ROMAN IRON AGE PLANT HUSBANDRY AT PEELO, THE NETHERLANDS

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ABSTRACT: Rye (*Secale cereale*) and hulled barley (*Hordeum vulgare*) were major crop plants at Roman Iron Age Peelo. Very likely also common oat (*Avena sativa*) was grown. Broomcorn millet (*Panicum miliaceum*) and flax (*Linum usitatissimum*) were of minor importance. No pulse-crop seeds were found. It is not clear whether weed seeds, such as those of *Chenopodium album*, served for human consumption. As usual, weedy vegetations (of cornfields and ruderal habitats) are well represented in the archaeological seed record. Although a fair number of grassland species has been demonstrated, the grassland acreage in the Peelo area was probably of limited extent.

KEYWORDS: Rye, barley, wild food plants, vegetation types, feeding livestock.

1. INTRODUCTION

In this paper the results will be presented of the examination of plant remains recovered from the Late Iron Age/Roman Iron Age settlement on the terrain called 'deEs' at Peelo (for location, see fig. 1). The final archaeological report on the excavations carried out in 1977-1979 has been published by Kooi (1991) in this volume. The publication of the archaeological and botanical examination of other sections of the Peelo settlement site, among which the medieval occupation, is scheduled for the next few years.

The soil samples taken by the excavators for botanical analysis are listed in table 1. As usual the plant remains were retrieved from the samples by means of manual water flotation. The flotation residues were completely or partly sorted for seeds and fruits. Almost all samples are from the fill of post-holes (posts, uprights) and various kinds of pits. The conditions in these features, viz. well-aerated, sandy soil above the groundwater level, allow the preservation of only carbonized plant remains. Non-charred seeds and fruits have been discarded because they must have been due to modern intrusions, e.g. by burrowing animals. In dry, sandy areas such as at Peelo, non-carbonized plant remains are preserved only in the waterlogged fill of wells and such-like. From the medieval settlement several well samples with excellently preserved waterlogged plant remains have been retrieved. The only well sample from 'de Es' (No. 209) is from a thick layer of charcoal that had been dumped in the well after this had fallen into disuse. This sample yielded only carbonized remains, but its composition differs from that of the other samples included in this study (see table 2).

As it appears from table 1, only a few samples date from the Late Iron Age, from the fourth to first century BC. Almost all samples are from Roman Iron Age (first five centuries AD) occupation features. Although for chronological reasons it would have been obvious to treat the Late Iron Age samples first, this is not done here because very little can be said about these samples. Thus, the below discussion is almost wholly devoted to the Roman Iron Age plant remains (as also indicated in the title of this paper).

Table 1 mentions for a number of samples 'no seeds'. Some of these did yield sclerotia of the fungus species *Cenococcum geophilum*. In many samples these durable sclerotia were present, sometimes in considerable quantities, but no attention will be paid here to these remains, the significance of which in an archaeological context is still obscure. From various samples charred stem fragments, presumably of *Calluna vulgaris* (heather), were retrieved.

In addition to the 'no seed' samples, a considerable number of samples turned out to be poor in seeds (the term 'seeds' used here includes cereal grains and other morphologically-defined fruits). In fact, relatively few samples yielded more than twenty seeds. Presentation of analyses of all samples in one or more tables consisting predominantly of zero scores was not considered meaningful. For that reason only the samples relatively rich in plant remains are shown here (table 2). In fact, it is these samples which provide most of the information on the plant husbandry of the site and on which the discussion is largely based. The samples are arranged in four groups. In the samples of the first group cereal grains are most numerous, while in the second group total weed-seed numbers are higher than those of cereals. The samples of the third group are fully dominated by weed seeds. The last group includes a sample of threshing remains and the well sample mentioned above.

Table 3 lists all plant taxa attested for the Roman

Iron Age occupation of 'de Es'. The total numbers of seeds are those actually found; for samples examined in part the numbers of seeds have not been converted for the whole of the sample.

The vegetable remains in the fill of pits and post-holes were there in secondary position. They must have been present in the soil which was shoveled into the pit or post-hole. It is likely that many samples are of mixed origin, that is to say, that they consist of plant remains of more than one provenance. It goes without saying that this is a complicating factor in interpreting the vegetable remains in terms of ancient plant husbandry practices. A few samples are definitely not of mixed origin, e.g. sample 80 (table 2) which represents the remains of a processed rye supply.

2. CULTIVATED PLANTS

The archaeobotanical data (tables 2 and 3) suggest that rye (*Secale cereale*) and hulled barley (*Hordeum vulgare*) were the most important crop plants at first to fifth century AD Peelo. It is interesting to note that rye played such a prominent part. The intentional cultivation of this corn crop could be attested also for occupation phase IV at Noordbarge (for location, see fig. 1), dated to 100 BC-AD 100 (van Zeist, 1981(1983)). There can be no doubt that in the present-day province of Drenthe, rye cultivation had started already in the first centuries AD and not only in medieval times as was formerly assumed. It is perhaps too far-fetched to see a connection with the Roman presence in continental western Europe. One could, for instance, speculate that in regions outside the occupied territory corn was grown for the provisioning of the Roman army and that, for one reason or another, rye was required. However, transportation of substantial corn supplies from Drenthe to the Roman-occupied territory must have met with serious difficulties, unless a network of overland routes and waterways already existed at that time. Be this as it may, we can only ascertain that in the first centuries AD rye cultivation had been firmly established in Drenthe.

