



Managing Herbicide Resistance

Crop Diversity in Rotations Can Help Manage Resistant Weed Populations (Central Great Plains)

Resistance in weed species is a key issue in weed management. Producers are seeking strategies to either avoid development of resistance or to minimize population growth of resistant biotypes now present.

One strategy is to diversify the crop rotation by adding crops with different growth periods. Crop diversity provides more opportunities for producers to control targeted weed species and prevent seed production. The impact of this strategy can be quantified by mathematical models that monitor weed populations across time.

One such model has been developed for jointed goatgrass. Components of the model include seed survival in soil, seedling emergence, seed production per plant, and removal of seed with grain at harvest. The model represents average growth conditions for jointed goatgrass with a no-till system in the Central Great Plains.

With this model, we predicted changes in jointed goatgrass population when summer annual crops such as corn and proso millet were added to a winter wheat-fallow rotation. We also compared two management systems in winter wheat, a conventional system comprised of a short-stature cultivar planted at 40 lbs/acre with N fertilizer broadcast before planting, and a competitive system comprised of a taller cultivar, higher seeding rate (65 lbs/acre), and N placement near the seed. A competitive canopy can reduce jointed goatgrass seed production per plant 45%.

Our simulation started with one jointed goatgrass plant in winter wheat. After 12 years, jointed goatgrass density in winter wheat-fallow (W-F) was 4610 plants (see Table below). In contrast, adding two summer annual crops to the rotation (W-C-M-F) eliminated jointed goatgrass, whereas adding spring wheat to W-F reduced

population growth six-fold. The difference in densities between W-C-F and W-SW-F reflects jointed goatgrass establishment and seed production in spring wheat. The later planting date with corn enables producers to control jointed goatgrass before they produce seeds. Growing winter wheat two years in a row, as in W-W-C-M, eliminates the effect of summer annual crops on jointed goatgrass population.

Table. *Population growth of jointed goatgrass across 12 years, as affected by crop rotation. The simulation started with one jointed goatgrass plant infesting the first winter wheat crop in each rotation.*

Rotation	Winter wheat canopy	
	Conventional	Competitive
	plants	plants
W ^a -F	4610	144
W-SW-F	806	16
W-C-F	6	0
W-C-M-F	0	0
W-W-C-M	4260	118

^a Abbreviations: W – winter wheat; F – fallow; SW – spring wheat; C – corn; M – proso millet.

Increasing the competitiveness of winter wheat further minimizes population growth of jointed goatgrass. Note that jointed goatgrass density in W-F was 32-fold less with a competitive canopy (4610 vs. 144).

Our simulation demonstrates the impact of crop management on weed resistance. If a resistant jointed goatgrass plant developed, it would not maintain a viable population in W-C-M-F. In contrast, the resistant population would increase dramatically in rotations comprised mainly of winter wheat.

Written by the WSWS Resistant Plants Committee

Dan Ball (Daniel.Ball@orst.edu) Mike Ensminger (Mike.ensminger@syngenta.com)
 Donn Thill (dthill@uidaho.edu) Steve Seefeldt (sseefeldt@pw.ars.usda.gov)
 Carol Mallory-Smith (Carol.Mallory-Smith@orst.edu)
 Kirk Howatt (khowatt@ndsuxt.nodak.edu)
 Mary Corp (Mary.Corp@oregonstate.edu)
 Jim Harbour (james.d.harbour@usa.dupont.com)
 Randy Anderson (randerson@ngirl.ars.usda.gov)