

	Common Name	<i>Latin Name</i> (Full USDA Nomenclature)
<p align="center">MN NWAC Risk Assessment Worksheet (04-2017)</p>	<p align="center">Blue Mustard (Other Common Names – Purple Mustard, Crossflower, Musk Mustard, Common Bluemustard, Bean-Podded Mustard, Tenella Mustard, Chorispora)</p>	<p align="center"><i>Chorispora tenella</i> (Pallas) DC. (Synonyms – <i>Cheiranthus chius</i> Pall., <i>Cheiranthus taraxacifolius</i> Schrank, <i>Chorispermum arcuatum</i> Andr. ex DC., <i>Chorispermum tenellum</i> R.Br., <i>Crucifera tenella</i> (Pall.) E.H.L. Krause, <i>Raphanus monnetii</i> H. Lév., <i>Raphanus tenellus</i> Pall.; see <i>The Plant List</i> at http://www.theplantlist.org/tpl1.1/record/kew-2719512)</p>
<p>Original Reviewer: James Calkins</p>	<p>Affiliation/Organization: Minnesota Nursery and Landscape Association (MNLA)</p>	<p>Original Review Date: (04/13/2018)</p>
<p>Current Reviewer: James Calkins</p>	<p>Affiliation/Organization: Minnesota Nursery and Landscape Association (MNLA)</p>	<p>Current Review Date: (07/11/2018)</p>

Species Description:

Appearance: Blue mustard (*Chorispora tenella*) is a winter or early spring annual that starts out as a rosette and later develops an upright to sprawling, branched habit with lavender flowers with four petals in terminal racemes beginning in early spring through early summer followed by narrow, beaked, pod-like fruits (siliques).

Family: Brassicaceae (Mustard Family).

Habitat: Blue mustard is a winter or early spring annual that is native to temperate Europe and Asia; the species requires full sun and grows on most soils so long as they are well-drained; disturbed sites are generally preferred.

Distribution: Blue mustard is native to eastern Europe and Asia and is believed to have been introduced to North America in 1929 as a contaminant in grain. More specifically, blue mustard is native to eastern Europe and Asia and has been introduced elsewhere including Minnesota and other parts of North America. According to the USDA, blue mustard has been documented in 31 states in the continental United States, including Minnesota south to Louisiana and all states west plus Michigan,



Copyright © 2010 [Barry Breckling](#); Lake Pueblo State Park (Pueblo County, CO); Creative Commons Attribution-NonCommercial-ShareAlike 3.0 ([CC BY-NC-SA 3.0](#)) license.

Illinois, Indiana, Ohio, Pennsylvania, Massachusetts, West Virginia, Tennessee, and Mississippi, and three Canadian provinces (British Columbia, Alberta, and Saskatchewan). It is most common and widely distributed in the drier regions of the western and southwestern United States centered on the Intermountain West and High Plains regions including Wyoming, Utah, Nevada, eastern Washington, Oregon, and California, and Montana, Idaho, and Colorado and western Nebraska and Kansas.

Blue mustard is generally considered an agricultural weed in arid climates and is primarily found and the most problematic in agricultural fields, especially small grains and most commonly in winter wheat, but is also found in other crops, including some perennial crops like alfalfa, disturbed and neglected areas like roadsides and railroad right-of-ways, and sometimes in native plant communities in semi-desert, foothill, dry meadow (Montana) (Schneider, 2004), and rangeland (Rollins, 1981) environments. It has also been reported as a weed in landscape plant production areas (i.e., nurseries) in Maryland. It is reportedly most abundant in fallow, cultivated fields. (Stubbendieck et al., 1995).

Detailed Botanical Description:

Life cycle: Blue mustard is a winter or early spring annual that typically germinates in the fall when the environmental conditions are most favorable (cooler and moister) initially producing a rosette of leaves and a shallow taproot. The plants over-winter as rosettes and resume active growth and complete their life cycle (flowering and fruit and seed development followed by senescence and seed dispersal) in the spring to early summer. When plants resume growth in the spring, the rosette habit is lost as the flower stems elongate (bolt) in a process known as bolting. Some seeds may also germinate during the winter in warmer regions and in early spring.

Leaves: The leaves are sub-opposite at first becoming alternate, variously entire to sinuate-dentate (wavy-edged with teeth), and sparsely covered with sticky, glandular trichomes (hairs).