In addition to barley and rye, very probably common oat (*Avena sativa*) was grown by the Peelo farmers. The oat grains themselves provide no clue as to whether the domestic or the wild species (*Avena fatua*) is concerned. *Avena fatua* has been a corn-field weed since Neolithic times and could have been found in the fields of the Peelo farmers together with other field weeds (see below). No oat flower bases, which would have permitted

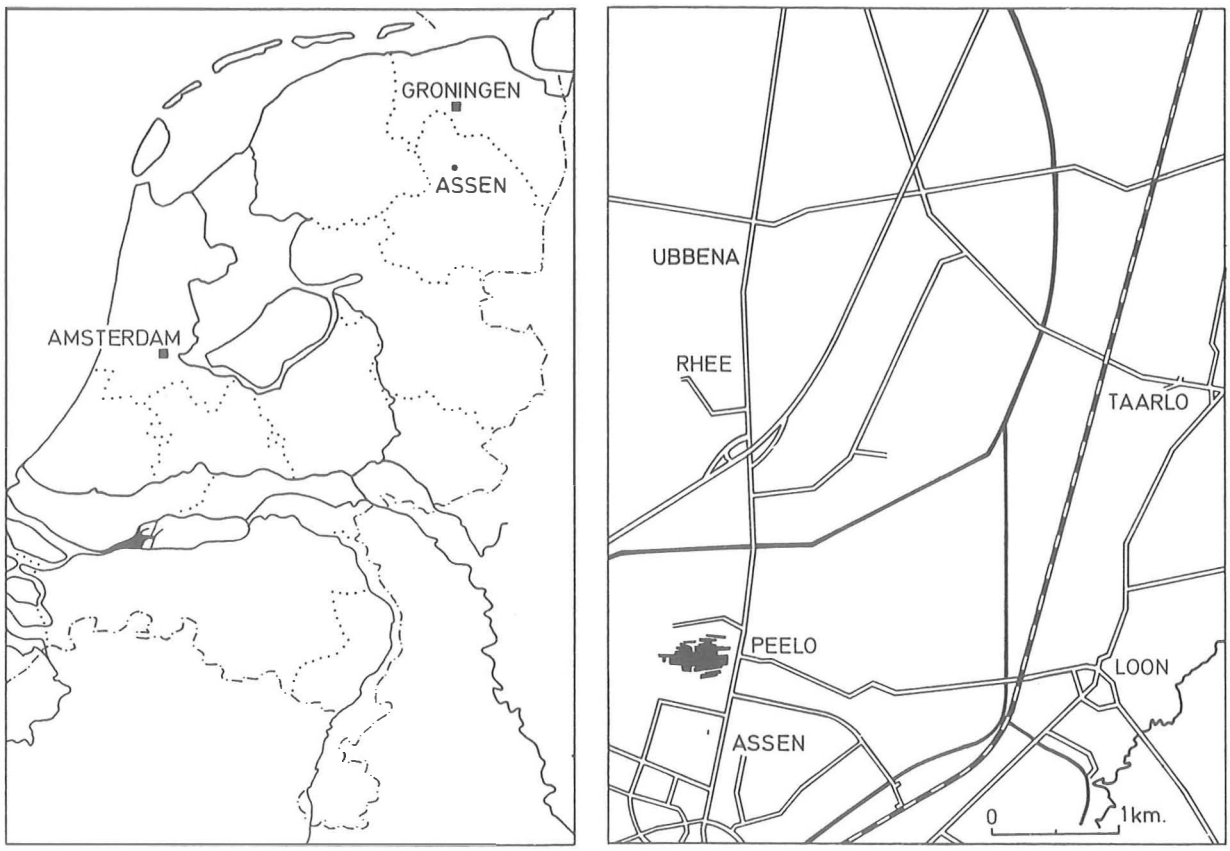

Fig. 1. Map showing the location of Peelo.

Table 1. Peelo, 'de Es' (excavations 1977, 1978, 1979). Samples taken for botanical examination. Dates in centuries AD, unless otherwise stated (Late Iron Age samples).

No.	Date	Context of sample	Remarks
1	3-4	Pit	
9	3-4	Pit	Table 2
16	2-4	Pit	
24	3-4	Pit	No seeds
35	2-3	Oven pit	Table 2
37	1-2	Pit	
41	1-2	Pit in sheep pen	Table 2
43	2-3	Pit	
46	3-4	Wall post	Samples 46-50 from same house
47	3-4	Wall post	
48	3-4	Entrance pit	Table 2
49	3-4	Pit	
50	3-4	Pit	No seeds
56	3-4	Post	Table 2, samples 56-67 from same house
62	3-4	Upright	
66	3-4	Upright	Table 2
67	3-4	Upright	
77	4-5	Pit	
80	3-4	Pit	Table 2
81	3-4	Pit	
82	3-4	Sunken hut	
84	3-4	Upright	Samples 84, 99 and 101 from same house
87	3-2 BC	Upright	Samples 87-92 from same house
88	3-2 BC	Upright	
89	3-2 BC	Wall post	
92	3-2 BC	Wall post	
99	3-4	Upright	
101	3-4	Upright	
111	3-4	Sunken hut	
115	2-4	Post, granary	
116	2-4	Upright	
131	2-3	Pit	No seeds
147	1-2	Pit	
169	2-3	Pit	No seeds
184	3-4	Post	
194	2-3	Pit	No seeds
195	2-4	Pit	
203	1-3	Post, granary?	
204	1-3	Post, granary?	
205	1-3	Post, granary	
209	2-4	Fill of well	Table 2, carbonized remains
228	3-4	Pit	Table 2
248	1-2	Post	Samples 248-250 from same house
249	1-2	Post	No seeds
250	1-2	Wall post	No seeds
257	3-4	Oven pit	Table 2, samples 257, 261 and 268-270 from same house
261	3-4	Upright	
267	3-4	Post	
268	3-4	Post	
269	3-4	Post	
270	3-4	Post	
277	4	Pit	GrN-10694: 1680±35 BP
279	5	Pit with iron slag	
288	3-4	Pit	No seeds
289	3-4	Sunken hut	Table 2
293	3-4	Pit	
295	5	Pit in granary	Table 2
306	3-4	Pit	Table 2
309	5	Pit in granary	
316	2-1 BC	Upright	Samples 316 and 317 from same house
317	2-1 BC	Upright	
328	3-4	Entrance pit	Samples 328-338 and 345-351 from same house, 2-3 periods
332	3-4	Entrance pit	
333	4-5	Wall post	
334	3-5	Upright	
338	3-5	Upright	
339	4-5	Pit	
345	3-5	Upright	
346	3-4	Entrance pit	
351	3-4	Entrance pit	
352	3-4	Pit	Table 2
356	4-5	Wall post	No seeds, samples 356 and 357 from same house
357	4-5	Entrance pit	
361	5	Oven pit	Table 2
364	4-5	Entrance pit	No seeds
366	5	Pit	
383	5	Pit	Table 2
384	5	Wall post	
385	4-5	Upright	Table 2, samples 385 and 386 from same house
386	4-5	Wall post	Table 2
389	5	Upright	
393	4-5	Upright	
399	5	Oven (?) pit	Table 2
435	5	Upright	
470	4-5	Wall post	Samples 470 and 472 from same house
472	4-5	Upright	Table 2
477	3-5	Post	
480	3-5	Pit	No seeds
481	3-5	Pit	No seeds
482	5	Upright	Samples 482 and 518 from same house
488	3-4	Post, barn	
491	3-4	Post, enclosure	No seeds
499	3-4	Upright	
509	3-4	Post	
511	3-4	Post	
512	3-5	Ditch	Table 2
513	5	Wall post	Samples 513-517 are from a 'smithy'
514	5	Wall post	No seeds
515	5	Wall post	
517	5	Fire place	No seeds
518	5	Upright	Table 2

