# PLANT REMAINS FROM IRON AGE NOORDBARGE, PROVINCE OF DRENTHE, THE NETHERLANDS

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## CONTENTS

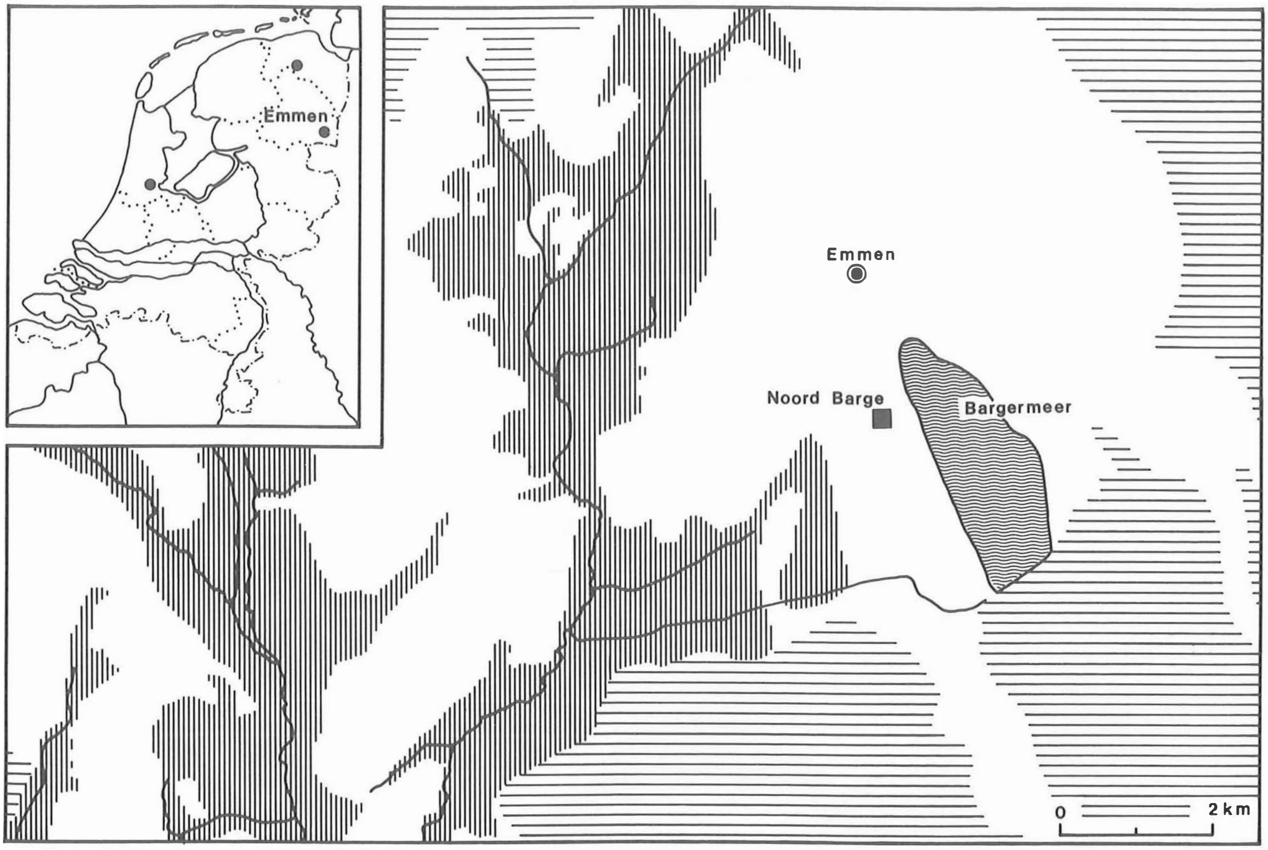


Fig. 1. Map of the Noordbarge area showing the maximum extent of the Bargermeer (after Kooi, 1979, fig. 160). Vertical hatching: stream-valley fen land; horizontal hatching: raised bog; white: higher sandy soils. Situation around A.D. 1850.

## 1. INTRODUCTION

In this paper the results will be discussed of the examination of charred plant remains recovered from the settlement site of Noordbarge, south of Emmen (fig. 1). On a terrain, called the "Hooge Loo" (52° 47′ N, 6° 53′ E) excavations have been carried out by the Biologisch-Archaeologisch Instituut in 1920, 1935, 1949 and 1972-1974 (cf. Kooi, 1979). These excavations revealed an urnfield, dated to the 9th to 5th centuries B.C., and settlement remains from various periods, consisting of houses of different type, sunken huts, granaries and fences. The urnfield and the associated finds have been described by Kooi (1979). Harsema (1976) published a preliminary report on the results of the 1972-1974 settlement excavations. The following details have been taken from Harsema's report.

On the basis of the horizontal stratigraphy (intersecting house-plans) and of the orientation, distribution and typology of the houses, five phases of habitation are distinguished by Harsema. The schematic settlement plan of fig. 2 shows the sites of the houses.

Houses 28 and 21, in the southeastern part of the excavation area, are attributed to phase I. In contrast to all other houses, these two have approximately a N-S orientation. The phase I houses are dated to the Middle Bronze Age (1100-1000 B.C.) or the beginning of the

Table 1. Samples taken for the examination of seeds and fruits.

| *No.* | *Phase* | *Origin of sample* | *Remarks* |
|---|---|---|---|
| 159 | IV? | pit inside house 7 | |
| 168 | ? | pit near house 8 | |
| 247 | IV | sunken hut between houses 5 and 6 | |
| 275 | IV | sunken hut beside house 5 | |
| 307 | IV | post inside house 7 | |
| 308 | IV | post inside house 7 | $^{14}$C: 1930 ± 35 B.P. (GrN-7251) |
| 312 | IV | post inside house 5 | |
| 318 | IV | central post, house 5 | |
| 336 | IV | central post, house 5 | broomcorn millet sample |
| 338 | IV | central post, house 5 | |
| 341 | IV | post inside house 5 | $^{14}$C: 2125 ± 50 B.P. (GrN-6865) |
| 352 | IV | sunken hut between houses 7 and 8 | |
| 612 | ? | pit near sunken hut and granary | |
| 621 | III | post, houses 15 or 16 | |
| 654 | ? | pit through house 12 | |
| 659 | IV | sunken hut near house 5 | |
| 702 | ? | pit near house 17 | |
| 710 | III | upright, house 17 | no seeds |
| 711 | III | upright, house 17 | |
| 712 | III | upright, house 17 | |
| 713 | III | entrance trench, house 17 | |
| 714 | III | upright, house 17 | |
| 715 | III | central (?) post, house 17 | |
| 716 | III | pit inside house 17 | |
| 717 | ? | foundation trench of fence | |
| 720 | III | upright, house 15 | |
| 721 | III | post, houses 15 or 16 | |
| 819 | III | post, granary near house 12 | |
| 833 | IV | sunken hut near house 19 | |
| 848 | IV? | post inside house 23 | |
| 849 | IV? | post inside house 23 | |
| 856 | IV? | entrance pit, house 18 | |
| 857 | IV? | upright, house 18 | |
| 870 | IV | fire place, house 19 | |
| 871 | IV | post, house 19 | |
| 872 | IV | foundation trench, house 19 | |
| 876 | II | wall post, house 20 | no seeds |
| 877 | II | wall post, house 20 | |
| 878 | II | fire place, house 20 | no seeds |
| 879 | II | wall post, house 20 | |
| 881 | II | wall post, house 20 | no seeds |
| 885 | II | corner post, house 20 | |
| 887 | I | upright, house 21 | no seeds |
| 888 | I | wall post, house 21 | |
| 889 | I | wall post, house 21 | |
| 890 | I | wall post, house 21 | |
| 892 | I? | pit besides house 21 | |
| 895 | I | upright, house 21 | no seeds |
| 896 | I | wall post, house 21 | |
| 898 | IV | fire place, house 22 | |
| 899 | IV? | pit in house 22 | no seeds |
| 910 | II? | wall post, house 20 (= 26) | |
| 911 | IV | wall post, house 25 | |
| 912 | ? | post in houses 26 and 28 | |
| 915 | II | wall post, house 20 (= 26) | no seeds |
| 920 | IV | upright, house 23 | |
| 921 | IV | upright, house 23 | |
| 922 | IV | upright, house 23 | |
| 923 | IV | wall post, house 23 | |

Table 1 (continued).

| *No.* | *Phase* | *Origin of sample* | *Remarks* | *No.* | *Phase* | *Origin of sample* | *Remarks* |
|---|---|---|---|---|---|---|---|
| 722 | III | upright, house 15 | no seeds | 931 | IV | wall post, house 25 | no seeds |
| 723 | III | upright house 16 | | 932 | II? | post in row of posts | no seeds |
| 724 | III | upright, house 16 | | 936 | II? | post in row of posts | |
| 727 | III | post, houses 15 or 16 | | 941 | IV | sunken hut over house 18 | |
| 738 | III | pit inside house 13 | | 952 | IV | sunken hut over house 25 | |
| 748 | III | post, house 13 | | 954 | IV | sunken hut near house 23 | no seeds |
| 756 | III | upright, house 14 | $^{14}$C house 14: 2175 ± 55 B.P. (GrN-7216) | 956 | II | wall post, house 29 | |
| | | | | 957 | IV | foundation trench, house 25 | |
| 761 | III | wall post, house 13 | no seeds | 959 | IV | foundation trench, house 25 | |
| 762 | III | wall post, house 13 | | 979 | IV? | upright, house 18 | no seeds |
| 766 | III | upright, house 13 | | 980 | IV? | upright, house 18 | |
| 767 | III | upright, house 13 | | 994 | II | wall post, house 29 | |
| 768 | III | wall post, house 14 | | 995 | ? | pit besides foundation trench, house 19 | |
| 774 | III | post, granary | | | | | |
| 794 | III | upright, house 11 | $^{14}$C: 2180 ± 50 B.P. (GrN-7217) | 997 | II | wall post, house 20 (= 26) | |
| | | | | 999 | IV | upright, house 25 | |
| 795 | III | pit inside house 11 | | 1004 | ? | upright?, house 20 (= 26) | |
| 804 | III | wall post, house 11 | | 1029 | III | post | |
| 815 | III | pit near granaries (near house 13) | | 1041 | III | post, granary | barley sample |
| 818 | III | wall post, house 12 | | | | | |

Late Bronze Age. Phase II is also represented by only two houses, viz nos. 29 and 20 (=26), again situated in the southeastern part of the excavation area. Phase II was either contemporaneous with phase III, dated to the second century B.C. (se
III directly. Be this as it may, there must have been a very considerable difference in time between phases I and II (800-1000 years).

