

Minnesota Noxious Weed Risk Assessment

Developed by the Minnesota Noxious Weed Advisory Committee

Assessment information

Common name: Palmer amaranth, carelessweed, Palmer pigweed

Scientific name: *Amaranthus palmeri* S. Watson

Family name: Amaranthaceae (Amaranth family)

Current reviewer name and organizational affiliation: Laura Van Riper, Minnesota Department of Natural Resources

Date of current review: September 9, 2025

Previous reviewer name and organizational affiliation: Roger Becker, University of Minnesota

Date of previous review: August 8, 2014

Species description

Photos



Photo caption: Palmer amaranth growing in Minnesota. Photo credit: Minnesota Department of Agriculture.



Photo caption: Pressed male and female Palmer amaranth plants. Photo credit: Minnesota Department of Agriculture.

Why the plant is being assessed

- Palmer amaranth is a plant of high concern because it can compete with row crops such as corn and soybeans and reduce yields. It is also known to develop resistance to multiple classes of herbicides.
- The 2014 risk assessment was written before Palmer amaranth was known to be in Minnesota. Palmer amaranth was first found in Minnesota in September of 2016 (Yu et al. 2021).

Identification, biology, and life cycle

- Description below is quoted from the Minnesota Department of Agriculture (2025a) Palmer amaranth webpage.
- Palmer amaranth is an annual plant native to the arid southwestern United States and northwestern Mexico.
- Palmer amaranth is a summer annual that commonly reaches heights of 6-8 feet but can reach 10 feet or more.
- The green leaves are smooth and arranged in an alternate pattern that grows symmetrically around the stem. The leaves are oval to diamond-shaped. There is a small, sharp spine at the leaf tip.
- The leaves of some Palmer amaranth plants have a whitish V-shaped mark on them. Not all Palmer amaranth plants display this characteristic.
- There are separate male and female plants.
- Palmer amaranth looks similar to our native pigweeds such as tall waterhemp (*A. tuberculatus*), redroot and smooth pigweeds (*A. retroflexus* and *A. hybridus* respectively). Here are some distinguishing characteristics:
 - Redroot and smooth pigweeds have fine hairs on their stems and leaves. Palmer amaranth and waterhemp do not have these hairs.

- The petiole (stalk connecting a leaf to the stem) is longer than the length of the leaf. For tall waterhemp, the petiole will be only half the length of the leaf.
- Seedhead spikes on female Palmer amaranth plants are much taller (up to three feet long) and more prickly than waterhemp or redroot and smooth pigweed spikes.
- Palmer amaranth is adapted to the arid habitat of the desert southwest. Outside of its native range, Palmer amaranth has been documented in annual row crop fields and disturbed, sunny areas.
- Seed can be spread in water movement, by wildlife and via agricultural practices such as plowing, harvesting and spreading manure.

Current distribution

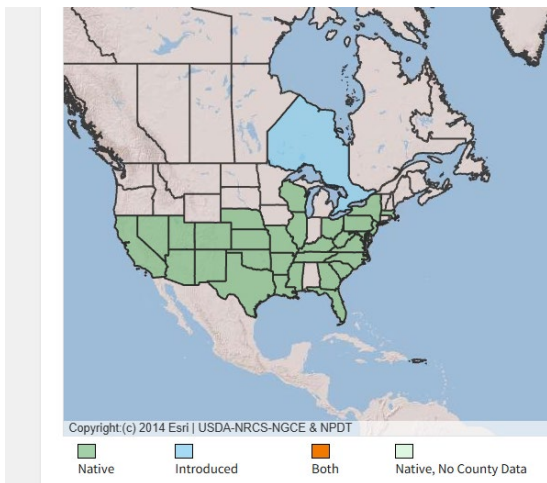


Image caption: National level Palmer amaranth map from USDA Plants (2025). Map accessed on January 9, 2025. Description of where the plant is found in the United States: Palmer amaranth is native to the southwestern United States but is not native to Minnesota. This map does not show Palmer amaranth as being present in Minnesota, but it has been confirmed in Minnesota.

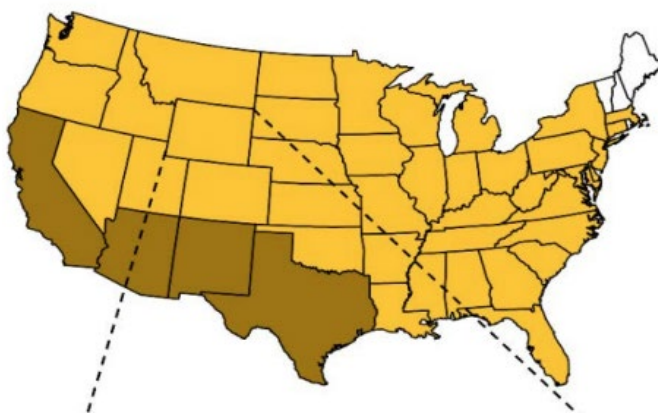


Image caption: National level Palmer amaranth occurrence map from Coles et al. (2024). Brown indicates the native range (California, Arizona, New Mexico, and Texas), white indicates no recorded occurrence (Maine, Vermont, and New Hampshire), and yellow indicates the invaded range (all other states in the continental U.S.).

