	A, Bw, D		A, Bw		A, Dz, D		A, Bw, Dz, D	
Soil unit	pgl; pgl:gl; pgl:gl; pglp; pglp:ps; pglp:gs; pgm:ps; pgm:gs; pgmp:ps; pgmp:gl; plz:ps; plz:gl; plz:gs		pgl:gl; pgm. gl; gl		pgl.pl.plz; pgl. ps; pgl:gl; pgl. gs; pgm:ps; pgm; pgm:glp; pgm.gl; plz; glp		pgl.ps; pgl:gl; pgm:ps; pgm. gl; pgmp; plz. gs; glp	
Range of number of species in relevés	8 – 22		14 – 25		12 – 35		15 – 33	
Mean number of species in relevé	14		19		26		24	
Number of columns	1		2		3		4	
	S	W	S	W	S	W	S	W
<b>I.Ch.D. <i>Vicietum tetraspermae</i></b>								
<i>Vicia tetrasperma</i>	V	806	V	350	V	718	V	395
<i>Vicia villosa</i>	III	255	V	377	II	130	I	50
<i>Bromus secalinus</i>	II	201	I	45	I	28	II	27
<i>Polygonum lapathifolium</i> subsp. <i>pallidum</i>					II	24	II	100
<b>II. D. var. z <i>Vicia grandiflora</i></b>								
<i>Vicia grandiflora</i>			V	1100				
<b>III. D. var. z <i>Oxalis fontana</i></b>								
<i>Oxalis fontana</i>					I	8	V	505
<b>IV. D. var. z <i>Juncus bufonius</i></b>								
<i>Juncus bufonius</i>			I	9	V	712	III	55
<i>Gnaphalium uliginosum</i>					V	148	III	55
<i>Gypsophila muralis</i>	I	5			III	88	II	36
<i>Plantago intermedia</i>	I	14			III	116	II	27
<i>Mentha arvensis</i>					III	166	II	486
<i>Polygonum hydropiper</i>					III	162	I	18
<i>Ranunculus repens</i>	I	5			II	28	II	186
<i>Potentilla anserina</i>					II	48	II	27
<i>Spergularia rubra</i>					II	28	I	18
<i>Sagina procumbens</i>					II	48	I	18
<i>Stachys palustris</i>					II	40	I	9
<b>V. Ch. <i>Aperion spicae-venti</i>, <i>Centaureta cyani</i></b>								
<i>Apera spica-venti</i>	V	1099	V	764	IV	1098	III	500
<i>Vicia hirsuta</i>	V	808	II	36	IV	580	III	390
<i>Centaurea cyanus</i>	IV	320	V	609	III	60	II	36
<i>Vicia angustifolia</i>	III	95	III	45	IV	108	V	82
<i>Anthemis arvensis</i>	IV	320	IV	222	III	126	IV	64
<i>Matricaria maritima</i> subsp. <i>inodora</i>	IV	360	IV	145	II	410	IV	64
<i>Agrostemma githago</i>	I	54	II	72	I	20		
<i>Rhinanthus serotinus</i>			II	64			I	9

**VI. Ch. Stellarietea mediae**

<i>Viola arvensis</i>	V	112	V	209	IV	72	V	118
<i>Stellaria media</i>	III	45	IV	160	IV	182	II	109
<i>Myosotis arvensis</i>	IV	199	V	136	IV	132	IV	64
<i>Chenopodium album</i>	I	24	III	45	III	64	III	45
<i>Fallopia convolvulus</i>	II	26	II	27	I	20	IV	109
<i>Capsella bursa-pastoris</i>	III	52	III	54	III	56	I	9
<i>Sonchus arvensis</i>	I	7	I	9	II	56	III	45
<i>Conyza canadensis</i>	II	89	I	9	II	40	III	45
<i>Polygonum aviculare</i>	I	7			III	52	I	55
<i>Geranium pusillum</i>	I	7	III	195	I	16		
<i>Galeopsis tetrahit</i>	I	2			II	32	II	27
<i>Spergula arvensis</i>					I	12	II	177
<i>Anagallis arvensis</i>	I	19			II	98	I	9
<i>Rumex crispus</i>	I	5			II	28	I	18
<i>Descurainia sophia</i>			II	64			I	0

