

Impacts of Long-term Cultural Practices on Weed Flora in Cereals

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The Long Term Research in Agricultural Systems project was initiated in the fall of 1993 at the University of California, Davis, research farm. The project compares three nitrogen supply systems: no additional nitrogen, adequate nitrogen fertilizer, and use of a vetch and pea winter legume cover-crop. The systems were either rain-fed or with supplemental irrigation as required in the spring. A two-year wheat/fallow rotation was employed. The wheat versus fallow entry points into the two-year rotations were maintained separately. Weeds in clean fallow systems were controlled with glyphosate. Broadleaf weeds in the wheat were controlled with a mixture of MCPA and bromoxynil. All treatments were replicated three times, and each individual plot was one acre (220 ft by 220 ft). Winter annual weeds were evaluated by annual counts in five quadrats per plot; quadrat size was adjusted according to weed density so that at least 100 weeds were assessed at each location.

Long Term Research in Agricultural Systems



A 100-year experiment located at the Russell Ranch, west of Davis: 1994-2008

Photo by Ford Denison

The total number of weeds showed no consistent change over the first 14 years. Species composition of the weed flora did change, however, in relation to nitrogen supply, irrigation, and weed management.

- Shepherd's purse (*Capsella bursa-pastoris* (L.) Medic.) was the dominant weed at the initiation of the experiment in 1994, but had been reduced to a minor species in all systems by 2008. All other weed species constituted less than 1% of the population at initiation in 1994.
- Systems using a winter legume cover-crop to provide nitrogen had higher, but variable, overall weed populations, which were dominated by common chickweed (*Stellaria media* (L.) Vill.) and miner's lettuce (*Claytonia perfoliata* Willd.) by 2008. Miner's lettuce did not increase in cover-crop systems with the fallow entry point until after 2003.
- After an initial lag period of about 8 years, yellow sweetclover (*Melilotus officinalis* (L.) Lam.) became a significant component of the weed population in systems that did not receive additional nitrogen.

- Henbit (*Lamium amplexicaule* L.), unexpectedly, became a significant component of the weed flora in the fallow entry point systems that did not utilize winter legume cover-crops; no increase occurred in systems that started as the wheat rotation at initiation.
- Species such as little mallow (*Malva parviflora* L.), coast fiddleneck (*Amsinkia intermedia* Fisch. & Mey.), wild mustard (*Sinapis arvensis* L.), common sowthistle (*Sonchus oleraceus* L.), and tooth-pick ammi (*Ammi visnaga* (L.) Lam.) were present in several systems, but populations were variable and remained at low levels.
- During the first eight years of the project littleseed canarygrass (*Phalaris minor* Retz.) populations increased in all systems with wheat as the crop at entry. Annual applications of the grass-killing herbicide fenoxaprop-p-ethyl since 2002 resulted in a subsequent decline in the grass population. However, for reasons that are not clear, the littleseed canarygrass increased between 2004 and 2008 in systems that were fallowed at initiation.
- Annual bluegrass (*Poa annua* L.) has increased in all systems with supplemental irrigation in contrast with rain-fed systems, and has become more abundant in systems employing the winter legume cover crop.

The following conclusions can be made after 14 years of different management strategies. Changes in weed populations required multiple years to be manifested; short term predictions (less than 5 years) were usually wrong.

- The two entry points into the rotations resulted in different changes in weed populations; no explanation can be provided for these differences.
- Utilizing a winter legume cover crop to provide nitrogen resulted in a small overall increase in total weed density; major population shifts towards increased common chickweed, miner's lettuce and annual bluegrass occurred. The winter legume cover crop suppressed the invasion of henbit into that treatment, but caused increases in miner's lettuce populations.
- Using only a broadleaf herbicide in the wheat crops resulted in steadily increasing littleseed canarygrass populations in all systems during the first eight years.
- Lack of nitrogen fertilizer allowed invasion by the nitrogen fixing weed yellow sweetclover.
- Several weeds developed larger populations in response to supplemental irrigation used in the spring to improve wheat yield.

The results clearly demonstrate that different management practices can result in alteration of species composition of the weed flora in wheat agricultural ecosystems, and that some changes could be expected based on understanding the ecology of weeds.