THE IDENTIFICATION OF WEED SEEDLINGS AND SOME ASPECTS OF WEED SEED BEHAVIOUR

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RESUM

Aquest estudi es refereix a la identificació dels plançons de les males herbes i toca uns quants principis bàsics de l'activitat de les llavors corresponents.

La correcta identificació dels plançons de les males herbes és la base essencial per a establir-ne un control efectiu. Establim aquí una sèrie de detalls per facilitar-ne la identificació mitjançant l'agrupament dels que posseeixen característiques comunes. Un llibre publicat a Anglaterra estableix certes referències sobre aquest mètode.

Hom té en compte la temporada en què apareixen les males herbes, els factors importants que regulen la latència de les llavors corresponents, el nombre de llavors que apareixen en terres de conreu i la vida que tenen aquestes llavors, ja que són referències útils per a comprendre com cal combatre els problemes de les males herbes d'una manera més efectiva.

SUMMARY

This paper is concerned with the identification of weed seedlings and with some of the basic principles of weed seed behaviour.

The correct identification of weed seedlings is an essential bassis for effective weed control. Details are given on how identification can be made easier by grouping together those which have common characteristics. Some details of this system are given from a book published in England.

Consideration is then given to the seasons when weeds emerge, to important factors which regulate dormancy in seeds, to the numbers of seeds which occur in arable soils and to the life-span of seeds, for these aspects are useful in understanding how the combat weed problems mostly effectively.

1. IDENTIFICATION

With the greatly increased use of herbicides in agriculture and horticulture, it has long been necessary to recognise weeds at the seedling stage. This is because they are most easily controlled at this stage and at this time the choice must often be made between a variety of herbicides, each of which is effective against a different range of species. Correct identification is therefore essential for effective weed control.

Unfortunately seedlings have relatively few characteristics an it is therefore advantageous to search for very young specimens so that the features of the cotyledons (seed leaves) can also be used. In my most recent book on seedlings identification (Chancellor, 1966) I have divided the 162 species into 32 groups based on the most obvious characters of the seedlings. Although the groups are taxonomically artificial every effort has been made to keep closely related species together. A dichotomous key is provided to reach the correct group. As no group contains more than 12 species the final naming of the seedling can be made from the illustrations. However, if difficulties are experienced then there are notes on the opposite page indicating the characters for distinguishing members of the group from one another and from other similar seedlings in other groups. In addition, the notes give details of the habitats in which each is found and the seasons of emergence.

The first group in the book is of members of the Leguminosae, in which the cotyledons remains below ground and the true leaves are of leaflets in opposite pairs, e.g. *Vicia* spp. and *Lathyrus* spp.

The second group is comprised of plants with true leaves divided into three leaflets, e.g. *Oxalis* spp, *Medicago* spp. and *Trifolium* spp.

The third group, which are mainly members of Cruciferae have branched star-like hairs on the leaves. Similarly, the other groups are composed of species which have obvious characteristics in common, such as the true leaves having spiny margins, or the cotyledons being kidney-shaped or very long and narrow, etc.

2. SEASONS WHEN SEEDLINGS EMERGE

In general, seedlings of annuals emerge in spring and autumn. Some, such as *Polygonum aviculare*, emerge only in the spring (Fig. 1). These are known as summer annuals for they pass the summer in the green or leafy phase and after flowering die in autumn. Other weeds germinate mainly in the autumn (Fig. 2). (In Britain *no* weed germinates only in autumn.) These autumn germinators include *Alopecurus myosuroides, Aphanes arvensis* (Fig. 2) and *Cerastium fontanum*. They are called winter annuals for they germinate in autumn, pass the winter in the green or leafy phase and flower and die in the following spring and summer.

Some of the most successful weeds germinate more or less equally in spring and autumn, e.g. *Papaver rhoeas* (Fig. 3), *Matricaria recutita* and *Stellaria media*. These benefit from any cropping rotation for they can germinate throughout the two main crop planting seasons.

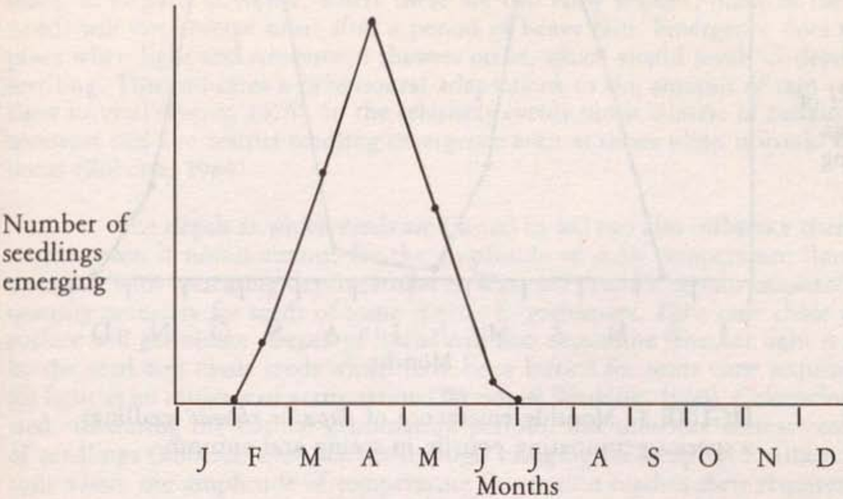

FIGURE 1. Monthly emergence of *Polygonum aviculare* seedlings, a summer annual germinating only in spring.

