

Herbicide Options for Benghal Dayflower Control in Field Crops

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Summary

Invasive weeds are troublesome in agronomic cropping systems and nearby non-crop environments. Benghal dayflower (*Commelina benghalensis* L.), also known as tropical spiderwort, was first detected in South Carolina by the Clemson University Department of Plant Industry in 2013.¹ Infestations have now been documented in agronomic fields in South Carolina. Once established, this invasive weed reproduces prolifically by producing both aboveground and belowground flowers and fruit, increasing the number of seeds in the soil seedbank. This article discusses Benghal dayflower identification, biology, and control options in corn, cotton, peanut, and soybean.

Introduction

Benghal dayflower (BD) is a tropical, perennial herbaceous weed listed on the federal noxious weed list² and is expanding in distribution across the southeastern United States. Benghal dayflower is native to the tropical areas of Africa, India, and the Pacific islands.³ It has been documented in Georgia, Florida, North Carolina, Virginia, and California.⁴ Benghal dayflower, at the early growth stages, visually resembles other *Commelina* spp. found in South Carolina including Asiatic dayflower (*Commelina communis* L.) and spreading dayflower (*Commelina diffusa* Burm. f.).⁵ However, identifying characteristics that visually separate BD from other dayflowers include (1) the presence of red or white trichomes or hairs (figure 1b) on the apex of the leaf sheath and leaf margins (the other two dayflowers have smooth, hairless stem, sheaths, and leaf margins) and (2) tuber-like white spathes or subterranean flowers borne on stolons in the root system (figure 1d). Each aerial fruit can produce four to five seeds and each subterranean fruit can produce two to three seeds.^{5,6} In one study, aerial seed production was 4.6 times higher than subterranean seed production.⁶ As a result, one BD plant can potentially produce up to 1,600 seeds per season.⁷ Currently, eight counties in South Carolina have confirmed populations of BD (figure 2).

In cases where infestations are small and isolated, such as in nurseries or urban gardens, hand removal or spot spraying with an herbicide is generally very effective in controlling BD. However, small or initial infestations in agronomic fields typically remain undetected for several years before the grower realizes the severity of the problem. In that time, BD has spread across the landscape (via rooting of stem fragments and seed) and added considerable quantities of seed to the soil seed bank. Benghal dayflower seed can remain viable for up to four years in the soil.⁸

Cultural, biological, and mechanical options are often under-utilized in weed management programs. There are no available biological control agents for BD. However, modification of crop row spacing, seeding density, and planting date are highly effective weed management tools, especially when deployed in combination. For example, the weed-free period (i.e., the time when weeds must be absent to achieve the maximum crop potential yield) for cotton planted on 21-inch rows was only six weeks. In contrast, cotton planted on wide rows (e.g., 31 and 42 inches) needed a significantly longer weed-free period of ten to fourteen weeks for optimum yield.⁹ Similarly, soybean planted in narrow rows reduced the incidence of weed populations compared to wide rows.¹⁰ Crop seeding density can reduce the incidence of weeds. With the same herbicide program, BD control increased from 85 to 96% as seeding density increased from 0.7 to 2.1 plants ft⁻² in single row cotton. In addition, cotton planted on a twin-row pattern resulted in 96 to 97% BD control averaged over seeding density and herbicide program eighteen weeks after emergence.¹¹

