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THE GRAIN STOREHOUSE FROM THE EARLY MEDIAEVAL STRONGHOLD AT JÓZEFÓW NEAR KALISZ

During the excavations conducted on the site of the early-mediaeval stronghold at Józefów (site 5) led by G. Teske, PhD and commissioned by the Provincial Department of Archeological Monument Conservation Agency, Branch in Kalisz, remains of a timber building which had once served as a grain storehouse were unearthed[1]. Considerable amounts of vegetal residues discovered inside the structure made it possible for the archaeologists to undertake archaeobotanical research, the results of which are the subject of the present paper.

The defensive compound at Józefów, Godziesze Wielkopolskie commune, situated in the Kalisz Upland, was part of a vast stronghold network created in southern Great Poland in the time of the early Piast state[2]. Being one of the fortresses situated on the bank of the Prosna River, it roughly marked the eastern border of the region. The stronghold, lying within the river terrace of the Prosna, about 300 metres away from the present riverbed, was laid out in the shape of a circle and surrounded by a single earthen and wooden bank, about 15 metres wide at the base, which, on the south-eastern side, was protected by the old riverbed area (Fig. 1). It was classified as a small defensive structure supported by a dozen or so settlements. The arrangement of the cultural and settlement strata recorded during the excavations, the morphological and technological analysis of the ceramics found on the site as well as the dendrochronological tests made lead to the conclusion that there was only one usage stratum of the stronghold, dating back to the D phase of the early Middle Ages (c. 950-1050)[3]. Within the bank, four building stages were identified. At the last stage, the stronghold burnt down and, as a result, stopped functioning.

The storage facility (Fig. 2) containing huge amounts of carbonized grain was unearthed during the excavations conducted in the stronghold yard in 1998 and 2003. The building was situated next to the defensive bank, where all the utility and residential buildings were located. It was erected using heavy timbers and had lath flooring. Besides the vegetal residue a number of ceramics (Fig. 3) and pieces of a leather sack used for storing the corn were discovered in the remains of the structure. They were partly destroyed by fire and the fallen timbers. The burnt vegetal residues were found inside the ceramics. They were also scattered around the pots and covered the wooden floor (or shelves?).

The samples sent for archeobotanical analysis were taken in two stages. The material obtained during the first archaeological season (samples Nos. 10-17) was analysed by J. E. Strzelczyk and the samples coming from the most recent archaeological excavations (Nos. 1-9) were examined by J. Koszałka. The vegetal macro-residues of the seventeen samples of different volumes (10-1500 ml) taken during the archaeological explorations were examined. After the lab analysis had been completed, the selected vegetal residues, which had survived in carbonized form, were classified by means of stereoscope microscopy and identi-

[1] G. T e s k e, *Józefów. Sprawozdanie z badań wykopaliskowych* (*Józefów. A Report on the Excavations*), typescript, 2003, pp. 1-2.

[2] G. T e s k e, *Budownictwo grodowe w Wielkopolsce południowej w państwie pierwszych Piastów. Wstęp do problematyki* (*Stronghold Architecture in Southern Great Poland in the State of the Early Piasts. An Introductory Study*), "Wielkopolskie Sprawozdania Archeologiczne", Vol. VI, 2003, 105-11, pp. 106 seqq.

[3] G. T e s k e, *Sieć grodów wczesnopiastowskich z okolic Kalisza, Studium archeologiczne* (*A Network of Early Piast Strongholds from the Vicinity of Kalisz. An Archeological Study*), Kalisz 1999, pp. 341 seqq; G. Teske, *Jozefów. Sprawozdanie z badań wykopaliskowych* (*Józefów. A Report on the Excavations*), typescript, 2003, pp. 1-2.