Nine houses, nos. 11-17, 31 and 32, in the western part of the excavation area, are attributed to phase III. The houses show a NE-SW orientation. Two radiocarbon determinations and the comparison with the pre-Roman Iron Age settlement of Hijken lead Harsema to a dating of around 200 B.C. for phase III.

The following house plans are attributed to phase IV: 1, 5, 6, 7, 8, 9, 19, 22, 23, 25 and 32. Most of the houses of this phase are located in the central part of the excavation area. Radiocarbon dates and comparisons with other sites suggest an age of 100 B.C. to A.D. 100 for phase IV.

Houses 27 and 30, a small part of which was unearthed at the eastern edge of the excavation area, are probably younger than phase IV.

Houses 2 and 4 (phase V) and 3 (probably phase IV) have been excavated by Professor A.E. van Giffen in 1949.

This study would not have been possible without the co-operation of various people. Dr. K.-H. Knörzer (Neuss, West-Germany) gave advice on the identification of some seed types. In the examination of the samples the present author was greatly assisted by Mrs. R.M. Palfenier-Vegter. Drs. O.H. Harsema procured the data on the origin of the samples, made the settlement plan available for publication and read the manuscript. Information on the site and its surroundings was provided by Dr. P.B. Kooi. The drawings of seeds and fruits and of the graphs were made by Mr. H.R. Roelink, while Mr. G. Delger prepared the map (fig. 1) and the settlement plan. The typing of the manuscript was carried out by Mrs. G. Entjes-Nieborg. The English text was improved by Mrs. S.M. van Gelder-Ottway.

## 2. THE SAMPLES

### 2.1. Sample processing

During the 1972-1974 excavations soil samples of a volume of 3000 cc were taken for botanical examination. The seeds occurred dispersed in the soil. Only in one case (sample 1041) were charred grains observed in the field. The location of the palaeobotanical samples is indicated on the plan of fig. 2. Further information on the origin of the samples (fill of post-hole, sunken hut, etc.) is given in table 1.

The plant remains were recovered in the laboratory by means of manual water flotation. The flotation residues were completely examined for seeds and fruits, the numbers of which are presented in table 2. Unidentified seeds or possible seeds and unidentifiable cereal grain fragments are not listed in table 2. From a small number of samples no seeds or fruits were retrieved. This is indicated in table 1. The local soil conditions allow the preservation of only carbonized plant remains. Occasional non-carbonized seeds and fruits have been discarded because they must have been due to modern intrusion (*e.g.* by animals). In all samples charcoal was present, sometimes in rather great quantities. Oak seems to be the dominant type of charcoal. Charred wood will not be considered in this paper.

Some of the results of the botanical examination have already been published in a paper in which particular attention is paid to the presence of rye at Noordbarge and in another site from the first centuries A.D. (Van Zeist, 1976). The final examination of the Noordbarge samples did not lead to any major changes in the data presented in table 2 of the 1976 paper. In the latter table, the phase indications for samples 856 (must be phase IV) and 1004 (must be of uncertain phase) have to be corrected.

### 2.2. The origin of the plant remains

The Noordbarge charred seed finds are from

Table 2. Numbers of seeds, fruits and other plant remains from Noordbarge. The numbers are not seldom estimates (broken seeds and fruits); this is not indicated in the table. cf. = identification uncertain; + = present. Species included in the palaeo-ecological histograms of fig. 7 are indicated with an asterisk.

| Sample number | 888 | 889 | 890 | 896 | 892 | 877 | 879 | 885 | 956 | 994 | 997 | 910 | 936 | 621 | 711 | 712 | 713 | 714 | 715 | 716 | 720 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phase | I | I | I | I | I? | II | II | II | II | II | II | II? | II? | III | III | III | III | III | III | III | III |
| Panicum miliaceum | . | . | . | . | 5 | . | . | . | . | . | . | 1 | . | 6 | 1 | . | ½ | 1 | 5 | 7 | . |
| Avena fatua/sativa | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 3 | 1½ | . |
| Secale cereale | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Hordeum vulgare | . | . | . | . | . | 1 | . | . | . | . | . | + | 1 | . | . | . | . | . | . | 1 | . |
| Triticum dicoccum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Triticum spikelet forks | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Triticum glume bases | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Camelina sativa | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Linum usitatissimum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Vicia faba var. minor | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Corylus avellana | . | + | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Pyrus malus | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Rubus idaeus | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Humulus lupulus | . | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . |
| *Bromus mollis/secalinus | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | . | . | . | . | 1 | 1 | . |
| *Echinochloa crus-galli | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Setaria viridis/italica | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Digitaria ischaemum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Spergula arvensis | . | . | . | . | . | . | . | 1 | . | . | . | . | . | 1 | 1 | 2 | . | . | 21 | 10 | . |
| *Chenopodium album | 3 | . | 3 | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | 5 | . | 1 |
| *Chen. rubrum/glaucum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Chenopodium ficifolium | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Atriplex hastata/patula | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Rumex acetosella | . | 1 | 2 | 1 | . | . | . | . | 1 | 1 | 3 | . | . | 6 | 1 | . | . | . | 33 | 7 | . |
| *Rumex crispus | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . |
| *Polygonum lapathifolium | . | ½ | 1 | . | . | . | . | . | . | . | . | . | . | cf.2 | 1 | . | . | . | 1½ | 2 | . |
| *Polygonum persicaria | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | ½ | . |
| *Polygonum aviculare | . | . | 2½ | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Polygonum convolvulus | 1 | . | . | . | . | . | . | . | . | . | 1 | . | . | 1 | . | . | . | . | . | . | . |
| *Polygonum hydropiper | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Scleranthus annuus[1] | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Stellaria media | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | . |
| *Stellaria graminea | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . |
| *Raphanus raphanistrum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Stachys arvenis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Prunella vulgaris | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Galium aparine | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Urtica dioica | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Solanum nigrum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Capsella bursa-pastoris | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Vicia | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Viola | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Plantago lanceolata | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Ranunculus repens | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Lotus | . | . | . | . | . | . | . | . | 3 | . | 1 | . | . | . | . | . | . | . | . | . | . |
| *Trifolium repens | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | . | . |
| *Medicago lupulina | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Festuca rubra | . | . | cf.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Phleum | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Poa | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Potentilla cf. erecta | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Calluna vulgaris[2] | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Valeriana officinalis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Carex nigra-type | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Carex serotina-type | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Carex rostrata/vesicaria | . | . | . | . | . | . | . | . | 2 | . | . | . | . | . | . | . | . | . | . | . | . |
| Eleocharis palustris | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Oenanthe aquatica | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cenococcum geophilum[3] | 15 | 6 | 25 | 1 | . | . | . | . | 14 | . | 1 | . | 2 | 295 | 12 | 4 | 2 | 18 | 100 | 18 | 700 |