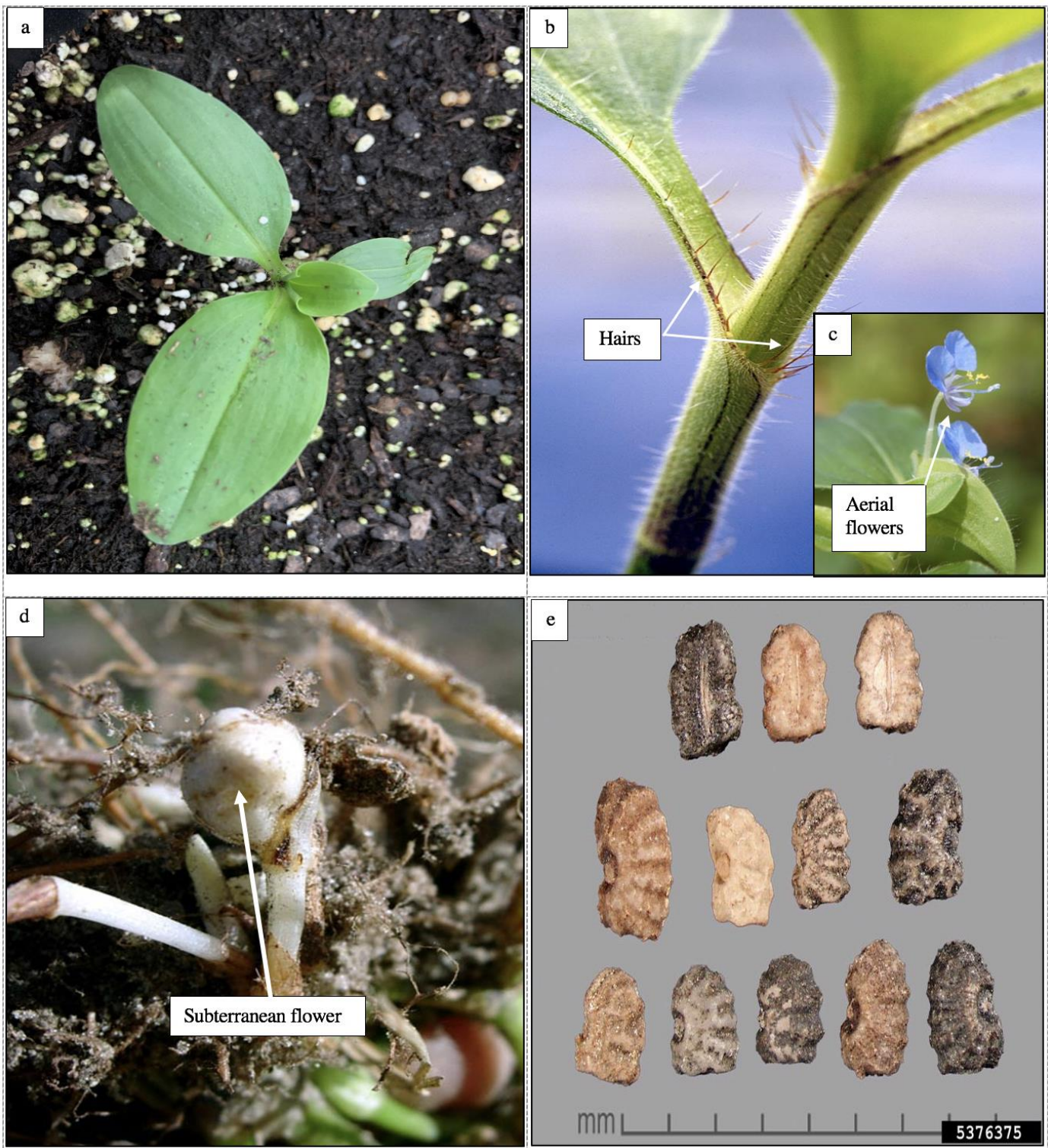
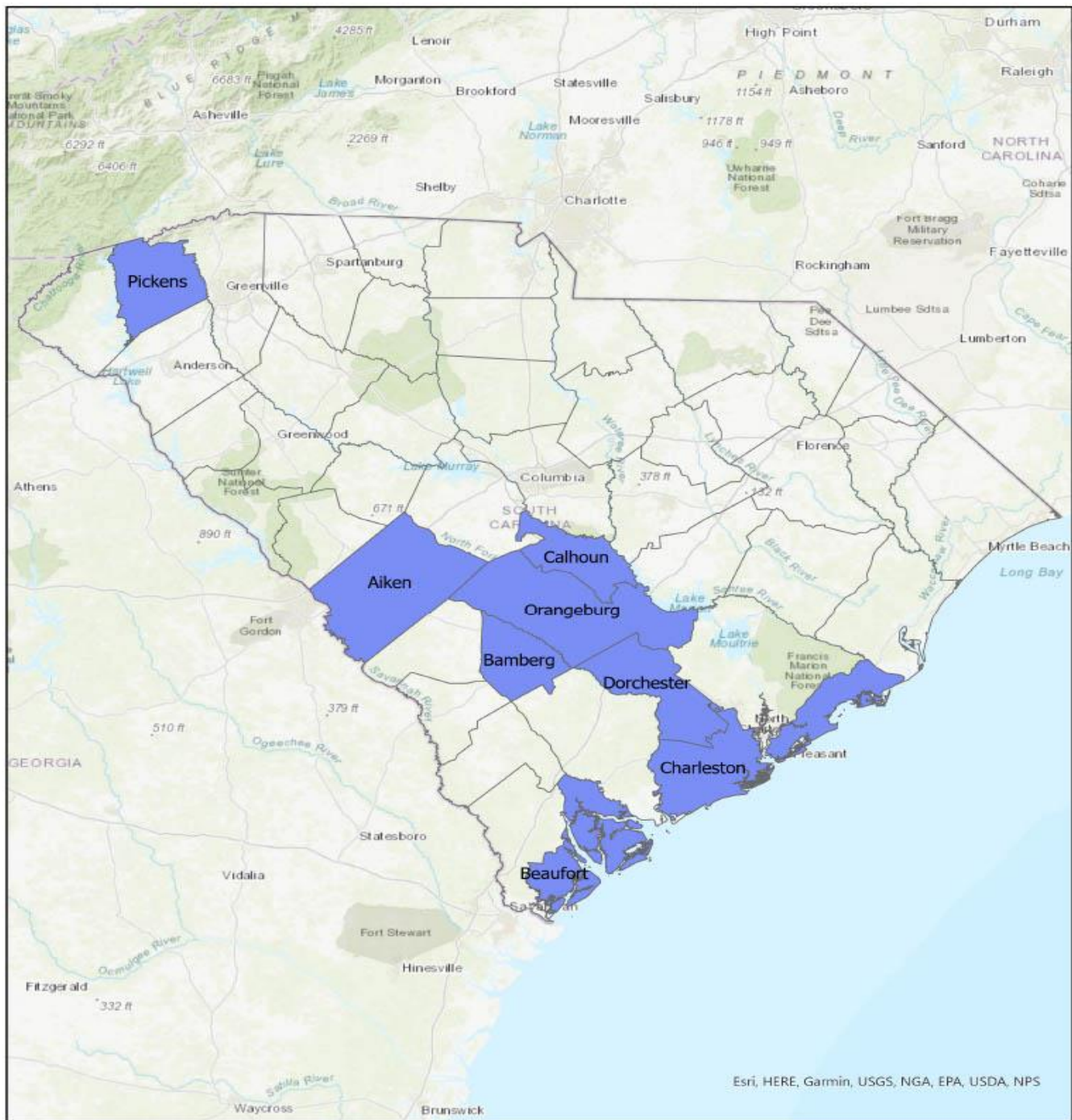
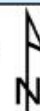