**VII. Accompanying species**

<i>Veronica arvensis</i>	I	17	IV	64	IV	84	II	36
<i>Cirsium arvense</i>	II	45	II	64	III	112	III	45
<i>Galium aparine</i>	III	198	II	223	II	112	II	214
<i>Equisetum arvense</i>	II	87	II	27	II	44	III	195
<i>Convolvulus arvensis</i>	II	36	I	18	I	8	III	82
<i>Elymus repens</i>	II	43	II	36	II	84	II	64
<i>Galeopsis bifida</i>			II	27	II	8	II	27
<i>Achillea millefolium</i>	I	7	I	9	II	40	II	27
<i>Rumex acetosella</i>	I	2	I	9	II	24	II	73
<i>Cerastium holosteoides</i>	I	14	II	27	II	32	I	18
<i>Arenaria serpyllifolia</i>	I	46	II	64	I	4	I	9
<i>Artemisia vulgaris</i>	I	14	II	27	I	20	I	18
<i>Trifolium repens</i>	I	5	I	9	II	24	I	9
<i>Erodium cicutarium</i>	I	7	II	27			I	18
<i>Medicago falcata</i>	I	5	II	27				
<i>Taraxacum officinale</i>	I	7			II	20	I	9

Sporadic species: **IV** – *Polygonum amphibium* 1, 3; *Veronica serpyllifolia* 3, 4; *Rorippa sylvestris* 3, 4; *Bidens tripartita* 3, 4; *Hypericum humifusum* 3, 4; *Riccia* sp. 3, 4; *Centunculus minimus* 3; *Myosurus minimus* 3; *Ranunculus sardous* 3; *Centaureum pulchellum* 3; *Equisetum sylvaticum* 3; *Rorippa palustris* 3; *Peplis portula* 3; *Juncus capitatus* 3; **V** – *Scleranthus annuus* 1, 2, 3, 4; *Vicia sativa* 1, 2, 3; *Consolida regalis* 1, 2, 3; *Arabidopsis thaliana* 1, 3, 4; *Lithospermum arvense* 1, 2; *Anthoxanthum aristatum* 1, 3; *Chamomilla recutita* 1; *Odontites serotina* 1; *Papaver dubium* 2; *Veronica triphyllos* 2; *Veronica dillenii* 2; *Avena fatua* 3; *Melandrium noctiflorum* 3; *Papaver rhoeas* 3; *Arnoseris minima* 3; **VI** – *Raphanus raphanistrum* 1, 3, 4; *Thlaspi arvense* 1, 3, 4; *Echinochloa crus-galli* 2, 3, 4; *Crepis tectorum* 1, 3; *Setaria viridis* 1, 3; *Galinsoga parviflora* 1, 3; *Sinapis arvensis* 2, 3; *Sisymbrium officinale* 1; *Anchusa arvensis* 1; *Lactuca serriola* 1; *Atriplex patula* 3; *Galeopsis speciosa* 3; *Setaria pumila* 3; *Sonchus asper* 3; *Lapsana communis* 4; **VII** – *Myosotis stricta* 1, 2, 3, 4; *Trifolium arvense* 1, 2, 3, 4; *Leontodon autumnalis* 1, 3, 4; *Agrostis stolonifera* 1, 3, 4; *Medicago lupulina* 1, 3, 4; *Plantago major* 1, 3, 4; *Melandrium album* 1, 3, 4; *Armoracia rusticana* 1, 2; *Erysimum cheiranthoides* 1, 3; *Alopecurus myosuroides* 1, 3; *Daucus carota* 1, 3; *Trifolium campestre* 1, 3; *Poa annua* 3, 4; *Stellaria graminea* 3, 4; *Heracleum sphondylium* 3, 4; *Hypochoeris radicata* 1; *Berteroa incana* 1; *Ornithopus sativus* 1; *Knautia arvensis* 1; *Cichorium intybus* 1; *Phleum pratense* 1; *Torilis japonica* 1; *Tragopogon dubius* 1; *Anthriscus sylvestris* 2; *Bunias orientalis* 2; *Bromus hordeaceus* 2; *Galeopsis pubescens* 2; *Anchusa officinalis* 2; *Chenopodium hybridum* 2; *Polygonum persicaria* 3; *Cerastium arvense* 3; *Veronica verna* 3; *Chamomilla suaveolens* 3; *Symphytum officinale* 3; *Ranunculus flammula* 3; *Ranunculus acris* 3; *Prunella vulgaris* 3; *Epilobium roseum* 3; *Polygonum lapathifolium* subsp. *lapathifolium* 3; *Glechoma hederacea* 3; *Campanula rapunculoides* 3; *Hypericum perforatum* 3; *Rubus caesius* 3; *Amaranthus retroflexus* 3; *Plantago media* 3.

