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# OBJECTIVE COMBINATIONS OF SPECIES*

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In our research of Dutch grasslands, those are characterized in different ways. This is done to avoid partiality, and became possible because more than one method of botanical analysis has been applied. Namely, the productivity method or dry weight analysis (*4*, *6*, *8*, *13*), in some cases replaced by estimation of the weight proportions of the species, as well as the 25 cm² specific frequency (= frequency of occurrence = valency) method, combined with the order- or rank method (*2*, *4*, *5*, *8*) are used, while in many cases also completing lists of species of the concerning fields are made.

To begin with, the grasslands could be distinguished according to those species which were leading in weight proportion. For these so called dominance communities must be referred to *1*, *3*, *11* and *12*.

In the second place, a characterization of agricultural importance has been worked out, for which the 25 cm² (specific) frequency percentages are used instead of weight percentages, because their variability is smaller, and real dominancy is replaced by potential dominancy. With this system of combinations of frequent species, preference has been given to species of extreme agricultural value, good as well as bad ones. See a.o. *7* and *9*.

In the third place has been tried to place the examined grasslands in the system of BRAUN–BLANQUET. The real significance of this sociological system lies more in the indicating value of combinations of species than in the distinction of characteristic species. It is a pity that the generally used method of this School is rather subjective. It is remarkable that this pure scientific sociological School still sticks to the choosing of the so called typical places for the readings, while with the applied botanical grassland research already during a considerable time objective methods of sampling are used. The agricultural science wants reliable average values. The work of the School of BRAUN–BLANQUET would win a great deal in importance if one would endeavour to examine homogeneous vegetations with the aid of a (specific) frequency method. A test of the grassland-associations is being worked out by us, using the numerous analyses, acquired in an objective way. For this, the combination of the species is put in the first place, then afterwards it will appear how far we

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can speak of faithfulness by comparing the presence- and (specific) frequency percentages of the separate species in the different associations.

In the fourth place, finally, it seemed desirable to divide the grasslands according to combinations of frequent species, for which no preference is given to species which are significant in agricultural view, as in our characterization mentioned before in the second place. This new characterization is especially of ecological importance, because it appeared that combinations as well as frequencies of species have indicating value (*10, 12*). To see which species really occur together or avoid each other, a mathematical statistical working out of the data of the first thousand of grasslands which have been analysed with the specific frequency method, is being done by Miss J. P. BARETTA. Correlations ($r$-values) between two species, every time, are being calculated, not according to the orthodox method but with formulae of the agricultural mathematician Dr G. HAMMING (Wageningen). For this, not only the number of cases, both species occur together or each separately (yes or not above certain specific frequency limits which are determined according to the most likely spreading of the $F$ %'s), but also the number of cases, none of them is present, are taken account of. $R = 0$ means that the species are found together as many times as agrees with the degree of their respective occurrence, while $+ 1$ or $- 1$ means that they occur always, respectively never, together.

Figure 1 indicates the constellation of grasslandplants which must be found in at least 30 parcels, will the reliability be satisfactory. The distances between the abbreviations of the species are about proportionate to the sizes of the positive $r$-values. The colour of the communicating lines indicates the correlation class, e.g. red means the highest class, from 0.70 — 1. The map shows that the constellation must properly be thought ball-shaped. Certain groups of species which have a great correlation with each other, as those of *Molinia coerulea* Moench. — *Sieglingia decumbens* Bernh. — *Potentilla erecta* Räuschel — *Carex panicea* L. — *Cirsium dissectum* Hill.; *Arrhenatherum elatior* J. et C. Presl. — *Trisetum flavescens* P. B. — *Dactylis glomerata* L; *Anthoxanthum odoratum* L. — *Rumex acetosa* L. — *Holcus lanatus* L.; *Caltha palustris* L. — *Lychnis flos-cuculi* L. — *Glyceria maxima* Holmb.; *Lolium perenne* L. — *Cynosurus cristatus* L. — *Trifolium repens* L.; *Ranunculus repens* L. — *Alopecurus geniculatus* L. — *Glyceria fluitans* R. Br. are obvious to the eye. In these objective combinations of frequent species, associations of the Swiss-French School can often be recognized. They are tested herewith for their justness. For instance, the fact that *Phleum pratense* L. and *Cynosurus cristatus* L. are both correlated with *Lolium perenne* L. and *Trifolium repens* L., but not positively correlated with each other, pleads in favour of a division of the *Lolieto–Cynosuretum* into a fat and a poor form. By doing justice to the occurrence together, as well as to the mass, a real bridge is built between the Southern and the Northern Sociological Schools.