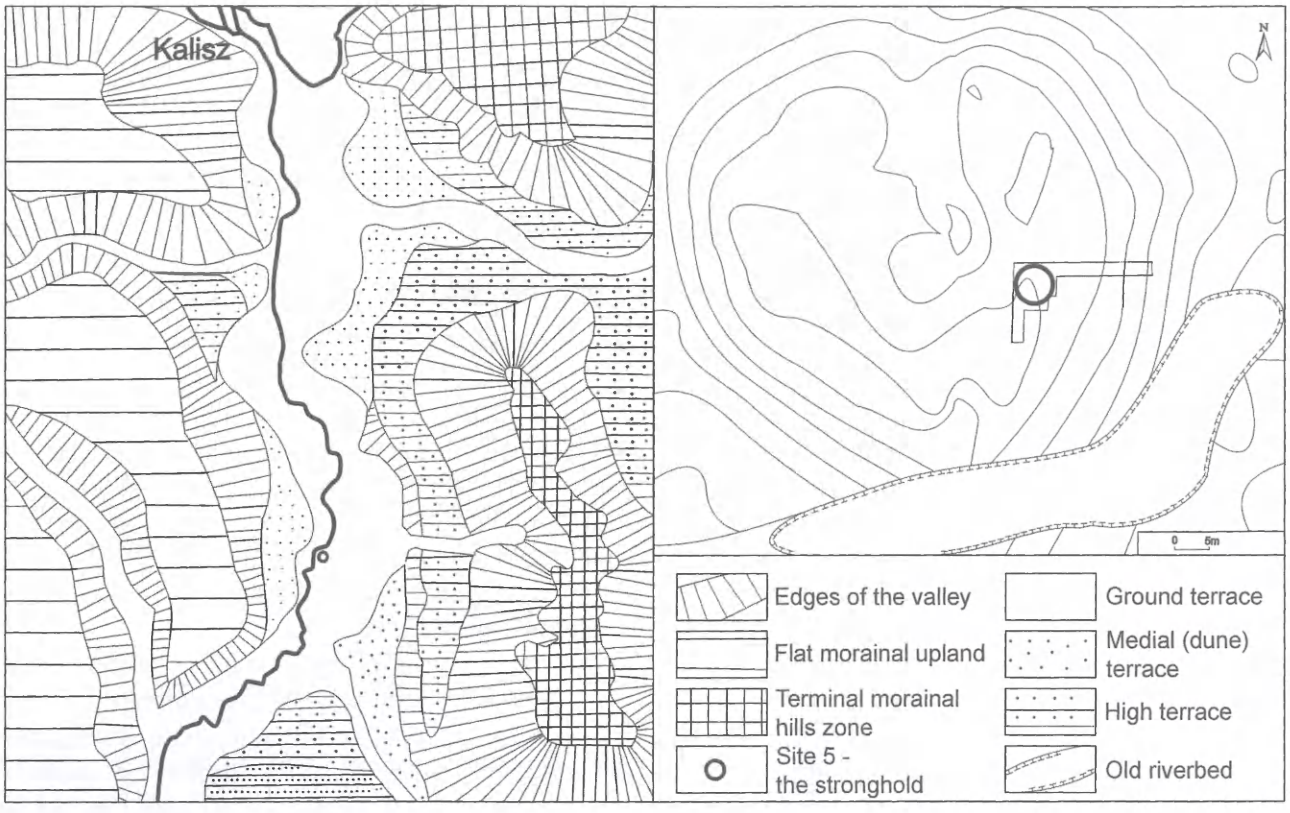

Fig. 1. Location of the early medieval stronghold at Józefów.

fied using guides, atlases as well as comparative carpological samples kept at the Archaeobiological Laboratory of the Institute of Archaeology and Ethnology of the Polish Academy of Sciences and the Department of Biogeography and Paleoecology of the University of Adam Mickiewicz in Poznań. The taxa recorded were named after the book *Flowering Plants and Pteridophytes of Poland. A Checklist*[4]. The ecological conditions in which the plants discovered in the samples had once grown were characterized using selected indicator values[5] providing information about the humidity, richness, acidity as well as texture of the soil. Species of the biological weed groups were identified according to Tymrakiewicz's[6] and Mowszowicz's[7] classifications. In the case of selected taxa, photographic documentation was made (Fig. 4).

As a result of the examination of the archaeobotanical material from Józefów, a numerous collection of carpological finds was identified. Fifty-three taxa were selected: 48 of them were identified at species level, 4 at genus level and 1 at family level. Nineteen finds remained unclassified (Tab. 1). Among the disseminules identified, the most numerous group were cereal caryopses, while the rest of the material were mostly vegetal macro-residues belonging to the class of cultivated fields weeds. The quantitative analysis of the material led to the conclusion that the samples were collections of grains belonging to the following cereal species: millet (*Panicum miliaceum*), rye (*Secale cereale*) and wheat (*Triticum aestivum*), of which the first group was the most numerous (Fig. 5). These were samples Nos. 6, 8, 9, 10, 11, 12, 13, 14, 16 and 17. Samples 1, 2, and 3 were classified as common rye, because of the large number of caryopses of this species present and a small admixture of millet, wheat and barley (*Hordeum vulgare*). Sample No. 7 was identified as awheat grain. Finally, samples 4, 5 and 15 were classified as secondarily mixed. Different types of corn, which had originally been stored in separate pots and sacks on the floor (or on the shelves?)

[4] Z. Mirek, H. Piękoś-Mirkowa, A. Zając, *Flowering Plants and Pteridophytes of Poland. A Checklist*, Kraków 2002.

[5] K. Zarzycki, H. Trzcińska-Tacik, W. Różański, Z. Szeląg, J. Wołek, U. Korzeniak, *Ecological Indicator Values of Vascular Plants of Poland*, Kraków 2002.

[6] W. Tymrakiewicz, *Atlas chwastów* (*Atlas of Weeds*), Warszawa 1962.

[7] J. Mowszowicz, *Krajowe chwasty polne i ogrodowe* (*Field and Garden Weeds of Poland*), Warszawa 1955.