Impoverished patches of *Vicetum tetraspermae typicum* were found in spring cereals with a low share of characteristic species of this association, with local mass occurrence of weeds which typically accompany tuber and root crops. Patches with characteristic species of *Panico-Setarion* established on the soils of very good rye complex as well as cereal-fodder complexes, *Echinochloa crus-galli* being a permanent component with high cover. Other *Panico-Setarion* species were found only occasionally, apart from *Setaria pumila* which was more frequent (Table 2). In addition to *Echinochloa crus-galli*, the phytocenoses were dominated by hygrophilous species, which is indicative of excessive moisture of these habitats. *Juncus bufonius* and *Polygonum hydropiper* had the highest cover. Other popular species included for example: *Gnaphalium uliginosum*, *Plantago intermedia*, *Mentha arvensis*, *Stachys palustris*, *Rorippa sylvestris*, *Bidens tripartita* and *Potentilla anserina*. *Apera spica-venti* and *Vicia hirsuta* were quite frequent and had high cover, too. The phytocenoses were floristically rich as the number of species per relevé ranged between 24 and 37, 28 on average.

More fertile habitats of the good wheat complex and cereal-fodder complexes had patches of *Vicetum tetraspermae typicum* with a share of characteristic species of *Polygono-Chenopodion polyspermi*. They were floristically rich phytocenoses with 28 species per relevé, on average (the range: 22–43) (Table 2). Just like in the above-mentioned phytocenoses, these communities had a low share of characteristic species of the association. However, there was found a numerous group of species which are indicators of substantial fertility of these habitats. They included: *Veronica persica*, *Lamium purpureum*, *Sonchus asper* and *Veronica agrestis* and other sporadic species. The following hygrophilous species were also popular in these patches: *Juncus bufonius*, *Plantago intermedia*, *Gnaphalium uliginosum*, *Mentha arvensis*, *Potentilla anserina* and others. Also, *Vicia hirsuta*, *Viola arvensis* and *Anagallis arvensis* were frequent components of these phytocenoses although in other cereal phytocenoses they were only occasionally found. Compared with other phytocenoses, *Apera spica-venti* was much more rare and had lower cover. What was interesting was the presence of rare species of carbonate and fertile habitats, such as: *Galeopsis speciosa*,

*Aethusa cynapium*, *Atriplex patula*, *Geranium dissectum*, *Lamium amplexicaule*, *Veronica polita*, *Chenopodium polyspermum* and *Euphorbia helioscopia*, which, as a rule, were not found in other cereal communities in this area

*Vicetum tetraspermae odontitetosum* was described based on 13 plant patches. It was found on various soils classified as rye complexes (4 and 5), a poor wheat complex (3) and cereal-fodder complexes (8 and 9) (Table 2). *Vicia tetrasperma* had the highest cover in patches of this sub-association. *Vicia villosa* was also quite frequent whereas *Bromus secalinus* and *Polygonum lapathifolium* subsp. *pallidum* were only occasionally found. An occurrence of *Odontites serotina* and *Rhinanthus serotinus* distinguished these phytocenoses. In patches of this sub-association, *Apera spica-venti* had the highest cover of all the syntaxons found. *Vicia hirsuta* and *Galium aparine* were also numerous, although the latter was found only locally. The following hygrophilous species were components of these phytocenoses: *Juncus bufonius* (high cover) *Gnaphalium uliginosum*, *Mentha arvensis*, *Stachys palustris*, *Gypsophila muralis*, *Polygonum hydropiper* and *Ranunculus sardous* (locally high cover).

