

Artificial Selection for Early Flowering in the Native Radish



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Introduction

Agricultural weeds cost the U.S. agricultural industry more than \$26 billion annually, due to decreased product yield and herbicide costs.

To learn about crop weeds, we studied wild radish (*Raphanus raphanistrum* ssp. *raphanistrum*). Wild radish exists in two forms, weedy and native, most noticeably differing in flower production time. Weedy radish is a bad weed in agricultural fields, and has evolved to grow and complete its life cycle rapidly, in order to reproduce in between harvesting seasons. In contrast, the native radish is free from agricultural crop time constraints, and takes much longer to flower and set seed. Native radish are winter annuals endemic to the Mediterranean, which germinate in the fall, flower in the spring, and sometimes require a cold period before flowering. To understand the relationship between native and weedy radish, we use artificial selection for early flowering on the native variety in order to compare them to the growth pattern of the weedy variety.



Native Radish

- Endemic to the Mediterranean
- Winter annuals

Weedy Radish

- Found in most agricultural fields
- 1-2 month life cycle

Questions

- How great is the difference in flowering rates between the control and selected lines of native radish?
- Will other phenotypic measurements like first flower height, and leaf size correlate to faster growth rate?

Hypothesis

The selected line will show faster flowering times, and tested phenotypic measurements will have a correlated response to selection on earlier flowering.

Methods



Flower height measured from soil to base of first flower pedicel (stem)

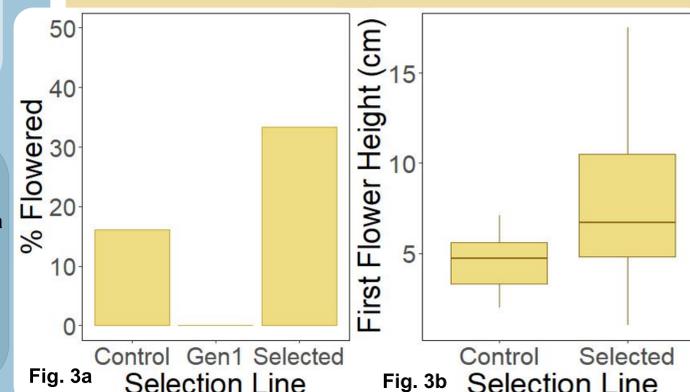
- Grew two native populations of wild radish, DEES and MAES.
- Recorded flowering time, flower height, rosette height, and number of leaves per rosette (only the first two are included in analyses).
- Additionally recorded largest leaf length and width.

Fig. 1 Flowering native radish plant. Two populations of native radish, DEES and MAES, were grown, but only MAES had enough data in the time period given. The MAES population was used for the data found in Figure 3. Rosette height and number of leaves showed no correlation, and so were not included in our findings.

Results

- Selected lines of both DEES and MAES were shown to flower the most in the time given.
- Selected lines were also found to have taller flower heights.

Fig. 3a Percent of flowered plants per selection line. 3 lines of plants were grown, Control, a second control (Gen 1, in case the Control may have undergone unintentional selection), and a line Selected for earlier flowering. Selected lines showed more flowering than either controls. (Chi-square, $\chi^2=22.2$, $p<0.01$)
Fig. 3b First flower height per selection line. Plants selected for earlier flowering were also found to have taller first flowers (t-test $t = -2.9779$, $p<0.01$).



Results (cont.)

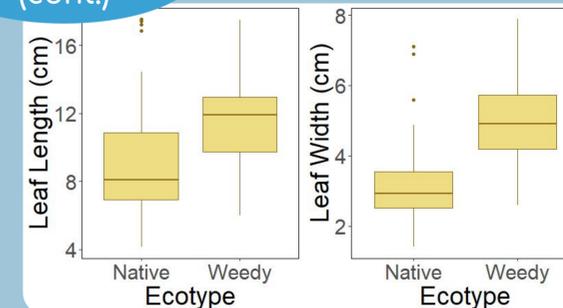


Fig. 4 Native vs Weedy leaf length and width. Measurements were taken of leaf dimensions using images from a 2016 experiment. Both weedy and native radish plants were measured, and weedy plants were found to have larger leaves (t-test, width $t = -8.0853$, $p<0.01$, length $t = -4.5922$, $p<0.01$).

- Weedy radish plants were found to have overall bigger leaves.
- Knowing this, future experimentation could look for a correlated response of leaf size to selection on earlier flowering time.

Conclusion

- As hypothesized, the selected lines of wild radish were found to flower earlier than those that were not artificially selected for earlier flowering.
- A significant difference between native and weedy leaf sizes was observed.
- In future experimentation, we will measure the leaves of selected native radish plants in search of a correlated response to early flowering.

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