GLYPHOSATE: A RE-APPRAISAL OF THE THREAT TO CROP PLANTS

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The environmental safety of glyphosate herbicide results partly from the strong adsorption of glyphosate residues in soil. Although glyphosate is commonly thought to exhibit no residual activity, recent field work with tomatoes has shown that phytoactive residues can persist, at least in sandy soils (1). Adsorption may also be low, and phytoactivity high, in soils with a low unoccupied P-sorption capacity. This paper reports experiments designed to re-assess the threat of glyphosate residues to crop plants.

MATERIALS AND METHODS

The first experiment examined the effect of soil texture and superphosphate on the response to glyphosate, using the tomato bioassay method of Cornish (1). Glyphosate at 0, 0.36, 0.72, 1.44, 2.88 and 5.76 kg a.i./ha was sprayed on to the surface of sand (6% clay), loam or clay soil in pots which had previously been treated with a single superphosphate topdressing at 0 or 1000 kg/ha. Tomato seedlings were transplanted into the soil 24 hrs after spraying. The second experiment measured the effect of glyphosate solutions (0, 9, 18, 27 mg/L) on germination and subsequent non-photosynthetic growth of nine field crop species in standard germination tests. The third experiment estimated the null-observable effect level for root-absorbed glyphosate in the same nine species growing in solutions of glyphosate (0-36 mg/L)

RESULTS AND DISCUSSION

Soil Texture. The effects of glyphosate and the interaction between glyphosate and soil type were significant ($P< 0.01$). Glyphosate reduced growth of tomatoes only in the sand and loam soils. Superphosphate had no effect on response to glyphosate. Rates of glyphosate of 0.36 and 2.88 kg a.i./ha were required to reduce growth in the sand and loam soils, respectively.

Germination and pre-emergence growth. Glyphosate had only a small effect on germination but a substantial effect on root and coleoptile length (Table 1). To put these results into perspective, glyphosate applied at a typical rate of 0.7 kg a.i./ha and mixed to 5 cm depth in a soil with 20% volumetric water content would result in a soil solution concentration of 7 mg/L given no adsorption.

Table 1. Effect of glyphosate on germination and root and coleoptile length (mean of 9 species).

Concentration (mg/L)	Germination (%)	Coleoptile (mm)	Root (mm)
0	9^{a}	11.1^{a}	24.9^{a}
9	76^{ab}	7.5^{b}	15.2^{b}
18	73^{b}	6.4^{c}	13.0^{c}
27	72^{b}	4.4^{d}	10.3^{d}

Photosynthetic growth. In the third experiment, all nine species suffered reduced root and shoot growth when glyphosate concentrations in the solution culture were above 4.5 mg/L, with some species showing effects at concentrations as low as 1.1 mg/L. These results reveal potential for crop damage, and justify further work on glyphosate residues in light textured soils.

ACKNOWLEDGMENTS

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REFERENCES

1. Cornish, P.S. 1992. Aust. J. Exp. Agric. 32, 395-399.