



**United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine**



**Review of Petition to Add Genetically
Engineered Glyphosate-tolerant Kentucky Bluegrass to the
Federal Noxious Weed Regulations**

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Introduction

The Plant Protection Act (PPA, 7 U.S.C. 7701 et seq.), authorizes the Secretary of Agriculture to prohibit or restrict the importation, entry, exportation, or movement in interstate commerce of any plant, plant product, biological control organism, noxious weed, article, or means of conveyance if the Secretary determines that the prohibition or restriction is necessary to prevent the introduction of a plant pest or noxious weed into the United States or dissemination of a plant pest or noxious weed within the United States.

The PPA defines “noxious weed” as “any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, and the natural resources of the United States, the public health, or the environment.”

Under the authority of the PPA, the Animal and Plant Health Inspection Service (APHIS) administers the regulations in 7 C.F.R. Part 360, “Noxious Weed Regulations,” which prohibit or restrict the importation and interstate movement of those plants that we have designated as regulated noxious weeds in § 360.200 (the Federal noxious weed list). The Secretary of Agriculture has discretion in determining which plants should be regulated under these regulations. Generally, plants regulated as listed noxious weeds are those plants that are determined likely to be aggressively invasive, have significant negative impacts, and are extremely difficult to manage or control once established. If APHIS determines that a plant poses a level of harm that would warrant its designation as a Federal noxious weed, APHIS may place the plant on the Federal noxious weed list and regulate it under 7 C.F.R. Part 360.

This document provides APHIS’s review of a petition to list herbicide tolerant Kentucky bluegrass as a regulated Federal noxious weed under 7 C.F.R. Part 360.

Background

APHIS does not currently regulate Kentucky bluegrass, *Poa pratensis* L., as a Federal noxious weed. In 2002, APHIS received a petition from the International Center for Technology Assessment and the Center for Food Safety (the petitioners) requesting that the Agency list in its Federal noxious weed regulations, two types of Genetically Engineered (GE) turf grass species (Kentucky bluegrass and creeping bentgrass) that are tolerant to the herbicide glyphosate.

In 2003, APHIS completed a weed risk assessment (WRA) and determined that GE glyphosate-tolerant creeping bentgrass did not meet the criteria to be regulated as a Federal noxious weed. The Center for Food Safety challenged APHIS’ decision in Federal Court, which remanded the WRA back to the Agency in 2007.

APHIS now has prepared a new weed risk assessment (WRA) and has conducted a review of the petition, which is described in this document, to determine whether the Kentucky bluegrass species, *Poa pratensis* L., which encompasses both Kentucky bluegrass that has been genetically engineered for tolerance to the herbicide glyphosate and non-herbicide-tolerant Kentucky bluegrass, should be listed and regulated as a Federal Noxious Weed.

Noxious Weed Regulatory Program History

The Federal Noxious Weed Act (FNWA) was passed in 1974 to establish a USDA program to address weeds that were having significant impacts on both plant and animal agricultural operations. The Act allowed USDA to regulate as a noxious weed “any living stage (including but not limited to, seeds and reproductive parts) of any parasitic or other plant of a kind, or subdivision of a kind, which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants, livestock, or poultry or other interests of agriculture, including irrigation, or navigation or the fish and wildlife resources of the United States or the public health.” THE FNWA gave USDA authority to designate plants as noxious weeds by regulation, and the movement of all such weeds in interstate or foreign commerce was prohibited except under permit. USDA was also given authority to inspect, seize and destroy products, and to quarantine areas, if necessary to prevent the spread of such weeds.

Witchweed was the first weed targeted for regulation, and was actually addressed via a Federally funded program prior to APHIS’s existence in 1957. Witchweed, and the first 22 weeds (including hydrilla and a number of parasitic weeds) were first regulated under FNWA in 1976. A Technical Committee to Evaluate Noxious Weeds was formed in 1979, and the next set of weeds was regulated in 1981. Historically, weeds regulated under FNWA authority were highly competitive with crops, or damaging to natural areas or aquatic habitats, or waterways.

