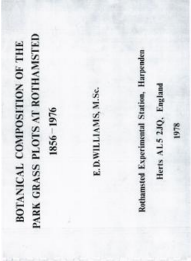
This work is licensed under a Creative Commons Attribution 4.0 International License.

Thank you for using eradoc, a platform to publish electronic copies of the Rothamsted Documents. Your requested document has been scanned from original documents. If you find this document is not readible, or you suspect there are some problems, please let us know and we will correct that.

Botanical Composition of the Park Grass Plots at Rothamsted 1856-1976


BOTANICAL COMPOSITION OF THE
PARK GRASS PLOTS AT ROTHAMSTED
1856 1976

E.D.WILLIAMS, M.Sc.

Rothamsted Experimental Station, Harpenden
Herts AL5 2JQ, England
1978

Full Table of Content

General

Rothamsted Research

Rothamsted Research (1978) *General ;* Botanical Composition Of The Park Grass Plots At Rothamsted 1856-1976, pp 13R - 14R **- DOI: https://doi.org/10.23637/ERADOC-1-156**

This work is licensed under a Creative Commons Attribution 4.0 International License.

temperatures early in the season tend to reduce the proportion of grasses. Seasonal variations in yield, however, cannot easily be related to differences in botanical composition at least as far as the three main groups of plants are concerned (Brenchley, 1935).

The weather conditions preceding the 1937 and 1938 and the 1975 and 1976 harvests were similar in many respects, the spring of 1937 and 1975 being very wet but 1938 and 1976 very dry. In 1938, % other species was high on both limed and unlimed halves of the unmanured plot but in 1976 only on the limed half; *Poterium, Plantago* and *Leontodon* were all increased. In 1976 only *Leontodon* had a greater % on the unlimed half than in 1975. The relatively small increase in % other species on the unlimed half in 1976 compared with 1975 (35% as against 29%) contrasts strongly with the increase in 1938 compared to 1937 (67% as against 35%) but the reason for this is unclear. *Arrhenatherum* on Plot 14 (N_2*PKNaMg) limed increased in 1938 and 1976 compared to the levels in 1937 and 1975 but it decreased on Plot 9 with equivalent treatment where N is given as ammonium sulphate. Different depths of rooting of the same species on the two plots (Lawes & Gilbert, 1871) may possibly account for the different result. On both halves of the unmanured plot % legumes was about 2% less in 1976 than in 1975 but on the limed half of the PKNaMg plot there was very much more legume in 1976 than in 1975. Both these results are in accord with Cashen's conclusions (1947) from past data: these were that an extra 25 mm of rain increased % legumes by 0.5% on the unmanured plot and that a greater proportion of leguminous plants would be expected to occur on the plot receiving mineral manures *following* a dry year. (1975 was very dry from mid-May onwards).

Although seasonal effects are often in themselves not permanent they may precipitate developments and changes already occurring on the plots. It is possible for example that the large permanent decreases in *Holcus* on the unlimed halves of Plot 10 (N_2PNaMg) after 1938 and of Plot 9 (N_2PKNaMg) after 1962 and the increasing amount and eventual dominance of *Anthoxanthum* on these plots might, to a large degree, be associated with the extreme weather conditions in both years, the summer of 1938 being exceptionally dry and the 1962/63 winter exceptionally cold. It would be of great interest to know the mechanism of increase of *Anthoxanthum* on Plot 9– whether it was by rapid increase of the 'ecotypes' already present on it or whether there was incursion from nearby Plot 10.

GENERAL

There were large changes in yield and botanical composition of the plots during the early years; changes in yield were possible from the outset because of the presence of appreciable amounts of species like *Holcus* and *Lolium* which responded to the increased fertility and in botanical composition because of the large number of species present. Since the changes depended on both the range and type of species present initially, the potential for such rapid change might not exist in all vegetation types. For example, it is likely that if the experiment were now started on land whose botanical composition resembled the present day unmanured plot, changes in yield at least would be smaller since many of the species may have become adapted to the low nutrient status and so could not respond to increased supplies. Some evidence in support of this comes from results from the microplot experiment on Plot 5[1] (unmanured 1897-1963 following N_2 as ammonium sulphate) where increased supplies of nitrogen have resulted in only small increases in yield (Johnston, personal

https://doi.org/10.23637/ERADOC-1-156

This work is licensed under a Creative Commons Attribution 4.0 International License.

communication). Although the unmanured plot can be regarded as a control plot and is the closest approximation to the state of the whole field at the outset, it is important to realise that it continues to change with time. Yield is now only half that at the start, the dominant grasses are different and there is a relatively much larger contribution of other species, three of which (*Leontodon, Plantago & Poterium*) are now abundant. It is also important to bear in mind that the botanical composition of the plots is not only a function of the fertiliser treatment but also of the management in general. Although this has remained fairly constant throughout, some changes have nevertheless occurred e.g. a change in method of cutting from scythe to mowing machine, and abandonment of grazing the aftermath after 1872. It is therefore possible that these changes in husbandry may have had some influence on changes in botanical composition with time.