a species determination, have been secured. As in a few samples the proportion of oat among the cereal grains is quite large, it is assumed here that *Avena sativa* formed part of the crop-plant assortment. Admittedly, there is no absolute proof for this assumption.

The minimal representation of emmer wheat (*Triticum dicoccum*) and bread wheat (*Triticum aestivum*) (see table 3) suggests that wheat was not intentionally grown here during the Roman Iron Age. Although emmer wheat was no longer a crop of major importance as it had been during the Neolithic and Bronze Age, it was still widely cultivated in continental western and northwestern Europe in the first half of the first millennium AD. It looks if at Peelo the cultivation of emmer wheat had been abandoned in favour of that

Table 2. Numbers of seeds and fruits in selected Roman Iron Age samples from Peelo ('de Es'). Of *Calluna* stems only the presence is indicated. I. Predominantly cereal grains; II. More weed seeds than cereal grains; III. Weed seeds by far predominant; IV. Rest group. Plant nomenclature in accordance with *Heukels' Flora van Nederland* (van der Meijden, 1990).

	I								II			
Sample number	9	80	352	383	385	386	512	518	35	228	257	295
Part examined	1/1	1/2	1/2	1/2	1/1	1/1	1/1	1/2	1/1	1/1	1/1	1/2
Avena (sativa)	.	.	19	1	.	.	1	.	1	.	9	3
Hordeum vulgare	12	.	50	.	1	1	10	.	62	7	14	31
Hordeum rachis internodes	.	.	1	.	.	.	.	.	.	.	.	.
Secale cereale	120	28	21	32	430	46	14	23	11	20	.	6
Secale rachis internodes	.	.	.	.	2	.	.	.	.	.	.	.
Cereal grain fragments (in grams)	0.14	.	0.35	0.23	0.92	0.08	0.03	+	0.06	.	0.06	0.05
Panicum miliaceum	.	.	.	.	.	.	.	.	3	1	.	.
Linum usitatissimum	.	.	.	.	.	.	.	.	2	.	.	.
Corylus avellana	.	.	.	.	.	.	.	.	.	+	.	.
Rubus spec.	.	.	.	.	.	.	.	.	1	.	.	.
Vaccinium myrtillus	.	.	.	.	.	.	.	2	.	.	.	.
Chenopodium album	1	.	.	1	5	.	.	.	200	40	5	28
Polygonum convolvulus	32	.	.	.	.	.	.	.	1	.	1	1
Polygonum lapathifolium	18	.	2	1	7	.	13	2	11	2	33	66
Rumex acetosella	.	.	10	3	48	7	.	5	.	.	12	.
Spergula arvensis	.	.	6	3	5	1	.	1	.	1	18	100
Vicia spec.	34	.	16	1	10	.	.	.	.	20	5	1
Agrostis spec.	.	.	.	.	.	.	.	.	.	.	.	1
Apera spica-venti	.	.	.	.	.	.	.	.	.	.	.	.
Bromus secalinus	.	.	1	.	.	.	.	.	.	.	.	.
Carex cuprina	.	.	.	.	.	.	.	.	.	.	.	.
Carex flacca	.	.	.	.	.	.	.	.	.	.	.	.
Carex nigra type	.	.	.	.	7	.	.	.	.	.	.	.
Carex oederi	.	.	.	.	1	.	.	.	.	.	.	.
Carex panicea	.	.	.	1	.	1	.	.	.	.	.	.
Carex rostrata/vesicaria	.	.	.	.	.	.	.	.	.	.	1	.
Carex spec.	.	.	.	.	.	1	.	.	.	.	2	.
Claviceps spec.	.	.	.	.	.	.	.	.	.	.	.	.
Conium maculatum	.	.	.	.	.	.	.	.	.	.	.	.
Cuscuta spec.	.	.	.	.	.	.	.	.	.	.	.	.
Echinochloa crus-galli	.	.	.	.	.	.	.	.	.	.	.	.
Eleocharis multicaulis	.	.	.	.	.	.	.	.	.	.	.	.
Eleocharis palustris	.	.	.	.	.	.	.	.	.	.	.	.
Euphrasia type	.	.	.	.	.	.	.	.	.	.	.	.
Festuca pratensis	.	.	.	.	.	.	.	.	.	.	.	.
Galeopsis tetrahit/speciosa	.	.	.	.	.	.	.	.	.	.	.	.
Galium palustre	.	.	.	.	.	.	.	.	.	.	.	.
Galium spec.	.	.	.	.	.	.	.	.	1	.	.	.
Gramineae indet.	.	.	5	.	.	.	.	.	.	.	.	.
Knautia arvensis	1	.	.	.	.	.	.	.	.	.	.	.
Matricaria maritima	.	.	.	.	.	.	.	.	.	.	.	.
Malva spec.	.	.	.	.	.	.	.	.	.	.	.	.
Phleum pratense	.	.	.	.	.	.	.	.	.	.	.	.
Plantago lanceolata	.	.	.	.	.	.	.	.	1	.	.	.
Poa annua	.	.	.	.	1	.	.	.	.	.	.	.
Poa pratensis/trivialis	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum aviculare	.	.	.	.	2	.	.	.	.	.	.	.
Polygonum hydropiper	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum persicaria	1	.	.	.	2	1	.	.	.	.	.	.
Potentilla erecta	.	.	.	.	1	.	.	.	.	.	.	.
Prunella vulgaris	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus flammula	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus repens	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus sardous	.	.	.	.	.	.	.	.	.	.	.	.
Raphanus raphanistrum	.	.	.	.	.	.	.	.	.	.	2	.
Rhinanthus spec.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex crispus	.	.	.	.	.	.	.	.	.	.	.	.
Rumex obtusifolius	1	.	.	.	.	.	.	.	1	.	.	.
Scleranthus annuus	.	.	.	.	.	.	.	.	.	.	1	.