| 721 | 722 | 723 | 724 | 727 | 738 | 748 | 756 | 762 | 766 | 767 | 768 | 774 | 794 | 795 | 804 | 815 | 818 | 819 | 1029 | 1041 | Sample number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| III | III | III | III | III | III | III | III | III | III | III | III | III | III | III | III | III | III | III | III | III | Phase |
| 1 | 8 | 2 | 4 | . | 8 | . | . | . | 2 | . | 1½ | . | 2 | 5 | . | 14 | . | . | . | 7 | Panicum miliaceum |
| . | . | . | . | . | . | . | . | . | . | . | . | 11 | 13 | . | . | 4 | . | . | . | 29 | Avena fatua/sativa |
| . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Secale cereale |
| . | . | . | . | . | 2½ | . | . | . | . | . | . | 10 | 12 | 1½ | . | 14 | . | . | . | 1980 | Hordeum vulgare |
| . | . | . | . | . | ½ | . | . | . | . | 1 | . | 18 | 8 | 2 | . | 7 | . | . | . | 150 | Triticum dicoccum |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | . | . | ½ | 18 | Triticum spikelet forks |
| . | . | . | . | . | . | . | . | . | . | . | . | 3 | . | 2 | . | 4 | . | . | . | 16 | Triticum glume bases |
| . | . | . | . | . | 25 | . | . | . | . | . | . | . | . | . | . | 165 | . | . | . | . | Camelina sativa |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 15 | . | . | . | . | Linum usitatissimum |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Vicia faba var. minor |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Corylus avellana |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Pyrus malus |
| . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Rubus idaeus |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Humulus lupulus |
| . | . | 1 | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | *Bromus mollis/secalinus |
| . | . | . | 1 | . | 27 | . | . | . | . | . | . | . | . | . | . | 11 | . | . | . | . | *Echinochloa crus-galli |
| . | . | . | . | . | 9 | . | . | . | 1 | . | . | 1 | . | . | . | 17 | . | . | . | . | *Setaria viridis/italica |
| . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | 13 | . | . | . | . | *Digitaria ischaemum |
| 3 | 1 | 2 | . | 2 | 2½ | . | 8 | . | 2 | 1 | . | . | 1 | 5 | 1 | 32 | 2 | 4½ | 2 | . | *Spergula arvensis |
| ½ | 5 | 4 | 18 | 4 | 20 | cf.1 | cf.1 | 1 | 15 | 2½ | 1 | . | 1 | 1 | 6 | 820 | ½ | 6 | 11 | . | *Chenopodium album |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Chen. rubrum/glaucum |
| 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Chenopodium ficifolium |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Atriplex hastata/patula |
| 14 | 8 | 12 | 35 | 16 | 3 | . | 1 | . | . | . | 2 | . | . | . | . | 70 | . | 1 | 1 | . | *Rumex acetosella |
| . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | 1 | *Rumex crispus |
| . | 2 | 1 | 12 | 4 | }45 | 1 | . | . | 14 | 1 | . | 4 | 2 | 2 | 3 | 18 | 1 | 8½ | 4 | . | *Polygonum lapathifolium |
| cf.½ | . | . | . | . | } | . | 1 | . | 3 | . | . | . | . | cf.1½ | 1½ | 5 | . | 3 | . | . | *Polygonum persicaria |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Polygonum aviculare |
| . | 1 | . | . | . | 4 | . | 1 | ⅓ | 1 | 1 | . | . | 21 | . | . | 7 | . | ½ | . | 2 | *Polygonum convolvulus |
| . | . | . | . | . | . | . | 1 | . | 2½ | . | 1 | . | . | . | . | . | . | ½ | . | . | *Polygonum hydropiper |
| . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | . | 1 | . | . | *Scleranthus annuus[1] |
| . | . | . | 1 | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Stellaria media |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Stellaria graminea |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Raphanus raphanistrum |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1½ | . | . | . | . | . | *Stachys arvensis |
| . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Prunella vulgaris |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Galium aparine |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Urtica dioica |
| . | . | . | 1 | . | 3 | . | . | 1 | . | . | . | . | . | . | 5 | . | . | . | . | . | *Solanum nigrum |
| . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | *Capsella bursa-pastoris |
| . | . | . | 1 | ½ | ½ | . | . | . | 1 | . | . | . | . | . | . | 2 | . | . | . | . | Vicia |
| . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Viola |
| . | . | . | 1 | 1 | . | . | . | . | . | . | . | . | . | . | . | 2 | . | . | . | 1 | *Plantago lanceolata |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Ranunculus repens |
| . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | Lotus |
| 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Trifolium repens |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Medicago lupulina |
| . | . | . | . | . | 2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Festuca rubra |
| . | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | 3 | . | . | . | . | Phleum |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Poa |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Potentilla cf. erecta |
| . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | . | Calluna vulgaris[2] |
| . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Valeriana officinalis |
| . | 1 | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | Carex nigra-type |
| . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | Carex serotina-type |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Carex rostrata/vesicaria |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | ½ | . | . | . | . | . | Eleocharis palustris |
| . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | Oenanthe aquatica |
| 1730 | 3325 | 295 | 1565 | 695 | . | 6 | 15 | 5 | 7 | 3 | 3 | . | . | . | . | . | . | . | 2 | . | Cenococcum geophilum[3] |

Table 2 (continued).

| Sample number | 247 | 275 | 307 | 308 | 312 | 318 | 336 | 338 | 341 | 352 | 659 | 833 | 870 | 871 | 872 | 898 | 911 | 920 | 921 | 923 | 941 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phase | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV |
| Panicum miliaceum | 4 | 2 | 25 | 105 | 2½ | 1 | 750 | 4 | 25 | 7 | . | 14 | 2 | 3 | 1 | 1 | . | . | . | . | . |
| Avena fatua/sativa | . | . | . | . | ½ | . | 1½ | . | 10 | . | . | 2 | . | 3 | ½ | . | . | . | . | . | . |
| Secale cereale | 28 | ½ | 290 | 50 | 15 | . | . | 6 | . | . | . | 2 | . | . | . | . | . | . | . | . | . |
| Hordeum vulgare | 5 | 1 | . | . | 5 | 1 | 2 | . | 1 | . | . | 2 | . | . | . | 26 | . | . | . | . | 1 |
| Triticum dicoccum | . | ½ | . | . | . | . | . | . | . | . | . | . | . | . | . | 58 | . | . | . | . | . |
| Triticum spikelet forks | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | . | . | . | . | . |
| Triticum glume bases | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Camelina sativa | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Linum usitatissimum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Vicia faba var. minor | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Corylus avellana | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | + | . | . | . | . |
| Pyrus malus | . | . | . | . | . | . | . | . | . | . | . | ½ | . | . | . | . | . | . | . | . | . |
| Rubus idaeus | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Humulus lupulus | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Bromus mollis/secalinus | 2 | ⅔ | 2½ | . | . | . | 1 | . | 35 | . | . | . | . | ½ | . | . | . | . | . | . | 2 |
| *Echinochloa crus-galli | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Setaria viridis/italica | . | 1 | 1 | . | . | . | 2 | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . |
| *Digitaria ischaemum | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Spergula arvensis | 12 | 8 | . | 1 | 1 | 4 | 9 | 6 | 22 | 43 | . | 6 | . | 6 | 4 | . | 1 | 1 | . | 2 | 25 |
| *Chenopodium album | 26 | 13 | 1 | 2 | . | 1 | 7 | 12 | 11 | . | . | 1 | 3 | . | 1 | 6 | . | . | 1 | 5 | 12 |
| *Chen. rubrum/glaucum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Chenopodium ficifolium | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Atriplex hastata/patula | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Rumex acetosella | 18 | 16 | 4 | 1 | . | . | 3 | 20 | 10 | 18 | . | 6 | 8 | 4 | 3 | . | 2 | 1 | . | 8 | 11 |
| *Rumex crispus | 3 | cf.½ | . | . | 1 | . | . | 1 | . | . | . | . | . | . | 1 | . | 1 | . | . | . | . |
| *Polygonum lapathifolium | 1 | 10 | 7 | 1½ | . | . | 3 | 2 | 7 | 1 | . | . | . | 2 | 1½ | 1 | . | 1 | . | 1 | 2 |
| *Polygonum persicaria | . | 2 | 1 | . | ½ | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Polygonum aviculare | 1 | 1½ | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Polygonum convolvulus | 1 | . | . | . | . | . | 1 | . | . | . | . | . | . | ½ | . | . | . | . | . | . | 3 |
| *Polygonum hydropiper | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Scleranthus annuus[1] | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Stellaria media | . | . | . | . | . | . | . | 5 | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Stellaria graminea | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Raphanus raphanistrum | 1 | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Stachys arvensis | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . |
| *Prunella vulgaris | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Galium aparine | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Urtica dioica | . | cf.1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . |
| *Solanum nigrum | . | . | . | . | . | . | 2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Capsella bursa-pastoris | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Vicia | . | . | . | . | . | . | . | . | ½ | . | . | . | 1 | . | . | . | . | . | . | . | . |
| *Viola | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| *Plantago lanceolata | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | 1 | . | . | . | . | . | 1 |
| *Ranunculus repens | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Lotus | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | . | . | . | . |
| *Trifolium repens | 3 | . | . | . | 1 | . | . | 2 | . | . | . | . | 2 | . | . | . | . | . | . | . | . |
| *Medicago lupulina | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 |
| *Festuca rubra | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Phleum | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Poa | . | . | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . |
| *Potentilla cf. erecta | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Calluna vulgaris[2] | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Valeriana officinalis | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Carex nigra-type | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Carex serotina-type | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Carex rostrata/vesicaria | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Eleocharis palustris | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Oenanthe aquatica | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Cenococcum geophilum[3] | 22 | 1375 | . | 1 | 4 | 4 | 32 | 550 | 7 | . | 50 | . | 2 | . | . | . | . | . | . | . | 6 |

[1] Calyces [2] Leafed stem fragments [3] Sclerotia

| 952 | 957 | 959 | 999 | 159 | 848 | 849 | 856 | 857 | 980 | 168 | 612 | 654 | 702 | 717 | 912 | 995 | 1004 | Sample number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IV | IV | IV | IV | IV? | IV? | IV? | IV? | IV? | IV? | ? | ? | ? | ? | ? | ? | ? | ? | Phase |
| . | 1 | . | 12 | 3 | . | . | 2 | 1 | . | 3 | . | 3 | 1 | 1 | . | . | 1 | Panicum miliaceum |
| . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Avena fatua/sativa |
| 5 | 1 | . | 10 | . | . | . | 1 | . | . | . | . | . | . | . | . | . | 10 | Secale cereale |
| . | . | . | . | . | . | . | 2 | 1 | . | . | . | . | . | . | . | 1 | 2 | Hordeum vulgare |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Triticum dicoccum |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Triticum spikelet forks |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Triticum glume bases |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Camelina sativa |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Linum usitatissimum |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | . | . | Vicia faba var. minor |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | Corylus avellana |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Pyrus malus |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Rubus idaeus |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Humulus lupulus |
| 1 | . | . | 1½ | . | . | . | . | . | . | . | . | . | . | . | . | . | ½ | *Bromus mollis/secalinus |
| . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | *Echinochloa crus-galli |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Setaria viridis/italica |
| . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Digitaria ischaemum |
| 1 | . | . | 23 | 1 | . | . | 1 | 2 | . | 8 | . | . | . | . | . | . | 9 | *Spergula arvensis |
| . | . | 1 | 2 | . | cf.1 | . | 3 | 1 | . | 1 | . | . | . | . | . | 1 | . | *Chenopodium album |
| . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Chen. rubrum/glaucum |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Chenopodium ficifolium |
| . | 1 | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | Atriplex hastata/patula |
| 1 | . | 1 | 22 | . | . | 1 | . | . | . | 12 | . | . | . | 3 | . | . | 8 | *Rumex acetosella |
| . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Rumex crispus |
| . | . | . | 4 | . | ½ | . | . | . | . | . | . | 1 | 2 | . | . | . | . | *Polygonum lapathifolium |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Polygonum persicaria |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Polygonum aviculare |
| . | . | . | . | . | . | . | 1 | . | . | . | 1 | . | . | . | . | . | . | *Polygonum convolvulus |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Polygonum hydropiper |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Scleranthus annuus[1] |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Stellaria media |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | *Stellaria graminea |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Raphanus raphanistrum |
| . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | *Stachys arvenis |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Prunella vulgaris |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Galium aparine |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Urtica dioica |
| . | . | . | 1 | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | *Solanum nigrum |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Capsella bursa-pastoris |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Vicia |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Viola |
| . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | *Plantago lanceolata |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Ranunculus repens |
| . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | Lotus |
| . | . | 1 | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Trifolium repens |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Medicago lupulina |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Festuca rubra |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Phleum |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Poa |
| 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | *Potentilla cf. erecta |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Calluna vulgaris[2] |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Valeriana officinalis |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Carex nigra-type |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Carex serotina-type |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Carex rostrata/vesicaria |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Eleocharis palustris |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | Oenanthe aquatica |
| . | 1 | 16 | 1 | . | . | . | . | 5 | 3 | . | 180 | 1 | 12 | 10 | . | 4 | . | Cenococcum geophilum[3] |


Fig. 2. Survey of the Noordbarge settlement showing the location of the houses and of the samples examined for charred plant remains. Five phases of habitation are distinguished. Phase I: houses 21 and 28; phase II: houses 20 (=26) and 29; phase III: houses 11-17, 31 and 32; phase IV: houses 1, 5-9, 19, 22, 23 and 25; phase V: houses 2, 4, 20 and 27.

