**Online Appendix**

**: Specific assumptions used in model simulationsmore weeds will reduce crop yields more.d next step when testing in real system**Table A1: Specific model assumptions

|  |
| --- |
| Model Assumptions |
| All weeds emerge simultaneously within their class, classified as “early” or “late” |
| Seeds removed from the seed bank by death, predation, and germination |
| Seed bank decays over time, but individual seeds do not have age-dependent germination |
| Crop effects on weeds are constant over time, but each crop can affect each weed differently |
| No environmental effects (e.g. wet/dry years, soil type) other than crop choice |
| Competition through the RYL contains both intra and inter-specific weed-weed competition |
| Impact parameters *Icj* picked so that cool crops have larger impact on warm weeds, and this is fixed for each simulation.  Different management practices and weed resistance can be described with *Icj* |
|  |
| No effects of facilitation between weeds or crops |
| No separate analysis of crop management practices (e.g. roundup ready corn vs. traditional corn, no-till vs. full till). All effects of management are contained in the *Icj* term. |
| Parameters based on generic types, not parameterized using real system data (a recommended next step when testing in real systems is discussed in the text). |
| Fewer weeds lead to less impact on crop yields; more weeds will reduce crop yields more. |

**Online Appendix**

Additional supporting figures, displaying similar results for other parameter sets, illustrate the generality of our qualitative results.

**Online Appendix Figure Legends**

**Figure A1.**In the main text, the competitive and fecund weeds were summer weeds. Here, we consider them as winter weeds. However, the same decrease in mean number of seeds as stacking number increases is observed. Also, the cross in the plots for the maize-soybean-wheat and maize-soybean-wheat-canola rotations show that the optimal rotation type can be dependent on stacking number. Stacking number has no effect on the soybean-wheat rotation because one of the species is competitively excluded.

**Figure A2.** In the main text, the conservative and risky weeds were both considered as winter weeds. Here, we consider the conservative weed to be a summer weed and the risky weed to be a winter weed. There is no advantage to stacking here, consistent with the results in the main text considering one summer weed and one winter weed.

**Figure A3.** In panels a-c, we change the intensity of rape on the conservative weed from 0.8 to 0.9, while leaving all other parameters and species life history traits constant. The changes observed in the plot for the maize-soybean-wheat-canola rotation across panels a-c illustrate that results can be sensitive to changes in intensity.

B

A

C