II			III				IV			
306	361	399	48	56	66	289	472	41	209	Sample number
1/1	1/3	1/10	1/1	1/1	1/1	1/3	1/1	1/1	1/1	Part examined
6	1	10	.	.	.	3	2	.	1	*Avena (sativa)*
4	6	19	.	1	4	11	3	1	5	*Hordeum vulgare*
.	.	.	.	.	.	4	.	47	.	*Hordeum* rachis internodes
.	40	32	5	1	1	.	.	2	1	*Secale cereale*
.	.	.	.	.	.	.	.	.	.	*Secale* rachis internodes
+	0.09	0.31	.	.	0.02	0.05	0.02	.	.	Cereal grain fragments (in grams)
.	.	.	.	.	.	.	.	.	.	*Panicum miliaceum*
1	.	.	.	.	.	.	.	.	.	*Linum usitatissimum*
.	+	.	.	.	.	.	.	.	.	*Corylus avellana*
.	.	.	.	.	.	.	.	.	.	*Rubus* spec.
.	.	.	.	.	.	.	.	.	.	*Vaccinium myrtillus*
10	9	10	28	15	2	560	16	.	40	*Chenopodium album*
.	.	1	.	.	.	.	.	.	.	*Polygonum convolvulus*
4	15	40	72	22	20	70	50	1	12	*Polygonum lapathifolium*
24	40	15	.	65	18	70	1	.	10	*Rumex acetosella*
3	15	9	1	64	21	15	2	.	12	*Spergula arvensis*
.	1	8	.	1	.	.	.	.	.	*Vicia* spec.
.	.	190	.	.	.	.	.	.	.	*Agrostis* spec.
.	1	14	.	.	.	1	.	.	.	*Apera spica-venti*
.	.	.	.	.	.	.	.	.	.	*Bromus secalinus*
.	.	.	.	.	.	.	.	.	13	*Carex cuprina*
.	.	.	.	.	.	.	.	.	3	*Carex flacca*
.	.	.	.	1	.	.	1	.	5	*Carex nigra* type
.	.	.	.	.	.	.	.	.	.	*Carex oederi*
.	.	.	.	.	1	.	.	.	1	*Carex panicea*
.	.	.	.	.	.	.	1	.	2	*Carex rostrata/vesicaria*
.	.	.	.	.	.	.	.	.	4	*Carex* spec.
.	1	.	.	.	.	.	.	.	.	*Claviceps* spec.
.	.	.	.	.	.	.	.	.	1	*Conium maculatum*
2	.	.	.	.	.	.	.	.	.	*Cuscuta* spec.
.	.	.	.	.	.	2	.	.	1	*Echinochloa crus-galli*
.	.	.	.	.	.	.	.	.	2	*Eleocharis multicaulis*
.	.	.	.	.	.	.	.	.	4	*Eleocharis palustris*
.	.	.	.	.	.	.	1	.	.	*Euphrasia* type
.	.	.	.	.	.	.	.	.	1	*Festuca pratensis*
1	1	.	.	1	.	.	.	.	.	*Galeopsis tetrahit/speciosa*
.	.	.	.	.	.	.	.	.	1	*Galium palustre*
.	.	.	.	.	.	.	.	.	.	*Galium* spec.
2	5	.	.	.	.	.	.	.	5	Gramineae indet.
.	1	.	.	.	.	.	.	.	.	*Knautia arvensis*
.	.	5	.	.	.	.	.	.	.	*Matricaria maritima*
.	.	.	.	.	.	.	.	.	1	*Malva* spec.
.	3	.	.	.	.	.	.	.	2	*Phleum pratense*
.	.	.	.	.	.	.	.	.	2	*Plantago lanceolata*
.	.	.	.	.	.	.	.	.	.	*Poa annua*
.	2	40	.	.	.	.	.	.	.	*Poa pratensis/trivialis*
.	.	.	.	1	3	.	1	.	11	*Polygonum aviculare*
.	.	.	.	.	2	.	.	.	.	*Polygonum hydropiper*
.	.	.	.	.	.	.	1	.	.	*Polygonum persicaria*
.	.	.	.	.	.	1	.	.	5	*Potentilla erecta*
.	.	.	.	.	.	.	.	.	1	*Prunella vulgaris*
.	.	.	.	.	.	.	.	.	1	*Ranunculus flammula*
.	.	.	.	.	.	.	.	.	6	*Ranunculus repens*
.	.	.	.	.	1	.	.	.	.	*Ranunculus sardous*
.	.	.	.	.	.	.	.	.	.	*Raphanus raphanistrum*
.	.	.	.	.	.	.	.	.	1	*Rhinanthus* spec.
.	.	.	.	.	.	.	.	.	.	*Rumex crispus*
.	1	.	.	.	.	.	.	.	8	*Rumex obtusifolius*
.	.	.	.	.	.	.	.	.	.	*Scleranthus annuus*

