THE GERMINATION BEHAVIOUR OF WIREWEED SEED

A.E. SAUNDERS* and R.J. FIELD

Plant Science Department, Lincoln College, Canterbury

SUMMARY

Freshly shed wireweed (*Polygonum aviculare*) seed has a large proportion of innately dormant seeds; a maximum laboratory germination of 10.4% being achieved with alternating temperature and diurnal illumination treatments combined. Storage at 4 °C for 10 weeks removed innate dormancy from over 50% of the seed, provided seeds were kept moist during cold temperature treatment. The release from dormancy did not necessarily lead to immediate field emergence in the spring, with a large percentage of buried seed being in a state of enforced dormancy.

INTRODUCTION

Wireweed is an annual weed found growing along roadsides, in waste places and cultivated land (Hilgendorf and Calder 1960; Taylor 1980). Wireweed is essentially a plant of open habitats and by invading bare ground at an early stage it seems able to compete with many of the smaller grass species amongst which it can be frequently found. When, however, a closed sward is formed or the associated weed vegetation becomes dense, wireweed seems to disappear (Harper 1960; Taylor 1980). The growth habit of this weed is changeable, a reflection of the variable environment it inhabits; thus wireweed may be prostrate when in the open or erect when drawn up amongst cereals or grass (Taylor 1980). In the absence of a vigorous nurse crop wireweed has the ability to cover the ground rapidly, forming a dense mat, and/or shading crop foliage (Lawson 1976). In the light of these observations and the reported spring germinating habit of wireweed, it is not surprising that this weed is a problem in spring-sown crops, particularly if the crop is slow to develop an effective canopy cover, for example, mangels, swedes (Hilgendorf and Calder 1960) and sugar beet (Clare and Bray 1974). The wiry climbing habit of wireweed, may result in plants growing tall enough to interfere with machinery harvesting wheat (*Triticum aestivum*), peas (*Pisum sativum*) and dwarf beans (*Phaseolus vulgaris*) (Fryer and Makepeace 1977; Taylor 1980).

This study was carried out to determine the germination behaviour and innate dormancy characteristics of wireweed seed samples collected in Canterbury.

METHODS

Experiment 1

Wireweed seed was collected on 30 April 1981 by gently shaking plants to detach the seed. Germination of the seed was determined under four different sets of conditions described in Table 1.

Experiment 2

Wireweed seed was collected on 2 May 1980. Germination of this seed was determined immediately after collection and following dry or wet storage at 4 °C. Details of germination conditions are given in Figure 1.

Each treatment in experiments 1 and 2 used 100 seeds and the treatments were replicated four times.

Experiment 3

Wireweed seed collected for Experiment 1 was placed in unsterilized, but wireweed seed-free soil in pots (200 seeds/pot) and buried in the field, during June 1981. The seed was planted on the soil surface or at three depths (1, 5 and 10 cm) below the surface.

*Present address: Ruakura Agricultural Research Centre, Private Bag, Hamilton.

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TABLE 1: The percentage germination of freshly harvested seed of wireweed under varying conditions.

Temperature Illumination	14h - 18 °C/ 10h - 13 °C	24h - 25 °C
14h light/10 h dark	10.4*	1.6
24h dark	0.8	0.2

*significantly different from other treatments

The treatments were replicated six times. The emergence of seedlings was recorded over the spring-summer period and the seed remaining in the pots retrieved in July 1982. The germination percentage of the seed placed in the soil was determined at the time of burial and when the seed was retrieved from the buried pots the following winter (July 1982) by measurement in a 18 °C/16 h light and 13 °C/8 h dark environment.

In all experiments statistical analysis was carried out on arcsine transformed data and stated differences are significant at the 0.05% level.

RESULTS

In Experiment 1 the highest germination percentage of freshly harvested seed obtained was 10% when seed was placed in a moist, 18 °C/14 h light and 13 °C/10 h dark environment (Table 1). Both alternation of temperature and some illumination were required for maximum germination.