It probably will be possible to calculate the correlation between

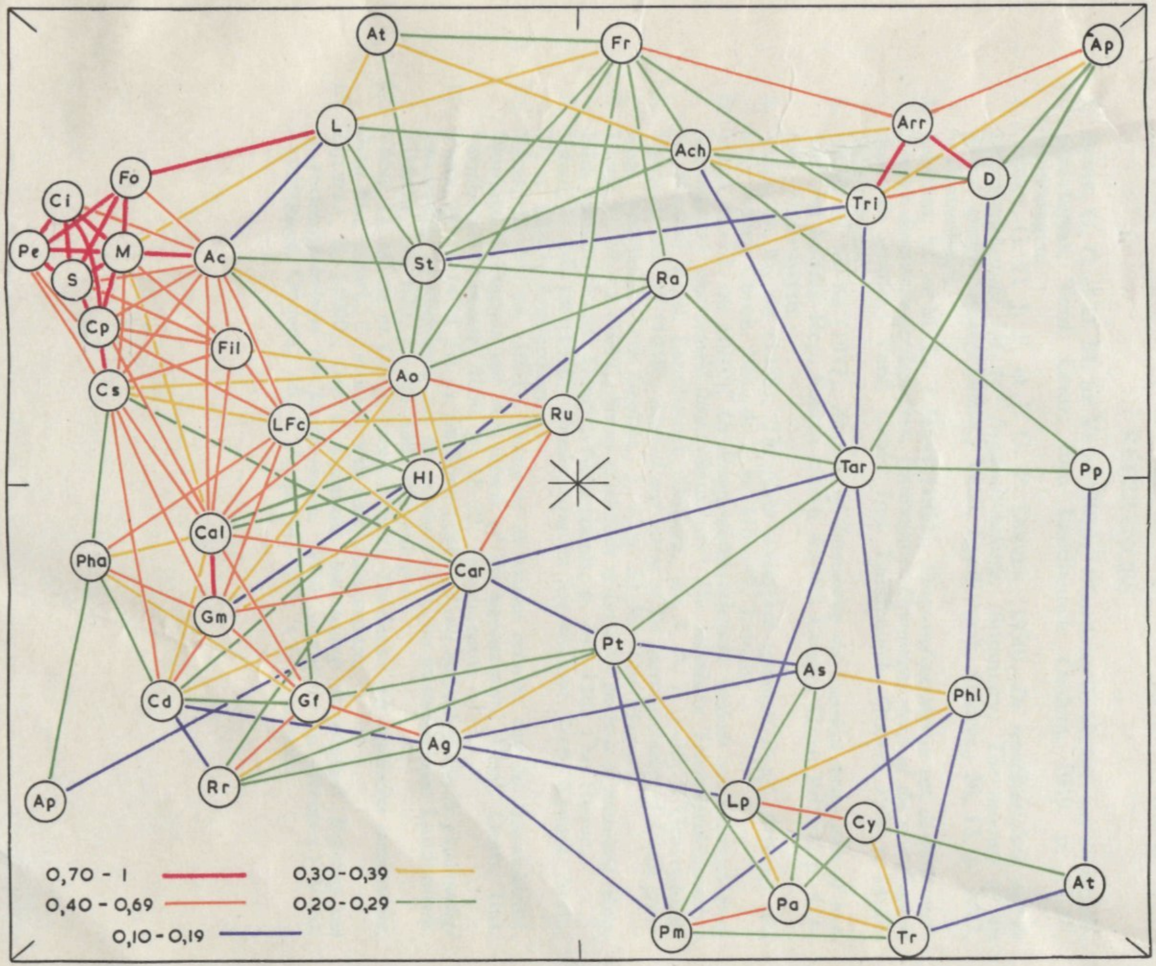


Fig. 1. Preliminary constellation of herbage plants. Correlation classes in colours: 0.70–1 red; 0.40–0.69 orange; 0.30–0.39 yellow; 0.20–0.29 green; 0.10–0.19 blue.

ABBREVIATIONS

| | |
|---|---|
| Ac | Agrostis canina |
| Ach | Achillea millefolium |
| Ag | Alopecurus geniculatus |
| Ao | Anthoxanthum odoratum |
| Ap | Alopecurus pratensis |
| Arr | Arrhenatherum elatius |
| As | Agrostis stolonifera |
| At | Agrostis tenuis |
| Cal | Caltha palustris |
| Car | Cardamine pratensis |
| Cd | Carex disticha |
| Ci | Cirsium dissectum |
| Cp | Carex panicea |
| Cs | Carex stolonifera |
| Cy | Cynosurus cristatus |
| D | Dactylis glomerata |
| Fil | Filipendula ulmaria |
| Fo | Festuca ovina |
| Fr | Festuca rubra |
| Gf | Glyceria fluitans |
| Gm | Glyceria maxima |
| Hl | Holcus lanatus |
| L | Luzula campestris |
| LFc | Lychnis flos-cuculi |
| Lp | Lolium perenne |
| M | Molinia coerulea |
| Pa | Poa annua |
| Pe | Potentilla erecta |
| Pha | Phalaris arundinacea |
| Phl | Phleum pratense |
| Pm | Plantago major |
| Pp | Poa pratensis |
| Pt | Poa trivialis |
| Ra | Ranunculus acer |
| Rr | Ranunculus repens |
| Ru | Rumex acetosa |
| S | Sieglingia decumbens |
| St | Stellaria graminea |
| Tar | Taraxacum officinale |
| Tr | Trifolium pratense |
| Tri | Trisetum flavescens |

groups of species, using the $r$-values of all couples of species. Herewith the existence of combinations of plants would be proved in a mathematical way.

Finally it seems that, by drawing four heartlines in the constellation figure, the species are divided respectively into those of hay fields (above) or pastures (below), into dry (right-above) or moist (left-below), fertile (right-below) or poor (left-above) soils, and into acid- (left) or lime loving (right) plants. This drawing which has been composed only with the aid of mathematical statistical data, demonstrates herewith already immediately its ecological sense.

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