Table 2 (Continued).

				I								II	
Senecio cf. *aquaticus*	.	.	1	.	.	.	.	.	.	.	.	.	.
Solanum nigrum	.	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium spec.	.	.	.	.	.	.	.	.	.	.	.	.	.
Umbelliferae indet.	.	.	.	.	.	.	.	.	.	.	.	.	.
stems (*Calluna*)	.	.	.	.	+	.	.	.	.	.	.	.	.

of rye. Broomcorn millet (*Panicum miliaceum*) is conspicuously scarce, suggesting that it was at most occasionally grown, this in contrast to Noordbarge, where millet must have been a common crop plant in the period of 100 BC to AD 100 (van Zeist, 1981(1983)).

Although for the oleaginous linseeds chances of becoming preserved in a carbonized condition are much smaller than for cereal grains, the poor representation of flax (*Linum usitatissimum*) in the seed record suggests that at Peelo this species was at most a crop of minor importance. It may be remembered here that in contemporary settlements in the coastal marshes in the north of the Netherlands there is convincing evidence of flax cultivation (van Zeist, 1974).

Pulse-crop seeds were not found, although one should consider the possibility that Celtic bean (*Vicia faba* var. *minor*) was grown by the Peelo farmers. This species is reported for pre-Roman and Roman Iron Age sites in continental western Europe (cf. Bakels, 1991).

3. (POTENTIAL) WILD FOOD PLANTS

Remains of wild fruits and nuts are extremely scarce. This could in part be due to the fact that in general nuts and fruits are poorly represented in a carbonized condition. In this respect waterlogged archaeological deposits offer better prospects. However, the collecting of wild fruits and nuts may have been of only little economic importance at Roman Iron Age Peelo; early-medieval waterlogged well deposits from this site did not yield evidence of intensive wild fruit collecting, either.

In table 2, typical weeds (cf. table 3 and discussion in section 4), which in one or more samples are represented by comparatively great numbers of seeds, are grouped together (*Chenopodium album* up to *Vicia* spec.). How should one interpret these field-weed seeds? In the samples of group one, with predominantly cereal grains, the weed seeds could be considered contaminants of the corn crop that had not yet been cleaned of impurities. In the samples of groups two and three the numbers of weed seeds are higher and very much higher, respectively, than those of cereal grains. Here it looks as if the weed seeds, after they had been removed from the crop, had been set apart to be used for some purpose. One could think of crop-cleaning waste destined to be thrown away or fed to the animals. However, typical threshing remains, such as rachis internode fragments, are absent from these samples. The only sample with predominantly rachis internode remains (No. 41) yielded just one weed seed. Apparently the weed seeds had been separated from other crop processing waste products. One wonders whether the starch-rich weed seeds could have served for human consumption, as famine food after crop failure. In this connection reference is made to the finds of weed-seed supplies in Iron Age sites in Denmark (Helbæk, 1951, 1960). Almost pure supplies of *Chenopodium album*, *Spergula arvensis* and *Polygonum lapathifolium* are reported. It is suggested that the weed seeds were harvested particularly on fallow fields. Another explanation of relatively large numbers of *Chenopodium album* seeds is that not the seeds but the green parts of the plants were used (as vegetable). Prior to food preparation, the seeds were removed (e.g. by beating or lashing), which would account for the many *Chenopodium album* seeds in settlement sites (Knörzer, 1973).

It remains a matter of speculation whether the relatively high weed seed proportions at Peelo are evidence of the exploitation of these wild food resources for human consumption. Admittedly, a more than occasional necessity to supplement the corn crop with wild weed seeds is difficult to reconcile with the suggestion that the Peelo farmers may have produced grain for a Roman market.

4. SPECULATIONS ON FARMING PRACTICES

One of the questions to which archaeobotanical research is expected to give an answer is that of the season of sowing. Depending upon the time of sowing (and tillage of the fields), so-called winter (autum-sown) and summer (spring-sown) cereals are distinguished. As for the main cereal species attested for Roman Iron Age Peelo, rye is at present a predominantly winter cereal, but spring-sown varieties do occur. Oats, on the other hand, is a typical summer cereal. Of barley, both autumn-sown and spring-sown varieties occur. Broomcorn millet and linseed (flax) are spring-sown.

From the above one may conclude that at least some of the fields were sown in the spring. However, were rye

Table 2 (Continued).