*Vicetum tetraspermae consolidetosum* established on soils richer in calcium carbonate which belonged to very good and good rye complexes as well as good wheat and good cereal-fodder complexes (Table 2). Of the association's characteristic species, only *Vicia tetrasperma* was the permanent component of the weed flora with high cover whereas the remaining species were quite infrequent. *Consolida regalis* was the most popular of the species which distinguish this sub-association whereas *Papaver rhoeas* and *Lithospermum arvense* were more rare and had lower cover. *Centaurea cyanus* was a permanent component of these phytocenoses with the greatest cover. Frequent weeds were: *Apera spica-venti* and *Cirsium arvense*, both with high cover, and *Viola arvensis*, *Myosotis arvensis*, *Vicia angustifolia* and *Veronica arvensis*, all with lower cover. *Agrostemma githago* occurred locally with higher cover, too. Rare carbonate species included only *Melandrium noctiflorum*, *Anagallis arvensis*, *Geranium dissectum* and *Anchusa arvensis*. Moreover, the following nitrophilous species were found: *Galium aparine*, *Matricaria maritima* subsp. *inodora*, *Sonchus asper* and *Lamium purpureum*.

Table 2  
*Vicietum tetraspermae* (Krusem. et Vlieg. 1939). Part. II

Association	<i>Vicietum tetraspermae</i>							
Subassociation	<i>typicum</i>				<i>odontitetosum</i>		<i>consolidetosum</i>	
Variant	with <i>Panico-Setarion</i>		with <i>Polygono-Chenopodion</i>		typical		typical	
Number of relevés	10		10		13		13	
	2, 8, 9		2, 4, 8		5, 4, 2, 8, 9		5, 4, 2, 8	
	A, M, Dz, D		A, Bw, Dz, D		A, Bw, D		A, Bw, Dz	
Soil unit	pgl.ps; pgl:gl; pgl.plz; pgm.gl; plz; glp; gl		pgl:gl; pgl:gl; plz.gl; pglp		pgl.ps; pgl:gl; pgl.ps:gs; pgm:gl; plz		pgl; pglp; pgl:gl; pgmp.ps; pgmp:gl; pgm.pgl:gl; pgmp; pgmp:gs; glp; gs.gc	
Range of number of species in relevés	24 - 37		22 - 43		14 - 31		10 - 25	
Mean number of species in relevé	28		28		23		17	
Number of columns	1		2		3		4	
	S	W	S	W	S	W	S	W
<b>I. Ch. D. <i>Vicietum tetraspermae</i></b>								
<i>Vicia tetrasperma</i>	V	220	V	260	V	995	V	627
<i>Vicia villosa</i>	I	50			II	205	II	181
<i>Bromus secalinus</i>	II	30	II	40	I	10	II	62
<i>Polygonum lapathifolium</i> subsp. <i>pallidum</i>			II	30	I	10	I	8
<b>II. Ch. <i>Panico-Setarion</i></b>								
<i>Echinochloa crus-galli</i>	V	660	I	60			I	8
<i>Setaria pumila</i>	II	70						
<b>III. Ch. <i>Polygono-Chenopodion</i></b>								
<i>Veronica persica</i>	I	20	IV	190				
<i>Lamium purpureum</i>			III	50			I	8
<i>Sonchus asper</i>	I	20	II	30			I	8
<i>Lapsana communis</i>			I	10			II	15
<i>Veronica agrestis</i>			II	40				
<b>IV. D. V t. <i>odontitetosum</i></b>								
<i>Odonites serotina</i>					V	590	I	142
<i>Rhinanthus serotinus</i>					III	590	I	142
<b>V. D. V t. <i>consolidetosum</i></b>								
<i>Consolida regalis</i>							V	631
<i>Papaver rhoeas</i>							II	150
<i>Lithospermum arvense</i>							II	92
<b>VI. D. var. z <i>Juncus bufonius</i></b>								
<i>Juncus bufonius</i>	IV	935	IV	475	IV	720	I	8
<i>Polygonum hydropiper</i>	V	630	II	30	III	90		
<i>Gnaphalium uliginosum</i>	V	130	IV	120	IV	150	I	15
<i>Plantago intermedia</i>	IV	285	IV	160	II	30		
<i>Mentha arvensis</i>	III	170	III	90	III	295		
<i>Stachys palustris</i>	III	100	II	80	III	215		