Stems: The stems are also covered with glandular hairs and are typically branched close to the ground. Plants typically grow to a height of about 18” (range – 8-24”) and give off a distinct, musky odor that is described as unpleasant and is compared to the smell of melted crayons by one source (Schneider, 2018) and stale dishrags by another (Parchoma, 2002). In open areas, older plants can become somewhat decumbent in habit.

Flowers: The lavender to bluish-purple flowers are about 5/16” wide when open and are produced on short stalks in erect, showy, terminal clusters (racemes) in beginning in April (Nebraska; probably later in Minnesota) with the flower buds opening first at the base of the raceme and progressing upward over time. As for other members of the mustard family, the flowers are perfect (hermaphroditic; male and female parts present) and 4-merous (four petals and 4 sepals). The petals emerge from four overlapping sepals (also lavender) that form a tube around the base of the flowers. The flower petals are wavy to twisted and oriented in an “x” or cross shape and is the reason behind the common name crossflower. The flowers are showy in numbers, are insect pollinated (long-tongued insects given the narrow, tubular flowers, and plants can bloom for 2-3 months, beginning when the plants are quite young and continuing as the plants continue to grow (May-July in Nebraska).

Fruit: The fruit is a tubular, typically upwardly-curved silique (an elongated, many-seeded, 2-valved fruit derived from two fused carpels with a persistent, central partition called a replum; the fruit produced by members of the Brassicaceae) with a tapered beak. The siliques are about 1.5” in length, turn light brown (tan) when mature, and contain multiple, small, rectangular-rounded but slightly flattened, smooth, reddish-brown seeds with a longitudinal groove on each side delineating the radicle from the cotyledons (swcoloraowildflowers.com). Viable seed can be produced within 10 days of flowering and large populations can produce copious amounts of seed. Unlike most siliques, the valves to not

separate from the fruit vertically to release the seeds; instead, the silique splits into 1-seeded sections (disseminules) horizontally with the seeds retained within the separated sections.

Seed Dispersal & Germination: Once again, the fruit is a silique that ripens in late spring and early summer and breaks into sections horizontally. The seeds are retained in the abscised fruit sections and are dispersed by gravity and the elements. Mature seeds may be able to pass through the digestive tract of grazing animals intact and may be spread to new areas in this manner by livestock. A winter or early spring annual, the seed typically germinates in the fall, but can germinate during the winter and early the following spring.

Economic Uses/Benefits: Blue mustard has no economic value, but the seeds are eaten by ground-foraging birds (Stubbendieck et al., 1995).

Human Health and Livestock Impacts: The leaves are edible and are not toxic to livestock if not eaten in large amounts with the possible exception of horses and most specifically pregnant mares and their foals; dairy animals that feed on blue mustard may produce milk with an off-taste.

Current Regulation: Blue mustard is currently listed as a noxious weed in California (B List – A pest of known economic or environmental detriment that, if present in California, has a limited distribution and may be managed for the purpose of containment or eradication at the discretion of state or county weed management authorities and may not be produced, held or offered for sale as nursery stock in California; https://www.cdfa.ca.gov/plant/IPC/encycloweedia/weedinfo/winfo_table-sciname.html; <https://plants.usda.gov/java/noxious?rptType=State&statefips=06>; <http://pi.cdfa.ca.gov/pqm/manual/pdf/107.pdf>; <https://plants.usda.gov/core/profile?symbol=CHTE2>). Blue mustard is not currently regulated in Minnesota and is not included on the Federal Noxious Weed List (<https://plants.usda.gov/java/noxious>).

Box	Question	Answer	Outcome
1	The plant species or genotype is non-native.	Yes; Blue mustard is native to Europe and Asia and is believed to have been introduced to North America in 1929 as a seed contaminant in grain from Asia (most likely Russia/Siberia) (Lyon et al., 2006) and was first documented in North America in Utah and Idaho (Lyon et al., 2006; Schneider, 2018).	Go to Box 3
2	The plant poses significant human or livestock health concerns or has the potential to significantly harm agricultural production.		
	A. Does the plant have toxic qualities that pose a significant risk to livestock, wildlife, or people?		