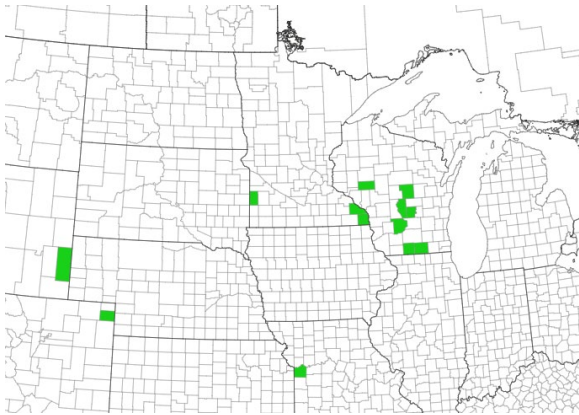


Image caption: State level map from EDDMapS (2025). Map accessed on January 9, 2025. The EDDMapS map does not match the Minnesota Department of Agriculture map. The Minnesota Department of Agriculture would need to provide data to EDDMapS to get the maps in sync.

Description of where the plant is found in Minnesota: Palmer amaranth is documented in three counties in Minnesota: Lincoln, Winona, and Houston Counties.

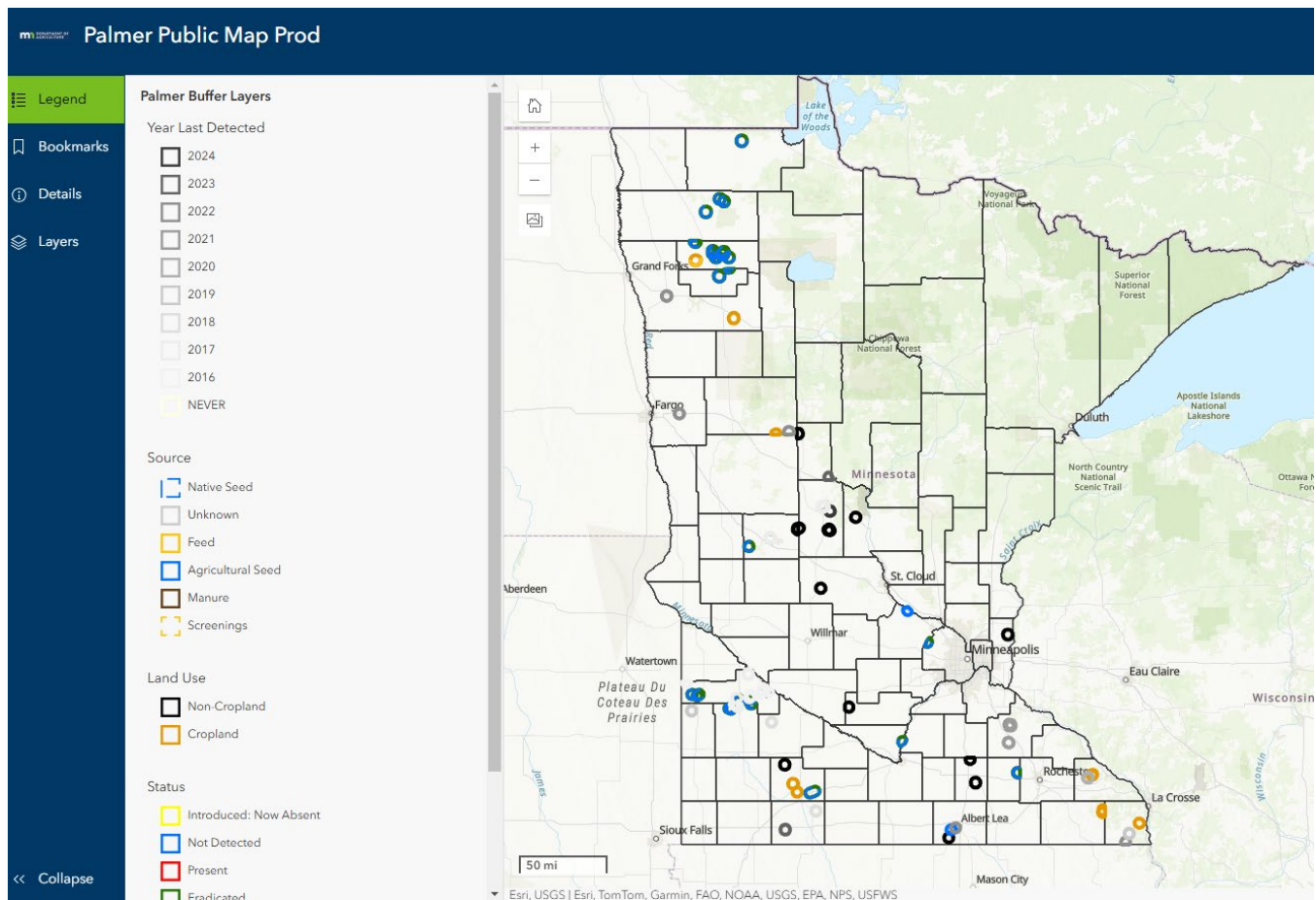


Image caption: The Minnesota Department of Agriculture (2025b) has an online map that provides more detail on Palmer amaranth distribution in Minnesota and introduction sources, land use, and status. Map accessed on January 9, 2025.

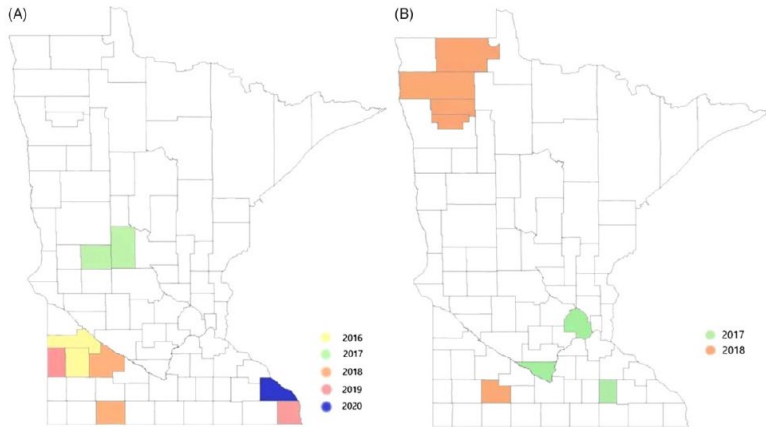


Figure 4. (A) Minnesota counties confirmed with Palmer amaranth. (B) Minnesota counties with sites where contaminated seed was sown, but no plants were found at inspection.

