Effects of Weeding Tactics and Nutrients on Weed Species Composition and Abundance in Vegetables

Douglas Doohan and Karen Amisi
Department of Horticulture and Crop Science
The Ohio State University – OARDC
1680 Madison Avenue, Wooster, OH 44691

Weed management is one of the biggest challenges faced by organic farmers and thus anything that can be done to reduce costs and improve control is of great interest. Weed ecologists have long considered the question of 'how much weed control is enough?' Is it possible that some organic farmers are spending more money on weed control than necessary? Are weed control dollars spent in the most useful way? We investigated two contrasting strategies to reducing costs and improving control, the Critical Period (CP) of competition and No Seed Threshold (NST). In the CP, weeds are controlled just long enough (usually 4-6 weeks) to prevent yield losses – after that no weed control is done. The goal of the CP is to minimize the cost of controlling weeds in a single year's crop. In contrast weeds are controlled throughout the growing season in the NST with the long-term goal of depleting the soil weed seedbank. During early years the cost of the NST will be high but in time will largely eliminating the need for intensive weed control.

In 2001, a 4-year transitional organic rotation of wheat, clover, cabbage, and processing tomato transitioning to organic was established at the Ohio Agricultural Research and Development Center in Wooster, OH, in a field previously in a conventional corn/soybean/forage agronomic rotation. The experimental design was a split plot in a randomized complete block design with 4 replications. Main plots were soil amendments (none, raw dairy manure, composted dairy manure). Amendments were applied in spring at the rate equivalent of 101 kg N/ha and incorporated prior to planting. Subplots were weed control strategies: NST, where seedling weeds were removed weekly for the whole season and no weeds permitted to mature seeds in the field, and CP, where plots were kept weed-free only for the first 5 weeks of crop growth. Each crop had 6 main plots of 222 m^2 each and 24 subplots with an area of 56 m^2 each. Weeds that occurred in each treatment were identified and counted several times throughout the growing season and seeds in soil samples taken each spring were identified and quantified in the greenhouse through exhaustive germination.

Forty-six weed species were identified from the soil weed seedbank and of these 40 species occurred in plots over the four years. Summer annuals (60%) were dominate, though some winter annuals (23%), biennials, simple and creeping perennials were present. Redroot pigweed (*Amaranthus retroflexus*) and common lambsquarter (*Chenepodium album*), were the dominant species and this discussion is restricted to them. Season-long weed control (NST) did not improve yield of cabbage or tomato over 6 weeks of weed control (CP) in any year. For any given year alone the cost of the NST was not justified. However, seed production on weeds that grew after the CP was significant and contributed to future weed control costs; whereas, this did not occur in NST plots. Hand labor required for the NST exceeded that required for the CP by about 100 – 200% depending on the year. However, by weeding every week when seedlings were small and easy to kill (the key to low-cost weeding) labor costs in NST plots for the

entire season never exceeded $327/A. The NST reduced pigweed and lambsquarters seed identified from soil samples by 50 - 90% in one year when compared to seed numbers in samples from CP plots. Seed number in the seedbank declined progressively each year of the rotation. The number of emerged seedlings was also lower each year in NST plots; however, this reduction was not always statistically significant. This is not surprising when one considers that even with a 50 – 90% reduction in seeds, each acre of soil still contains many millions of seed. It was not possible to maintain this research beyond the initial 3 years due to lack of funding and soil weed seedbanks were never sufficiently depleted to cause a reduction in weed control costs. However, data from California indicates that preventing weed seed production for 5-6 years will reduce weed populations sufficiently for the cost of weed control to drop.

Impact of the soil amendments on weed communities was not determined with certainty. Generally, there were fewer pigweeds and lambsquarters in manure amended plots than in unamended soils or soils amended with compost. However, this was not consistent. In a couple of instances the number of emerged weeds was highest in manure amended plots. In greenhouse experiments, redroot pigweed was very sensitive to manure additions to field soil. For most parameters of plant growth (height, leaf area index, seed production), even the lowest ratio of soil:manure (7:1) reduced growth relative to soil that had not been amended. Plant growth response to compost in the media was somewhat variable from parameter to parameter, but was always equal to or greater than growth in soil. These data indicate that weed community structure might change over time as organic amendments are added to the soil. Changes brought about in this manner may have positive or negative implications for weed management and these deserve closer attention.