The Biology and Ecology of Palmer Amaranth: Implications for Control

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Palmer amaranth is a highly competitive weed of field corn, cotton, peanut, and soybean and has been confirmed to be resistant to glyphosate in nearly every agronomic county in GA (Figure 1). Glyphosate-resistant (GR) Palmer amaranth's establishment and spread has been assisted by its rapid growth rate, extensive rooting structure, high seed production, physical seed movement (man, animal, water), and most importantly by pollen (wind) dispersal. Growers must understand the biology and ecology of GR Palmer amaranth if effective control is to be achieved.

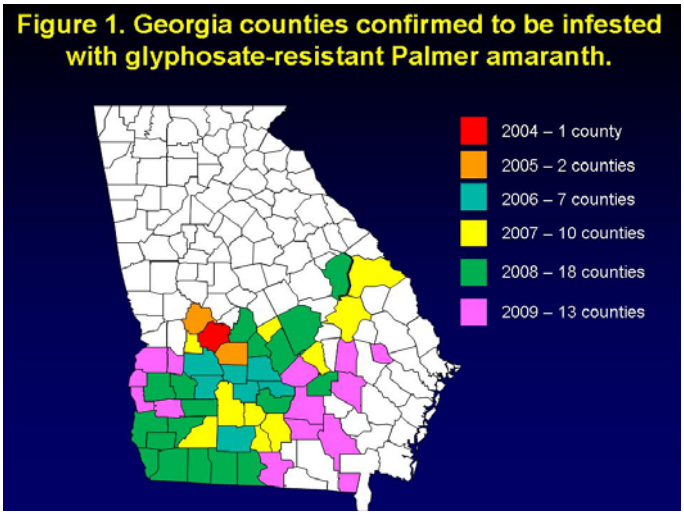
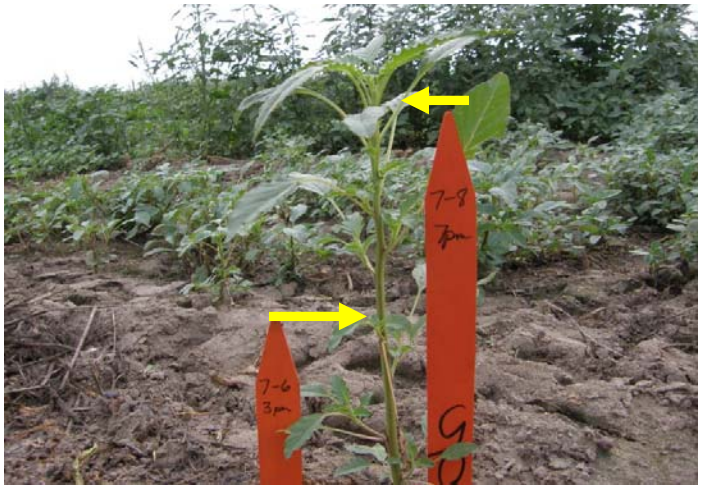


Figure 2. Growth of Palmer amaranth over 52 hours.



Rapid growth rate:

Palmer amaranth converts CO_2 in the air via photosynthesis into sugars more efficiently than corn, cotton, or soybean allowing rapid growth even under hot and dry conditions. Because Palmer amaranth is so efficient at fixing carbon, it is capable of growing several inches per day under ideal growing conditions (Figure 2).

Implications for management: Herbicides tend to be more effective on smaller, rather than larger, plants. Because of Palmer's rapid growth rate, the window of time available to make effective topical herbicide applications is very short.

Deep and diverse root system:

Palmer amaranth has a deep taproot as well as a network of finer, fibrous roots (Figure 3). Research from NC has shown that Palmer amaranth can produce more and longer roots than soybean and are more capable than the roots of soybeans at penetrating compacted soils.

Implications for management: Because of its rooting structure, Palmer amaranth may have more access to water and nutrients than many commonly grown crops. This contributes to Palmer amaranth's rapid growth and competitiveness. The presence of a taproot can make it difficult to remove Palmer amaranth by hand. Broken-off stems as small as 1"can resprout, flower, and produce seed.

Figure 3. The extensive Palmer amaranth root system. Photo by E. Prostko

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Seed production, germination, emergence and longevity:

Palmer amaranth is capable of producing extraordinary amounts of seed. Research conducted by UGA has shown that Palmer amaranth females produced up to 460,000 seeds per plant when growing in competition with dryland cotton for an entire season. Under optimal conditions, a single female Palmer amaranth plant can produce up to 1 million seed.