<i>Gypsophila muralis</i>	I	10	I	20	III	90	I	8
<i>Rorippa sylvestris</i>	III	50	I	10	I	10		
<i>Potentilla anserina</i>	II	195	II	80	II	70		
<i>Ranunculus sardous</i>	I	50			II	462		
<i>Bidens tripartita</i>	II	195	I	60	I	10		
<i>Ranunculus repens</i>	II	30	I	60	I	50		
<i>Sagina procumbens</i>	II	30	I	10	I	10		
<i>Spergularia rubra</i>	II	40			I	10		
<i>Polygonum amphibium</i>	I	50	II	40			I	8
<i>Rorippa palustris</i>	II	70	I	10				
<b>VII. Ch. <i>Aperion spicae-venti</i>, <i>Centaurealia cyani</i></b>								
<i>Apera spica-venti</i>	IV	695	III	595	IV	1700	IV	581
<i>Centaurea cyanus</i>	II	30	II	30	V	285	V	400
<i>Vicia hirsuta</i>	III	465	IV	245	V	1000	III	335
<i>Matricaria maritima</i> subsp. <i>inodora</i>	I	225	III	215	IV	355	V	342
<i>Vicia angustifolia</i>	III	100	II	40	IV	120	IV	92
<i>Anthemis arvensis</i>	II	30	II	30	III	505	II	62
<i>Avena fatua</i>	II	70					I	8
<i>Scleranthus annuus</i>	I	10	I	10	II	70	I	15
<i>Agrostemma githago</i>							II	431
<b>VIII. Ch. <i>Stellarietea mediae</i></b>								
<i>Viola arvensis</i>	II	30	IV	110	V	120	IV	131
<i>Stellaria media</i>	IV	160	III	265	II	70	III	38
<i>Myosotis arvensis</i>	III	50	III	60	IV	110	IV	92
<i>Anagallis arvensis</i>	II	30	IV	110	II	30	I	8
<i>Spergula arvensis</i>	IV	120			I	20		
<i>Chenopodium album</i>	III	170	III	90	I	10	I	15
<i>Fallopia convolvulus</i>	I	10	III	60	II	20	III	46
<i>Capsella bursa-pastoris</i>	II	30	II	30	II	30	III	77
<i>Polygonum aviculare</i>			II	40	I	10	I	15
<i>Sonchus arvensis</i>	III	90	III	90	I	10		
<i>Conyza canadensis</i>	I	10	I	10	II	70	II	62
<i>Rumex crispus</i>	II	20	I	20	I	0		
<i>Galeopsis tetrahit</i>	II	120	I	20				
<i>Galeopsis speciosa</i>			II	70				
<i>Anchusa arvensis</i>							II	31
<b>IX. Accompanying species</b>								
<i>Cirsium arvense</i>	III	140	III	60	IV	160	IV	92
<i>Veronica arvensis</i>	III	60	IV	70	III	50	IV	62
<i>Galium aparine</i>	I	20	III	180	II	235	IV	219
<i>Elymus repens</i>	III	180	III	170	I	10	I	15
<i>Equisetum arvense</i>	II	30	III	50	II	30	I	15
<i>Convolvulus arvensis</i>	I	10	II	40	II	80	III	69
<i>Rumex acetosella</i>	I	20	I	10	III	100	I	8
<i>Polygonum persicaria</i>	III	50	II	40	I	10		
<i>Medicago lupulina</i>	I	20	III	50			II	23
<i>Artemisia vulgaris</i>	III	20	I	10			II	23