Figure 1. The growth stages of Bengal dayflower: (a) Seedling. Image credit: Michael W. Marshall, Clemson University. (b) White and red hairs on the leaf margins and sheath apex. Image credit: Herb Pilcher, USDA-ARS, Bugwood.org; (c) Blue to purple-blue aerial flowers. Image credit: Theodore Webster, USDA-ARS, Bugwood.org. (d) Subterranean flower borne on underground stolons. Image credit: Byron Rhodes, University of Georgia, Bugwood.org. (e) Mature seeds. Image credit: Julia Scher, USDA-APHIS PPQ, Bugwood.org.



Benghal Dayflower (*Commelina benghalensis*)
 South Carolina, October 2020



BDF_Counties
 Counties

Figure 2. Bengal dayflower distribution (counties marked in purple on the map) in South Carolina as of October 2020 based on surveys conducted by the Clemson University Department of Plant Industry.



Early planting dates (early-May) are recommended to minimize BD competition in cotton.¹² Burial through inversion tillage (>6 inches) can also prevent BD germination. This drastic form of tillage should only be considered when infestation levels are extremely high due to its negative impact on soil structure and the environment.¹³

For BD infestations in agronomic fields, herbicides are the management tool preferred by growers. A majority of agronomic crops (corn, cotton, and soybeans) planted in the United States and South Carolina are glyphosate-tolerant (GT).¹⁴ Glyphosate herbicide efficacy on BD decreases rapidly as weed size increases.¹⁵ For example, glyphosate alone in GT cotton only provided 53% control of 1- to 4-inch BD.¹⁵ The lower control value of 53% was attributed to the larger BD (3- to 4-inch) plants. Similarly, Liberty (glufosinate) provided 68% control, which is below the acceptable economical threshold of 70%.¹⁶ The tank mix combination of Staple (pyrithiobac) plus glyphosate in GT cotton increased BD control compared to glyphosate alone.¹⁵ In 2017, cotton and soybean varieties were introduced with tolerance to 2,4-D or dicamba herbicides. Benghal dayflower control was 99% and 94% with Liberty plus 2,4-D and Liberty plus dicamba, respectively.¹⁶ In 2016, Strongarm (diclosulam) was registered for postemergence suppression of BD in peanut when applied at the 1- to 2-inch BD growth stage.¹⁷ Strongarm preemergence activity on BD was limited.¹⁸

Benghal dayflower seed typically germinates and emerges later in the growing season (June-July) and continues to grow until frost.⁸ Therefore, soil residual herbicides tank mixed with postemergence herbicides are a critical tool for long-term control of BD during the growing season. For example, Dual Magnum (s-metolachlor) is a highly effective preemergence herbicide that provides 96% to 99% BD control six weeks after application.¹⁸ In contrast, BD control was less than 70% with the residual herbicides diuron, Valor (flumioxazin), and Staple.¹⁸ Other herbicides in the same family as Dual Magnum, which include Warrant (acetochlor), Zidua (pyroxysulfone), and Outlook (dimethanemid-p), can provide similar levels of preemergence control, although the length of residual control may be shorter.

Herbicide Programs for Managing Benghal Dayflower in Agronomic Crops

Corn

Corn is typically planted early in the spring (March-April), well before the optimum BD emergence period (June-July). At later corn growth stages (V7-V10), there is potential BD may emerge before canopy closure and need to be controlled with a herbicide. The more likely scenario is BD will emerge later in the growing season (about three to four weeks before corn maturity) as the crop canopy opens and sunlight reaches the soil surface (light is required for BD germination).¹⁴ In that case, a post-harvest herbicide application may be necessary. For effective long-term control of BD, tank mix Dual Magnum (s-metolachlor), Warrant, or Outlook at each postemergence application timing (table 1). Consult the product labels for seasonal application limits for each herbicide and practice resistance management by rotating herbicide modes-of-action.

Table 1. Suggested herbicide programs for Benghal dayflower (BD) control in field corn. Consult the [South Carolina Pest Management Handbook](https://www.clemson.edu/extension/agronomy/pest%20management%20handbook.html) for current recommendations for herbicide product use rates and restrictions (<https://www.clemson.edu/extension/agronomy/pest%20management%20handbook.html>).

Application Timing	Herbicide Program(s)
Preemergence ^a	atrazine + Dual Magnum (s-metolachlor)
Postemergence ^b	atrazine + glyphosate + Warrant (acetochlor) <i>or</i> Dual Magnum + glyphosate + Callisto (mesotrione) + atrazine <i>or</i> Liberty (glufosinate) + Dual Magnum + atrazine
Late Postemergence ^c	Status (dicamba + safener)
Post Harvest ^d	dicamba +Dual Magnum <i>or</i> 2,4-D + Dual Magnum <i>or</i> paraquat (2 applications, 14 d apart) + Dual Magnum



Note: ^aImmediately after corn planting and before BD emergence. ^bApply between the V2 to V6 corn growth stage, after emergence but before corn reaches the V7 corn growth stage and BD is less than 2 inches in height. ^cUse drop nozzles after the V7 corn growth stage to ensure adequate spray coverage of the weeds at ground level. ^dApply after the crop has been harvested and when BD is less than 2 inches in height. Exercise caution when spraying 2,4-D, dicamba, and paraquat near sensitive crops.