Image caption: Yu et al. (2021) provided this map of (A) Minnesota counties confirmed with Palmer amaranth at the time of publication and (B) Minnesota counties where seed contaminated with Palmer amaranth seed was planted, but no Palmer amaranth plants were found to be growing.

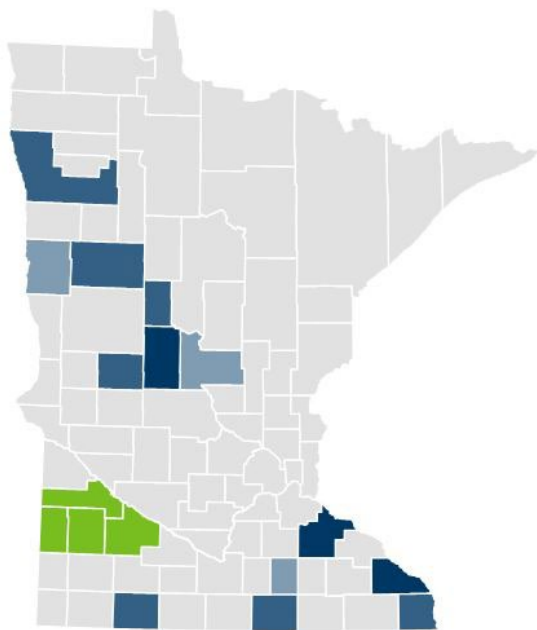


Image caption: The Minnesota Department of Transportation provided this map on January 22, 2025. The green counties are where Palmer amaranth was detected and eradicated. The blue counties are where Palmer amaranth was found and is still present.

Current regulation

Palmer amaranth is regulated in Minnesota as a Prohibited-Eradicate noxious weed.

The National Risk Assessment in 2020 listed the following states as regulating Palmer amaranth as a noxious weed: Delaware, Iowa, North Dakota, Ohio, and Pennsylvania (USDA APHIS 2020). A 2025 review of information

compiled by the National Plant Board (2025) listed the following states as regulating Palmer amaranth: Delaware, Indiana, Maryland, North Dakota, Ohio, Oregon, and Pennsylvania.

Palmer amaranth is not regulated by the federal government.

Risk assessment

Box 1:

Is the plant species or genotype non-native?

Answer: Yes

Outcome: Go to Box 3

Palmer amaranth is not native to Minnesota. Kew (2025) lists Palmer amaranth as being native to: Arizona, California, Mexico Central, Mexico Gulf, Mexico Northeast, Mexico Northwest, Mexico Southwest, Nevada, New Mexico, and Texas.

Box 2:

Does the species pose significant human or livestock concerns or have the potential to significantly harm agricultural production?

Question 2A: Does the plant have toxic qualities that pose a significant risk to livestock, wildlife, or people?

Outcome: Decision tree does not direct to this question.

Question 2B: Does the plant cause significant financial losses associated with decreased yields, reduced quality, or increased production costs?

Outcome: Decision tree does not direct to this question.

Box 3:

Is the species, or a related species, documented as being a problem elsewhere?

Answer: Yes.

Outcome: Go to Box 6.

Ward et al. (2013) note that “by 2009, Palmer amaranth was ranked as the most troublesome cotton weed in the southern U.S.” and that it is also “listed among the most troublesome weeds of corn (#7 in 2009, not listed in 1994) and soybean (#2 in 2010, ranked #23 in 1995)” and “has become one of the most economically damaging glyphosate-resistant weed species in the U.S.”

Field studies in Kansas by Bensch et al. (2003) found soybean losses of up to 78.7% due to competition with Palmer amaranth.

Bagavathiannan and Norsworthy (2016) summarized the issues of herbicide resistance in Palmer amaranth and its effects on crops. They note “Palmer amaranth (*Amaranthus palmeri*) is currently a widespread glyphosate-resistant weed issue in row-crop production in the southern US.” They also note “the first ALS-inhibitor-resistant Palmer amaranth (resistance to imidazolinones) in the US was documented in Kansas in 1993”. Additionally, ALS inhibitor resistance (resistance to sulfonyleureas, imidazolinones, and pyrimidinyl-thio-benzoate) was documented in Arkansas and Tennessee and the first glyphosate-resistant Palmer amaranth population was

discovered in 2004 in Georgia. In their study, they found widespread herbicide resistance in roadside Palmer amaranth populations in Arkansas.

Hartzler (2021) summarized the history of Palmer amaranth in Iowa since its first official finding in 2013. He noted that most crop fields are treated for waterhemp making it difficult for Palmer amaranth to invade fields. He notes that “Palmer amaranth is renowned for its higher growth rate and greater competitiveness with crops than waterhemp. Under Iowa conditions, Palmer amaranth did not consistently produce more biomass or seed than waterhemp.” He concludes “Palmer amaranth has not lived up to the hype presented upon its arrival in Iowa. However, Palmer amaranth will undoubtedly adapt to our climate, and therefore will pose a larger challenge than it currently does. While it is unlikely to be eradicated, early detection and rapid response should make it relatively easy to prevent new detections from becoming permanently established in fields.”