<i>Plantago major</i>	I	10	III	40			I	8
<i>Cerastium holosteoides</i>	I	10	II	30	II	10	I	15
<i>Trifolium repens</i>	I	0	II	20	II	30	I	8
<i>Taraxacum officinale</i>	II	10	II	30	I	20	I	15
<i>Agrostis stolonifera</i>	I	10	I	10	II	40		
<i>Achillea millefolium</i>	II	20	I	10	I	10	I	8
<i>Trifolium arvense</i>	I	10			I	20	II	62
<i>Poa annua</i>	II	110	I	20				
<i>Trifolium campestre</i>	II	30	I	10			I	8
<i>Chamomilla suaveolens</i>	II	70	I	20				

Sporadic species: **II** – *Raphanus raphanistrum* 1, 2, 3, 4; *Setaria viridis* 2; **III** – *Galinsoga parviflora* 1, 2, 3; *Oxalis fontana* 1, 2; *Sonchus oleraceus* 2, 3; *Lamium amplexicaule* 2, 4; *Veronica polita* 2; *Chenopodium polyspermum* 2; *Euphorbia helioscopia* 2; **VI** – *Centunculus minimus* 1, 2, 3, 4; *Riccia* sp. 1, 2; *Equisetum sylvaticum* 2, 3; *Myosurus minimus* 2, 3; *Centaureum pulchellum* 1; *Anthoceros punctatus* 2; *Phragmites australis* 2; *Illecebrum verticillatum* 2; *Veronica serpyllifolia* 3; **VII** – *Vicia sativa* 2, 3; *Arabidopsis thaliana* 3, 4; *Aethusa cynapium* 2; *Chamomilla recutita* 3; *Odontites verna* 3; *Melandrium noctiflorum* 4; **VIII** – *Sinapis arvensis* 1, 2; *Geranium dissectum* 2, 4; *Thlaspi arvense* 3, 4; *Atriplex patula* 2; *Sisymbrium officinale* 2; *Crepis tectorum* 4; **IX** – *Lolium perenne* 1, 2, 3; *Stellaria graminea* 1, 2, 3; *Polygonum lapathifolium* subsp. *lapathifolium* 1, 2; *Galeopsis bifida* 1, 2; *Melilotus alba* 2, 3; *Knautia arvensis* 1; *Leontodon autumnalis* 2; *Rumex obtusifolius* 2; *Galium boreale* 2; *Cichorium intybus* 2; *Erophila verna* 3; *Galeopsis ladanum* 3; *Medicago falcata* 3; *Alopecurus myosuroides* 3; *Trifolium pratense* 3; *Lotus corniculatus* 3; *Potentilla collina* 3; *Festuca ovina* 3; *Trifolium medium* 3; *Glechoma hederacea* 3; *Plantago lanceolata* 3; *Pimpinella saxifraga* 3; *Arenaria serpyllifolia* 4; *Myosotis stricta* 4; *Urtica dioica* 4; *Berteroa incana* 4; *Daucus carota* 4.

## DISCUSSION

*Vicietum tetraspermae*, which is the most widespread association in Poland, was found on heavy soils of the Łuków Plain. It is common in many regions of Poland [2–5] and others, being less frequent only in the north-eastern part of Poland [3, 6]. The habitat and ecological amplitude of the association in terms of soil moisture and nutrient availability is, respectively, quite wide and wide. It is reflected in the local habitat diversity and division of the association into lower syntaxonomic units [2, 3, 5, 7–10] and others. Moreover, the floristic diversity of *Vicietum tetraspermae* in the area of the Łuków Plain reflects the association's habitat variation. Typical patches of *Vicietum tetraspermae* were the most popular whereas the wet variant with *Juncus bufonius* was less frequent.

The variant with *Vicia grandiflora* indicates a kind of degradation of *Vicietum tetraspermae typicum* patches in which a mass occurrence of *Vicia grandiflora* leads to impoverishment of floristic and phytocenotic richness of these communities. Such phytocenoses in the area of the Łuków Plain occur locally and only on the outskirts of the town along the road to Stoczek Łukowski. Phytocenoses dominated by *Vicia grandiflora* have been mentioned by Warcholińska [11, 12], Wójcik [13], Ziąja and Wnuk [14]. The status of this species is ambiguous in Poland. In many regions it is classified as an expansive species [11, 12, 14, 15] whereas in others it is a rare species [16–18]. Similar situation has been noticed in the South Podlasie Lowland where *Vicia grandiflora* is expansive only in

some areas. The population of *Vicia grandiflora* on the outskirts of Łuków revealed expansive tendencies but recent studies by Ciosek and Skrzyżczyńska [19] conducted in that region have demonstrated that the species has been withdrawing from these sites.

