Effects of interactions between germination environment, seed provenance and soil disturbance on emergence of Chenopodium album


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Materials & Methods
An experiment commenced in autumn 2005 aimed to assess the influence of the treatments on the magnitude and distribution of emergence of Chenopodium album agg., variability of the common seedlot among locations, and differences between the common seedlet and the local seedlet within a location. A common seedlot of C. album from Denmark was used at 11 locations: Canada, Czech Republic, Denmark, Finland, Italy, Norway, Portugal, Spain, Sweden, United Kingdom and USA (Illinois) (Figure 2). A local seedlot of C. album was also included at each site. 1000 seeds of either seedlot were mixed into a standard soil mixture in 24 plots of app. 0.049 m² to 5 cm depth in autumn 2005 (Figure 3). The treatments were disturbance, simulating tillage, at 5 different times before, at and after emergence in spring 2006 in undisturbed soil. The timing of disturbance events were standardised as much as possible between sites using the number of growing degree days (approx. 50, 100, 200 and >200 day degrees) after the first seedling emergence was observed in the untreated pots.

Results so far
1. In no cases did the treatments result in the expected decrease in number of emerged seedlings over time from the first to the last treatment for the common seedlot (Figure 4). However, except for Sweden, a decrease was seen for at least some of the later treatments, indicating that our hypothesis could be true for these treatments. The reason for less emergence after early disturbance could be that this disturbance was often performed in very moist soil, possibly resulting in dense soil with less aeration and a crust that was difficult to penetrate.

2. Almost all treatments resulted in more emergence than the no disturbance treatment. However, the effect differed greatly among locations (Figure 4). At one location (Denmark), emergence was increased to approx. 7 times that in untreated soil, while at another (Sweden) the largest increase was only about 1.3 times greater than the untreated soil. Most locations reached between 2 and 6 times the number of emerged seedlings in disturbed compared to untreated soil. The actual numbers also differed greatly among locations; the lowest emergence varied between 11 (Spain) and 167 (Sweden) seedlings, the highest between 93 (Spain) and 382 (UK) seedlings.

3. Noticeable time lags between disturbance events and emergence flushes were not consistent among sites and are most likely explained by environmental variability at the time of disturbance (Figure 4). Generally, disturbance in a dry soil resulted in a much longer lag phase than a disturbance in a moist soil, or in a dry soil shortly before a precipitation event. Initial results showed significant differences in emergence patterns between common and local seedlots.

4. At half of the locations the emergence from local seedlots was lower – in some cases much lower – than the common seedlot from Denmark, while at the remaining locations they were approximately the same. Also the reaction to timing of treatments differed between seedlots within some of the locations.

Conclusions
All of these results warrant further analysis and exploration which is currently underway. A new series of experiments is being planned for the Working Group in autumn 2007. Despite variation amongst locations, the results overwhelmingly demonstrate that seedling emergence of C. album reacts positively to superficial soil disturbance.

The problem
Soil disturbance may influence weed emergence:

- **Positive influences** could occur by exposing seeds to light or increasing oxygen in the soil, by reducing water logging, or by breaking soil crusts.

- **Negative effects** include killing or burying seeds that have already started to germinate (at the white thread stage – Figure 1).

In the field, a disturbance event could be affected through preparation of seedbeds or mechanical weed control. Added knowledge about the effects of such disturbance events on any modification of emergence patterns or depletion of the seedbank will be beneficial.

Figure 1. Seedling at “white thread stage” exposed during soil disturbance

Our hypothesis was that: the later the soil was disturbed, the fewer seedlings would occur because of the preponderance of the latter negative effects.

Figure 2. Experimental sites at in Italy (right) and the Czech Republic (left)

Figure 3. Excavated “pots” lined with mesh

Figure 4. Emergence of C. album (common Danish seedlot) at 11 different sites

**Treatments:**

<table>
<thead>
<tr>
<th>Arrows show time of disturbance for treatment of corresponding colour</th>
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<tbody>
<tr>
<td><strong>Untreated</strong></td>
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<tr>
<td>1st soil disturbance (T1) (when emergence seen under glass plate)</td>
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<tr>
<td>2nd soil disturbance (T2) (when emergence seen in the untreated pots)</td>
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<tr>
<td>3rd soil disturbance (T3) (approx. 50 day degrees)</td>
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<tr>
<td>4th soil disturbance (T4) (approx. 100 day degrees)</td>
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<tr>
<td>5th soil disturbance (T5) (approx. 200 day degrees)</td>
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<tr>
<td>6th soil disturbance (T6) (approx. 200 day degrees)</td>
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<td>All sites sowed 1000 seeds per pot, except Sweden (4000 seeds per pot) and Spain (2000 seeds per pot) – both shown here rescaled to 1000 seeds per pot</td>
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This study is an activity of the EWRS Germination & Early Growth Working Group

Background photo supplied by Bastian Brak