In 2000, the PPA altered the definition of “noxious weed” by expanding the applicability of the definition to include aquatic weeds and weeds in natural areas, and by removing the limitation on listing weeds that are “new to or widely prevalent” in the United States.

Originally much of the control/eradication work to address listed and regulated noxious weeds was done by APHIS, but now most efforts are funded through Cooperative Agreements with state or private stakeholders. Today, the vast majority of program funding is dedicated to

addressing a small number of targeted Federal noxious weed priorities, including the following examples of listed noxious weeds:

Asian dodder (*Cuscuta japonica*)
Caulerpa - Med. clone (*Caulerpa taxifolia*) Eradicated
Cogongrass (*Imperata cylindrica*)
Common Broomrape (*Orobanche minor*)
Branched Broomrape (*Orobanche ramosa*)
Giant Hogweed (*Heracleum mantegazzianum*)
Giant Salvinia (*Salvinia molesta*)
Goatsrue (*Galega officinalis*)
Hydrilla (*Hydrilla verticillata*)
Onionweed (*Asphodelus fistulosus*)
Tropical Soda Apple (*Solanum viarum*)
Tropical Spiderwort, aka Benghal Dayflower (*Comelina benghalensis*)
Witchweed (*Striga asiatica*)
Wormleaf salsola (*Salsola vermiculata*)

Each of these listed noxious weeds has proven to have significant impacts in areas where they have been introduced, and the damage several of them cause is described later in this document.

Kentucky Bluegrass

Kentucky bluegrass is grown throughout the United States; it is commonly known as a turf crop that can provide dense green sod that is especially adapted for parks and home lawns. It is highly prized and significant investments are made by citizens to maintain a healthy Kentucky bluegrass lawn. Kentucky bluegrass is often encountered in pasture and prairie plant communities; where it would be considered a forage crop. It can also become established in semi-open woodlands and rangelands. Kentucky bluegrass can also volunteer in agricultural production systems (e.g. row crops, fruit trees, nurseries).

Established weed management practices are used throughout the United States to maintain the desired balance of plant species within the plant communities in agricultural, horticultural and rangeland/prairies systems. Kentucky bluegrass is a preferred pasture grass in some areas of the country and considered a less desirable and potentially weedy plant in other portions of the country where it can compete with native grassland species; management systems for Kentucky bluegrass vary dependent upon the ecosystem under consideration. Kentucky bluegrass is effectively managed through use of standard practices that have multiple

benefits; implementation of these measures is not solely triggered by the presence of Kentucky bluegrass. Management options include the measured use of animals for grazing, mowing, mechanical removal and prescribed burns; the latter of which is renowned for many benefits it affords to prairie/pasture/rangeland systems that go well beyond benefits derived from Kentucky bluegrass management alone. In certain instances, herbicides may be used to control Kentucky bluegrass. There are several registered herbicides that are available that provide effective control.

In 2009, Kentucky bluegrass yielded sales receipts at \$52.4 million nationwide, nearly half of which resulted from exports. Export market values in the last five years averaged approximately \$25 million.

For the purposes of most of our review of the petition, we will refer to Kentucky bluegrass, generally, to mean both herbicide tolerant and non-tolerant types. Both are the same species, and our analysis shows that the only distinction between the two is glyphosate tolerance. This suggests that in the field, GE and non-GE Kentucky bluegrass will behave exactly the same, except that the glyphosate tolerant Kentucky bluegrass will survive glyphosate treatment, while the non-tolerant Kentucky bluegrass will not. The GE type would be theoretically more difficult to control were it not for the fact that alternative management practices would continue to be effective for the control of Kentucky bluegrass regardless of its ability to tolerate glyphosate treatment. We have concluded, on the basis of our WRA, that the risks posed by Kentucky bluegrass regardless of whether it has been genetically engineered for glyphosate tolerance are essentially the same. Thus, consistent with the provisions of the PPA which provide APHIS authority to regulate noxious weeds, it has been the Agency's policy to regulate at the species level. As such, any decision to regulate GE Kentucky bluegrass as a Federal noxious weed would obligate us to do the same for both types of Kentucky bluegrass. The minor distinction in risk between the two is reflected in the results of the Weed Risk Assessment (described in more detail below); the Impact Potential scores differ by only one point, and that difference is again due specifically to glyphosate tolerance.