Table 1. List of identified taxa from site 5 at Józefów.

	Takson	Sample numbers																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		Volume of samples																
		400	1500	200	500	1300	300	500	400	350	50	250	300	10	300	150	920	1400
	Cereals																	
1	***Avena sativa* L.** Owies zwyczajny	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-
2	***Hordeum vulgare* L.** Jęczmień zwyczajny	1	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-
3	***Panicum miliaceum* L.** Proso zwyczajne	-	20	-	2975	10625	2550	-	12750	1724	6050	30250	36300	1210	36300	12100	111320	169400
4	***Secale cereale* L** Żyto zwyczajne	2053	5328	823	3478	2818	-	106	-	10	-	2	2	-	1	144	6	-
5	***Triticum aestivum* L. s.l.** Pszenica zwyczajna	4	1	-	-	17	-	1720	3	22	-	1	5	-	1	750	-	-
	Weeds																	
6	***Aethusa cynapium* L.** Blekot pospolity	1	-	-	-	-	-	-	-	-	-	-	4	-	2	-	-	-
7	***Agrostemma githago* L.** Kąkol polny	37	31	56	50	34		32	-	-	-	-	-	-	-	4	-	-
8	***Apera spica-venti* (L.) P.Beauv.** Mietlica zbożowa	1	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
9	***Aphanes arvensis* L.** Skrytek polny	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
10	***Arenaria serpyllifolia* L.** Piaskowiec macierzankowy	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
11	***Asperugo procumbens* L.** Lepczyca rozesłana	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	***Avena* sp.** Owies	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
13	***Bromus hordeaceus* L.** Stokłosa miękka	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
14	***Bromus secalinus* L.** Stokłosa żytnia	5	2	4	12	16	-	6	1	3	-	-	-	-	-	-	-	-
15	***Bromus* sp.** Stokłosa	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	***Centaurea cyanus* L.** Chaber bławatek	-	1	-	1	2	-	2	-	-	-	-	-	-	-	1	-	-
17	***Chenopodium album* L.** Komosa biała	3	4	-	12	68	10	20	4	21	2	7	-	5	48	27	9	96
18	***Chenopodium polyspermum* L.** Komosa wielonasienna	-	-	-	2	8	-	-	-	-	-	-	-	-	-	-	-	-
19	***Chenopodium* sp.** Komosa	-	-	-	-	1	-	-	-	-	-	-	-	5	-	33	7	8
20	***Digitaria sanguinalis* (L.) Scop.** Palusznik krwawy	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
21	***Echinochloa crus-galli* (L.) P.Beauv.** Chwastnica jednostronna	-	-	1	-	1	2	-	-	1	-	-	-	-	-	-	-	-
22	***Elymus repens* (L.) Gould** Perz właściwy	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
23	***Euphorbia helioscopia* L.** Wilczomlecz obrotny	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
24	***Fallopia convolvulus* (L.) A.Löve** Rdestówka powojowata	-	-	-	4	45	21	12	-	11	-	3	1	1	4	3	12	12
25	***Galeopsis ladanum* L.** Poziewnik polny	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
26	***Galeopsis t. tetrahit* L.** Poziewnik szorstki	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
27	***Lamiaceae*** Wargowe	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	***Lolium temulentum* L.** Życica roczna	1	1	2	-	1	-	2	-	-	-	-	-	-	-	-	-	-
29	***Melandrium album* (Mill.) Garcke** Bniec biały	9	18	2	6	13	21	35	1	2	-	2	-	2	7	11	11	23
30	***Melandrium noctiflorum* (L.) Fr.** Bniec dwudzielny	1	-	-	3	2	-	3	-	-	-	-	-	-	-	-	-	-
31	***Mentha arvensis* L.** Mięta polna	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	***Papaver rhoeas* L.** Mak polny	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	***Pastinaca sativa* L. S. Str.** Pasternak zwyczajny	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	***Plantago cf. arenaria* Waldst.& Kit.** Babka piaskowa	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-

35	***Plantago lanceolata* L.** Babka lancetowata	1	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
36	***Polygonum aviculare* L.** Rdest ptasi	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
37	***Polygonum lapathifolium* L. s.l.** Rdest szczawiolistny	-	-	-	1	1	-	2	1	1	-	-	-	-	-	-	-	-
38	***Polygonum minus* Huds.** Rdest mniejszy	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
39	***Polygonum persicaria* L.** Rdest plamisty	-	-	-	1	21	6	-	2	12	3	1	-	-	-	4	3	1
40	***Rinanthus serotinus* (Schönh.) Oborny** Szelężnik większy	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
41	***Rumex acetosella* L.** Szczaw polny	11	1	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-
42	***Rumex obtusifolius* L.** Szczaw tępolistny	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
43	***Setaria pumila* (Polr.) Roem.& Schulz** Włośnica sina	-	-	1	-	4	1	1	-	1	-	2	-	-	4	3	-	-
44	***Setaria viridis/verticillata*** Włośnica zielona/okółowa	-	-	5	1	3	4	2	1	1	-	2	-	-	5	3	3	2
45	***Sherardia arvensis* L.** cf. Rolnica pospolita	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
46	***Silene gallica* L.** Lepnica francuska	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
47	***Stellaria media* (L.) Vill.** Gwiazdnica pospolita	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
48	***Typha* sp.** Pałka	-	-	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-
49	***Veronica cf. serpyllifolia* L.** Przetacznik macierzankowy	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	***Viola arvensis/tricolor*** Fiołek polny/trójbarwny	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	nieoznaczone	-	-	-	-	4	-	-	-	-	-	-	-	-	-	12	3	-