Box 4:

Are the species’ life history and growth requirements understood?

Outcome: Decision tree does not direct to this question.

Box 5:

Gather and evaluate further information

Outcome: Decision tree does not direct to this question.

Box 6:

Does the species have the capacity to establish and survive in Minnesota?

Question 6A: Is the plant, or a close relative, currently established in Minnesota?

Answer: Yes.

Outcome: Go to Box 7

Palmer amaranth is currently established in multiple counties in Minnesota. See maps in “Current distribution” section from Yu et al. (2021) and Minnesota Department of Agriculture (2025b).

Question 6B: Has the plant become established in areas having a climate and growing conditions similar to those found in Minnesota?

Answer: ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Oliveira et al. (2022) found that “Palmer amaranth is well-adapted to growing conditions throughout the Midwestern US, and is simply limited in its range by seed dispersal”. They “confirmed Palmer amaranth’s extraordinary plasticity to adapt to different agroecosystems. For example, Palmer amaranth mimicked crop architecture in competing for light, where plants growing in corn allocated resources to height, while plants growing in bareground allocated resources to numerous branches. Plants growing in the absence of a crop produced the greatest biomass, responding to a greater abundance of light, nutrients, and water resources. These results support the argument that Palmer amaranth can quickly evolve life-history traits to adapt to different cultural practices.”

Question 6C: Has the plant become established in areas having a climate and growing conditions similar to those projected to be present in Minnesota under future climate projections?

Answer: ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Briscoe Runquist et al. (2019) used modeling to project the future distribution of Palmer amaranth. They state: “**Projected future distributions.** Under all future climates, using the native + invaded range models, the

area of high habitat suitability expanded and models projected greater habitat suitability in the Upper Midwest (MI, WI, MN, ND, SD), Pennsylvania and New York. Projections of the invaded range models predicted a similar northern expansion of suitable habitat, albeit accelerated and more extensive. For example, regions of high suitability are evident in central Minnesota and North Dakota by 2030, and by 2070 the majority of both states are deemed highly suitable.”

Box 7:

Does the species have the potential to reproduce and spread in Minnesota?

Question 7A: Are there cultivars of the plant that are known to differ in reproductive properties from the species?

Answer: No.

Outcome: Go to Question 7B.

No information was found indicating that there are any cultivars of Palmer amaranth.

Question 7B: Does the plant reproduce by asexual/vegetative means?

Answer: No.

Outcome: Go to Question 7D.

No information was found indicating Palmer amaranth reproduces by asexual/vegetative means.

Question 7C: Are the asexual propagules - vegetative parts having the capacity to develop into new plants - effectively dispersed to new areas?

Outcome: Decision tree does not direct to this question.

Question 7D: Does the plant produce large amounts of viable, cold hardy seeds? For woody species, document the average age the species produces viable seed.

Answer: Yes.

Outcome: Go to Question 7G.

Ward (2013) summarized study results that showed ranges of 200,000 to 600,000 seeds per plant when grown without competition in California and 250,000 seeds per plant in Missouri. Ward (2013) also summarized studies reporting on seed production per square meter, reporting 139,000 to 211,000 seeds/m² in South Carolina and 1,800 to 514,000 seeds/m² in Kansas. No information was found on cold hardiness of seeds.

Question 7E: For species that produce low numbers of viable seeds, do they have a high level of seed/seedling vigor or remain viable for an extended period (seed bank)?

Answer: ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

In the Sosnoskie et al. (2013) study, they state: “Seed viability at the initiation of the study was 96%; after 6 mo of burial, viability declined to 65 to 78%. As burial depth increased, so did Palmer amaranth seed viability. By 36 mo, seed viability ranged from 9% (1-cm depth) to 22% (40-cm depth).”

Question 7F: Is the plant self-fertile?

Answer: ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Palmer amaranth is dioecious meaning it has separate male and female plants. Therefore, a single plant cannot self-pollinate. However, Ward et al. (2013) discuss agamospermy (asexual reproduction in which seeds are produced from unfertilized ovules). They note that “Apparent agamospermy has been reported in female Palmer amaranth plants pollinated by common waterhemp (*A. tuberculatus* Moq. J.D. Sauer, formerly *A.*

rudis L.) (Trucco et al. 2007).” They note that “More usually, Palmer amaranth is wind-pollinated, and male plants produce prodigious amounts of pollen.”

Question 7G: Are sexual propagules – viable seeds – effectively dispersed to new areas? List and consider all vectors.

Answer: Yes.

Outcome: Go to Question 7I.

Palmer amaranth seeds can move through irrigation waters, wind and on machinery used in plowing, herbicide application, mowing, harvesting, and other agricultural practices (Yue et al. 2021). Yu et al. (2021) share that the introduction of Palmer amaranth to the Midwest likely occurred through multiple pathways including the movement of contaminated livestock feed and equipment and planting seeds that were contaminated with Palmer amaranth (including cases in Iowa where Palmer amaranth was inadvertently introduced in Conservation Reserve Program seed plantings). They note that in 2016 the Minnesota Department of Agriculture identified contaminated conservation seed as the introduction pathway for the first Palmer amaranth plants found in Minnesota. In 2018 they identified manure as a pathway when cattle were fed sunflower screenings contaminated with Palmer amaranth and then their manure was spread on to cropland. Additional pathways they identified in Minnesota were contaminated grass seed and contaminated proso millet seed. Since that time, pearl millet seed, sorghum Sudan grass seed, sunflower screenings, and wheat screenings are additional sources that tested positive for Palmer amaranth seeds (Shane Blair personal communication 2025).