Considerations for Decisionmaking

In evaluating a request to list a proposed species as a noxious weed, we ask two overarching questions:

1. Does the species proposed for listing meet the PPA definition of a noxious weed?
2. If the answer to question 1 is yes, then should the species be listed as a noxious weed and regulated by the Secretary?

Our evaluation of the petition within the framework of these two questions is described in detail below.

Does the species proposed for listing meet the PPA definition of a noxious weed?

In order to be considered for listing, the plant must meet the definition of a noxious weed. The term “noxious weed” means any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment.

The first consideration in determining if a plant is a noxious weed is identifying what direct injury or damage (physical harm) the plant may cause. If direct harm or damage is possible, the next consideration is to evaluate any indirect damage the plant may cause to interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment.

We prepared a weed risk assessment (WRA), entitled “Weed Risk Assessment for non-herbicide resistant and herbicide resistant types of *Poa pratensis* L.” The purpose of the weed risk assessment was to evaluate the weediness of non-herbicide tolerant (non-genetically engineered, or non-GE) and herbicide tolerant (GE) types of Kentucky bluegrass, and determine whether or not the species (which encompasses both types) is a candidate for listing as a Federal noxious weed. While the analysis was based solely on field observations using non-GE Kentucky bluegrass (glyphosate susceptible), we consider that the two types will behave in a similar manner to other crops that differ solely with respect to GE-glyphosate tolerance. In the field, GE and non-GE Kentucky bluegrass are expected to behave exactly the same, except that the glyphosate tolerant type will survive glyphosate treatment, while the non-tolerant type will not. The WRA does not by itself draw conclusions about whether a species should be considered a Federal noxious weed, but provides an analysis to policymakers to inform their consideration of regulatory decision making.

To determine whether or not Kentucky bluegrass is a candidate for listing, we used a weed risk assessment tool that was validated using data on 204 plant species with known noxious behavior in the United States. This validated weed risk assessment tool predicts weed risk potential based on scores for Impact Potential (i.e., harm), and Establishment/Spread Potential. The model estimates Impact Potential with 18 scored questions related to the types of damage to crops or the environment that a species may cause (e.g., reducing crop yields, requiring control, changing community function or structure, adverse effects on human health). We assess Establishment/Spread potential using 27 scored questions on species biology and history (e.g., invasiveness elsewhere, dispersal mechanisms, likelihood of being a contaminant, reproduction). The model was developed to assess basic invasiveness of plants, however, and not to distinguish between plant types with different genotypes.

The Establishment/Spread Potential scores for the two types of Kentucky bluegrass were 23 for the non-GE type, and 24 for the GE type, which are high on the scale of -25 to 32. The one point difference, which is not significant, is due entirely to the glyphosate tolerance of the GE type.

For Impact Potential, both types scored 2.5 on a scale of 1 to 5.1. That score exceeds all those for non-invasive species in the validation dataset, but is low or moderate when compared with scores for High risk species. The most harmful species in the validation dataset (e.g., Canada thistle, *Cirsium arvense*) have Impact Potential scores of 4 or greater. In this case, because the model is qualitative, the score for Impact Potential may overestimate the true damage this species can cause. For example, although Kentucky bluegrass can act as a weed in U.S. agricultural systems, we found very few reports. It is also reported to be a weed of production crops in only two other countries, despite a wide distribution throughout Europe and Asia. Some recent studies indicate that Kentucky bluegrass can invade U.S. prairie or grassland ecosystems, but general weed management programs are typically recommended in such situations. Finally, no states regulate Kentucky bluegrass or have it prioritized for control.