Small differences in management e.g. slightly more frequent cutting, as on access strips for studies of the Entomology department in 1973 and 1974, may have profound influence on the botanical composition of the swards (Thurston, Williams and Johnston, 1976). This serves to emphasise the extreme plasticity of the grass sward with each new treatment imposed giving rise to a different species balance.

FUTURE WORK

Examination of the data from hay analysis over the duration of the experiment shows that although the rate of change has decelerated an end-point in botanical composition (plagioclimax) has not been, and possibly may not be, reached on most plots. Changes are also still occurring as a result of the new liming scheme and are likely to continue as new plots are brought into it. The scheme of differential liming was introduced to enable comparisons of the botanical and chemical compositions of the herbage to be made at several pH values for all manurial treatments (Warren, Johnston & Cooke, 1965). It is therefore desirable that assessments and/or surveys should continue to be done to provide some of the information for which the new liming scheme was designed and which it is now yielding. Such information is all the more valuable since the vegetation has been well documented in the past. At the same time a measure of long-term changes on plots not yet in the new scheme and a base line for future changes on the plots would be obtained.

It is clear, however, from comments made in the Introduction that the problem of how best to assess the changes in botanical composition is a very real one since although visual surveys give information on the relative amount of heading of different species at particular points of time they provide only limited information on the contribution of the species to the yield of the plots. Analyses of hay samples, on the other hand, whilst giving a better indication of contribution to yield at one particular point in time, are too laborious and time-consuming to be done regularly. Other methods e.g. point quadrat (Warren Wilson, 1960) would involve too much disturbance of the swards especially those of the taller-growing plots. However, despite these shortcomings it is clear that, when many changes are occurring, visual surveys may give a reasonable indication of them but are less successful at detecting changes in components already present. For example, visual surveys between 1965 and 1972 (Williams, 1974) gave a good indication of change on sub-plots *c* but not on sub-plots *b*. It is possible that botanical separations might be done more easily on fresh or frozen herbage than on air-dried material but this would require more people and much storage space, because such samples would be bulkier than hay samples. It would be desirable that if

https://doi.org/10.23637/ERADOC-1-156

This work is licensed under a Creative Commons Attribution 4.0 International License.

and when a change be made in the method of analysing the vegetation, comparison be made with the traditional method of analysis if the results are to be compared with those in the past.

Since the large number of sub-plots now precludes hay analysis being used routinely to monitor the vegetation, a more worthwhile approach, as previously explained, is to use the method to try to answer specific questions for a limited number of plots and treatments. In the early years of the experiment and again following the liming scheme of 1903 when major changes were occurring on the plots it was clearly of greatest interest to quantify the changes in species composition of the plots and this remains so for plots when new treatments are imposed. However, the emphasis has now changed: whereas this aspect was of paramount importance at the outset, data on the distribution and contributions of the different species may now serve as a background to more detailed studies of individual species and factors affecting the distribution of groups of species.

The Park Grass plots provide within a small area of relatively constant soil-type, a range of discrete types of vegetation which receive similar weather and management. They give ample opportunity for work to ascertain why some species are confined to particular habitats whilst others occur on a wide range of plots. Species may be confined to particular habitats either because of a direct preference for or adaptation to particular conditions or because they are less adversely affected than other species and so are at a competitive advantage under such conditions. The wide distribution of other species might be the result of a wide tolerance within the species as a whole or because morphologically and physiologically different populations have evolved on the plots. Such intraspecific variation for many heritable characteristics has been shown to occur in *Anthoxanthum* by Snaydon and Davies (Davies, 1975; Davies and Snaydon, 1973a, 1973b, 1974, 1976; Snaydon, 1970; Snaydon and Davies, 1972, 1976) in a significant lead on this type of work on species with a wide distribution on the Park Grass plots. The species has increased its contribution on many plots in recent years : the facts that it produces viable seed before the first cut and is cross-pollinated must contribute to the speed of differentiation within the species. Similar studies of other species e.g. *Festuca rubra* would not only help to explain their distribution on the Park Grass plots but also add to the understanding of the mechanisms of adaptation and differentiation within plant species. Populations of *Holcus* from the different plots are also now being used by the Unit of Comparative Plant Ecology (Natural Environment Research Council) at Sheffield University in a study of the variation of response within the species to different nitrogen sources.

Apart from the autecology and ecological genetics of individual species, studies of the comparative ecology and competition between pairs of species should also help to elucidate their distribution on the plots. Some species e.g. *Alopecurus* and *Arrhenatherum* usually occur together and appear to have roughly similar requirements but *Arrhenatherum* tends to become dominant at the higher pH values. However, on some plots e.g. 11^1 and 11^2 the relative amount of the two species has fluctuated with time despite unchanging pH. *Holcus* and *Anthoxanthum* also have very similar ecological requirements and at different times have dominated the same plots : *Holcus* was dominant for 30 years on Plot 9 and also for a shorter length of time on Plot 10 before being replaced by *Anthoxanthum*. The rapidity of transition suggests that the species have fairly similar requirements since it is unlikely that there would be any large differences in nutrient status of the soil during the time of change-over of species.

14 R