EARLY-SEASON MORPHOLOGY OF GIANT RAGWEED AND WOOLLY CUPGRASS AS AFFECTED BY CROP-MEDIATED CHANGES IN LIGHT QUALITY. Greta G. Gramig and David E. Stoltenberg, Graduate Research Assistant and Professor, Department of Agronomy, University of Wisconsin, Madison, WI 53706.

Process-based descriptions of competition between weed and crop plants require knowledge of the mechanisms underlying alterations in plant morphology that are key determinants of resource acquisition among competitors. Plants use an array of physiological mechanisms to sense changes in resource availability and to alter production and distribution of biomass so that investments maximize returns, i.e. competitive ability. Numerous studies conducted in controlled environments have documented altered biomass allocation patterns in response to changes in light quality. Exposure to decreased red/far-red (R/FR) ratios, which are characteristic of plant canopies where red wavelengths are preferentially absorbed, has been associated with changes in root to shoot ratio, vertical leaf area distribution, stem length, specific leaf area, and branching pattern. Previous results suggest that plants sense subtle changes in R/FR ratios that occur before mutual shading; it has been hypothesized that this may be a critical mechanism for early neighbor detection and avoidance. Few studies have investigated the effects of decreased R/FR ratios on competitive interactions among plants in the field, where light intensities far exceed those in controlled environments, and where other important environmental variables fluctuate both spatially and temporally. Our objective was to determine if crop-mediated changes in light quality are associated with early changes in weed morphology in the field. Preliminary experiments were conducted to investigate methodological approaches, with the results primarily intended for planning of subsequent experiments.

Four field experiments were conducted in 2003 at the University of Wisconsin-Arlington Agricultural Research Station. The design of each experiment was a randomized complete block with three replications. The experiments were giant ragweed in corn, giant ragweed in soybean, woolly cupgrass in corn, and woolly cupgrass in soybean. Standard agronomic practices were used for seed bed preparation, fertilization, and crop planting. Weed seeds were planted by hand 1 d after crop planting. Each plot consisted of a 6.10-m long row of target weed plants equidistant between two rows of neighbor crop plants spaced 0.76-m apart. Light quality treatments were imposed by 1) removal of neighbor crop plants at emergence, 2) removal of neighbors when shading of weeds commenced, and 3) no removal of neighbor plants. A spectroradiometer with a 25-degree field of view was used to measure the spectral composition of horizontally propagated radiation from 325 to 1,075 nm at the apex of target weed plants. Spectral irradiances of 645 and 735 nm were used to calculate R/FR ratios. Target weed plants were measured before mutual shading to determine shoot height and volume, mainstem internode number and length, leaf area, branch or tiller number, and biomass of leaves, branches, and mainstems. Root biomass was measured for woolly cupgrass only. Analysis of variance and specific paired comparisons were used to assess the effect of treatments on plant morphological attributes including total shoot dry biomass, specific mainstem length (SSL), leaf area ratio (LAR), leaf to shoot ratio (LSR), specific leaf area (SLA), leaf mass ratio (LMR), shoot height, branch or tiller number, average mainstem internode length, mainstem internode number, and root to shoot ratio (RSR). Analysis of variance was also used to determine treatment effects on R/FR ratios.

Prior to mutual shading, R/FR ratios were consistently lower for target weed plants with adjacent neighboring crop plants, except for giant ragweed in corn. Woolly cupgrass LSR, LMR, and RSR were greater without corn neighbors than with corn neighbors. In soybean, woolly cupgrass RSR was greater without crop neighbors than with neighbors. In corn, giant ragweed SSL, LAR, and SLA were lower and biomass was greater without crop neighbors. For giant ragweed in soybean LAR was lower and number of branches was greater without neighbors. These results suggest that early season shifts in R/FR ratios were associated with changes in weed morphology, but that the response was species-specific.

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