Question 7H: Can the species hybridize with native species (or other introduced species) and produce viable seed and fertile offspring in the absence of human intervention?

Answer: ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

In an experiment, Franssen et al (2001) found that they could pollinate female common waterhemp (*Amaranthus rudis* which is now called *Amaranthus tuberculatus*) with pollen from male Palmer amaranth plants. They confirmed that hybrid offspring were possible. *Amaranthus tuberculatus* is native to Minnesota.

Question 7I: Are there natural controls (species native to Minnesota) which have been documented to effectively prevent the spread of the species in question?

Answer: No.

Outcome: Go to Box 8.

No information was found indicating that there are natural controls that effectively prevent the spread.

Question 7J: Was the answer to Question 7A (Are there cultivars that differ in reproductive properties from the original species) “Yes”?

Outcome: Decision tree does not direct to this question.

Box 8:

Does the species pose significant human or livestock concerns or have the potential to significantly harm agricultural production, native ecosystems, or managed landscapes?

Question 8A: Does the plant have toxic qualities, or other detrimental qualities, that pose a significant risk to livestock, wildlife, or people?

Answer: No.

Outcome: Go to 8B.

While in certain circumstances Palmer amaranth can be toxic, it is not a significant risk. In the 2014 Palmer amaranth Minnesota noxious weed risk assessment, author Roger Becker (University of Minnesota) answered this question with: “No, with one notable exception. Nitrate poisoning in livestock from consumption of *Amaranthus* species or common lambsquarters has occurred when both of the following occur: a.) conditions exist that promote excessive N accumulation and b.) pigweeds comprise a significant portion of the forage available. For example, this has occurred in field corn where high levels of nitrogen fertilizer have been applied but the crop subsequently fails such as following hail, out or in a drought where silage is harvested rather than taking the crop to yield grain. High percentages of the forage harvested are often pigweeds due to excessive growth due to low crop competition coupled with high nitrogen nutrient levels.”

Alegbejo (2013) explains: “Nitrate is a simple form of nitrogen. Plants absorb nitrates from the soil and convert them into more complex forms of nitrogen, such as proteins. *Amaranthus* is one of the plants that accumulate nitrates especially when soil fertility is very high (generally the result of adding nitrogen fertilizer), and when something slows the process of photosynthesis, such as herbicide, drought, or frost. Nitrates are accumulated mainly in the plant tissues and not in the seeds.” Alegbejo (2013) further explains: “Nitrites bind to the hemoglobin in blood, robbing it of the ability to carry oxygen. Since hemoglobin's function is to carry oxygen, the net effect is oxygen starvation. Hence the symptoms of nitrite poisoning include shortness of breath and reduced immunity to disease, and, in extreme cases, may lead to death from suffocation. This is the cause of 'blue baby syndrome'. Livestock, though, are frequently poisoned by high nitrate levels in food, possibly due to the lack of variety in their diet.”

The USDA APHIS (2020) Palmer amaranth risk assessment notes that people can eat the leaves and seeds of *Amaranthus* species, but Palmer amaranth may be toxic to livestock due to nitrates. They caution that Palmer amaranth can be used as forage, but if the nitrate levels become high, the plant can kill or cause illness in livestock. They note that cattle (ruminants) are more prone to death by nitrate poisoning than pigs.

Question 8B: Does, or could, the plant cause significant financial losses associated with decreased yields, reduced crop quality, or increased production costs?

Answer: Yes.

Outcome: Go to Box 9.

Yu et al. (2021) summarized that “Palmer amaranth is recognized as one of the most troublesome agricultural weed species in the United States” and “it has an aggressive growth habit and is extremely competitive with row crops even at low densities”. They note “It has been reported to grow 7.62 cm per day and commonly reaches heights of 1 to 3 m. Studies have shown that Palmer amaranth reduced corn (*Zea mays* L.) yields 11% to 91% (Massinga et al. 2001, Massinga and Currie 2002)”. It has “reduced soybean (*Glycine max* L. Merr.) yields 17% to 68% (Klingaman and Oliver 1994)”. Additionally, “Palmer amaranth has evolved resistance to multiple herbicide mechanisms of action including herbicides that inhibit acetolactate synthase, dinitroanilines, triazines, glyphosate, and inhibitors of 4-hydroxyphenylpyruvate dioxygenase”.

Ward et al. (2013) noted that “by 2009, Palmer amaranth was ranked as the most troublesome cotton weed in the southern U.S.” and that it is also “listed among the most troublesome weeds of corn (#7 in 2009, not listed in 1994) and soybean (#2 in 2010, ranked #23 in 1995)” and “has become one of the most economically damaging glyphosate-resistant weed species in the U.S.”

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Question 8C: Can the plant aggressively displace native species through competition (including allelopathic effects)?

Answer: ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.*** No information was found on impacts of Palmer amaranth in native ecosystems. In laboratory studies, Palmer amaranth has been found to have allelopathic effects (Menges 1987, Menges 1988). Coles et al. (2024) state: “So far there have been no recorded impacts to natural ecosystems, although few data are being collected in these areas. However, Palmer amaranth’s affinity for tilled soil and man-made habitats suggests that it may invade natural areas experiencing human disturbance or soil erosion.”

Question 8D: Can the plant hybridize with native species resulting in a modified gene pool and potentially negative impacts on native populations?