Box	Question	Answer	Outcome
	B. Does the plant cause significant financial losses associated with decreased yields, reduced quality, or increased production costs?		
3	The plant, or a related species, is documented as being a problem elsewhere.	<p>Yes; Blue mustard is currently documented as present in 31 U.S. states and three southwestern Canadian provinces (southern portions). It has been documented as a weed problem in agricultural crops and disturbed, neglected areas in several states and primarily in the arid regions of Intermountain West and High Plains in the western and southwestern United States (USDA, NRCS – The PLANTS Database, 2018; https://plants.usda.gov/core/profile?symbol=CHTE2; EDDMapS, 2018, http://www.eddmaps.org/distribution/usstate.cfm?sub=5317. The EDDMapS reports are mostly literature reports. st; see Appendix, Figures 1-7, for maps). See the introductory information on “Distribution” and the Appendix, Figures 1-7, for more specific information.</p> <p>Interestingly, blue mustard has not gotten much attention as a weed species as it is not referenced in most of the principal weed references including <i>Common Weeds of the United States</i> (USDA ARS, 1971), <i>Weeds of the North Central United States</i> (North Central Regional Technical Committee NC-121, 1981), <i>Weeds of the Northeast</i> (Uva et al., 1997), and <i>An Illustrated Flora of the Northern United States and Canada</i> (Britton and Brown, 1970). It does, however, appear in <i>Weeds of Nebraska and the Great Plains</i> (Stubbenieck et al., 1995), likely as a result of its preference for more arid environments.</p> <p>When present, blue mustard is generally considered an agricultural weed in arid climates and is primarily found and most problematic in agricultural fields, especially</p>	Go to Box 6

Box	Question	Answer	Outcome
		<p>small grains and most commonly in winter wheat (Lyon et al., 2006; Lyon et al., 2018, Swan, 1971), but is also found in other crops, including some perennial crops like alfalfa (Lyon et al., 2006). It is reportedly most abundant in fallow, cultivated fields (Stubbendieck, et al., 1995), but is also found in disturbed and neglected areas like roadsides and railroad right-of-ways, and sometimes in native plant communities in semi-desert, foothill, and dry meadow environments (Montana) (Schneider, 2004), and in rangelands (Rollins, 1981) environments. Blue mustard has also been reported as a weed in landscape plant production areas (i.e., nurseries) in Maryland (Schuster, 2014) and in stock yards (Hilty, 2017).</p> <p>Blue mustard is listed as a noxious weed and regulated in the United States in California (B List – A pest of known economic or environmental detriment that, if present in California, has a limited distribution and may be managed for the purpose of containment or eradication at the discretion of state or county weed management authorities and may not be produced, held or offered for sale as nursery stock in California; https://www.cdfa.ca.gov/plant/IPC/encycloweedia/weedinfo/winfo_table-sciname.html; https://plants.usda.gov/java/noxious?rptType=State&statefiles=06; http://pi.cdfa.ca.gov/pqm/manual/pdf/107.pdf).</p> <p>Blue mustard is sometimes referenced as being listed as a noxious weed in Colorado, but blue mustard is not included on the Colorado Noxious Weed List (https://www.colorado.gov/pacific/sites/default/files/1206-2%20Final%20Website.pdf).</p>	

Box	Question	Answer	Outcome
		<p>Although present in the Chicago area and in a few other scattered counties in Illinois, local populations are described as not persistent (Hilty, 2017). Similarly, though present, blue mustard is described as rare and not persisting in southern British Columbia, Alberta, and Saskatchewan, Canada (Mulligan, 2002).</p> <p>Blue mustard has been reported as becoming a concern in some nursery settings in Maryland (Schuster, 2013).</p>	
4	The plants' life history & growth requirements are sufficiently understood.		
5	Gather and evaluate further information.	(Comments/Notes)	
6	The plant has the capacity to establish and survive in Minnesota.		
	A. Is the plant, or a close relative, currently established in Minnesota?	<p>Yes; Several species of mustard and many other species in the Brassicaceae (native and introduced) are present in Minnesota (Morley, 1969). Blue mustard has been specifically documented at three locations in the state, all three in the central Twin Cities area (USDA, NRCS – The PLANTS Database, 2018, https://plants.usda.gov/core/profile?symbol=CHTE2; EDDMapS, 2018, http://www.eddmaps.org/distribution/usstate.cfm?sub=5317). Of the three reports, two are literature reports in Ramsey County (one report based on data from the Biota of North America Program entered in 2010 and a second report based on data from the USDA PLANTS Database in 2008) and one is an observational report in Hennepin County southwest of Minneapolis in Eden Prairie by Monika Chandler of the Minnesota Department of Agriculture in 2014; see Appendix, Figures 1-7, for distribution maps).</p>	Go to Box 7