Based on those scores, the predictive logistic regression model indicated that both the non-GE and GE types have High weed risk potentials. Our uncertainty about these findings was small because of the abundance of information about the biology, behavior, and performance of non-GE Kentucky bluegrass in the United States. The analysis concludes that Kentucky bluegrass species *P. pratensis* (including GE and non-GE) can be considered for regulation as a Federally listed noxious weed.

Our review of the WRA shows that there is evidence that Kentucky bluegrass has caused some problems in grassland or prairie ecosystems, when such areas are not managed properly (e.g., Grant et al., 2009). Kentucky bluegrass spreads aggressively (Nature Serve, 2011; Weber, 2003). It has escaped cultivation into native prairies (Grant et al., 2009). The WRA also found that Kentucky bluegrass can act as a weed in U.S. agricultural systems (e.g., Bridges, 1992) and is reported to be a weed of production crops in two other countries, despite a wide distribution through Europe and Asia. It is listed as an arable weed in Japan (Holm et al., 1979; Morita, 1997), and in Australia, it is an agricultural weed. Given that Kentucky bluegrass shows potential to cause damage to crops and natural resources of the United States, we conclude that Kentucky bluegrass meets the PPA definition of “noxious weed.”

Should the species be listed as a noxious weed by the Secretary?

The distinction between a weed and a noxious weed warrants emphasis. “Weeds,” in the broadest sense of the word, could include any plant growing where and/or when it is unwanted; even plants that are desirable in some settings may be considered weeds in others. In a narrower sense, weeds are invasive, often non-native, plants which impact natural and managed ecosystems, often with significant negative consequences due to lost yields, changes in management practices, altered herbicide use, etc. Only a fraction of these problematic weeds are considered to be so invasive, so harmful, and so difficult to control that Federal regulatory intervention to prevent their introduction or dissemination is justified, and these are the focus of the regulatory controls placed on them by APHIS. The Plant Protection Act commits the decision to list a weed as a noxious weed to the discretion of the Secretary. In general, federally listed noxious weeds are species that are likely to be aggressively invasive, have significant negative impacts, and are extremely difficult to manage or control once established.

APHIS currently lists 98 aquatic, terrestrial, or parasitic plant taxa as noxious weeds. The species included in the list illustrate the kinds of plants APHIS considers to be sufficiently invasive, damaging, and difficult to control to be deemed noxious weeds. Table 1 describes some specific examples from the Federal noxious weed list and the kinds of negative impacts noxious weeds can have, to illustrate the types of effects APHIS will be looking for when evaluating whether plants reviewed under the PPA to have any potential noxious weed traits.

Table 1.—Examples of impacts caused by federally listed noxious weeds

Impact	Description of impact	Example species
Lost productivity of crop fields	Noxious weeds may directly compete with crop plants for limited resources, dramatically reducing yields.	Cogongrass (<u><i>Imperata cylindrica</i></u>) infests over 20 crop species; it releases chemicals into the soil that suppress crop growth and causes damaging puncture wounds to plant roots, bulbs, and tubers. Other examples include Benghal dayflower (<u><i>Commelina benghalensis</i></u>), red rice (<u><i>Oryza</i> spp.</u>), and kikuyugrass (<u><i>Pennisetum clandestinum</i></u>).