Answer: ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.*** In an experiment, Franssen et al (2001) found that they could pollinate female common waterhemp (*Amaranthus rudis* which is now called *Amaranthus tuberculatus*) with pollen from male Palmer amaranth plants. They confirmed that hybrid offspring were possible. *Amaranthus tuberculatus* is native to Minnesota.

Sharpe et al. (2024) share the Canadian perspective that “Fourteen species of *Amaranthus* are found in Canada, nine of which (including waterhemp) possess herbicide-resistant biotypes. A total of 45 hybrids between various Canadian *Amaranthus* species with each other or Palmer amaranth have been noted. Hybrids have been experimentally produced or observed from herbarium specimens, with three cases of herbicide resistance transfer notably with Palmer amaranth or waterhemp. Mitigation strategies will depend on successful species identification and herbicide resistance status determination.”

Question 8E: Does the plant have the potential to change native ecosystems (adds a vegetative layer, affects ground or surface water levels, etc.)?

Answer: ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.*** No information was found indicating that Palmer amaranth changes ecosystem processes.

Question 8F: Does the plant have the potential to introduce or harbor another pest or serve as an alternate host?

Answer: ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.*** CABI (2019) states that Palmer amaranth is a major host of *Frankliniella occidentalis* (western flower thrips – an insect) and *Heterodera schachtii* (beet cyst eelworm – a nematode).

Michelle Grabowski (Minnesota Department of Agriculture plant pathologist, personal communication 2025) shared this information about *Heterodera schachtii*: “*Heterodera schachtii* sugarbeet cyst nematode would be a pathogen of concern to Minnesota. This nematode has been reported in North Dakota but has not been detected in Minnesota. We have surveyed for it for several years as part of our potato cyst nematode survey in NW Minnesota and have never found it despite intensive soil sampling in the fields where potato and sugar beet are commonly grown. I do not see a clear pathway for Palmer amaranth to introduce *H. schachtii*, assuming it is seeds being carried in. Cyst nematodes are most likely to be transported on soil and equipment contaminated with soil. However, it could act as an alternate host to *H. schachtii* in the event that both were introduced to a field.”

Angie Ambourn (Minnesota Department of Agriculture entomologist, personal communication 2025) shared information about *Frankliniella occidentalis* (western flower thrips). She noted that western flower thrips are mostly a concern in greenhouse settings as they are difficult to manage there. She has not heard of being a considerable threat to field agriculture. She noted that CABI indicates that western flower thrips are already abundant in wildflowers throughout most of the U.S., so the addition of Palmer amaranth as another host isn’t likely to make a large difference in populations.

Box 9:

Does the species have clearly defined benefits that outweigh associated negative impacts?

Question 9A: Is the plant currently being used or produced and/or sold in Minnesota or native to Minnesota?

Answer: No.

Outcome: Go to Box 10.

Palmer amaranth is not native to Minnesota and is not being sold in Minnesota. Palmer amaranth has been listed as a prohibited-eradicate noxious weed in Minnesota since 2015, so has been illegal to sell since 2015. At the time of the 2014 Minnesota Noxious Weed Risk Assessment there was no indication Palmer amaranth was being purposefully sold in Minnesota.

Question 9B: Is the plant an introduced species and can its spread be effectively and easily prevented or controlled, or its negative impacts minimized, through carefully designed and executed management practices?

Outcome: Decision tree does not direct to this question.

Question 9C: Is the plant native to Minnesota?

Outcome: Decision tree does not direct to this question.

Question 9D: Is a non-invasive, alternative plant material or cultivar commercially available that could serve the same purpose as the plant of concern?

Outcome: Decision tree does not direct to this question.

Question 9E: Does the plant benefit Minnesota to a greater extent than the negative impacts identified at Box #8?

Outcome: Decision tree does not direct to this question.

Box 10:**Should the species be regulated as Prohibited/Eradicate, Prohibited/Control, or Restricted Noxious Weed?**

Question 10A: Is the plant currently established in Minnesota?

Answer: Yes.

Outcome: Go to Question 10D.

See maps in current distribution section. The Minnesota Department of Agriculture closely tracks known Palmer amaranth site and management actions. In the 2024 Annual Report of the MDA's Noxious and Invasive Weed Program there is a Palmer amaranth summary (Minnesota Department of Agriculture 2025c). It notes that in 2024 the total confirmed acres of Palmer amaranth sites was 854 acres and that 509 acres were managed for Palmer amaranth. They explain that "typically, the actual area occupied by Palmer plants growing on a site is smaller than the total acres. In general, when Palmer is confirmed at a site, it is found in a portion or several portions of a site, although on occasion a few sites have had Palmer distributed throughout." They also noted that there were 34 total sites being monitored, 4 sites that were new in 2024, and 5 confirmed Palmer amaranth sites (new and recurring).

Question 10B: Would prohibiting this species in trade prevent the likelihood of introduction and/or establishment?

Outcome: Decision tree does not direct to this question.

Question 10C: Does this risk assessment support this species being a top priority for statewide eradication if found in the state?

Outcome: Decision tree does not direct to this question.

Question 10D: Does the plant pose a serious human health threat?

Answer: No.

Outcome: Go to Question 10F.

No evidence was found that Palmer amaranth poses a serious human health threat.

Question 10E: Is the health threat posed by the plant serious enough, and is the plant distribution sufficiently small enough to be manageable, and are management tools available and effective enough to justify listing as Prohibited / Eradicate species?

Outcome: Decision tree does not direct to this question.

Question 10F: Is the plant known to cause significant ecological or economic harm and can the plant be reliably eradicated (entire plant) on a statewide basis using existing practices and available resources considering the distribution, reproductive biology and potential for spread?