Cotton

Peak Benghal dayflower emergence (June-July) occurs closer to cotton planting (May) in South Carolina. The time from crop emergence to row closure in cotton can range from six to eight weeks or longer under stress conditions where the row middles are left unshaded. Develop and implement a robust soil residual preemergence and postemergence program to manage BD populations until canopy closure occurs (table 2). Herbicide application timings should be planned to reduce (preemergence) or coincide with (postemergence) BD emergence. Consult the product labels for seasonal application limits on each herbicide and practice resistance management by rotating herbicide modes-of-action.

Table 2. Suggested herbicide programs for Benghal dayflower (BD) control in cotton. Consult the [South Carolina Pest Management Handbook](https://www.clemson.edu/extension/agronomy/pest%20management%20handbook.html) for current recommendations for herbicide product use rates and restrictions (<https://www.clemson.edu/extension/agronomy/pest%20management%20handbook.html>).

Application Timing	Herbicide Program(s)
Preemergence ^a	Reflex (fomesafen) + Warrant (acetochlor)
Early Postemergence ^b	glyphosate or Liberty (glufosinate) + Dual Magnum (s-metolachlor) <u>or</u> Liberty + Dual Magnum + Enlist One (2,4-D choline) ^c <u>or</u> glyphosate + Xtendimax (dicamba) ^d <u>or</u> Enlist One ^c
Late Postemergence ^e	Liberty or Glyphosate + Warrant <u>or</u> Liberty + Warrant + Enlist One ^c <u>or</u> glyphosate + Xtendimax (dicamba) ^d <u>or</u> Enlist One ^c
Layby ^f	Sequence (glyphosate + s-metolachlor) <u>or</u> glyphosate <u>or</u> Liberty + Warrant

Note: ^aAt-planting or shortly after planting but before any BD emergence; ^b2-3 leaf cotton growth stage and before BD reaches 1-2 inches in height; ^cEnlist cotton varieties only; ^dXtendFlex cotton varieties only; ^e5-7 leaf cotton growth stage and before BD reaches 1-2 inches in height; ^fAfter cotton rows have reached canopy closure for any remaining BD escapes. Exercise caution when spraying 2,4-D and dicamba near sensitive crops.

Peanut

May is the primary planting window for peanuts in South Carolina; this is close to peak BD emergence (June-July). During this period, peanuts are small with large gaps between rows resulting in rapid emergence, establishment, and spread of BD. Non-selective herbicides, such as Liberty and glyphosate, are not registered for use in peanuts. Postemergence choices for BD control in peanut are limited. The key to managing BD in peanut is overlapping soil residual herbicides during the season (table 3). Consult the product labels for seasonal application limits on each herbicide and practice resistance management by rotating herbicide modes-of-action.

Table 3. Suggested herbicide programs for Benghal dayflower (BD) control in peanut. Consult the [South Carolina Pest Management Handbook](https://www.clemson.edu/extension/agronomy/pest%20management%20handbook.html) for current recommendations for herbicide product use rates and restrictions (<https://www.clemson.edu/extension/agronomy/pest%20management%20handbook.html>).

Application Timing	Herbicide Program(s)
Preemergence ^a	Valor (flumioxazin) + Dual Magnum (s-metolachlor)
At-Crack ^b	paraquat + Storm (acifluorfen + bentazon) + Dual Magnum <u>or</u> paraquat + Storm + Warrant (acetochlor) <u>or</u> paraquat + Basagran (bentazon) + Zidua (pyroxysulfone) <u>or</u> paraquat + Strongarm (diclosulam) + Warrant <u>or</u> Zidua



Mid-Postemergence ^c	Cadre (imazapic) + Dual Magnum + 2,4-DB <u>or</u> Cadre + Strongarm + Dual Magnum <u>or</u> Cadre + Warrant + 2,4-DB <u>or</u> Cadre + Zidua + 2,4-DB
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Note: ^aImmediately after planting and before BD emergence; ^b14 days after planting, BD less than 2 inches in height; ^c28 to 30 days after planting, BD less than 2 inches in height.