II			III			IV				
.	.	.	.	.	.	.	.	.	.	*Senecio* cf. *aquaticus*
.	.	.	.	.	.	.	.	.	2	*Solanum nigrum*
.	.	.	.	.	.	.	.	.	28	*Trifolium* spec.
.	.	:	.	.	.	.	.	.	1	Umbelliferae indet.
.	.	.	+	.	.	.	.	.	+	stems (*Calluna*)

Table 3. Ecological affinity of the plant taxa attested for Roman Iron Age Peelo ('de Es'). In the left column the total numbers of seeds actually recovered are shown. An asterisk indicates that more than half of the seeds were found in one sample. 1. Cultivated plants; 2. Wild fruits; 3. Weeds of winter cereals; 4. Weeds of summer cereals and root crops; 5. Weeds of ruderal habitats; 6. Grassland species; 7. Plants of marshy habitats; 8. Plants of heathlands.

Number of seeds etc.		1	2	3	4	5	6	7	8
63	*Avena* (*sativa*)	x	.	.	.	.	.	.	.
323	*Hordeum vulgare*	x	.	.	.	.	.	.	.
59*	*Hordeum* internodes	x	.	.	.	.	.	.	.
878	*Secale cereale*	x	.	.	.	.	.	.	.
4	*Secale* internodes	x	.	.	.	.	.	.	.
1	*Triticum aestivum*	x	.	.	.	.	.	.	.
2	*Triticum dicoccum*	x	.	.	.	.	.	.	.
5	*Panicum miliaceum*	x	.	.	.	.	.	.	.
4	*Linum usitatissimum*	x	.	.	.	.	.	.	.
+	*Corylus avellana*	.	x	.	.	.	.	.	.
1	*Rubus* spec.	.	x	.	.	.	.	.	.
2	*Vaccinium myrtillus*	.	x	.	.	.	.	.	.
37*	*Polygonum convolvulus*	.	.	x	.	.	.	.	.
2	*Scleranthus annuus*	.	.	x	.	.	.	.	.
16	*Apera spica-venti*	.	.	x	.	.	.	.	.
2	*Arnoseris minima*	.	.	x	.	.	.	.	.
1	*Bromus secalinus*	.	.	x	.	.	.	.	.
105	*Vicia* spec.	.	.	x	.	.	.	.	.
372	*Rumex acetosella*	.	.	x	x	.	.	.	.
340	*Spergula arvensis*	.	.	x	x	.	.	.	.
4	*Raphanus raphanistrum*	.	.	x	x	.	.	.	.
4	*Galeopsis tetrahit/speciosa*	.	.	x	.	x	.	.	.
5	*Echinochloa crus-galli*	.	.	.	x	.	.	.	.
8	*Polygonum persicaria*	.	.	.	x	.	.	.	.
1	*Setaria viridis*	.	.	.	x	.	.	.	.
1	*Anagallis arvensis*	.	.	.	x	.	.	.	.
1006*	*Chenopodium album*	.	.	.	x	x	.	.	.
547	*Polygonum lapathifolium*	.	.	.	x	x	.	.	.
5	*Matricaria maritima*	.	.	.	x	x	.	.	.
4	*Solanum nigrum*	.	.	.	x	x	.	.	.
1	*Stellaria media*	.	.	.	x	x	.	.	.
7	*Polygonum hydropiper*	.	.	.	x	.	.	x	.
1	*Conium maculatum*	.	.	.	.	x	.	.	.
3	*Poa annua*	.	.	.	.	x	.	.	.
23	*Polygonum aviculare*	.	.	.	.	x	.	.	.
16	*Rumex obtusifolius*	.	.	.	.	x	.	.	.
2	*Ranunculus sardous*	.	.	.	.	?	.	.	.
1	*Rumex crispus*	.	.	.	.	x	x	.	.
193*	*Agrostis* spec.	.	.	.	.	.	x	.	.
1	*Senecio* cf. *aquaticus*	.	.	.	.	.	x	.	.
1	*Euphrasia* type	.	.	.	.	.	x	.	.
2	*Knautia arvensis*	.	.	.	.	.	x	.	.
1	*Malva* spec.	.	.	.	.	.	x	.	.
5	*Phleum pratense*	.	.	.	.	.	x	.	.
3	*Plantago lanceolata*	.	.	.	.	.	x	.	.
42*	*Poa pratensis/trivialis*	.	.	.	.	.	x	.	.
1	*Festuca pratensis*	.	.	.	.	.	x	.	.

Table 3 (Continued).

Number of seeds etc.		1	2	3	4	5	6	7	8
1	*Prunella vulgaris*	.	.	.	.	.	x	.	.
6	*Ranunculus repens*	.	.	.	.	.	x	.	.
1	*Rhinanthus* spec.	.	.	.	.	.	x	.	.
28*	*Trifolium* spec.	.	.	.	.	.	x	.	.
3	*Carex flacca*	.	.	.	.	.	x	.	.
16	*Carex nigra* type	.	.	.	.	.	x	x	.
5	*Carex panicea*	.	.	.	.	.	x	.	x
8	*Potentilla erecta*	.	.	.	.	.	x	.	x
7	*Carex rostrata/vesicaria*	.	.	.	.	.	.	x	.
13	*Carex cuprina*	.	.	.	.	.	.	x	.
1	*Carex oederi*	.	.	.	.	.	.	x	.
1	*Galium palustre*	.	.	.	.	.	.	x	.
1	*Ranunculus flammula*	.	.	.	.	.	.	x	.
5	*Eleocharis palustris*	.	.	.	.	.	.	x	.
2	*Eleocharis multicaulis*	.	.	.	.	.	.	.	x
+	*Calluna vulgaris*	.	.	.	.	.	.	.	x
7	*Carex* spec.								
1	Chenopodiaceae indet.								
1	*Claviceps* spec.								
2	*Cuscuta* spec.								
1	*Galium* spec.								
19	Gramineae indet.								
1	Umbelliferae indet.								

Table 4. Total numbers of seeds etc. recovered from six Late Iron Age samples (Nos 87, 88, 89, 82, 316, 317).