The carbonate-richer habitats in the study area were covered by patches of *Vicietum tetraspermae consolidetosum* as no phytocenoses were found representing the association *Caucalidion lappulae* reported in various regions, in particular the southern and south-eastern part of Poland: the Lublin region [20, 21], Zamość area [22], the Polish Jurassic Highland [23], the Przedbórz-Małogoszcz Chain and Poland [24, 25], the Szczerców Valley [26], Sieradz area [27], the Piotrków Plain and Radomsko Hills [28, 29] and the Skierbieszów Landscape Park [30]. *Consolido-Brometum*, which has been found in the Przemyśl Foothills [13], the Suwałki Lake District [6] and the Skierbieszew National Park [30], was absent in the study area. The core range of *Vicietum tetraspermae consolidetosum* species was similar to that reported by Węgrzynek [4] for the Silesian Upland, but the phytocenoses in this study were poorer due to lack of rare calcium-loving species from the association *Caucalidion lappulae*. Species from the aforementioned ecologic group in the area of the Łuków Plain were represented by *Avena fatua* and *Melandrium noctiflorum*.

The sub-association *Vicietum tetraspermae odontitetosum*, which is quite rare in Poland [9, 23, 24, 31, 32], occurred in the study area.

Communities establishing in spring cereals in the study area can be classified as an impoverished form



of *Vicietum tetraspermae* with a high share of species characteristic of *Panico-Setarion* and *Polygono-Chenopodion polyspermi* which are typical of tuber and root crops. The characteristic species of the association in these phytocenoses are not frequent but they were classified as communities with *Aperion spicae-venti* because they contained numerous species characteristic of the alliance and order *Centauretalia cyani*. Communities in spring cereals which are difficult to classify unambiguously are usually not included in phytosociological works. Sometimes, better developed patches presented in tables accompany phytocenoses of winter cereals where communities are better developed and represent typical patches of cereal associations [2, 24] and others. A different approach has been employed by Kozak [33] who has classified them as tuber and root crop communities, thus stressing that they are more similar to tuber and root rather than cereal communities.

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### Author's contributions

The following declarations about authors' contributions to the research have been made: concept of the study: ZR, ST; field work: ZR, ST; data analysis: ZR, ST; writing of the manuscript: ZR, ST.

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## Zespoły i zbiorowiska upraw zbożowych Równiny Łukowskiej Cz. II. Zespoły gleb związanych

### Streszczenie

Artykuł ten jest drugą częścią opracowania dotyczącego zbiorowisk segetalnych Równiny Łukowskiej. W pracy przedstawiono charakterystykę fitocenoz wykształcających się w zasiewach zbóż na glebach związanych. W analizowanych siedliskach notowano jedynie *Vicetum tetraspermae*, nie stwierdzono natomiast płatów *Consolido-Brometum* ani zbiorowisk ze związku *Caucalidion lappulae*. Zróżnicowanie florystyczne i ekologiczne *Vicetum tetraspermae* na badanym terenie realizowało się wyróżnieniem 8 jednostek syntaksonomicznych: 3 podzespółów (*Vicetum tetraspermae typicum*, *V. t odontitetosum* i *V. t consolidetosum*) i 6 wariantów w ramach *Vicetum tetraspermae typicum*. Na badanym terenie najczęściej notowano płaty *Vicetum tetraspermae typicum*, rzadziej pozostałe podzespoły. Na szczególną uwagę zasługują ubogie gatunkowo płaty *Vicetum tetraspermae typicum* zdominowane przez *Vicia grandiflora* spotykane w okolicach Łukowa jako przejaw degeneracji fitocenoz tego zespołu.

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