of the storehouse had survived in some modified form. As a result of the fire and the subsequent destruction of the building the pots broke and the corn was scattered all over the place. In addition, the material could have been partly mixed during the archaeological exploration on the site. Thus, part of the material which was taphonomicly tested could not be used for further research.

Although the samples of cultivated plants analysed were stored in one place, they could be considered as crops coming from various fields[8].

One can tentatively assume that the mutual proportion of different types of grain finds reflects the contemporary crop structure[9]. Consequently, the common millet would have been the dominant grain crop at that time. Rye would have been the second most important crop and the common wheat the next most popular cereal. Barley and oats (*Avena sativa*) were only found in very small amounts. The presence of several types of cultivated grain considered admixtures to the main crop may suggest the use of crop rotation.

A proportion of seeds and fruits of segetal weeds found in the samples makes it possible for the researcher to gain information about the technology used, contemporary crop structure and typical features of their habitats. Reconstructions of this type would not be possible without a knowledge of the biological and ecological characteristics of weeds found in modern and historical corn fields[10]. It should also be noted that the species of weed found in the samples do not reflect the real proportion of these plants in ancient crops. Data needed in order to establish the biological characteristics of weeds and their habitat regarding selected soil factors such as humidity, trophic characteristics, pH level and soil texture, is shown in Table 2 and accompanying diagrams (Fig. 6).

The mutual proportion of the weed diasseminules present in the contaminated grain samples

[8] M. L i t y ń s k a - Z a j ą c, *Roślinność i gospodarka w okresie rzymskim* (*Flora and Farming in the Roman Period*), Kraków 1997, p. 148; R. K o s i n a, *Wrocławskie spichlerze z XI w. – przyczynek do badań nad gospodarka regionu* (*The Granaries of Wrocław from the Eleventh Century. A Contribution to Research into the Economy of the Region*), "Kwartal-nik Historii Kultury Materialnej", Vol. XXV, 1977, p. 265; K. W a s y l i k o w a, *Antropogeniczne zmiany roślinności w holocenie* (*Anthropogenic Changes to Flora in the Holocene*), [in:] *Człowiek i środowisko w pradziejach*, ed. J. K. Kozłowski, S. K. Kozłowski, Warszawa 1983, pp. 53-72.

[9] K. W a s y l i k o w a, *Antropogeniczne zmiany...*, pp. 53-72.

[10] *Ibidem*, pp. 64 seqq.

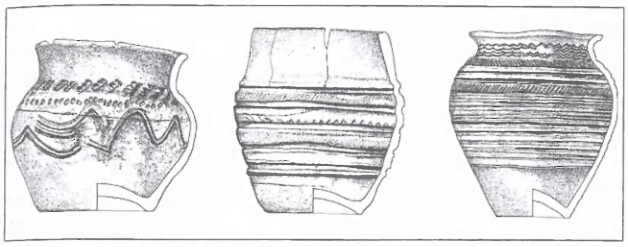

Fig. 3. Selected pottery finds from the grain storehouse.

is as follows: 34 taxa were found in the samples of rye and wheat and 14 taxa were discovered in the samples of millet. The majority of the weeds coming from the samples of millet belong to the group of short-lived, spring plants, whose life cycle lasts for only one vegetation season. These are tall plants germinating in the second half of spring. The following species were identified: lambsquarters (*Chenopodium album*), barnyard grass (*Echinochloa crus-galli*), black-bindweed (*Fallopia convolvulus*), pale smartweed and lady's thumb (*Polygonum lapathifolium* and *P. persicaria*), and yellow bristlegrass and green/bristly foxtail (*Setaria pumila* and *S. viridis/verticillata*). Only one of the disseminules recorded, the fruit of field parsley-piert (*Aphanes arvensis*), belonged to the lower stratum of the corn field. The fact that the fragments of millet weeds found were scanty while the millet grains caryopses were the most numerous group among the kinds of corn discovered in the storehouse could have been a result of weeding the field, which was necessary while cultivating the crop.