The germination percentage of the seed in Experiment 2, when tested at the start of the experiment under conditions of alternating temperature and light was similar to that obtained in Experiment 1 for freshly harvested mature seed. The germination percentage of the seed sample stored dry at 4 °C did not alter with duration of storage, while the percentage germination of seed stored moist at 4 °C and then placed in a 23 °C/16 h light and 18 °C/8 h dark environment steadily increased over a 10 week period and then became essentially constant (Figure 1). This treatment gave significantly higher germination than the other treatments. Germination of seed during moist storage at a constant 4 °C was observed in some samples after 16 weeks storage.

Fig. 1: The effect of period of chilling (4 °C), moisture status during chilling and subsequent germination conditions on the germination of wireweed seed.

Fig. 2: The mean cumulative total of wireweed seedlings emerging in the field following surface sowing or burial at various depths, from a sample of 200 seeds in each treatment.

In Experiment 3 seed placed on the soil surface or buried at 1 cm produced a few seedlings in early August. However, the onset of the main flush of germination was not until late August. By the end of September 90% of the seedlings that emerged that year had done so (Figure 2). The number of seedlings emerging from 10 cm was negligible; two out of a possible 1200 seeds. The number of seedlings emerging from 1 cm was significantly greater than that from 5 cm or from seed placed on the soil surface. Seed germination on the soil surface and seedling emergence from 5 cm were not significantly different except early in the season, with a more rapid seedling emergence from surface-sown seed. The fate of the seeds after one year of burial is shown in Figure 3. The same proportion of seed was unaccounted for at each depth of burial. This seed may have decayed, been lost in the retrieval process or have germinated but failed to emerge. Seed for this experiment had been collected and stored dry for 7 weeks prior to field burial. The percentage germination when tested at this stage was 45%. After a year of burial 96% of the retrieved seed germinated when tested under the same conditions.

Fig. 3: The fate of wireweed seed after one year of burial at various depths.

DISCUSSION

The seed of wireweed is described as possessing an innate dormancy when shed mature from the parent plant (Courtenay 1968; Hammerton 1964; Henson 1969; Justice 1941). Approximately 90% of the freshly harvested seed tested in the experiments reported here exhibited an innate dormancy (Table 1), preventing establishment of seedlings at the onset of harsh winter conditions. Germination of a small percentage of the freshly shed seed provides evidence of the variable dormancy status exhibited by a population of wireweed seed (Table 1).

The results of this study (Figure 1) show that the innate dormancy of wireweed seeds can be largely overcome if exposed to low temperatures (4°C) provided they are moist during this exposure. Although this overall trend of innate dormancy release is clear the absolute values recorded vary greatly between different wireweed populations. (Courtenay 1968; Hammerton 1964; Henson 1969; Justice 1941). This period of low temperature moist storage would naturally be provided in the soil by winter conditions, provided the seed was buried.

The pattern of seedling emergence in Experiment 3 if translated into Northern hemisphere seasons, shows a close agreement with previous work (Courtenay 1968; Roberts and Potter 1980; Wits 1960). However, the time of emergence may vary between years, as wireweed seedling emergence was first observed in late July in the previous year in Canterbury (Saunders 1982). Thus wireweed is a summer annual germinating in late winter or early spring. The emergence of wireweed seedlings occurred over a very limited period, in the absence of any soil disturbance, both in this experiment and a similar one conducted in 1981 (Saunders 1982).

Retrieval of buried seed in midwinter showed that the buried seed was in a germinable state yet emergence of seedlings was not expected for at least another month. It is likely that the environment of the buried seed prevents germination by imposing an enforced dormancy on the seed. The factors that release seed from this enforced dormancy require further study.

The fate of seed buried below the soil surface (Figure 3) indicates that not all viable seed buried at 1 cm germinated in the first spring season, although it is evident that a higher percentage of the seed was capable of doing so. It is significant that an even smaller fraction of seed buried at 5 cm was observed to emerge in the first spring following burial. These observations indicate the existence of subtle differences between the micro-environments of different seeds and also the possibility of subtle differences in the requirements of individual seeds in a population for the release of innate dormancy and enforced dormancy. Germination of only a small part of the viable buried seed in any one season ensures seed remains in the soil seed bank and is therefore present as a source of weed reinfestation the following spring.

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