Soybean

Soybean planting dates in South Carolina can range from April to July depending on the maturity group and the previous crop, such as small grains. Early planted soybean (April-May) typically grow rapidly and shade the soil surface in the row middles before BD emergence occurs (June-July). However, double-crop (soybean following a small grain crop) or late-planted soybean (mid-June to mid-July) are sown during optimum BD emergence. For GT soybean varieties, glyphosate will control small BD (less than two inches in height). Planting non-GT soybean varieties in BD infested fields is not recommended. Consider narrow row (less than thirty inches) soybeans if planting during the optimum BD emergence period (i.e., mid-June to July). As discussed in other crops, overlapping soil residual herbicide programs are the key to minimizing BD emergence in soybean (table 4). Consult the product labels for seasonal application limits on each herbicide and practice resistance management by rotating herbicide modes-of-action.

Table 4. Suggested herbicide programs for Benghal dayflower (BD) control in soybean. Consult the [South Carolina Pest Management Handbook](https://www.clemson.edu/extension/agronomy/pest%20management%20handbook.html) for current recommendations for herbicide product use rates and restrictions (<https://www.clemson.edu/extension/agronomy/pest%20management%20handbook.html>).

Application Timing	Herbicide Program(s)
Preemergence ^a	Boundary (s-metolachlor + metribuzin) <u>or</u> Dual Magnum (s-metolachlor) <u>or</u> Fierce (flumioxazin + pyroxasulfone) <u>or</u> Prefix (fomesafen + s-metolachlor)
Early Postemergence ^b	glyphosate ^c <u>or</u> Liberty (glufosinate) ^d <u>or</u> 2,4-D choline ^e <u>or</u> dicamba ^f + Warrant (acetochlor) <u>or</u> Outlook (dimethanemid-p)
Late Postemergence ^g	glyphosate ^c <u>or</u> Liberty ^d + 2,4-D choline ^e <u>or</u> dicamba ^f + Warrant <u>or</u> Outlook

Note: ^aAt-planting or shortly after planting but before BD emergence; ^bV2-V3 soybean growth stage and before BD reaches 1-2 inches in height; ^cGlyphosate-tolerant varieties only; ^dLiberty-Link varieties only; ^eEnlist soybean varieties only; ^fXtend/XtendFlex soybean varieties only; ^gV5-V6 soybean growth stage and before BD reaches 1-2 inches in height. Exercise caution when spraying 2,4-D and dicamba near sensitive crops.

Key Points

1. Benghal dayflower is an invasive weed that spreads and reproduces (via stem fragments and seed) quickly once established in agronomic fields.
2. In cotton and peanuts, BD will be more difficult to control due to lack of shading of the soil surface during peak BD seedling emergence.
3. Deep broadcast tillage (e.g., moldboard plowing, greater than six inches in depth) can effectively bury BD seed to a depth where it cannot germinate.¹³ This option should be used as a last resort for out-of-control fields.
4. Combinations of postemergence (e.g., glyphosate, Liberty, Strongarm) and preemergence (e.g., Dual Magnum) herbicide programs are required for long-term management of BD in agronomic fields.
5. In fields where BD infestations are extensive, select a fast-growing crop (e.g., GT-corn or -soybean) that can be planted early and quickly produce a canopy that shades out the soil surface before the peak BD emergence period (June-July).



6. Benghal dayflower seed longevity in the soil is relatively short, less than four years. Vigilance combined with developing and following a high-level management plan using one or more of the cultural, mechanical, and herbicide programs discussed in this publication can effectively reduce BD seed production and the amount of viable seed in the soil seedbank over time.

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