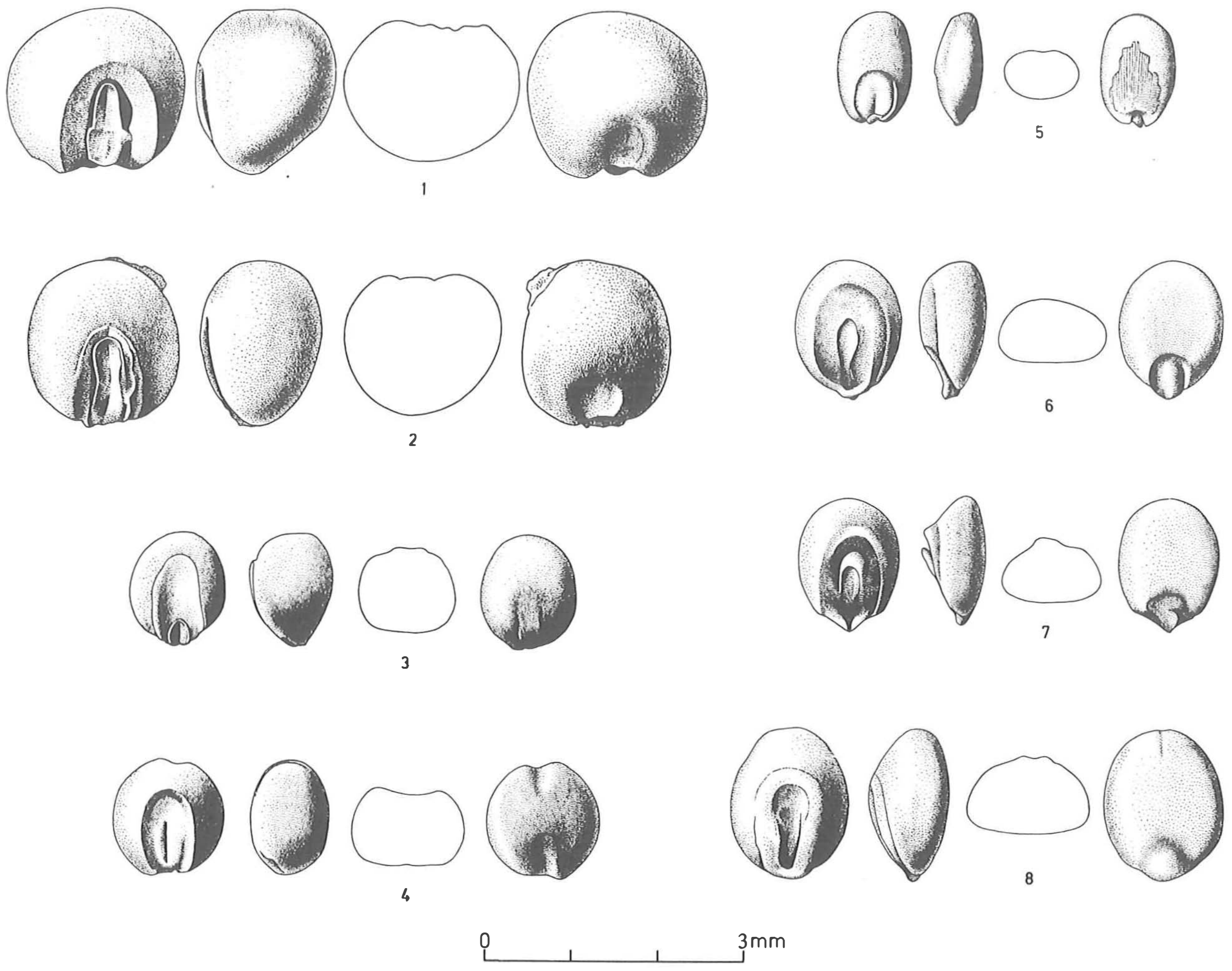


Fig. 3. Millet-type grains from Noordbarge. Sample numbers are in brackets. 1-2: *Panicum miliaceum* (336); 3-4: *Setara* cf. *viridis* (815); 5: *Digitaria ischaemum* (815); 6-7: *Echinochloa crus-galli* (738); 8: *Echinochloa crus-galli* (815).

the fill of pits, post-holes and such-like. There are no indications of storage pits. Samples 336 and 1041, which yielded rather great numbers of crop-plant grains, are both from the fill of post-holes. The vegetable remains in the pits and post-holes are there in secondary position. They must have been present in the soil which was shovelled into the pit or the post-hole.

The charred seed contents of most, if not of all the Noordbarge samples must have been of mixed origin. Some seeds may have formed part of the fully processed crop ready for storage or for the preparation of food, others may have originated from the residue left after crop processing, such as threshing and seed cleaning. If the plant remains in a sample represent already one particular crop-processing activity, if, for instance, they are from the tail-corn left after sieving or basket-winnowing, this may be difficult to demonstrate. Moreover, considerable numbers of seeds of wild plants did not arrive in the site together with the harvested crop, but they were brought in, intentionally or unintentionally, as a result of other activities of the inhabitants of the site. Consequently, in evaluating the palaeobotanical data one should be aware

Table 3. Dimensions in mm and index values for *Hordeum vulgare* from Noordbarge 1004 (N = 72).

| | *L* | *B* | *T* | *100L:B* | *100T:B* |
|---|---|---|---|---|---|
| min. | 4.4 | 2.3 | 1.7 | 158 | 71 |
| aver. | 5.51 | 3.05 | 2.45 | 181 | 80 |
| max. | 6.5 | 3.8 | 3.1 | 219 | 92 |

Table 4. Mean dimensions in mm and index values for *Hordeum vulgare* from various sites. E.I.A. = Early Iron Age; R.I.A = Roman Iron Age; Med. = Medieval.

| | *L* | *B* | *T* | *100L:B* | *100T:B* | *period* |
|---|---|---|---|---|---|---|
| Angelsloo 84 | 4.91 | 2.31 | 1.69 | 214 | 73 | E.I.A. |
| Gees 14a | 5.42 | 2.83 | 2.20 | 193 | 78 | E.I.A. |
| Dalfsen 436 | 5.46 | 2.78 | 2.16 | 197 | 78 | R.I.A. |
| Wijster 1239 | 5.58 | 2.89 | 2.19 | 193 | 76 | R.I.A. |
| Noordbarge 1004 | 5.51 | 3.05 | 2.45 | 181 | 80 | R.I.A. |
| Gasselte 418 | 5.56 | 2.93 | 2.23 | 191 | 76 | Med. |
| Gasselte 428 | 5.92 | 2.87 | 2.21 | 206 | 77 | Med. |
| Gasselte 544 | 5.45 | 2.78 | 2.14 | 197 | 77 | Med. |

Table 5. Dimensions in mm and index values for *Triticum dicoccum* from Noordbarge.

| | | *L* | *B* | *T* | *100L:B* | *100T:B* |
|---|---|---|---|---|---|---|
| Sample 1041 | min. | 5.3 | 2.7 | 2.5 | 165 | 85 |
| (N = 7) | aver. | 5.47 | 2.97 | 2.66 | 186 | 90 |
| | max. | 6.2 | 3.2 | 2.8 | 223 | 97 |
| Sample 898 | min. | 4.6 | 2.2 | 1.7 | 171 | 77 |
| (N = 8) | aver. | 4.85 | 2.52 | 2.29 | 193 | 90 |
| | max. | 5.1 | 3.0 | 2.6 | 215 | 103 |

of the usually heterogeneous origin of the plant remains in the samples examined.

## 3. CROP PLANTS AND POSSIBLE CROP PLANTS

### 3.1. Panicum miliaceum (fig. 3: 1-2)

Of the crop-plant species, *Panicum miliaceum* (broomcorn millet) shows the highest presence percentage. It was found in 44 of the 81 samples which yielded charred seeds. Sample 336 is a nearly pure *Panicum* sample, with only a minor admixture of other seeds. The preservation of the millet in this sample was not particularly good, so that only a rather small number of grains was suitable for measuring (table 7). At least during phases III and IV, in the period from 200 B.C. to A.D. 100, *Panicum miliaceum* must have been cultivated at Noordbarge. The samples from phases I and II which yielded a few *Panicum* grains have been attributed to these periods with some reserve, so that there is no firm evidence for the presence of this crop plant in Middle Bronze Age and Early Iron Age Noordbarge.

The economic importance of *Panicum* at Noordbarge during phases III and IV, that is to say, its relative proportion in the crop-plant production, cannot be determined. One may, however, assume that it must have been a common crop plant. From the charred seed finds published so far it appears that from the Middle Bronze Age on, *Panicum* was present in the north of the Netherlands (Van Zeist, 1970). As in the samples concerned millet constitutes only an insignificant admixture to barley or wheat, is was not clear whether this species was grown intentionally. On the other hand, grain impressions in pottery suggest that millet must have been a crop plant in its own right. This conclusion is confirmed by the Noordbarge evidence.