Box	Question	Answer	Outcome
		<p>The EDDMapS Hennepin County report references a 1-square foot infestation and indicates that the plants were removed before seed was released and that the area would be treated with herbicide and monitored in future years. The Ramsey County reports provide nothing more than verification that plants were present.</p> <p><i>Are the documented reports sufficient to conclude that blue mustard is established or has the capacity to establish and survive in Minnesota? If Yes, Go to Box 7; If No, Go to Question B. Either way, the risk assessment ultimately leads to Box 7.</i></p>	
	B. Has the plant become established in areas having a climate and growing conditions similar to those found in Minnesota?	Yes; most specifically, blue mustard has been found (though not widely) in several counties in northern Iowa where the climate (temperatures and rainfall) would be similar to the environment in southern Minnesota (see maps in Appendix).	This text is provided as additional information not directed through the decision tree process for this risk assessment.
7	The plant has the potential to reproduce and spread in Minnesota?		
	A. Does the plant reproduce by asexual/vegetative means?	No; Blue mustard is a winter or early spring annual that only reproduces by seed (Stubbenieck et al., 1995).	Go to Question C
	B. Are the asexual propagules – vegetative parts having the capacity to develop into new plants – effectively dispersed to new areas?		
	C. Does the plant produce large amounts of viable, cold-hardy seeds?	Yes; Information on the seed production of blue mustard is limited, but one study has reported that individual plants yield an average of about 40 seeds (Gómez, and Fuentes, 2001). When unmanaged, populations of blue mustard can become very large (e.g., 9 plants/square foot; Swan, 1971) and can produce large numbers of seeds that are presumably cold hardy in Minnesota based on the distribution of blue mustard in other states.	Go to Question F

Box	Question	Answer	Outcome
		<p>Blue mustard plants begin to bloom very early in the spring and viable seed can be produced within 10 days of flowering (Lyon et al., 2006; California Department of Food and Agriculture, 2016).</p> <p>Reported as cold hardy to USDA Cold Hardiness Zones 7-8 (0 to 20°F; Flora Italia) and 7-10 (0 to 40 °F; Plants For A Future), but has been documented in colder areas including Zones 4 and 3 in Wyoming and other states.</p>	
	<p>D. If this species produces low numbers of viable seeds, does it have a high level of seed/seedling vigor or do the seeds remain viable for an extended period?</p>	<p><i>Only one reference to seed banks has been encountered and was a reference to mustards in general and not specific to blue mustard – decades (Lyon et al., 2018).</i></p>	<p>This text is provided as additional information and is not part of the decision tree process for this risk assessment.</p>
	<p>E. Is this species self-fertile?</p>	<p><i>Unknown – no information specific to blue mustard found; some mustards are self-fertile and some are not (Mulligan, Undated and 2002); about half of the mustard species are self-compatible (autogamous) and half are self-incompatible (allogamous) (Nasrallah, 1997).</i></p> <p><i>Self-incompatible mustards exhibit Sporophytic Self-Incompatibility (SSI) (Kimball, 2018).</i></p>	<p>This text is provided as additional information and is not part of the decision tree process for this risk assessment.</p>
	<p>F. Are sexual propagules – viable seeds – effectively dispersed to new areas?</p>	<p>Yes; Although little specific information on seed dispersal to new areas has been found, blue mustard has been effectively dispersed to new areas and has become widely distributed in North America since its introduction. Infestations can expand locally to encompass relatively large areas in cultivated fields perhaps through cultivation and other field activities and movement by wind and water. It has been suggested that seed passing through the digestive system of livestock could introduce blue mustard to new areas (i.e., manure and manure management). Blue mustard is fairly common in alfalfa fields (Lyon et al., 2006) so alfalfa hay from infested fields might be a vector.</p>	<p>Go to Question I</p>

Box	Question	Answer	Outcome
		<p>Nursery stock may harbor seed or young plants and serve as a vector to new areas (Schuster, 2013).</p> <p>Unlike the fruits/silques for other mustards, the valves of blue mustard silques do not separate from the fruit vertically to release the seeds; instead, the silique splits into 1-seeded sections (disseminules) horizontally with the seeds retained within the separated sections; these seed-containing sections of the silique are the primary dispersal units (disseminules) for blue mustard seeds released from blue mustard plants (Walters, 2011).</p>	
	<p>G. Can the species hybridize with native species (or other introduced species) and produce viable seed and fertile offspring in the absence of human intervention?</p>		
	<p>H. If the species is woody (trees, shrubs, and woody vines) is the juvenile period less than or equal to 5 years for tree species or 3 years for shrubs and vines?</p>		
	<p>I. Do natural controls exist, species native to Minnesota, which are documented to effectively prevent the spread of the plant in question?</p>	<p>No (apparently not); no information found.</p>	<p>Go to Box 8</p>
<p>8</p>	<p>The plant poses significant human or livestock health concerns or has the potential to significantly harm agricultural production, native ecosystems, or managed landscapes.</p>		
	<p>A. Does the plant have toxic qualities, or other detrimental qualities, that pose a significant risk to livestock, wildlife, or people?</p>	<p>No; Blue mustard leaves are edible raw or cooked (many references online) and the plant is not considered a significant risk to livestock (unless large amounts are eaten; Young-Mathews, 2012), wildlife, or people. Blue mustard is not toxic if eaten by livestock (Stubbendieck et al., 1995) with the possible exception of horses and most specifically pregnant mares and their foals (Gay, Undated;</p>	<p>Go to Question B</p>