The biological spectrum of the rye weeds shows that the short-lived, overwintering plants were the most numerous group, which might suggest that rye was cultivated as a winter crop. The life cycle of these weeds begins in the autumn and ends in the spring the following year. They are still found in contemporary winter crops[11]. The plants are relatively tall and belong to the middle crop stratum. The weeds are as follows: corncockle (*Agrostemma githago*), wind bentgrass (*Apera spica-venti*), cornflower (*Centaurea cyanus*), white campion (*Melandrium album*) and night flowering campion/night flowering catchfly (*M. noctiflorum*), and corn poppy (*Papaver rhoeas*). The cultivated crops and the weeds ripe together and, as a result, the grain gets contaminated by the weed seeds. Among the other species madwort (*Aspergo procumbens*), narrowleaf plantain (*Plantago lanceolata*), field madder (*Sherardia arvensis*) and thymealeaf speedwell (*Veronica serpyllifolia*) are characterized by remarkable fitness. They all belong to the group of low stratum weeds, which grow so low that nowadays they do not get cut while harvesting[12]. Only the dwarf forms of such species as lambsquarters (*Chenopodium album*), barnyard grass (*Echinochloa crus-galli*) or foxtail (*Setaria ssp.*) are to be found in the present-day rye crop, but they are over 1 metre tall in spring crops. The presence of the disseminules of lower

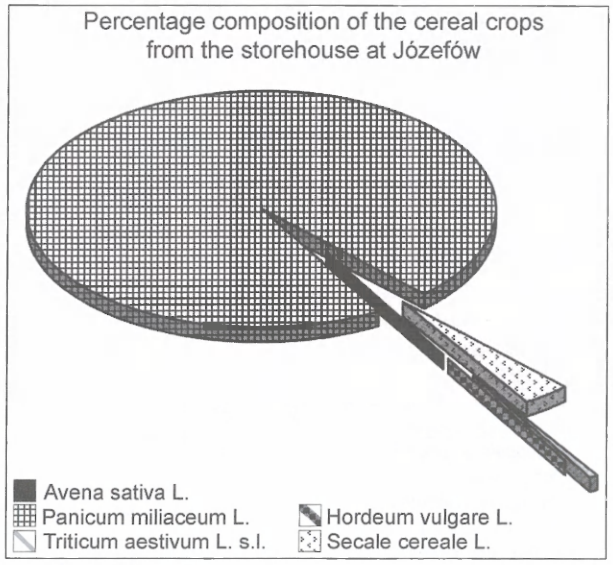

Fig. 5. Percentage composition of the cereal crop from the storehouse at Józefów.

stratum weeds in the grain harvested in the fields situated in the vicinity of the Józefów stronghold may be considered evidence of the fact that the crops were cut very low, just above the ground[13]. The other species discovered in the rye crop, namely wild mint (*Mentha arvensis*), sheep's sorrel (*Rumex acetosella*), round-leaved dock (*Rumex obtusifolius*) as well as the above-mentioned narrowleaf plantain (*Plantago lanceolata*) and thymealeaf speedwell (*Veronica serpyllifolia*) belong to the group of perennial plants and their presence in the crop suggests that rye was sown in a wasteland or fallow[14].

The biological characteristics of the weeds found in the wheat grain differ from those of the weeds present in the rye crop. Most of them,

[11] W. T y m r a k i e w i c z, *Atlas chwastów*, Warszawa 1962, pp. 44-48.

[12] *Ibidem*, p. 43 (Tymrakiewicz 1962).

[13] Cf.: M. L i t y ń s k a - Z a j ą c, *Roślinność i gospodarka...*, p. 157.

[14] K. W a s y l i k o w a, *Antropogeniczne zmiany...*, p. 70.

Table 2. Ecological requirements of the crop weeds from Józefów and their classification into biological groups.

