Physiology of Benghal dayflower (*Commelina benghalensis*), a new invasive weed of the south-eastern USA

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INTRODUCTION

In the USA, Benghal dayflower (*Commelina benghalensis*) (also known as tropical spiderwort) is listed as a noxious weed in 35 states. In Georgia, in a span of just 3–5 years, Benghal dayflower has gone from a relatively unknown plant to the most troublesome weed in cotton. In most cropping systems, chemical, cultural and biological control for this invasive weed is limited and, in glyphosate-resistant cotton, glyphosate often fails to provide >70% control. The plant's ability to germinate and thrive under a crop canopy limits many traditional cultural weed controls strategies. In addition, the ability of Benghal dayflower to root from the nodal areas severely limits tillage as a control tactic. There are no known biological controls.

The objectives were to examine specific parameters of the leaf surface of Benghal dayflower in relation to herbicide uptake (including leaf composition, thickness and morphology) under three soil moisture regimes (75, 50 and 25% of maximum relative soil capacity) and to compare herbicide uptake in moisture-stressed and non-moisture-stressed plants.

MATERIALS AND METHODS

Greenhouse-grown Benghal dayflower was moisture stressed, using procedures similar to those described by Earl (2003), stress being determined by keeping pots at desired maximum relative soil water contents of 75, 50 and 25%.

Leaf characterization was done at the University of Georgia Center for Ultrastructural Research, with a JEOL 100 CX TEM. From these images, cuticle thickness and the number of trichomes/μm^2 were calaculated (see Table 1).

The dose response of Benghal dayflower to several herbicides was examined at the three soil moisture regimes described above. Plants were sprayed with four non-zero rates of 2,4-D, diclosulam, flumioxazin, glufosinate, glyphosate, metolachlor and glyphosate + metolachlor, to derive an ED_{50} (effective dose to kill 50% of the test population, expressed in g/ha) value at each moisture level, based on a visual injury scale of 0–100% (0 = no control; 100 = complete control). Plants (all then c. 15–20 cm tall) were sprayed following exposure to moisture stress for 2 wk, and the stress continued for 7 d after spraying. ^{14}C-herbicide uptake was examined in excised leaves following treatment with diclosulam, flumioxazin, imazapic, sulfentrazone, atrazine, glyphosate, metolachlor, ^{14}C-glyphosate + metolachlor and ^{14}C-metolachlor + glyphosate, a field-use rate being mixed with the ^{14}C-herbicide counterpart. Ten µlitre drops of herbicide solution (containing a total of 20,000–200,000 dpm) were applied uniformly to the upper surface of each mature leaf. Unabsorbed ^{14}C-herbicide was then removed by washing the treated leaf in 2 ml of 70:30 methanol:water v/v in a scintillation vial. The percentage of absorbed herbicide was then calculated by determining the amount of ^{14}C-herbicide in the leaf wash. Samples were quantified by liquid scintillation counting. ^{14}C uptake by the plant was expressed as the percentage of that applied.

RESULTS

Table 1. Cuticular thickness and trichome density of Benghal dayflower exposed to three soil moisture regimes.

	Moisture level (% of field capacity)		
	25	50	100
Cuticle thickness (µm):	1.1 ± 0.26	0.55 ± 0.07	0.30 ± 0.07
Trichomes/μm^2:	0.045	0.030	0.020

Leaf cuticle and trichomes increased with soil moisture stress (Table 1). Benghal dayflower was more susceptible to flumioxazin, glufosinate and metolachlor at higher moisture levels. The response to flumioxazin (ED_{50} = 2.9 to 0.1 g/ha; from 25 to 100% soil moisture), glufosinate (ED_{50} = 2.6 to 0.9 g/ha) and metolachlor (ED_{50} = 3.0 to 1.1 g/ha) increased significantly with soil moisture. Soil moisture did not affect the response of Benghal dayflower to 2,4-D, diclosulam or glyphosate. For 2,4-D (ED_{50} = 2.3 to 6.7 g/ha), this was due to the excellent response at all soil moisture levels. For diclosulam (ED_{50} = 38 to 62 g/ha) and glyphosate (ED_{50} >1,000 g/ha at all moisture levels), it was due to the poor response at all moisture levels. Whole plant responses to atrazine imazapic and sulfentrazone were not examined. Foliar uptake of flumioxazin, glyphosate, and metolachlor increased with soil moisture. For flumioxazin (37–82% uptake from 25 to 100% soil moisture), glyphosate (18–58% uptake) and metolachlor (31–78% uptake) uptake increased with soil moisture from 25 to 100% of field capacity. The addition of metolachlor to ^{14}C-glyphosate improved uptake over that of glyphosate alone, at all moisture levels (65–96%), and the addition of glyphosate to ^{14}C-metolachlor improved uptake over that of metolachlor alone, again at all moisture levels (79–92%). Foliar uptakes of atrazine, diclosulam, imazapic and sulfentrazone were not affected by soil moisture; 2,4-D and glufosinate uptakes were not examined. These data indicate that soil moisture can affect the response of several herbicides that are currently available to control Benghal dayflower in various cropping systems.

REFERENCES

Earl H J (2003). A precise gravimetric method for simulating drought stress in pot experiments. *Crop Science* **43**, 1868-1873.