Impact	Description of impact	Example species
Parasitic damage to crops	Parasitic plants can cause significant reductions in yield by attaching themselves to a host plant, removing nutrients and ultimately killing it.	Federally listed noxious parasitic plants include the dodders (<u>Cuscuta</u> spp.)—with common names like strangleweed, devil’s-guts, hellbine, and witch’s hair— and witchweed (<u>Striga</u> spp.), which causes devastating losses in corn, sorghum, and rice.
Reduced productivity of pasture	Grazing animals may avoid noxious weeds and consume the more favorable pasture species, resulting in increased noxious weed populations at the expense of more favorable species. Noxious weeds may also outcompete desirable pasture species.	Serrated tussock (<u>Nassella trichotoma</u>) has heavily infested large areas, leaving them completely incapable of supporting livestock.
Injury to humans or livestock	Many noxious weeds are toxic, harming humans or livestock either when consumed or by direct contact.	Cape tulip (<u>Homeria</u> spp.) contains a cardiac glycoside, which can be fatal to livestock. Contact with giant hogweed (<u>Heracleum mantegazzianum</u>) causes painful skin blisters. Three-cornered jack (<u>Emex australis</u>) and devil’s thorn (<u>Emex spinosa</u>) both bear spiny fruits that can cripple or cause injury to livestock or other animals.
Unchecked overgrowth	Noxious weeds may be capable of completely dominating the landscape and preventing the use of cultivated or pasture lands for agriculture.	Mile-a-minute vines (<u>Mikania cordata</u> and <u>M. micrantha</u>) can entirely smother fields and forests in a dense, tangled mass of vines. A single plant of the aquatic weed giant salvinia (<u>Salvinia</u> spp.) can blanket 40 square miles in 3 months, and produce an underwater mat 3 feet thick.

Impact	Description of impact	Example species
Physical obstructions	Growth rate and habit of some noxious weeds may physically hamper the movement of livestock and humans, or interfere with navigation of waterways.	Certain mesquites (<u>Prosopis</u> spp.), jointed prickly pear (<u>Opuntia aurantiaca</u>), and African boxthorn (<u>Lycium ferocissimum</u>) form impenetrable thickets filled with thorns or needles, blocking the movement of grazing animals, injuring them or preventing access to food and water.
Disruption of water flow	Aquatic noxious weeds may disrupt water flow, adversely affecting irrigation, drainage and flood control canals, city water intakes, and recreational water use.	Notable examples include hydrilla (<u>Hydrilla verticillata</u>), giant salvinia (<u>Salvinia</u> spp.), and Chinese waterspinach (<u>Ipomoea aquatica</u>). Dense mats of oxygen weed (<u>Lagarosiphon major</u>) can completely shut down operation of hydroelectric plants.
Habitat alteration	Noxious weeds may severely alter water quality by changing oxygen and nutrient content, may dramatically lower local water tables, or could so significantly outcompete or overgrow other vegetation resulting in a complete ecological shift of the habitat.	Infestation of lakes and ponds with hydrilla (<u>Hydrilla verticillata</u>) can alter aquatic ecosystems so drastically that native plants are entirely eliminated, rendering the habitat unsuitable for fish and other wildlife.

Certainly, some noxious weeds can cause physical harm to the health of humans or livestock and other animals. In general, these impacts occur when individuals come into direct contact with the noxious plants or plant parts, which may cause physical injury or are toxic or otherwise harmful when consumed. Conceivably, noxious weeds growing in crop fields could potentially threaten public health, for example, if toxic parts of the noxious weeds are harvested and inadvertently enter the food supply. If such toxic or otherwise harmful noxious weed parts were found in food and caused the food to be “adulterated” within the meaning of the FFDCA, FDA could take regulatory action against the food.

Our review of the WRA and analysis above shows that Kentucky bluegrass has not caused the kinds of impacts that we see from currently listed Federal noxious weeds. The WRA

found that although Kentucky bluegrass can act a weed in U.S. agricultural systems, that is only reported by Bridges (1992) for a total of three crops—apples, spearmint, and peppermint—out of the hundreds of crops grown in the United States. In apples, we have found no evidence of it being a significant weed (e.g., listed but with no indication of severity in Rifai et al., 2002 [Nova Scotia, Canada]). Another report has volunteer bluegrass as a weed in bluegrass seed plots (Lee, 1978). Given both the long history of Kentucky bluegrass in the United States and the paucity of domestic reports about weedy behavior under a diverse range of weed management strategies, it seems highly unlikely that it is a significant weed in managed agricultural systems in the United States.

