

WEED ESCAPES AND DIVERSITY IN GLYPHOSATE-TOLERANT SOYBEAN: TRENDS ALONG A TRANSECT FROM MINNESOTA TO LOUISIANA. Frank Forcella, Research Agronomist, USDA-ARS, Morris, MN 56267.

Objectives of this study were to examine the number and diversity of weed escapes, as well as soybean yields, along a latitudinal transect in glyphosate-tolerant soybean systems. An additional aim was to determine mechanisms that allowed certain species to escape control by glyphosate. Data were collected in 2001 and 2002 from established weed management trials at 12 experiment stations along a north-south gradient throughout the central USA. The states (and number of sites) included Minnesota (4), Iowa (3), Missouri (2), Arkansas (2), and Louisiana (1). Yield and weed diversity data were collected from the following herbicide treatments: One-Pass Glyphosate, Two-Pass Glyphosate, Standard PRE + Glyphosate, Standard PRE only or PRE + Standard POST or Standard POST only, and Weedy Check. Field methods and calculations included yield samples, density recorded by species, percent cover recorded by species, effective species richness ( $e^H'$ ), 3 to 4 plots per treatment, and field sampling in autumn. At the Minnesota sites, permanent quadrats were monitored in weedy check treatments to determine patterns of seedling emergence. Seeds of plants that escaped control in glyphosate-treated plots were collected, as were those from weedy check plots. These seeds were germinated in pots, the seedlings exposed to a dilute rate of glyphosate in a spray cabinet, and assessed two weeks later. For crop yields, no latitudinal trends for weedy checks were apparent, possible slight decreases in maximum yield occurred with latitude for the Two-Pass Glyphosate and PRE + Glyphosate treatments, and strong positive increases occurred in maximum yield with latitude for One-Pass Glyphosate and PRE/POST treatments. For weed diversity, there were no latitudinal trends, but distinct treatment effects: weedy checks had highest weed densities, but not necessarily the highest  $e^H'$ , and this was consistent between years; One-Pass Glyphosate always had high diversity; Two-Pass Glyphosate and Standard PRE + Glyphosate had the best weed control and lowest diversity; and Standard PRE/POST also had low diversities, but not necessarily low densities. The One-Pass Glyphosate treatment allowed for the expression of the greatest diversity, apparently by suppressing the dominant species, thereby allowing less common species too express themselves in the population. If weed diversity is valued by society, as in Europe, farmers can maintain better diversity with a One-Pass Glyphosate application than with traditional treatments and still maintain high yields, but only at higher latitudes. Below 45°N latitude, yields in the One-Pass Glyphosate treatment decreased by about 2% per degree of latitude. During 2001 about 70% of the variation surrounding the number of weed escapes found at the study sites could be explained simply by the abundance of weeds found in weedy check plots. That is, weedy fields tended to have more escapes than clean fields. However, during 2002, only 13% of the variation could be explained by general weediness of experimental sites. Delayed emergence played an important role in governing the likelihood to escape control. Escaped species were those that had low levels of emergence when glyphosate was applied, especially at the first application. Fecundity of late-emerging plants may be a key to understanding proliferation of some species in cropping systems that use glyphosate frequently. The number of escapes in the Two-Pass Glyphosate treatment was an order of magnitude less than that in the One-Pass Glyphosate treatment. Seeds of plants that previously were exposed to field rates of glyphosate sometimes produced seedlings that tolerated dilute glyphosate applications better than plants not previously exposed to glyphosate. This phenomenon was most obvious in common lambsquarters (*Chenopodium album*), which was the most frequently observed species that escaped control by glyphosate in our studies.

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