

WHY RAGWEED PARTHENIUM IS NOT A PERNICIOUS WEED IN THE CONTINENTAL USA ?

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ABSTRACT

Ragweed parthenium has achieved major weed status in India and Australia within the past few decades. In the continental USA (48 contiguous states), ragweed parthenium is not a major weed despite close proximity to its native range. We provide rationale for why ragweed parthenium is not a major weed in the USA. Unfavorable temperate climatic conditions, extensive use of herbicides, tillage and cultivation practices, and competition from other aggressive weeds may have restricted recruitment and survival of ragweed parthenium in the USA. Several weed surveys provide evidence that ragweed parthenium is not a major weed in USA at the present time.

Keywords: *Climate, herbicide, invasive, Parthenium hysterophorus, tillage.*

INTRODUCTION

Ragweed parthenium (*Parthenium hysterophorus* L.) is an annual herb of neotropical origin that now has pantropical distribution (Evans, 1997). It has spread throughout Southern USA, Mexico, the Caribbean, Brazil, Taiwan, China, Ethiopia, India, and Australia. This weed adversely affects crop production, animal husbandry, human health, and biodiversity. Ragweed parthenium reproduces by seed and can complete several life cycles annually. It is a prolific seed producer with up to 30,000 seed per plant (Navie *et al.*, 2004). The seed is easily spread by produce, vehicles, farm machinery, animals, and water. It infested almost all field crops, pastures, wastelands, yards, fencerows, and right-of-ways. Rapid increase in populations following initial establishment is mainly due to its prolific seed production. Ragweed parthenium has achieved major weed status in India and Australia within the past few decades and is based mainly on its invasiveness. In the USA, however, ragweed parthenium has not achieved a major weed status despite close proximity to its geographic center of origin (tropical America). Not much has been written about this weed in Weed Science and Weed Technology journals published by Weed Science Society of America. Seven of eight recent publications in these journals are from Ethiopia, India, and Mexico. This report is an attempt to provide rationale for reasons that ragweed parthenium has not become a major weed in the continental USA.

Climate and distribution

Continental USA is located between about 25°N and 50°N latitude. Weather is mostly temperate, but tropical or semitropical in Florida and southern California and Texas. Weather varies widely from coast-to-coast. Summers are hot and humid in the plains and southern states, while the southwest is even hotter, but dry. Endless summers are the trademark of southern California, while in the Pacific northwest and New England states, summers are warm (some say hot), but often cooler with pleasant evening conditions. Winters in the north, northeast, and in the western mountains and plains states are often quite cold with prolonged freezing conditions. Heavy snows are common place in these regions.

Ragweed parthenium is distributed from south (Florida) to north (Michigan) and from east (Massachusetts) to west (Texas). It is not widely distributed or common in the northern USA, although presence has been confirmed. We speculate that it may be an occasional weed as a result of spread thorough vehicular traffic. However, it is more commonly present in certain counties in southern states especially in Florida and Texas (between 25°N and 30°N latitude). Nevertheless, it is not an ubiquitous weed in the Southern USA. Summer temperatures (July mean) decrease from 27°C in Florida and Texas to 20°C in Massachusetts and Michigan. Winter temperatures (December mean) decrease from =14°C

in Florida and Texas to $\approx -4^{\circ}\text{C}$ in Massachusetts and Michigan. Unfavorable temperate climatic conditions may have restricted spread and survival of ragweed parthenium in the USA.

Ragweed parthenium is a summer annual, normally germinates in spring and early summer, produces flowers and seed, and dies in fall. Ragweed parthenium is temperature-sensitive, grows vigorously during the summer months compared with winter months in India (Pandey *et al.*, 2003). Seeds buried in soil remain viable for more than 2 years, but seeds on the soil surface may not be viable longer than 6 months (Navie *et al.* 1998). Harsh winter conditions will exacerbate seed decay. Ragweed parthenium germination was the greatest at $25\text{-}30^{\circ}\text{C}$ / $15\text{-}20^{\circ}\text{C}$ day/night temperatures (Pandey and Dubey 1988). It germinates in several flushes during growing season. However, it is unlikely that ragweed parthenium can complete more than one life-cycle in a growing season in most parts of USA with the exception of Florida and Texas. In Mississippi, we have observed the majority of the ragweed parthenium populations on the edges of row crop production, around barn lots, near farm equipment and storage areas, in poorly maintained lawns, and along roadsides and railroads.

Herbicides

The era of chemical weed control began with the introduction of 2,4-D in mid-1940s. Since then a wide array of herbicides were developed that were more specific and more active than the herbicides of the 1940's. New herbicide research and development after the 1940's started with the auxinic phenoxy acids followed by the photosynthesis-inhibiting phenylurea and s-triazine compounds, bleachers (e.g., amitrole, norflurazon, clomazone), desiccants (e.g., paraquat), and an ever growing number of new structures. Currently, over 270 herbicides with differing modes of action at 23 different primary (molecular) target sites are on the market. Although use of each herbicide is limited to a specific situation, herbicides have greatly expanded preemergence and postemergence weed control options in both crop and noncrop lands. It is now difficult to imagine crop production (except organic farming) without the use of herbicides in the USA. Herbicides provide cost-effective, timely weed control, and have helped farmers become highly productive and economically viable.