The WRA also found that Kentucky bluegrass is reported to be a weed of production crops in only two other countries, despite a wide distribution through Europe and Asia. It is listed as an arable weed in Japan (Holm et al., 1979; Morita, 1997), but is not regulated or heavily controlled (NIES, 2011). In Australia, it is an agricultural weed, but was not ranked as either a noxious weed, or a serious, high impact weed (Randall, 2007).

Most of the evidence gathered through the WRA process for invasiveness by Kentucky bluegrass comes from grassland or prairie ecosystems. When it invades native prairies, the recommended management is typically to apply general, adaptive (i.e., location specific) programs to control multiple species, not just Kentucky bluegrass (e.g., Grant et al., 2009; Hendrickson and Lund, 2010). Preferred methods of control are grazing and controlled burns (FEIS, 2009). Fire is usually a successful method of control for Kentucky bluegrass in these systems (Sather, 1996). When herbicides are used in such situations, invasive Kentucky bluegrass populations can be reduced to low levels in one or two seasons (Waller and Schmidt, 1983). The tolerance of Kentucky bluegrass to glyphosate would not affect the ability of land managers and farmers to manage it.

The WRA found that Kentucky bluegrass has demonstrated value in some natural areas, however. For example, it can be an important part of the diet of wildlife (e.g., elk, bighorn sheep) (FEIS, 2009), and Kentucky bluegrass is one of the most important forage species for cattle and sheep summering in mountain meadows in eastern Oregon (McInnis and Vavra, 1986). The WRA also notes that Kentucky bluegrass is a recommended pasture grass in some eastern and western states (e.g., Tregoning, N/D; Wiedmeier et al., 2005), and is widely grown as a turfgrass species in all 50 United States.

Given the very limited reports of domestic damage caused by Kentucky bluegrass despite substantial plantings all over the country, together with the apparent lack of interest at the state or local government level in managing it as a weed that poses unique or challenging control strategies, Kentucky bluegrass does not appear to warrant listing and regulation as a Federal noxious weed.

Funding for federal regulatory response for Kentucky bluegrass is unlikely to be available at a time when our noxious weed program is facing funding limitations, and the required response would be beyond the combined federal and state regulatory capacity.

Furthermore, the PPA does not provide authority to hold, seize, quarantine, treat, apply other remedial measures to, destroy, or otherwise dispose of any noxious weed being imported or moving in interstate commerce unless the noxious weed is “new to or not known to be widely prevalent” in the United States. Kentucky bluegrass is neither. Therefore, the widespread prevalence of Kentucky bluegrass regardless of glyphosate tolerance would preclude any sort of eradication effort or other effective regulatory response.

APHIS has little authority to take regulatory actions related to preventing the evolution of herbicide-tolerant weeds. While the PPA gives APHIS the authority to regulate noxious weeds, to date APHIS has never regulated a weed as “noxious” due to its resistance to an herbicide alone, nor has it ever taken action to prevent the *evolution* of noxious weeds.

Herbicide resistant weeds are not an issue exclusively associated with the use of herbicides on genetically engineered HR crops. Many weed species have evolved resistance to a wide variety of herbicides, long before the advent of GE crops, resulting from the common use of herbicides in agriculture for decades.

We have no evidence, whether in the WRA or otherwise, that Kentucky bluegrass poses a threat to irrigation, navigation, or public health. There are no states that have regulations or have published weed risk analyses for Kentucky bluegrass, which suggests that control of Kentucky bluegrass is not a priority for States.

Conclusion

For all these reasons, APHIS has determined that Kentucky bluegrass *Poa pratensis* L., whether GE or not, should not be listed as a noxious weed in 7 CFR Part 360 pursuant to the PPA and the regulations.

