ESTIMATING PLANT GROWTH IN MIXED SPECIES COMMUNITIES FROM MONOCULTURE EXPERIMENTS. Michael J. Moechnig*, David E. Stoltenberg, Chris M. Boerboom, and John M. Norman, Graduate Research Assistant, Associate Professor, Professor, Department of Agronomy, and Professor, Department of Soil Science, University of Wisconsin, Madison, WI 53706.

Traditional approaches of characterizing the relative competitive ability of plant species based on mixed species communities have been problematic in some aspects. These approaches are often labor intensive and results are often inconsistent among years and locations. Furthermore, few experiments address the influence of asymmetric competitive effects on relative competitive ability. Estimating plant competitive ability based on monoculture experiments may be less labor intensive and results may be more consistent. However, it has been difficult to apply the results from monoculture experiments to mixed species communities. One principal reason for this is the inability to accurately predict the plasticity of height growth, which is necessary for accurate estimations of light interception.

The plasticity of height growth may be influenced by light availability and the wind stress imposed on each plant. Plants growing in lower density communities are exposed to greater wind stress per plant, thus greater stem mass per unit of height is required for support. In higher density communities, wind stress is distributed among more stems resulting in greater height per unit of stem mass. Stem height growth is also a function of stem mass, which is determined by the quantity of available light for carbon assimilation. Therefore, height growth can be described as a function of light availability and wind stress. The objectives of this study were to parameterize a mechanistic model that characterizes the plasticity of height growth and use the model to determine whether plant growth interactions in mixed species communities can be estimated from monoculture experiments.

Common lambsquarters, giant foxtail, or corn monoculture experiments were established at the University of Wisconsin Arlington Agricultural Research Station in 2002. Density treatments were 4, 49, or 120 plants m^{-2} for common lambsquarters, 4, 64, 1000 plants m^{-2} for giant foxtail, and 3, 9, or 21 plants m^{-2} for corn. The experimental design was a randomized complete block with 3 replications of 4- by 4-m plots for each weed species or 6- by 6-m plots for corn. Plant height, leaf area, and biomass partitioning to leaves and structural material was measured from two plants per plot on a weekly basis for the first 6 wks after emergence and then biweekly until physiological maturity.

The mechanistic growth model was parameterized to accurately predict the density effect on biomass accumulation per plant and height growth in monoculture communities of each species. The parameterized model was validated using data from previous studies conducted at the Arlington Agricultural Research Station. The first study, conducted in 1998 and 1999, included a wide range of densities and species proportions of common lambsquarters and giant foxtail in corn. The second study, conducted in 2000 and 2001, included equal proportions of common lambsquarters and giant foxtail at one density planted at three different times relative to corn planting. Validation results indicated that the model accurately characterized the difference in common lambsquarters height when grown in corn compared to that in monoculture. Intraspecific interactions of weed communities in a corn canopy were also accurately characterized. Consequently, growth parameters estimated from monoculture experiments accurately predicted the effects of weed density and time of emergence on corn yield loss.

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