From the above it is, once again, evident that isolated, large charred seed finds may give a picture of prehistoric crop-plant husbandry which is incomplete and which to some extent may even be misleading. In this respect the analysis of a great number of samples originating from various features in the settlement must provide more reliable information although each individual sample may be rather poor in seeds and fruits. Due to lack of material for comparison the role of broomcorn millet in the economy of Late Bronze Age and Iron Age farmers on the sandy soils in the north of the Netherlands is still obscure. There are no indications for the cultivation of *Panicum miliaceum* in Iron Age sites in the coastal area of the north of the Netherlands. Broomcorn millet is reported for Jemgumkloster, on the Ems river in Northwest Germany, in samples from the last century B.C. and from the beginning of our era (Behre, 1972). In contrast to most other coastal settlement sites, Jemgumkloster was situated in a fresh-water environment. According to Knörzer (1971) broomcorn millet must have been an important crop plant in Early Iron Age Rhineland; it is represented there in various sites by considerable numbers of grains.

### 3.2. Hordeum vulgare

The barley of Noordbarge is of the hulled type. Grains of the naked variety have not been found. *Hordeum* is represented in a relatively great number of samples, but gegenerally only by a few grains. An exception in this respect forms sample 1041, from the fill of a granary post-hole, which yielded nearly 2000 barley caryopses. This is a predominantly barley sample (more than 90% *Hordeum*) with an admixture of other cereal grains. Unfortunately, the preservation is poor, the grains being more or less deformed due to puffing. As a consequence only a relatively small number of caryopses could be selected for measuring (table 3), but also of these grains the dimensions may more or less seriously have been affected by the carbonization. In addition to the grains, samples 794 and 1041 yielded 1 and 3 rachis internodes, respectively.

In table 4 the mean dimensions and index values of charred barley grains from various sites on sandy soils in the north of the Netherlands are shown. From this table it appears that the mean dimensions of the Noordbarge grains do not differ markedly from those of most other barley samples from prehistoric and early-historical sites. The barley from Angelsloo is notably small. This is also true for the *Triticum dicoccum* from the same sample, suggesting that at least during the season in which the crop plants of this Angelsloo sample were grown the conditions for plant cultivation must have been rather poor. The barley from Gasselte sample no. 428 is conspicuously long, but in other samples from this site the grains are smaller (Van Zeist & Palfenier-Vegter, 1979, table 7). One may conclude that the Noordbarge barley is of average size.

The comparatively low mean L:B index value of the Noordbarge barley may have been the effect of the carbonization (decrease in length, increase in width). The same explanation may apply for the relatively high average T:B index value.

### 3.3. Triticum dicoccum

Emmer wheat is represented in a much smaller number of samples than barley. On the other hand, there can be no doubt that it was cultivated by the Noordbarge farmers. It is unlikely that *Triticum dicoccum* could maintain itself as an admixture to other crop-plant species. The charred seed evidence for the north of the Netherlands shows that the role of emmer wheat diminished in Late Bronze Age and Iron Age times. This wheat species gave way, first to barley and subsequently also to oats and rye. In medieval sites in the north of the Netherlands, *Triticum dicoccum* has disappeared altogether. The decreasing economic importance of emmer wheat in late prehistoric times is also reflected at Noordbarge.

From samples 1041 (phase III) and 898 (phase IV) small numbers of emmer wheat grains have been measured (table 5). The grains of sample 898 are distinctly smaller than those of sample 1041. The measured specimens from the latter sample are conspicuously large for emmer wheat from sandy soils (cf. Van Zeist, 1968 [1970], table 64).

Sample 898, with predominantly emmer wheat, yielded a *Triticum monococcum*-type grain fragment.

### 3.4. Secale cereale

The presence of rye grains at Noordbarge has been discussed in a previous paper (Van Zeist, 1976). The question whether the rye grains in this site point to the intentional cultivation of this species or whether it may have occurred only as an admixture to other crop plants has been treated rather extensively. Particularly samples 307 and 308, in which *Secale* grains occur in fairly large numbers, were considered as conclusive evidence of rye cultivation. The present author sees no reason to change this conclusion. Indeed, current investigations of charred plant remains from the multi-period settlement site of Peeloo, north of Assen (Harsema, 1979; Kooi, 1980), yielded *Secale* grains from Roman Iron Age and early medieval features. Consequently, for the north of the Netherlands rye cultivation in the first centuries A.D. is now attested for two sites lying c. 40 km apart.

As for the beginning of rye cultivation at Noordbarge, the following should be mentioned. In the 1976 paper, sample 1004 which yielded c. 10 rye grains, has been attributed to phase II, suggesting that during the period concerned *Secale* was grown here. A re-examination of the settlement plan has led to the conclusion that the post-hole of sample 1004 should not be assigned to any particular building phase. Consequently, in table 2 this sample is shown among the group of samples of questionable periodization.

Sample 856 (with one rye grain) should not be attributed to phase III, as was done erroneously in the 1976 paper, but to phase IV, be it with some reserve (table 2). As for sample 738, also with one rye grain, the following should be remarked. The sample is from the fill of a pit inside house no. 13 and it is reasonable to assume that this pit belongs to the house concerned and that consequently it must be attributed to phase III. However, posts of a fence of phase IV have been dug in the fill of this pit. For that reason the fill of the pit must have been contaminated with material from phase IV. It will be clear that the single rye grain in sample 738 could possibly date from phase IV and that it cannot be considered as evidence of rye cultivation during phase III.

The conclusion that only for phase IV is there firm evidence of rye cultivation at Noordbarge is not really affected by the fact that the largest rye sample (no. 307), from the fill of a post-hole, has been attributed to phase IV with some reserve. The post concerned was no structural element of house no. 7. On the other hand, there are no other buildings of which this post could have formed part.

The dimensions and index values of rye grains from sample 307 are shown in table 6.

### 3.5. Avena fatua/sativa

The oat grains in the Noordbarge samples pose some problems. In an earlier paper (Van Zeist, 1976) it was suggested that *Avena sativa* formed part of the crop-plant assortment of the Noordbarge farmers. However, after a reconsideration of the factual evidence the present author feels obliged to take a more sceptical point of view. The numbers of *Avena* fruits are in themselves no indication of the intentional growing of oats, that is of *A. sativa*. In none of the samples is it by far the dominant cereal grain type. The greatest number of oat caryopses (c. 25 specimens) occurs in sample 1041, but this is a fairly large barley sample the proportion of *Avena* being only 1.2%.

Altogether two *Avena* flower bases have been recovered. One of them, in sample 774, shows the oval articulation scar characteristic of *A. fatua* (wild oat). The other flower base, in sample 1041, has been rather seriously damaged which makes a reliable identification next to impossible. Most probably the flower base is of *A. sativa*. It will be clear that this damaged flower base cannot be considered as firm evidence of oat cultivation. On the other hand, it is well possible that *A. sativa* was grown by the Noordbarge farmers.

### 3.6. Linum usitatissimum

Sample 815 yielded about 15 seeds of *Linum usitatissimum*. All seeds (fig. 4:8) are more or less seriously deformed as a result of the carbonization. Five specimens have been measured although the dimensions may deviate rather considerably from those of the seeds before carbonization: 3.5 x 1.7, 3.0 x 1.5, 3.3 x 1.4, 3.0 x 1.8, 3.0 x 1.8 mm. Although flax is represented by a small number of seeds in only one sample, one may assume that this crop plant was cultivated by the Noordbarge farmers, at least at some stage of the habitation of the site. It is unlikely that linseed could have occurred as a weed in the fields. This crop plant cannot maintain itself for some time without being cultivated intentionally. One could hypothesize that the linseeds had been obtained by trade, *e.g.* from the inhabitants of the coastal area where *Linum* was cultivated rather widely. However, this suggestion must be regarded as rather unlikely.

### 3.7. Camelina sativa

*Camelina sativa* seeds (fig. 4:3) occur in fairly considerable numbers in samples 738 and 815 from phase III. As usual the oleaginous seeds of this species have more or less seriously been affected by the carbonization. For 26 specimens from sample 815 length and breadth have been determined: 1.52 (1.4 - 1.7) x 0.96 (0.8 - 1.1) mm.

The *Camelina* seeds at Noordbarge do not necessarily imply that this species was grown intentionally. Gold-of-pleasure could have