- *For distribution, note if the distribution is well documented, the number and acreage of known infestations and how widespread they are in the state. Note if there are infestations in border areas.*

- *For reproductive biology, note if there are reproductive biology factors that make the plant easier to control and eradication more likely (for example, long pre-reproductive period, self-incompatible pollination, short-lived seed bank).*
- *For potential for spread and re-invasion of controlled areas, note its potential to spread beyond places where it is being controlled such as deliberate planting by people, wildlife vectors, re-infestation from border states, or other factors that facilitate spread.*
- *For known management tools, note what management tools are available, potential non-target impacts, and the reasonableness of state management or mandating that landowners throughout the state use the management tools to eradicate or control existing plants.*
- *For available resources, consider the capacity of state and local personnel and availability of funding to respond to new and existing infestations.*

Answer: Yes.

Outcome: LIST THE PLANT AS A PROHIBITED / ERADICATE NOXIOUS WEED.

Due to Palmer amaranth's potential for large economic impacts and because its known locations are well tracked and managed, the Prohibited-Eradicate category remains the appropriate regulatory level for this species.

Potential for statewide harm and statewide eradication: Palmer amaranth has the potential to cause significant economic hard to agriculture. Palmer amaranth reports have been closely tracked and management efforts monitored. There are now well document management actions for Palmer amaranth and there have been extensive educational outreach efforts to the agricultural community.

Distribution: The Minnesota Department of Agriculture closely tracks the distribution. See distribution maps and Question 10A for more detail.

Reproductive biology: There are male and female plants. Plants are wind pollinated. The seeds are small and spread easily.

Potential for spread and reinvasion: There are many vectors that can introduce Palmer amaranth seeds. See Question 7G for more detail. Extensive efforts have gone into identifying those pathways and working to reduce the chance of Palmer amaranth introductions through those pathways.

Known management tools: There are management recommendations for managing Palmer amaranth and reducing the chances of spreading herbicide-resistance. Since management is challenging, prevention and early detection are highly

The Minnesota Department of Agriculture (2025) has these recommendations for prevention and management:

- Be proactive and prevent Palmer amaranth establishment. Familiarize yourself with Palmer amaranth identification and actively look for it in crop fields, borders, ditches and around dairies. Palmer amaranth is difficult to control because it can be resistant to multiple classes of herbicides and their different modes of action. Populations of Palmer amaranth have been documented with resistance to one or more of the following classes: Dinitroanilines, triazines, ALS (acetolactate synthase) inhibitors, glyphosate and HPPD (4-hydroxyphenylpyruvate dioxygenase) inhibitor herbicide.
- Mowing alone is not as effective as cultivation, as Palmer amaranth plants are usually not killed by mowing. They can regrow from cut stalks and set seed close to the ground. Mowing must therefore be

done in conjunction with other methods of control like herbicide application, prescribed fire or propane weed torching to be effective.

- Prevent all Palmer amaranth plants from producing seed if possible. Plants can be hand weeded and removed for disposal. If hand weeding is not feasible, contact your local University of Minnesota Extension agent, co-op, or certified landscape care expert for a specific herbicide recommendation.
- Always clean vehicles and equipment after exiting infested areas. If seed was produced, deep tillage will reduce the quantity of seeds that can readily germinate.
- A cereal rye cover crop can reduce Palmer amaranth germination and growth.

The University of Minnesota (2024) provides these management recommendations:

- Full labeled rates of residual herbicides with multiple Site of Actions (SOAs) are a must in corn and soybeans.
- If a field becomes infested, rotate it to a crop with more diverse management options, such as alfalfa, small grains or even corn.
- Early postemergence herbicide applications (when Palmer is less than 3 inches) are critical in managing this weed. Remember, Palmer can grow 2 to 3 inches in a day, so it can quickly exceed heights that herbicides can acceptably control.

Coles et al. (2024) has these recommendations for control:

- Unfortunately, the only universal recommendation we can make regarding Palmer amaranth control is that prevention is best. In some cases, prevention may be the only feasible option because this plant is exceptional in its ability to rapidly evolve herbicide resistance and alternatives may be expensive, time consuming, and possibly ineffective. In fact, many farmers first identify this plant simply as the only weed that did not die in their fields after routine herbicide applications. It is possible that some populations can be resistant to more than one herbicide type, and some fields have been abandoned due to a lack of practical control methods.
- We recommend taking every opportunity to detect Palmer amaranth early and prevent it from going to seed. In cases where seed production cannot be prevented and harvesting will spread seeds further, producers may consider sacrificing production on parts of a field, especially if the infestation is caught early (see Figure 3). This tactic may be the cheapest option because, once established, multiple control methods (including non-chemical ones) will likely be necessary to control Palmer amaranth in perpetuity, and methods may need to change frequently to manage resistance.
- Control strategies that have had some success elsewhere:
 - Deep Tillage - Deep tillage has been shown to reduce populations by 81%.
 - Herbicides - A mixture of pre-emergent and post-emergent herbicides consisting of different modes of action can help prevent resistance and manage resistant populations in some cases.
 - Hand-pulling - Can be effective for small populations, but plants probably should be removed from the field because they may re-root and produce seeds even after being pulled.

Washington State Noxious Weed Control Board (2025) lists the following control actions:

- Small infestations can be hand pulled or dug out.
- Larger infestations will need repeated cultivation.
- Mowing alone will not control Palmer amaranth, as plants will survive and just set seed closer to the ground.
- Prescribed fire will kill Palmer amaranth

- Most Palmer amaranths are resistant to many herbicides! Because of this, it is important to change the method of action of the herbicide you use each year or throughout a season, only coming back to a previously used chemical after multiple years.