Lp.	Takson	Indicator values				Annual weeds			Biennial weeds in winter cereals	Perennial weeds
		W	Tr	R	D	spring	perennial	winter		
1	***Aethusa cynapium*** L. Blekot pospolity	3	4	4-5	4-5	O				
2	***Agrostemma githago*** L. Kąkol polny	3	3-4	4-5	4-3		O			
3	***Apera spica-venti*** (L.) P. Beauv. Mietlica zbożowa	3	3	2-3	3-4		O			
4	***Aphanes arvensis*** L. Skrytek polny	3-4	3	3	3-4		O			
5	***Arenaria serpyllifolia*** L. Piaskowiec macierzankowy	2	2	3-5	2-5	O	O			
6	***Asperugo procumbens*** L. Lepczyca rozesłana	2-3	5	4-5	4		O			
7	***Bromus hordeaceus*** L. Stokłosa miękka	3	4	4	4	O	O			
8	***Bromus secalinus*** L. Stokłosa żytnia	3	3	3-4	3-4			O		
9	***Centaurea cyanus*** L. Chaber bławatek	3	3	3-4	2-4		O			
10	***Chenopodium album*** L. Komosa biała	3	4-5	4	3-5	O				
11	***Chenopodium polyspermum*** L. Komosa wielonasienna	3	3-5	3-4	4-5	O				
12	***Digitaria sanguinalis*** (L.) Scop. Palusznik krwawy	3	2	2	3	O				
13	***Echinochloa crus-galli*** (L.) P. Beauv. Chwastnica jednostronna	3-4	4-5	3-4	2-4	O				
14	***Elymus repens*** (L.) Gould Perz właściwy	3	3-4	3-5	4					O
15	***Fallopia convolvulus*** (L.) A. Löve Rdestówka powojowata	3	3-4	3-4	2-5	O				
16	***Galeopsis ladanum*** L. Poziewnik polny	2	3	3	2-3	O				
17	***Galeopsis t. tetrahit*** L. Poziewnik szorstki	3-4	3-4	4	3-4	O				
18	***Lolium temulentum*** L. Życica roczna	3	3-4	4-5	3-4	O				
19	***Melandrium album*** (Mili.) Garcke Bniec biały	3	4	4	3-4		O			
20	***Melandrium noctiflorum*** (L.) Fr. Bniec dwudzielny	2-3	3-4	5	3-5		O			
21	***Mentha arvensis*** L. Mięta polna	3-4	3-4	3-5	3-4					O
22	***Papaver rhoeas*** L. Mak polny	3	4	4(5)	3-4		O			
23	***Pastinaca sativa*** L. S. Str. Pasternak zwyczajny	3	4	4	3-4				O	
24	***Plantago cf. arenaria*** Waldst.& Kit. Babka piaskowa	2	2	3	3	O				
25	***Plantago lanceolata*** L. Babka lancetowata	2-4	3-4	4	4					O
26	***Polygonum aviculare*** L. Rdest ptasi	3	4-3	4-5	2-5	O				
27	***Polygonum lapathifolium*** L. s.l. Rdest szczawiolistny	3-4	4-5	4	2-4	O				
28	***Polygonum minus*** Huds. Rdest mniejszy	3-4	3	3	2-4	O				
29	***Polygonum persicaria L.*** Rdest plamisty	3	4-3	4	3-4	O				
30	***Rinanthus serotinus*** (Schönh.) Oborny Szelężnik większy	3-4	4	4	4			O		
31	***Rumex acetosella*** L. Szczaw polny	2	2	2-3	2-4					O
32	***Rumex obtusifolius*** L. Szczaw tępolistny	3-4.	4-5	3-5	4-5					O
33	***Setaria pumila*** (Poir.) Roem.&Schult Włośnica sina	2-3	3	3-4	2-4	O				
34	***Sherardia arvensis*** L. Rolnica pospolita	3	3-4	4-5	4-5		O			
35	***Silene gallica*** L. Lepnica francuska	3	3	4	3-4	O				

10 species, are short-lived, spring plants, which might indicate that wheat was sown in springtime. Among the weeds, there were a number of long-stemmed plants such as lambsquarters (*Chenopodium album*), darnel ryegrass (*Lolium temulentum*), black-bindweed (*Fallopia convolvulus*), red hempnettle (*Galeopsis ladanum*), pale smartweed (*Polygonum lapathifolium*), yellow bristlegrass (*Setaria pumila*) and common catchfly (*Silene gallica*)[15]. Some of them, corncockle (*Agrostemma githago*) and ryegrass (*Lolium*), were dangerous for humans because the seeds of those plants contained poison. Thymeleaf sandwort (*Arenaria serpyllifolia*), French psyllium (*Plantago arenaria*) and common knotgrass (*Polygonum aviculare*), which are spring plants, field parsley-piert (*Aphanes arvensis*), field madder (*Sherardia arvensis*), chickweed (*Stellaria media*), which are overwintering plants, as well as perennial narrowleaf plantain (*Plantago lanceolata*) all belong to the lower stratum of the crop, which could be interpreted as evidence for the fact that wheat was also cut low and that it was planted in a wasteland or fallow.

The edaphic characteristics of a field biotope where cereals used to be grown might be reconstructed thanks to ecological indicator values formulated using modern phitosociological observations. These values, given by Zarzycki[16], identify weeds' requirements in respect of humidity, soil richness (its trophic characteristics), the pH level and texture of the soil (Table 2, Fig. 6).

In the millet samples, there were lambsquarters (*Chenopodium album*), barnyard grass (*Echinochloa crus-galli*), white campion (*Melandrium album*) and lady's thumb (*Polygonum persicaria*). These species of weeds are nowadays found on fertile, structural, friable soils rich in nitrogen[17]. The indicator values of the remaining species suggest a similar pattern: a fresh, meso- to eutrophic biotope, whose pH is nearly neutral.