Amaranth seed require sunlight for germination; the majority of seeds that do emerge will have likely germinated in the upper 2" of soil. Although Palmer amaranth produces a lot of seed, those seed are fairly short-lived in the soil. Research at UGA has demonstrated that after 3 years of burial with no natural predation, almost 80% of the seed will have died (Figure 4).

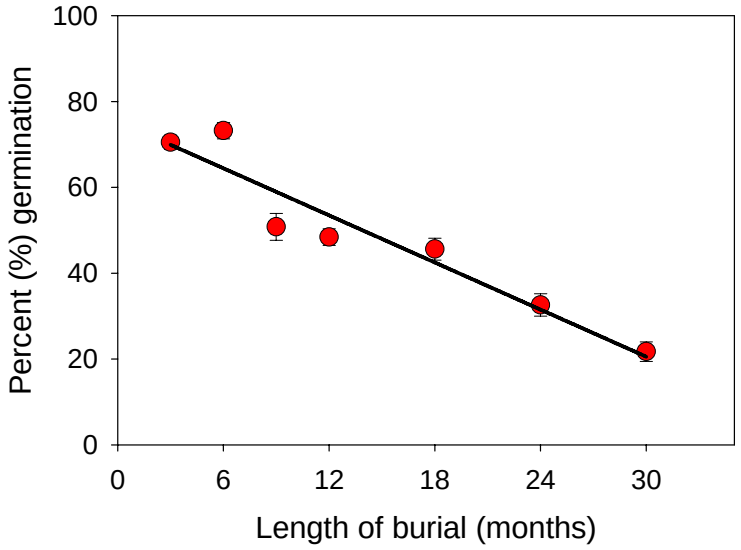

Figure 4. Palmer amaranth seeds become less viable with time.

Implications for management: *This year's seeds become next year's weeds!* Effective weed management means removing all Palmer amaranth plants from a field before they reach reproductive maturity to prevent seed production. Winter cover crops that provide sufficient amounts of biomass can be used to suppress Palmer amaranth in strip tillage operations. Cover crops shelter the seeds from sunlight and physically interfere with seedling emergence. When heavy infestations exist, moldboard plowing may be required to bury seed below their optimal germination/emergence zone. Deep tillage operations should only be used infrequently so that the deeply buried seeds can die and decompose.

Seed and pollen dispersal:

Palmer amaranth produces male and female flowers on different plants; for seed to develop, pollen from a male needs to be carried by the wind to a female plant. If pollen from a glyphosate-resistant male Palmer amaranth fertilizes a susceptible female, a portion of the offspring will also have the resistance trait. UGA research has shown that pollen from GR males can travel at least 1000 feet in the field and fertilize susceptible females (Figure 5). Seeds can also move resistance around. Palmer amaranth seeds are known to be spread on equipment, in flowing water, and by animals.

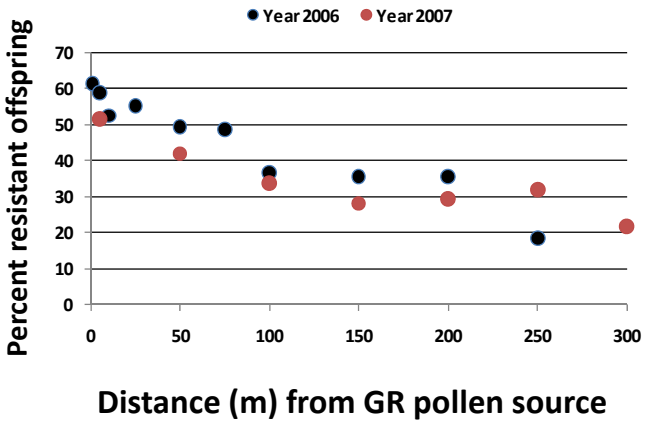

Figure 5. Number of GR offspring developing from susceptible mother plants at varying distances from a GR Palmer pollen source.

Implications for management: Herbicide resistance is mobile; both pollen and seeds contribute to the spread of resistance. GR pollen can fertilize distant susceptible females; resulting seed will be resistant to glyphosate as well. GR seed may be spread from field to field after getting caught up in cotton pickers, mowers, or trapped in mud on tractor tires. To slow the spread of resistance, don't allow plants to reach reproductive maturity and produce pollen and seed.

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