Cornell University (2025) has detailed management guidance include advice on rotating land in perennial sod, inversion tillage, timing of rotary hoeing and tine weeding, crop planting density, black plastic, and genetic testing.

Nunes et al. (2024) provide guidance for using cereal rye (*Secale cereale*) as a cover crop and using preemergence herbicides to manage soybean fields to reduce Palmer amaranth impacts. Planting soybeans into the living cover crop is considered “planting green”. They note that “Accumulating adequate cereal rye biomass for effective suppression of *Amaranthus* spp. can be challenging in the upper Midwest due to the short window for cereal rye growth in a corn–soybean rotation. Farmers are adopting the planting green system to optimize cereal rye biomass production and weed suppression.” Their study found that “Planting soybean green is a feasible management practice to optimize cereal rye biomass production, which, combined with preemergence herbicides, provided effective *Amaranthus* spp. management. Soybean stand was a key factor in maintaining soybean yields compared with no-till when planting green. Farmers should follow best management recommendations for proper planter and equipment setup to ensure effective soybean establishment under high levels of cereal rye biomass when planting green.”

In a global review by Roberts and Florentine (2021) they conclude: “There has been a wide array of research developed to control *A. palmeri* including creating competitive pastures, herbicide application, flood irrigation, manual removal, grazing management, prevention and early response strategies and tillage management. Notwithstanding the contributions of this research, they have failed to effectively control the species in the long-term, this being further complicated by the evolution of herbicide-resistant populations. Based on this review, it is recommended that future research should focus on integrating a wide range of management strategies such as creating competitive pastures (cover crops), tillage management, grazing management, herbicide application and manual removal for greater confidence in control. It would also be of value for future research to investigate the effect of alternative synthetic herbicides such as the use of essential oils or the use of an iHSD. The use of decision support systems and modelling approaches would also be helpful in understanding the long-term management of *A. palmeri*. The development of early detection protocols utilising drone technology and ‘spot and spray’ practises is also highly recommended in addition to an increase in farm and vehicle hygiene to help reduce the spread and establishment of this invasive weed.”

Palmer amaranth seed contamination in seed lots of other species is a concern. There has been work done to improve genetic testing so that Palmer amaranth can be found in seed testing (Murphy et al. 2017, Brusa et al. 2021).

A study by Fletcher et al. (2016) examined “leaf hyperspectral reflectance data to develop spectral profiles of Palmer amaranth, redroot pigweed, and cotton and to determine regions of the light spectrum most sensitive for pigweed and cotton discrimination”. They concluded: “Spectral bands were identified for separating Palmer amaranth and redroot pigweed from cotton lines with bronze, green, and yellow leaves. Ground-based and airborne sensors can be tuned into the regions of spectrum identified, facilitating using remote sensing technology for Palmer amaranth and redroot pigweed identification in cotton production systems”.

Available resources: Funding for noxious weeds is always a challenge. Due to the potential for large negative economic impacts to agriculture, there has been more funding for Palmer amaranth than other noxious weeds.

Question 10G: Is the plant known to cause significant ecological or economic harm and can the plant be reliably controlled to limit spread on a statewide basis using existing practices and available resources? Would the economic impacts or other hardships incurred in implementing control measures be reasonable considering any ongoing or potential future increase of ecological or economic harm?

- Also consider all bullet points listed under 10F when evaluating 10G

Outcome: Decision tree does not direct to this question.

Question 10H: Would prohibiting this species in trade have any significant or measurable impact to limit or reduce the existing populations or future spread of the species in Minnesota?

Outcome: Decision tree does not direct to this question.

Question 10I: Are there any other measures that could be put in place as Special Regulations which could mitigate the impact of the species within Minnesota?

Outcome: Decision tree does not direct to this question.

Box 11:

The species is being proposed to be designated as a Specially Regulated Plant. What are the specific regulations proposed?

Answer: Decision tree does not direct to this question.

Final outcomes of risk assessment (2025)

NWAC Listing Subcommittee

Outcome: Remain a prohibited eradicate noxious weed.

Comments: No comments

NWAC Full Committee

Outcome: Remain a prohibited eradicate noxious weed.

Comments: The vote on 12/16/25 was 19 to 0 in favor of the recommendation.

MDA Commissioner

Outcome: Remain a prohibited eradicate noxious weed.

Comments: No comments

Risk Assessment Current Summary (06-30-2025)

- Palmer amaranth is a concern due to its potential negative economic impacts on agricultural crops. Palmer amaranth can outcompete crops and has developed herbicide resistance to multiple herbicide modes of action. The Minnesota Department of Agriculture (2025a) notes that yield losses have been up to 91% in corn and 79% in soybean.
- The Minnesota Department of Agriculture has been actively tracking Palmer amaranth in Minnesota and following up on the pathway of introduction and monitoring and tracking sites so that the Palmer amaranth is removed. There are a limited number of sites with Palmer amaranth in Minnesota at this time.

- Due to potential for large negative economic impacts of Palmer amaranth and its limited distribution in Minnesota, it makes sense to continue to keep Palmer amaranth as Prohibited-Eradicate noxious weed.

Final outcomes of risk assessment (2014)

NWAC Listing Subcommittee

Outcome: List as Prohibited-Eradicate.

Comments:

NWAC Full Committee

Outcome: List as Prohibited-Eradicate.

Comments: Send to the Commissioner for an emergency 2015 listing.

MDA Commissioner

Outcome: List as Prohibited-Eradicate.

Comments: Approved 3/03/15 – Prohibited Noxious Weed – Eradicate List

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