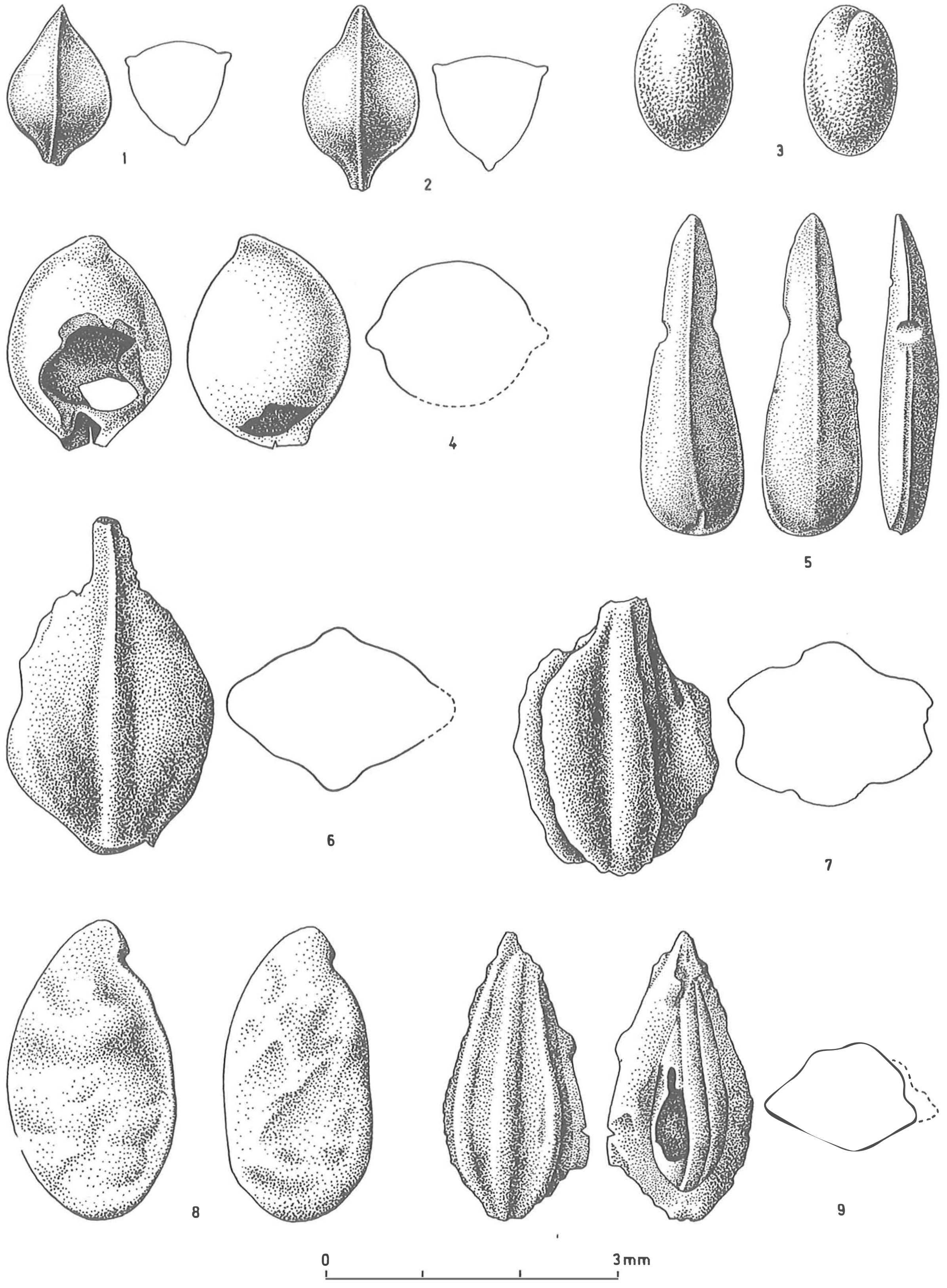


Fig. 4. Charred seeds from Noordbarge. 1: *Rumex crispus* (872); 2: *Rumex crispus* (247); 3: *Camelina sativa* (815); 4: *Humulus lupulus* (910); 5: *Valeriana officinalis*, inner fruit (738); 6-7: unidentified seed (1041); 8: *Linum usitatissimum* (815); 9: *Oenanthe aquatica* (766).

occurred as a weed in linseed fields. In this respect it should be remembered that the *Linum* seeds discussed above occurred in one of the two samples with *Camelina* (sample 815). The *Camelina* seeds could consequently have formed part of the residue left after the cleaning of the linseed crop.

The cultivation of *Camelina sativa* could be demonstrated convincingly for pre-Roman and Roman Iron Age settlement sites in the coastal area of the north of the Netherlands (Van Zeist, 1974) and of Northwest Germany (Körber-Grohne, 1967). Moreover, in various Iron Age sites in the Rhineland area *Camelina sativa* is well represented (Knörzer, 1978; 1980). It seems justified to assume that this species was grown by the Noordbarge farmers because of its oil-rich seeds. The question whether it was cultivated only during phase III or also during phases II and IV must remain undecided. In this connection it should be kept in mind that in general *Camelina* seems to be poorly represented in the charred seed record.

## 4. WILD PLANT SPECIES

### 4.1. Wild millet-type fruits

Wild millet-type fruits, which include grains of *Echinochloa crus-galli, Digitaria ischaemum* and *Setaria* cf. *viridis*, have been found in various samples. In only two samples, nos. 738 and 815, do these grains occur in somewhat greater numbers.

#### 4.1.1. *Setaria cf. viridis* (fig. 3:3-4)

*Setaria* grains are characterized by a long and rather narrow radicle shield. The species identification of the charred fruits, somewhat greater numbers of which were found in samples 738 and 815, proved to be difficult. Is *Setaria viridis*, which could have occurred as a weed in the fields, concerned here, or must the charred grains be attributed to *S. italica*, implying that Italian millet was a crop plant of the Noordbarge farmers? In this connection it should be mentioned that according to Knörzer (1971) *Setaria italica* was grown in the Rhineland area in Iron Age times.

The charred *Setaria* grains from Noordbarge show more resemblance to those of modern *S. italica* than of *S. viridis*. However, to what extent may the carbonization have changed the shape of the grains? To gain some insight into the possible effect of carbonization on the shape of millet-type fruits, 50 modern dehusked grains of *Panicum miliaceum* were measured (table 7). A comparison with the dimensions of the charred *Panicum* grains from sample 336 is not meaningful because the original size of the Noordbarge specimens may have differed rather considerably from that of the modern ones. On the other hand, the index values are probably more indicative of possible changes in the dimensions as a result of carbonization. The lower mean L:B index value in the charred grains indicates that relative to the breadth of the grains the length has decreased. The higher mean T:B index value suggests that the thickness of the grains increased relative to the width. The carbonization resulted in a decrease in length, an increase in thickness and probably also in some increase in width. The charred grains are more compact than the non-carbonized modern ones.

Further, 25 modern dehusked grains of both *Setaria italica* and *S. viridis* were measured for comparison with 8 charred *Setaria* grains from sample 815 (table 7). The latter were the only charred *Setaria* fruits suitable for measurement. Modern naked grains of *S. italica* and *S. viridis* from various proveniences present in the seed reference collection of the Biologisch-Archaeologisch Instituut differ quite distinctly from each other. The fruits of *S. viridis* are more slender than those of *S. italica*. This finds expression in the L : B index values (table 7) which do not even show an overlap (89-113 for *S. italica* and 138-169 for *S. viridis*). The grains of the cultivated *S. italica* are, on average, shorter than those of its wild ancestor *S. viridis*, but, on the other hand, they are noticeably thicker.

Table 6. Dimensions in mm and index values of *Secale cereale* from Noordbarge 307 (N = 32).

| | *L* | *B* | *T* | *100L:B* | *100T:B* |
|---|---|---|---|---|---|
| min. | 3.9 | 1.6 | 1.5 | 167 | 70 |
| aver. | 4.99 | 2.14 | 1.95 | 235 | 91 |
| max. | 6.2 | 2.5 | 2.4 | 350 | 108 |

Table 7. Dimensions in mm and index values of *Panicum miliaceum* and *Setaria* species.

| | | *L* | *B* | *T* | *100L:B* | *100T:B* |
|---|---|---|---|---|---|---|
| *Panicum miliaceum* | min. | 2.0 | 1.7 | 1.3 | 108 | 71 |
| modern (N = 50) | aver. | 2.20 | 1.86 | 1.41 | 118 | 76 |
| | max. | 2.3 | 2.0 | 1.6 | 132 | 83 |
| *Panicum miliaceum* | min. | 1.5 | 1.4 | 1.2 | 88 | 73 |
| Noordbarge 336 | aver. | 1.79 | 1.72 | 1.43 | 105 | 86 |
| (N = 52) | max. | 2.1 | 2.1 | 1.7 | 121 | 95 |
| *Setaria italica* | min. | 1.4 | 1.2 | 0.8 | 89 | 67 |
| modern (N = 25) | aver. | 1.51 | 1.48 | 1.07 | 102 | 72 |
| | max. | 1.6 | 1.6 | 1.1 | 113 | 81 |
| *Setaria viridis* | min. | 1.6 | 1.0 | 0.6 | 138 | 60 |
| modern (N = 25) | aver. | 1.72 | 1.16 | 0.75 | 149 | 65 |
| | max. | 1.8 | 1.3 | 0.9 | 169 | 73 |
| *Setaria* | min. | 1.1 | 1.0 | 0.8 | 100 | 63 |
| Noordbarge 815 | aver. | 1.22 | 1.12 | 0.83 | 109 | 75 |
| (N = 8) | max. | 1.3 | 1.3 | 0.9 | 115 | 85 |

Table 8. Dimensions in mm of *Echinochloa crus-galli* from various sites.

| | *Length* | *Breadth* | *Thickness* |
|---|---|---|---|
| Noordbarge 738 (N = 14) | 1.33 (1.1-1.6) | 1.10 (1.0-1.3) | 0.69 (0.6-0.9) |
| Rheydt[1] (N = 10) | 1.30 (1.2-1.4) | 1.03 (0.9-1.1) | 0.58 (0.5-0.7) |
| Neuss[2] (N = 10) | 1.64 (1.5-1.7) | 1.36 (1.2-1.5) | 0.69 (0.6-0.8) |
| Gasselte[3] (N = 11) | 1.64 (1.3-2.0) | 1.31 (1.1-1.5) | |

[1] Knörzer 1971 (Hallstatt) [2] Knörzer 1970 (Roman) [3] Van Zeist & Palfenier-Vegter 1979 (Medieval)

Which conclusions may be drawn from a comparison of the index values of the charred *Setaria* grains with those of the modern ones, taking into consideration the differences in the index values between modern and carbonized prehistoric *Panicum miliaceum*? The *Panicum* grains suggest an increase in the T:B index values of about 13% as a result of carbonization. A similar increase in the T/B ratio of *Setaria* grains would result in mean T:B index values of about 81 and 73 for *S. italica* and *S. viridis*, respectively, after carbonization. The mean T:B index value of 75 established for the charred *Setaria* from sample 815 could point to *S. viridis*. This suggestion is not confirmed by the L:B index values of the charred *Setaria*. In the charred *Panicum* grains the mean L:B index value is about 11% lower than that of the modern grains. For *Setaria italica* and *S. viridis* a similar decrease would result in mean L:B index values of about 91 and 133, respectively. The mean L:B index value of 109 obtained for the carbonized *Setaria* from Noordbarge does not conform more or less to either of the two calculated values.