R.J. Chancellor Figure 1.

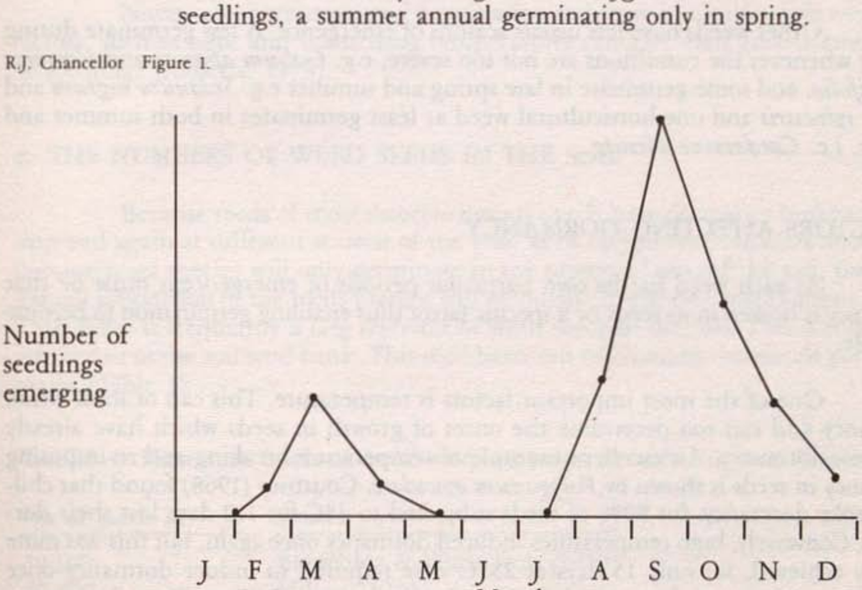

FIGURE 2. Monthly emergence of *Aphanes arvensis* seedlings, a winter annual germinating mainly in autumn.

R.J. Chancellor Figure 2.

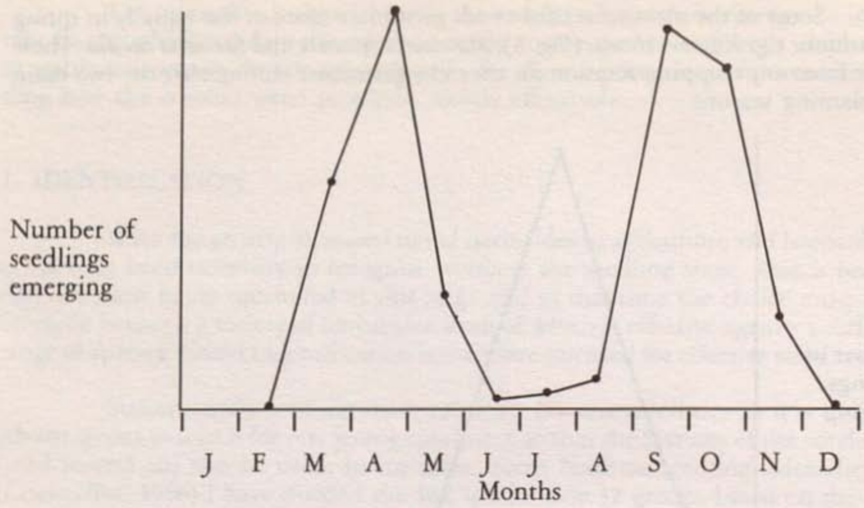

FIGURE 3. Monthly emergence of *Papaver rhoeas* seedlings, a species germinating equally in spring and autumn.

R.J. Chancellor Figure 3.

Other weeds have less usuals seasons of emergence. A few germinate during winter whenever the conditions are not too severe, e.g. *Galium aparine* and *Veronica hederifolia*, and some germinate in late spring and summer e.g. *Solanum nigrum* and *Malva sylvestris* and one horticultural weed at least germinates in both summer and winter, i.e. *Cardamine hirsuta*.

3. FACTORS AFFECTING DORMANCY

As each weed has its own particular periods of emergence,it must be that dormancy is broken in its seeds by a specific factor thus enabling germination to become possible.