Hordeum vulgare	2
Triticum dicoccum glume base	1
Panicum miliaceum	1
cf. *Brassica*	1
Carex oederi	1
Carex pseudocyperus	1
Carex rostrata/vesicaria	1
Chenopodium album	10
Chenopodiaceae indet.	1
Echinochloa crus-galli	3
Poa pratensis/trivialis	1
Polygonum aviculare	1
Polygonum convolvulus	3
Polygonum hydropiper	3
Polygonum lapathifolium	132
Polygonum persicaria	2
Rumex acetosella	2
Solanum nigrum	7
Spergula arvensis	16
Stellaria media	7
stems (*Calluna*)	+

and perhaps part of the barley sown in the autumn? In principle, arable weeds should be informative in this respect. Among these weeds, those of winter-corn and summer-corn fields are distinguished. As already appears from table 3, this differentiation is not particularly clear-cut. Quite a lot of weeds grow in various habitats. Although for Peelo only a rather small number of weeds typical of autumn-sown cornfields have been attested, one may assume that winter cereals were indeed cultivated.

Rachis internode remains are almost absent in the samples with comparatively large numbers of cereal grains (table 2), suggesting that the grains are of corn supplies thathad been threshed and cleaned of threshing waste. Only sample 47 (table 2) represents threshing waste, namely of barley. It is tempting to assume that the corn crop had been stored in a threshed condition.

The great numbers of caryopses ('seeds') of the perennial grasses *Agrostis* and *Poa pratensis/trivialis* in sample 399 (table 2) make one wonder whether this sample includes the remains of a hay supply. However, other grassland species are not represented in this sample. For that reason one could speculate that both grasses occurred as weeds of arable. The comparatively slight disturbance of the soil by ard ploughing, as was practised at the time, did not eliminate perennial weeds as happened with mouldboard ploughing. The other wild grass rather well represented in sample 399 is *Apera spica-venti*; this annual grass is characteristic of winter-corn fields.

The above brings us to the question of the feeding of the livestock which, judging from the size of the farmhouses, must have been quite considerable. We have no information as to how much pasture land (grassland, probably of poor quality, and heathland) may have been available, but one may safely assume that tree foliage was a major animal fodder. The gathering of leaf fodder, i.e. the cutting and drying of the branches

of deciduous trees, must have been an important economic activity. The potential importance of *Calluna* heath in the feeding of livestock should not be underestimated. From medieval times until a hundred years ago and even more recently heather played a key role in the agricultural economic system on poor acid soils of Atlantic West and Northwest Europe. If properly managed it provides a suitable fodder for cattle and sheep (Kaland, 1986). One could speculate that the charred *Calluna* stems recovered from the Peelo samples were of heather that had been stored as winter fodder. However, heather could have been used for other purposes, too. It is generally assumed that at the time, in the first centuries AD, heaths were still of limited extent and consequently they could at most have been of secondary importance as grazing land.

5. SOME REMARKS ON THE VEGETATION

In the previous section mention has already been made of differences between the weed communities in fields of winter and summer cereals. Another group of weedy vegetations includes those of ruderal habitats, such as waste places in farmyards, muck-heaps and roadsides. As appears from table 3, various species of ruderal habitats are also found in fields of summer cereals and root crops, among which two species that are particularly well represented in the Peelo seed record, viz. *Chenopodium album* and *Polygonum lapathifolium*. Curiously, the *Atriplex prostrata/patula* seed type, which includes two species common in fields and other disturbed habitats, has not been attested for Roman Iron Age Peelo. It is not clear whether orache (*Atriplex*) was not present at or close to the site or whether its absence in the seed record is more a matter of lack of preservation in a carbonized condition. Fairly characteristic of, but not confined to trodden places are *Polygonum aviculare* and *Poa annua*. The poisonous species *Conium maculatum* is better represented in late-prehistoric sites than one would expect on the basis of its present occurrence.

Various species attested for Peelo are nowadays predominantly found in grasslands. It has already been discussed that *Agrostis* and *Poa pratensis/trivialis* may (also) have occurred in cornfields. *Plantago lanceolata* and *Knautia arvensis* may formerly have been elements of the arable weed flora (Groenman-van Waateringe, 1986; Pals, 1987). It is not the ecology of the species that had changed but the ecological conditions in the fields. Except for coastal areas, where a kind of natural grassland vegetation occurs on the high salt marshes, in the greater part of Europe meadows and pastures are anthropogenic, that is to say, their origin and continued existence are due to the activity of man. Grasslands have replaced forest vegetations. In prehistoric Europe, synanthropic grasslands were at most of limited extent and consequently could have played only a minor part in the economy (for a review, see van Zeist, 1991). On the other hand, in Roman-occupied Germany, and this applies probably also to the part of the Netherlands under Roman authority, the grassland acreage had expanded considerably, which is associated with an increased emphasis on stock-breeding (provisioning of the Roman army with meat) and with the procurement of grazing land and hay for the Roman cavalry horses.

In the Peelo area, only the wet to moist stream valleys naturally covered by alder and willow carr could have been converted to rather extensive grasslands (hay meadows) of not too poor a quality. However, it is not likely that large-scale cutting of the stream-valley forest had started already in the first centuries AD. This probably did not happen until medieval times. Grassland vegetation in the vicinity of Roman Iron Age Peelo must have been of limited extent, consisting predominantly of ratherdry, poor pasture land, only suitable for grazing. Around bog sites (see below) patches of a moister type of 'grassland', with sedge (*Carex*) species, may have occurred.