Literature Cited

- Bridges, D.C. 1992. Crop Losses Due to Weeds in the United States – 1992. Weed Science Society of America, Champaign, Illinois, USA.
- FEIS. 2009. USDA Forest Service-Fire effects information center. USDA Forest Service. <http://www.fs.fed.us/database/feis/>. (Archived at PERAL).
- Grant, T. A., B. Flanders-Wanner, T. L. Shaffer, R. K. Murphy, and G. A. Knutsen. 2009. An Emerging Crisis across Northern Prairie Refuges: Prevalence of Invasive Plants and a Plan for Adaptive Management. *Ecological Restoration* 27(1):58-65.
- Hendrickson, J. R., and C. Lund. 2010. Plant Community and Target Species Affect Responses to Restoration Strategies. *Rangeland Ecology & Management* 63:435-442.
- Holm, L. G., J. V. Pancho, J. P. Herberger, and D. L. Plucknett. 1979. A Geographical Atlas of World Weeds. Krieger Publishing Company, Malabar, Florida, U.S.A. 391 pp.

- Lee, W. O. 1978. Volunteer Kentucky bluegrass (*Poa pratensis*) control in Kentucky bluegrass seed fields. *Weed Science* 26(6):675-678.
- McInnis, M.L., and M. Vavra. 1986. Summer diets of domestic sheep grazing mountain meadows in northeastern Oregon. *Northwest Science*. 60(4): 265-270.
- Morita, H. 1997. *Handbook of Arable Weeds in Japan*. Niimura Printing Co., Ltd., Tokyo. 128 pp.
- NAPPPFAST. 2008. Databases used in the NAPPPFAST system. NCSU APHIS Plant Pest Forecasting System (NAPPPFAST).
<http://www.nappfast.org/databases/NAPPPFAST%20Databases.htm>. (Archived at PERAL).
- Nature Serve. 2011. Nature Serve Explorer: An online encyclopedia of life [web application] Version 7.1. Nature Serve. <http://natureserve.org>. (Archived at PERAL).
- NIES. Invasive species of Japan. Invasive Species Research Team, Center for Environmental Biology and Ecosystem Studies, National Institute for Environmental Studies, Ibaraki, Japan. <http://www.nies.go.jp/biodiversity/invasive/DB/detail/80770e.html> (Archived at PERAL)
- Randall, J. M. 2007. The introduced flora of Australia and its weed status. CRC for Australian Weed Management, Department of Agriculture and Food, Western Australia, Australia.
- Rifai, M.N., T. Astatkie, M. Lacko-Bartosova, and J. Gadus. 2002. Effect of two different thermal units and three types of mulch on weeds in apple orchards. *Journal of Environmental Engineering and Science*. 1: 331–338.
- Sather, N. 1996. Element Stewardship Abstract for *Poa pratensis*, *Poa compressa*. The Nature Conservancy, Minneapolis, MN. 21 pp.
- Tregoning, D. No date. Pasture Renovation and Seeding. Montgomery County Cooperative Extension, Maryland.
<http://www.equinestudies.umd.edu/documents/UMSeminar/Tregoning.pdf> (Archived at PERAL)
- Waller, S. S., D.K. Schmidt. 1983. Improvement of eastern Nebraska tallgrass range using atrazine or glyphosate. *Journal of Range Management*. 36(1): 87-90.
- Weber, E. 2003. *Invasive Plant Species of the World: A Reference Guide to Environmental Weeds*. CABI Publishing, Wallingford, UK. 548 pp.
- Wiedmeier, R.D., D.R. ZoBell, A.C. Young, and P.R. Schmidt. 2005. Yearly Forage Production of Irrigated Pastures Grazed by Cow-Calf Pairs as Affected by the Timing of Sprinkler Irrigation Application. Department of Animal, Dairy and Veterinary Sciences, Utah State University, Logan.