One of the most important factors is temperature. This can of itself break dormancy and can too determine the onset of growth in seeds which have already lost their dormancy. An excellent example of temperature breaking and re-imposing dormancy in seeds is shown by *Polygonum aviculare*. Courtney (1968) found that chilling broke dormancy, for 80% of seeds subjected to 4°C for 110 days lost their dormancy. Conversely, high temperatures induced dormancy once again, but this was more rapidly achieved, for only 15 days at 25°C were required to induce dormancy once again in a majority of those which has just lost it through chilling. Thus *P. aviculare* germinates only in spring because the dormancy re-imposed by the warmth of summer can only be broken by the cold of the next winter. So temperature alone regulates the emergence pattern of this species and probably that of the other annual *Polygonum* species as well.

Moisture is another important factor regulating both dormancy and germination. Seeds from *Avena fatua* plants grown at 15° or 20°C showed less dormancy (22-53%) when matured under moisture stress than when matured with a sufficiency of moisture (70-90%) (Peters, 1982). Rainfall also regulates germination. In a dry climate, as in parts of Kenya, where there are two rainy seasons, many of the annual weeds will not emerge until after a period of heavy rain. Emergence does not take place when light and unseasonal showers occur, which would result in death of the seedling. This indicates a behavioural adaptations to the amount of rain to ensure their survival (Popay, 1976). In the relatively evenly moist climate of Britain, lack of moisture can also restrict seedling emergence even at times when it would normally occur (Roberts, 1984).

The depth at which seeds are buried in soil can also influence their germination, even if non-dormant, for the amplitude of daily temperature fluctuations decreases with increasing depth (Stoller & Wax, 1973) and a certain amplitude is frequently necessary for seeds of some species to germinate. Thus only those near the surface will germinate. Depth of burial will also determine whether light is received by the seed and many seeds which have been buried for some time acquire a need for light as an initiator of germination (Wesson & Wareing, 1969). Cultivation, if carried out during the natural germination periods, will therefore increase emergence of seedlings (Roberts, 1984) either through bringing seeds up into surface layers of soils where the amplitude of temperature fluctuation reaches their requirements or because they perceive light during the disturbance of the soil.

Nitrate also encourage seed germination and these in combination with other factors, such as light and fluctuating temperatures can give even greater emergence of seedlings (Roberts, 1973).

4. THE NUMBERS OF WEED SEEDS IN THE SOIL

Because seeds of most dicotyledonous weeds have dormancy broken and reimposed again at different seasons of the year, as in *Polygonum aviculare* above, and because most species will only germinate in the topmost layers of the soil, then only a small proportion of the seeds present will germinate in any one year (Roberts, 1966). Thus there is frequently a larg reservoir of weed seeds in the soil. This is commonly referred ot as the soil seed bank. This seed bank can reach many thousands per square metre (Table 1).

TABLE 1. Maximum levels of weed seeds recorded in arable soils in Britain.

No of seeds m^{-2}	Source
39,100	Brenchley & Warington (1930)
27,400	Milton (1943)
71,600	Roberts (1958)
86,000	Roberts & Stokes (1966)
24,300	Roberts & Neilson (1982)
25,000	Warwick (1984)

5. THE LIFE-SPAN OF SEEDS

At least 10 experiments have been made in which seeds have been buried at different depths in various containers and dug up again at intervals to see whether way remained alive.

The earliest and possibly the best-known experiment is that started by Dr. Beale at Michigan State University in 1879. When samples were exhumed after one hundred years of burial it was found that seeds of *Verbascum blattari, V. thapsus* and *Malva rotundifolia* germinated and produced normal plants. Six seeds of other species also germinated and produced normal plants. Six seeds of other species also germinated but died before identification was possible (Kivilaan & Bandurski, 1981). Another experiment in the USA started by Dr. Duvel in 1902 is also well-known. In this experiment seeds of 107 crops and weeds were buried. It lasted for 39 years and seeds of 32 species were still viable to some extent at the end (Toole & Brown, 1946). Other similar tests, which ran for shorter periods have confirmed that some weed species are capable of persisting for several decades in undisturbed soil.

Other experiments have been made on seed persistence in soil disturbed by cultivation. Here the situation is very different for, by disturbing the soil, buried seeds are encouraged to germinate. One of the more important experiments carried out in England (Roberts, 1962) has shown that the decline of seeds in a mixed species population approaches 50% per year, *provided no further seed is shed.* Mathematically this means that, with a half life of one year, it will take a farmer seven years of perfect weed control to reduce a serious infestation to 1% of the original population. This is unlikely to occur, for weed seeds will inevitably be introduced from outside and anyway weed control is seldom complete.

6. CONCLUSIONS

For satisfactory weed control it is essential to know the names of weeds and to be able to identify seedlings accurately. This enables the best herbicide or other treatment to be applied.

It is also necessary to know something about the weeds themselves, particularly their biology and ecology, for weak points in their life-cycle or behavioural characteristics can then be exploited to maximize the effectiveness of the weed control measures employed.

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