It is self-evident that the effect of the carbonization on the shape of the grains is not necessarily the same in *Panicum* and *Setaria* and that, moreover, not too much weight should be attached to the measurements of only 8 charred *Setaria* grains. From the above it will be obvious that a satisfactory species identification is not possible. *Setaria viridis* seems to be the most likely candidate. It should, however, be mentioned that Knörzer (1971) attributes *Setaria* grains from Iron Age (Hallstatt C/D) Nettesheim in Rhineland, of about the same dimensions as the Noordbarge specimens (1.27x1.20x 0.82 mm for 10 caryopses), to *S. italica*.

### 4.1.2. *Echinochloa crus-galli*

The grains of *Echinochloa crus-galli* are characterized by the flat ventral side and by the large radicle shield extending over about 3/4 of the domed dorsal side (fig. 3:6-8). In general the grains of *Echinochloa* can easily be recognized, but with some grains from samples 738 and 815 it was difficult to make a distinction between *Setaria* and *Echinochloa*. The dimensions (and index values of carbonized grains from Noordbarge and from a few other sites are shown in table 8.

The Noordbarge grains are of about the same size as those from Iron Age (Hallstatt) Rheydt (Rhineland), but are smaller than those from Roman Neuss and medieval Gasselte. The variations in the size of the *Echinochloa* grains are probably to be ascribed to local soil conditions.

### 4.1.3. *Digitaria ischaemum*

The caryopses of *Digitaria (Panicum) ischaemum* are more slender than those of *Echinochloa*, whereas the radicle shield extends over only 1/3 to 2/5 of the dorsal side (fig. 3:5). This species is scarcely represented at Noordbarge; only sample 815 yielded a somewhat greater number of *Digitaria* grains. Six specimens from this sample measure 1.21(1.1-1.3) x 0.76(0.7-0.8) x 0.48(0.3-0.6) mm. These dimensions agree with those obtained for seven *Digitaria ischaemum* grains from Iron Age (Hallstatt C/D) Rommerskirchen in Rhineland (Knörzer, 1971): 1.18 x 0.69 x 0.49 mm.

### 4.1.4. *Wild millets as food plants?*

Knörzer (1971) suggests that the grains of *Setaria* and *Echinochloa* served as food for prehistoric man. He assumes that these species occurred in the broomcorn millet fields, leaving undecided whether or not in Iron Age times intentional mixtures of wild and domesticated millets were grown. The wild millet-type grains from Noordbarge give no indication as to their possible economic role. The somewhat greater numbers in samples 738 and 815 could point to the harvesting of these grains for human consumption, but they can also be interpreted as the residue of crop cleaning. The charred seeds and fruits in the Noordbarge samples are very probably of mixed origin, that is to say, that they are derived from various domestic activities (2.2.).

## 4.2. Other potential wild food plants

A few nutshell fragments of *Corylus avellana* indicate that hazelnuts were collected, but no speculations can be made as for their possible role in the diet of the inhabitants of the site. The picking of wild fruits is attested by one *Rubus* fruitstone and by half an apple pip. The find of a charred seed of *Humulus lupulus* (fig. 4:4) is certainly interesting, but it does not yet suggest that hop was used for beer brewing.

The seeds of various weeds from fields and other disturbed habitats represented at Noordbarge are assumed to have served as food for prehistoric man. Thus, Knörzer (1977) makes a strong point of the intentional harvesting of the caryopses of *Bromus secalinus*, a common weed in grain fields, by prehistoric man. The fairly great number of *Bromus* grains in sample 341 could indicate that they were consumed by the Noordbarge people. However, the *Bromus* caryopses in this sample could also represent the residue of crop cleaning, implying that the brome-grass grains had been removed from the crop together with other weed seeds. Five *Bromus* grains from sample 341 measure: 3.8 x 1.4 x 1.1, 3.9 x 1.7 x 1.0, 4.6 x 1.5 x 1.2, 4.6 x 1.6 x 1.3 and 4.6 x 1.4 x 1.3 mm.

*Chenopodium album*, *Spergula arvensis* and *Polygonum lapathifolium/persicaria* are regularly reported in palaeo-ethnobotanical literature as potential wild food plants. Particularly for Iron Age sites in Jutland there is firm evidence of the harvesting of the seeds of these field weeds for human consumption. *Chenopodium album* occurs in a great number of seeds in sample 815, while *Spergula*, *Polygonum* and also *Rumex acetosella* are well represented in various samples. But, again, the presence of greater quantities of these seeds can be explained as an indication of intentional gathering as well as in terms of residues of crop cleaning.

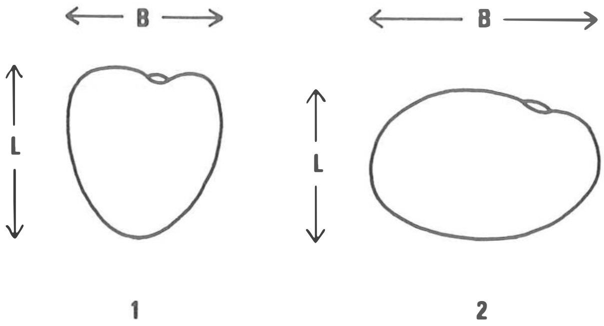


Fig. 5. Position of the measurements in seeds of *Trifolium* (1) and *Lotus* (2).

## 4.3. Lotus and Trifolium repens

Two types of small leguminous seeds are represented at Noordbarge by more than only one specimen, viz. those of *Trifolium repens* and *Lotus*. On the basis of the shape, the seeds of *Trifolium repens* can be distinguished from those of the other *Trifolium* species which could come into consideration for this site (cf. Knörzer, 1970, pp. 80-82).

The seeds of *Lotus corniculatus* and *L. uliginosus* differ from each other only in size. The dimensions of 25 modern seeds of both *Lotus* species are shown in table 9. As is demonstrated by the measurements *Lotus corniculatus* seeds are appreciably larger than those of *L. uliginosus*. There is hardly any overlap. As for the dimensions, the length is taken between the side with the hilum and the opposite end. The breadth is perpendicular to the length axis (fig. 5). The carbonized *Lotus* seeds from Noordbarge are smaller than those of modern *L. uliginosus* (table 9). The carbonization must have resulted in a more or less considerable decrease in size. This is also clear from the comparison of the dimensions of modern and charred seeds of *Trifolium repens*.

Table 9. Dimensions in mm for modern and charred seeds of *Lotus* and *Trifolium repens*.

| | | *L* | *B* |
|---|---|---|---|
| *Lotus* | min. | 0.7 | 0.9 |
| Noordbarge (N = 9) | aver. | 0.76 | 0.95 |
| | max. | 0.8 | 1.0 |
| *Lotus uliginosus* | min. | 0.8 | 0.9 |
| modern (N = 25) | aver. | 0.97 | 1.08 |
| | max. | 1.0 | 1.3 |
| *Lotus corniculatus* | min. | 1.1 | 1.3 |
| modern (N = 25) | aver. | 1.23 | 1.40 |
| | max. | 1.0 | 1.6 |
| *Trifolium repens* | min. | 1.0 | 0.9 |
| modern (N = 25) | aver. | 1.17 | 0.96 |
| | max. | 1.3 | 1.0 |
| *Trifolium repens* | min. | 0.8 | 0.6 |
| Noordbarge (N = 6) | aver. | 0.89 | 0.72 |
| | max. | 1.0 | 0.8 |

Without any information on the degree of shrinkage of *Lotus* seeds in carbonization the Noordbarge specimens cannot be identified to the species level. One may wonder whether the size reduction in the *Trifolium repens* seeds could provide a clue in this respect. Length and breadth of the Noordbarge *Trifolium* seeds are, on average, about 25% smaller than those of the modern seeds. A 25% reduction of both dimensions in the modern *Lotus* seeds results in mean values of 0.73 x 0.81 mm for *L. uliginosus* and 0.93 x 1.05 mm for *L. corniculatus*. A reduced average length of 0.73 mm for *L. uliginosus* corresponds well with the value of 0.76 mm obtained for the Noordbarge seeds. On the other hand, the average breadth of 0.95 mm for the latter seeds is notably larger than that for *L. uliginosus* after a 25% reduction (0.85 mm). The reduced dimensions of *L. corniculatus* (0.93 x 1.05 mm) are both distinctly larger than those of the Noordbarge specimens. Consequently, the dimensions would plead more in favour of *L. uliginosus* than of *L. corniculatus*. However, in view of the many uncertainties one should rather refrain from attributing the Noordbarge *Lotus* seeds to either of the two species which come into consideration here.

### 4.4. Cenococcum geophilum

Sclerotia of *Cenococcum geophilum* are quite regularly present at Noordbarge, in some samples even in very great numbers. These sclerotia are always somewhat problematic. They are at most listed in reports on charred seed finds, but generally without further comment. Natho (1957) published a rather detailed report on *Cenococcum* from Wahlitz. For the superimposed culture layers there – from the Neolithic (Rössen culture) to medieval times – he established increasing numbers of *Cenococcum* sclerotia with decreasing depth. Natho does not attribute this to possible

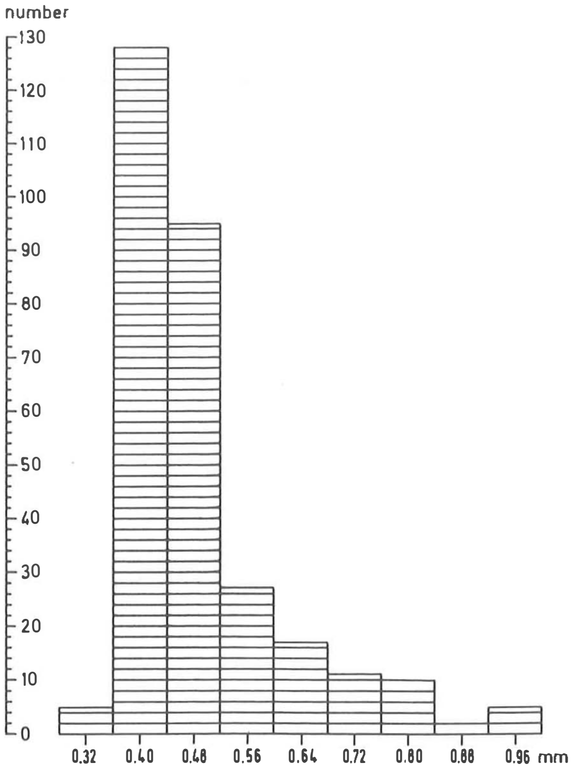


Fig. 6. Frequency distribution of the greatest dimension of 300 sclerotia of *Cenococcum geophilum* from sample 722.

secondary deposition (infiltration from the upper layers), but he assumes that in more remote times the growing conditions for *Cenococcum geophilum* were not favourable. This fungus species is reported to live in the humus layer of forest and heath-land and also in peaty soils (Natho, 1957).