In the rye and wheat samples, the light soil taxa ranging from sands to dusty clays, from fertile to medium fertile, fresh with neutral pH were the most numerous group. In addition, in the case of some weed species found in these samples, the number of data suggests specific edaphic conditions. Weeds growing on poor and acid soils found in the rye samples are sheep's sorrel (*Rumex acetosella*) and large crabgrass (*Digitaria sanguinalis*). Thymeleaf sandwort (*Arenaria serpyllifolia*), red hempnettle (*Galeopsis ladanum*) and French psyllium (*Plantago arenaria*), which are present in the wheat samples, grow on dry sites poor in plant nutrients. Common knotgrass (*Polygonum aviculare*) is to be found in areas where the surface stratum has been displaced: washed away or silted up, on clay soils and in trampled places.

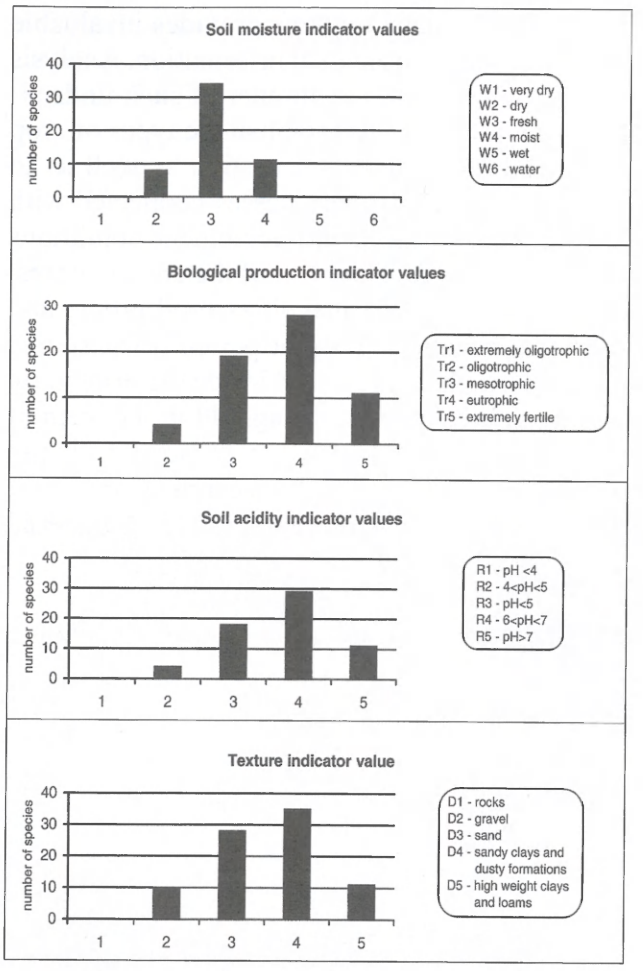

Fig. 6. Ecological indicator values (soil conditions) of the crop weeds from Józefów.

The presence in the storehouse of some seeds of cattail (*Typha sp.*), a species typical of rush plants, could be explained by the fact that some parts of the plant were commonly used for thatching houses and they could have fallen into the storehouse after the structure had collapsed.

Archaeobotanical examination of the pieces of cultivated crops and accompanying weeds found on archaeological sites in the form of a

[15] W. Tymrakiewicz, *Atlas chwastów*, pp. 48 seqq., 150, 364.

[16] K. Zarzycki, H. Trzcińska-Tacik, W. Różański, Z. Szeląg J. Wołek, U. Korzeniak, *Ecological Indicator Values*...; cf.: H. Ellenberg, H. Weber, R. Düll, V. Wirth, W. Werner, D. Paulißen, *Indicator Values of Plants in Central Europe*, "Scripta Geobotanica", Vol. 18, Göttingen 1992.

[17] W. Tyrakiewicz, *Atlas chwastów*, p. 63.

mass of carbonized remains provides invaluable economic and sociological information. Analysis of the composition and number of such finds allows the researcher to establish the types of crop cultivated at the time in question as well as to identify the economic processes connected with the technology used, the ecological conditions and seasonal characteristics of the ancient crops, the storage methods as well as food production methods characteristic of the period[18]. The source material which had survived inside the storehouse facility at the Józefów stronghold in the form of grain, seeds and weed fruits conserved by fire was sufficient to conduct research of this sort. The paleoecological interpretation of the material discovered points to the fact that the stronghold regularly exploited the natural environment and the land in the immediate vicinity of the fortress itself and the surrounding settlements. This phenomenon may be considered evidence of the economic activity of its ancient inhabitants. The research conducted provides information on the kinds of crop cultivated, the ecological conditions, such as humidity and soil nutrients, they required, and the technology. Biology helps reconstruct, among other things, the size and life cycle of the weeds. In addition, the place where the remains examined were discovered is a source of knowledge about the way the grain harvest used to be stored in early medieval times.

[18] K. W a s y l i k o w a, *Antropogeniczne zmiany...*, pp. 64 seqq.