A modest number of species characteristic of marshy habitats could be demonstrated for Roman Iron Age Peelo. Marsh vegetation was found in small peat-bogs in and around the settlement terrain (cf. Bardet et al., 1983: fig. 3). It is striking that almost all species listed here as marsh plants are represented in sample 209 from the fill of a well (table 2). Although the vegetable remains in this sample are carbonized, the composition compares with that of waterlogged (i.e. non-carbonized) well samples, viz. a variety of species from divergent habitats.

A few species of dry heath (*Calluna vulgaris*, *Potentilla erecta*) and damp heath (*Carex panicea*) are represented, while *Eleocharis multicaulis* is found in oligotrophic pools such as occur in heathlands. Various samples yielded charred stem remains of *Calluna*, sometimes in considerable numbers. As has been mentioned above, no estimate of the heathland acreage can be given.

In addition to the open vegetations discussed above, oak-dominated woodland (open forest) must have been present in the Peelo area. Oak was the main building timber. Hazel (*Corylus avellana*), bramble (*Rubus* spec.) and bilberry (*Vaccinium myrtillus*) are woodland and forest-edge species.

6. THE LATE IRON AGE PLANT REMAINS

The number of Late Iron Age (fourth to first century BC) samples retrieved from 'de Es' is too small to allow a satisfactory evaluation. The total numbers of seeds recovered from six Late Iron Age samples are shown in table 4. *Calluna* stems are fairly numerous, suggesting that heather was exploited for some purpose or other. *Secale* (rye) has not been recorded, which may indicate that this corn crop was not introduced until the beginning

of the Christian era. Comparatively great numbers of seeds of some weedy species make one again wonder whether the seeds concerned were collected on purpose to serve for human consumption (cf. section 3).

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APPENDIX. English and Dutch names of wild plant taxa attested for Iron Age Peelo.

Agrostis spec.	Bent-grass	Struisgras
Anagallis arvensis	Scarlet pimpernel	Gewoon guichelheil
Apera spica-venti	Loose silky-bent	Windhalm
Arnoseris minima	Lamb's succory	Korensla
Bromus secalinus	Chess	Dreps
cf. *Brassica*	Cabbage/mustard	Kool/mosterd
Calluna vulgaris	Heather	Struikheide
Carex cuprina	False fox-sedge	Valse voszegge
Carex flacca	Glaucous sedge	Zeegroene zegge
Carex nigra type	Common sedge	Gewone zegge
Carex oederi (*C. demissa/serotina*)	Yellow sedge (*Carex flava* agg.)	Geelgroene zegge/dwergzegge
Carex panicea	Carnation sedge	Blauwe zegge
Carex pseudocyperus	Cyperus sedge	Cyperzegge
Carex rostrata/vesicaria	Bottle sedge/bladder sedge	Snavel-/blaaszegge
Carex spec.	Sedge	Zegge
Chenopodiaceae indet.	Goosefoot family	Ganzevoetfamilie
Chenopodium album	Fat hen	Melganzevoet
Claviceps spec.	Ergot	Moederkoren
Conium maculatum	Hemlock	Gevlekte scheerling
Corylus avellana	Hazel	Hazelaar
Cuscuta spec.	Dodder	Warkruid
Echinochloa crus-galli	Cockspur grass	Hanepoot
Eleocharis multicaulis	Many-stemmed spike-rush	Veelstengelige waterbies
Eleocharis palustris	Common spike-rush	Gewone waterbies
Euphrasia type	Eyebright	Ogentroost
Festuca pratensis	Meadow fescue	Beemdlangbloem
Galeopsis tetrahit/speciosa	Common/large-flowered hempnettle	Bleekgele hennepnetel/dauwnetel
Galium palustre	Common marsh-bedstraw	Moeraswalstro
Galium spec.	Bedstraw	Walstro
Gramineae indet.	Grass family	Grassenfamilie
Knautia arvensis	Field scabious	Beemdkroon
Matricaria maritima	Scentless mayweed	Reukeloze kamille
Malva spec.	Mallow	Kaasjeskruid
Phleum pratense	Timothy grass	Timoteegras
Plantago lanceolata	Ribwort plantain	Smalle weegbree
Poa annua	Annual meadow-grass	Straatgras
Poa pratensis/trivialis	Meadow grass/rough meadow-grass	Veldbeemdgras/ruw beemdgras

Polygonum aviculare	Knotgrass	Varkensgras
Polygonum convolvulus	Black bindweed	Zwaluwtong
Polygonum hydropiper	Water-pepper	Waterpeper
Polygonum lapathifolium	Pale persicaria	Knopige/viltige duizendknoop
Polygonum persicaria	Persicaria	Perzikkruid
Potentilla erecta	Common tormentil	Tormentil
Prunella vulgaris	Self-heal	Brunel
Ranunculus flammula	Lesser spearwort	Egelboterbloem
Ranunculus repens	Creeping buttercup	Kruipende boterbloem
Ranunculus sardous	Hairy buttercup	Behaarde boterbloem
Raphanus raphanistrum	Wild radish	Knopherik
Rhinanthus spec.	Yellow-rattle	Ratelaar
Rubus spec.	Bramble	Braam
Rumex acetosella	Sheep's sorrel	Schapezuring
Rumex crispus	Curled dock	Krulzuring
Rumex obtusifolius	Broad-leaved dock	Ridderzuring
Scleranthus annuus	Annual knawel	Eenjarige hardbloem
Senecio cf. *aquaticus*	Marsh ragwort	Waterkruiskruid
Setaria viridis	Green bristle-grass	Groene naaldaar
Solanum nigrum	Black nightshade	Zwarte nachtschade
Spergula arvensis	Corn spurrey	Gewone spurrie
Stellaria media	Chickweed	Vogelmuur
Trifolium spec.	Clover	Klaver
Vaccinium myrtillus	Bilberry	Bosbes
Vicia spec.	Vetch	Wikke
Umbelliferae indet.	Carrot family	Schermbloemenfamilie