The Noordbarge evidence suggests that carbonized *Cenococcum* sclerotia were not evenly distributed in the upper soil layers. Thus, in the fill of post-holes of houses 15 and 16 (samples 621, 720, 721, 722, 723, 724, 727) great numbers of *Cenococcum* sclerotia were found, whereas the fill of post-holes of houses 11, 12, 13, 14 and 17, equally attributed to phase III, yielded usually no or only few sclerotia (samples 711, 712, 713, 714, 715, 716, 748, 756, 762, 766, 767, 768, 794, 804, 818). The present author prefers to refrain from speculations to explain the local differences in the distribution of carbonized *Cenococcum* sclerotia, but he only wishes to draw attention to this phenomenon.

For 300 sclerotia from sample 722 the greatest dimension has been determined: 0.3-1.0 (aver. 0.49) mm. The frequency distribution of the dimensions is shown in fig. 6. The Gasselte sclerotia are small; the absence of specimens larger than 1.0 mm is striking (cf. Natho, 1957).

## 5. SOME REMARKS ON THE DISTRIBUTION OF THE PLANT REMAINS

It has been suggested (2.2.) that the charred seeds and fruits in the fill of pits and post-holes must have originated from the top soil in the vicinity of these features. This opinion leads to some considerations regarding the presence of man on the terrain prior to the construction of the houses. The seeds and fruits must for the greater part have arrived in the settlement area as the result of human activities. Without the interference of man no crop-plant seeds and only small numbers of weed seeds were to be expected in the area concerned.

In the samples from phase I, dated to the Middle Bronze Age, seeds occur in only small numbers. Apart from a few broomcorn-millet grains in sample 892, attributed to phase I with some reserve, no other crop-plant fruits have been recovered from phase I samples. Samples 857 and 895, not listed in table 2, did not yield any seeds at all. Apparently the Bronze Age settlement had been built on a terrain on which domestic activities which, among other things, result in carbonized seeds and fruits, had up to then been of only limited extent. It was not a terrain that had been used intensively for some time prior to the construction of the settlement.

The same applies to the samples from phase II. In addition to the samples listed in table 2, 4 samples from phase II (house no. 20) were devoid of seeds and fruits. It looks as if settlement phase II was built on a terrain which only recently had been occupied. In this connection it should be remembered that there is a hiatus of 800 to 1000 years between phases I and II (see 1.)

In contrast, the plant remains of phase III samples point to a longer activity of man in the settlement area before the construction of the houses. In many places carbonized seeds and fruits of crop plants and weeds from fields were present on or near the surface of the soil. This is no surprise because the phase III houses were built on the same terrain as those of phase II and no interruption in the habitation had taken place.

However, some caution has to be observed in drawing the kind of conclusions presented above. The Noordbarge evidence indicates that even on a terrain that has been in use already for a longer period carbonized seeds and fruits may locally have been scarce or absent. Thus, in samples 920 to 923, from house no. 23 (phase IV), crop plants are not represented at all and other species only poorly. This fact invalidates to some degree the assumption that settlement phases I and II had been erected on a terrain that only just recently had been taken into exploitation. In fact the phase I samples examined for plant remains are all from the same house (no. 21). For phase II, 8 out of the 12 samples (including the samples not listed in table 2) are from the same house (no. 20). One cannot exclude the possibility that it is by accident that the houses of phases I and II which were sampled for palaeobotanical examination yielded only small numbers of seeds and fruits and that those samples are not representative for the whole of the settlement phases concerned.

## 6. THE ECOLOGICAL SIGNIFICANCE OF THE WILD PLANTS

Nearly all wild plants represented at Noordbarge grow on dry to moderately moist soils. Species from marshy habitats, such as *Eleocharis* and *Carex rostrata/vesicaria*, are only scarcely represented, which is rather surprising. One may assume that not far to the east of

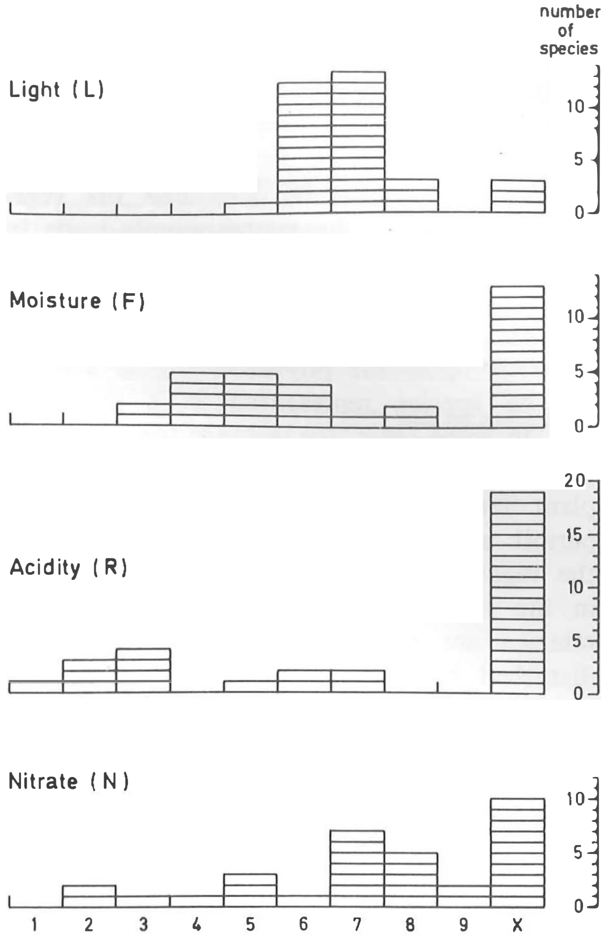


Fig. 7. So-called palaeoethnobotanical eco-diagrams: frequency distribution graphs of ecological indicator values. For explanation see text (section 6).

the site a rather large body of water, viz. the Bargermeer (Lake of Barge) was present. The reconstructed maximum extension of the Bargermeer is shown in fig. 1. To the west, north and east, the lake was bordered by the higher sandy soils. The 20 m contour line must have corresponded approximately with the highest lake level. Raised bog constituted the border of the lake to the south. At its maximum size the lake must have extended to less than 500 m from the locality of the Noordbarge site. It is likely that at the time of the settlement the lake had not yet reached its maximum extension, so that it was somewhat further away from the site than 500 m. However, the lake shore, and consequently marshy vegetations, must have been situated at a rather short distance from the settlement.

As for the other wild plant species, the majority of them are weeds from fields, waste places and road sides. In previous papers it has been attempted to determine the vegetation types, *i.e.* the syntaxonomic units in the sense of the Zürich-Montpellier School of Phytosociology, in the vicinity of the settlement. This reconstruction of the vegetation is based upon the phytosociological affinity of the species represented in a particular site. In some cases, for instance for sites from the coastal area in which non-carbonized plant remains are well preserved, this may permit a rather detailed reconstruction of the vegetation and hence of the environment in the vicinity of the site. If the vegetable remains are predominantly of species from disturbed habitats this method is somewhat less satisfactory, particularly because it is hardly justified to determine the prehistoric field-weed vegetation types below the highest syntaxonomic units (see *e.g.* Van Zeist & Palfenier-Vegter, 1979, pp. 290-91). For that reason in this paper another approach to evaluate the ecological information provided by the species demonstrated for Noordbarge will be presented, viz. that of the indicator values (*Zeigerwerte*) of plants introduced by Ellenberg (1974). This method has already been applied to archaeological plant remains by Willerding (1978; 1980).

The so-called ecological behaviour of a plant is expressed in its reaction to six environmental factors, viz. three climatic factors: light (L), temperature (T), continentality (K); and three soil factors: moisture (F), acidity (R), nitrogen content (N). Nine degrees of behaviour (1-9) with regard to these factors are distinguished. Thus, L 1 is a full-shadow plant, L 5 a half-shadow plant, and L 9 a full-light species. R 1 grows on very acid soils, R 5 on moderately acid soils, and R 9 on neutral soils. N 3 is found on soils poor in nitrogen, N 8 is a nitrogen indicator plant. Indifferent behaviour with regard to an environmental factor is indicated with an X.

In the graphs of fig. 7 the ecological behaviour is expressed of 32 wild plants which could be identified to the species level with a fair degree of certainty (in table 2 indicated by an asterisk). Marsh plants are not included in this group of species. For four of Ellenberg's environmental factors the frequency distributions of the indicator values of the Noordbarge species are shown. From these graphs the following conclusions can be drawn.

By far the majority of the plants may be considered as moderately light demanding. This will be no surprise because they are species from fields and other open habitats. Plants from neutral to basic soils are in the minority. Most of the Noordbarge species are either characteristic of acid soils or indifferent to soil reaction. As for the moisture content, moderately dry soils (M4-M6) must have prevailed. A rather great number of species prefer soils which are rich in nitrogen (N7-N9). This could indicate that the fields were rather rich in nitrate suggesting that some kind of fertilization (litter from the forest, animal manure, vegetable debris) was practised. On the other hand, it is also possible that the species concerned were particularly found in and near the settlement, in places where refuse was dumped.

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