Translated by Zuzanna Poklewska-Parra

Fig. 2. Remains of the grain storehouse.

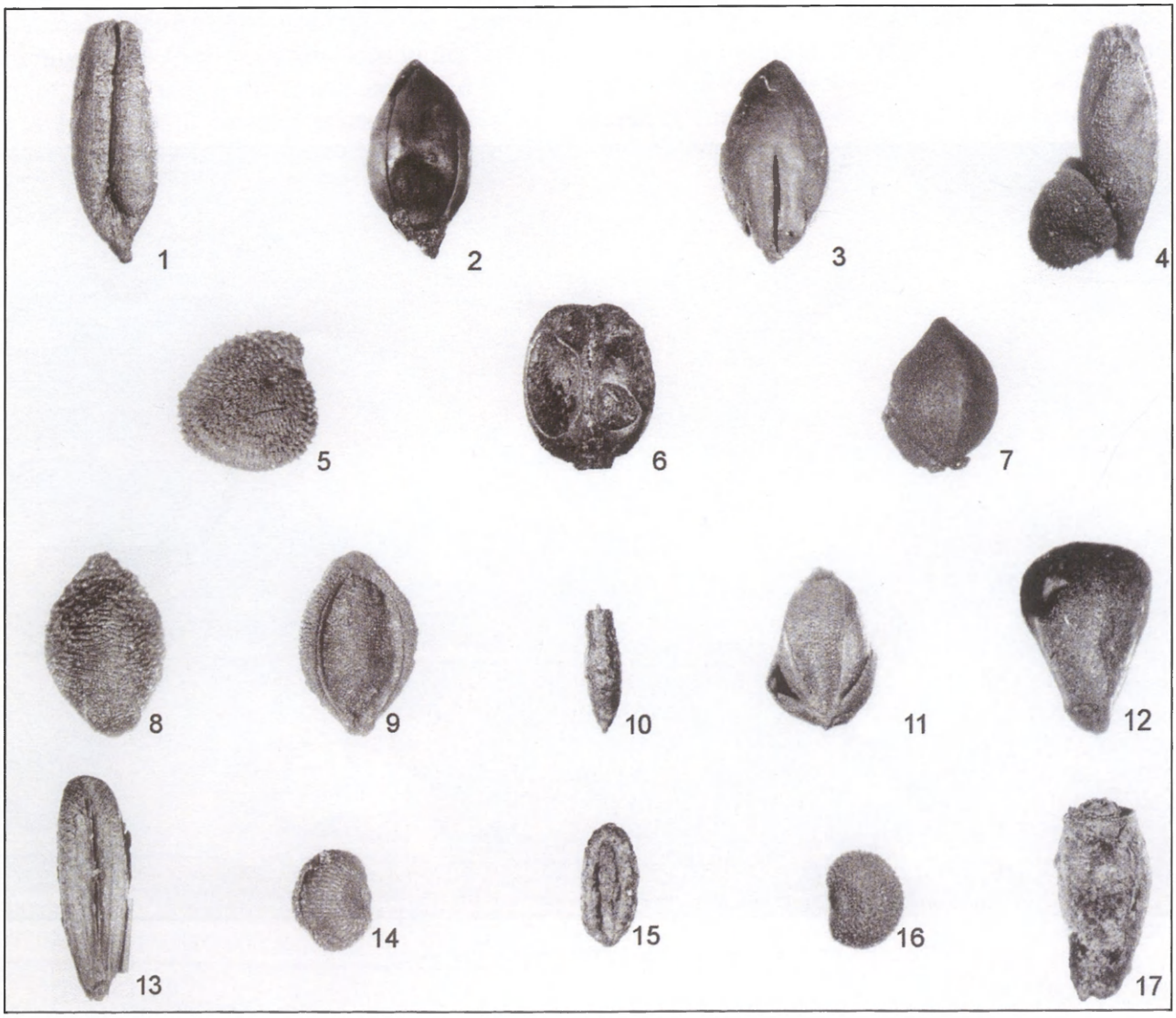

Fig. 4. 1 – Common Rye *Secale cereale*; 2, 3 – Common Millet *Panicum miliaceum*; 4 – Common Rye *Secale cereale* and Corncockle *Agrostemma githago*; 5 – Corncockle *Agrostemma githago*; Common Wheat *Triticum aestivum*; 7 – Black-Bindweed *Fallopia convolvulus*; 8, 9 – Yellow Bristlegrass *Setaria pumila*; 10 – Cattail *Typha sp.*; 11 – Green/Bristly Foxtail *Setaria viridis/verticillata*; 12 – Bristlestem Hempnettle *Galeopsis t. tetrahit*; 13 – Rye Brome *Bromus secalinus*; 14 – French Campion/Catchfly *Silene gallica*; 15 – Narrowleaf Plantain *Plantago lanceolata*; 16 – White Campion *Melandrium album*; 17 – Cornflower *Centaurea cyanus*.