Several herbicides used in agricultural and non-agricultural weed management provide various levels of ragweed parthenium control. For example, atrazine, flumioxazin, fomesafen, linuron, metribuzin, and oxyfluorfen applied preemergence and 2,4-D, acifluorfen, bentazon, chlorimuron, clomazone, fomesafen, glufosinate, glyphosate, halosulfuron, imazaquin, MSMA, and trifloxysulfuron applied postemergence provide over 80% control of ragweed parthenium. Postemergence control of ragweed parthenium at rosette and bolting stage growing in an uncultivated land near Stoneville, MS is presented in Table 1. Control of ragweed parthenium was lower at bolting stage compared with rosette stage. Both preemergence and postemergence herbicides are commonly used to control broad-spectrum of weeds in most crops in the USA. It is not uncommon for a farmer to apply three to seven herbicides in a crop. Extensive use of herbicides in both crop and noncrop weed management seemed to have played a major role in restricting recruitment and survival of ragweed parthenium in the USA.

Tillage and cultivation

Tillage is used to prepare a seedbed, remedy compaction, incorporate fertilizers and herbicides, and control weeds. Tillage operations are usually performed either in the fall following harvest or early spring. In any case, tillage in the fall can bury mature weeds and prevent/minimize seed set and tillage in the spring can kill large population of emerged weeds before crop planting. Inter-row cultivation is often used in row crops to complement herbicides. Banded herbicide application over crop row combined with inter-row cultivation is another common practice used to effectively manage weeds in row crops. Cultivation can control the weeds escaping herbicide. These mechanical disturbances may also have reduced spread potential of ragweed parthenium.

Transgenic crops

Glyphosate- and glufosinate-resistant corn, cotton, and soybean were introduced in mid 1990s. Farmers in the USA have rapidly adopted GR crops, planting about 87% of soybean, 61% of cotton, and 26% of maize hectares to GR varieties in 2005 (<http://usda.mannlib.cornell.edu/reports/nassr/field/pcp-bba/acrg0605.pdf>). Consequently, use of glyphosate and glufosinate has increased dramatically within crops and both herbicides are active on ragweed parthenium.

Table 1: Ragweed parthenium control 3 weeks after postemergence application of herbicides at Stoneville, MS. Herbicides were applied on May 18, 2005 to rosette plants and June 6, 2005 to bolted (flowering) plants. Control was visually estimated.

Herbicide	Rate	Rosette	Control
			Bolted
	g/ha (ae or ai)	%	%
Glyphosate	840	93	95
Glufosinate	410	93	90
Chlorimuron	13	95	40
MSMA	1120	90	55
2,4-D	806	89	55
Halosulfuron	70	82	46
Bromoxynil	560	58	21
Basagran	1120	31	36
Aciflourfen	560	26	45
Paraquat	1120	24	15
Trifloxysulfuron	8	-	80
Clomazone	1400	-	73
Atrazine	2240	25	43
Flumioxazin	90	-	18
LSD (0.5)		4	7

Competition from other native and invasive weeds

All forms of disturbance (whether physical and chemical) result in survival and selection of best adapted weeds. In the USA, there are a large number of weeds that compete with ragweed parthenium for resources and space. Ragweed parthenium could be a weak competitor compared to other native and non-native invasive weeds. Examples are johnsongrass (*Sorghum halepense*), cogongrass (*Imperata cylindrica*), barnyardgrass (*Echinochloa crus-galli*), morningglories (*Ipomoea* spp. and *Jacquemontia tamnifolia*), common cocklebur (*Xanthium strumarium*), sesbania (*Senna obtusifolia*), hemp sesbania (*Sesbania exaltata*), giant ragweed (*Ambrosia trifida*), pigweeds (*Amranthus* spp.) and many other weeds that are listed as major cropland and non-cropland weeds of the USA by Bryson (2003). Many of these weeds grow tall, are tolerant to shade and drought, reproduce asexually, and have adapted to local environmental conditions.

Federal and several state authorities have identified noxious (regulated or identified by law as being undesirable, troublesome, and difficult to control) and invasive weeds and a list and photos of many of these are available at Invasive and Exotic Species of North America (www.invasive.org). Federal noxious weed list of the USA (Federal Noxious Weed Act of 1974 and updated in the Plant Protection Act of 2000 at www.aphis.gov) contains 77 species. There are 378 species listed as noxious and invasive weeds by various states within the USA. The number of species per list ranges from 1 in Louisiana to 114 species in Florida. Ragweed parthenium is not on any of these lists.

Weed surveys

The Southern Weed Science Society has conducted an annual survey of the 10 most troublesome weeds in corn, cotton, peanuts, rice, soybeans, sorghum, small grains, pastures, turfs, fruits, ornamentals, and vegetables for each of the 13 participating southern states since 1971. Ragweed parthenium was among the 10 most troublesome

weeds in vegetables and pastures in Texas in 1976, 1979, 1983 and in vegetables in Florida in 1999 (SWSS 1976, 1979, 1983, 1999). A Mississippi survey conducted in 2000 on 192 selected soybean fields listed 68 weedy species, but not ragweed parthenium (Rankins *et al.*, 2005). These surveys provide further evidence that ragweed parthenium is not a major weed in USA. The reason for occasional presence in vegetable and pastures in Texas and Florida could be due to the lack of cultivation and fewer herbicide applications than in row crop production systems.

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