Box	Question	Answer	Outcome
		<p>Arnold, 2018). Dairy animals may produce off-flavored milk after eating blue mustard (Stubbendieck et al, 1995).</p> <p>Although not specific to blue mustard, the roots, leaves, and especially seeds of <i>Brassica rapa</i> and related species contain sulfur compounds (glucosinolates) that can irritate the digestive tracts or create thyroid problems in livestock if consumed in large quantities over time (DiTomaso and Healy, 2007). Toxicity in livestock, particularly horses, can cause a number of negative symptoms including colic, diarrhea, anorexia, excessive salivation, and thyroid enlargement (DiTomaso and Healy, 2007; Ahmann Hanson, 2008). Such problems arise when livestock eat large quantities of seed or are confined to pastures with large mustard populations. Nitrate nitrogen toxicity can also be a problem for ruminants if field mustard is grazed when immature or if soil nitrogen levels are high (Undersander et al., 1991).</p>	
	<p>B. Does, or could, the plant cause significant financial losses associated with decreased yields, reduced crop quality, or increased production costs?</p>	<p>No; Little information about blue mustard specific to Minnesota is available and blue mustard has not been highlighted as a problem in Minnesota. In addition, although blue mustard can reduce yields in a few crops, blue mustard is easily controlled in most agricultural systems with proper field preparation, scouting, and weed management (Lyon et al., 2006; Lyon et al., 2018, Swan, 1971; Parchoma, 2002). Based on the information found to date, it appears blue mustard is unlikely to cause widespread significant financial losses in Minnesota.</p> <p>Significant reductions in yield of 13-51% have been documented in areas where blue mustard is problematic and not well-managed (Swan, 1971).</p>	<p>Go to Question C</p>

Box	Question	Answer	Outcome
		<p>If required, herbicide applications can certainly increase production costs. When blue mustard populations are high enough to cause significant yield reductions, control must be pursued early (preferably during the fall or during the winter and early spring before bolting when the plants are still in the rosette stage (Lyon et al., 2018; Swan, 1971). One blue mustard plant/square foot during the fall and winter can reduce yields by 13% and by 28% if allowed to mature the following spring (Swan, 1971).</p> <p>I'm not sure about the answer to this question; depending on degree, the answer could be Yes (= Go to Box 9) and some form of regulation (Restricted, Prohibited/Control, or Prohibited/Eradicate).</p> <p>Given the lack of reporting (presence of blue mustard and negative effects), the distribution of blue mustard in Minnesota may be very limited so eradication may be possible (= Prohibited/Eradicate), but blue mustard may not have the capacity to be a sustained weed problem in Minnesota (= No Regulatory Action).</p> <p>Blue mustard is not intentionally sold in Minnesota and could be listed as Restricted to help prevent spread through agricultural practices and/or commodities; and once again, blue mustard may not have the capacity to be a sustained weed problem in Minnesota (= No Regulatory Action).</p>	
	<p>C. Can the plant aggressively displace native species through competition (including allelopathic effects)?</p>	<p>No (generally not); Blue mustard is mainly found in agricultural fields (primarily fallow ground and small grains and especially winter wheat (Lyon et al., 2006; Lyon et al., 2018; Stubbendieck, 1995), along roadsides, and in waste places (Stubbendieck, 1995).</p> <p>No information on allelopathy found.</p>	<p>Go to Question D</p>

Box	Question	Answer	Outcome
	D. Can the plant hybridize with native species resulting in a modified gene pool and potentially negative impacts on native populations?	No (unlikely); Of the at least 18 species of mustard documented to be in Minnesota (blue mustard not included), plus other members of the Brassicaceae (at least 48 species), all are from different genera and, in both cases, about half are native and half are introduced (Morley, 1969; Minnesota Wildflowers, 2018).	Go to Question E
	E. Does the plant have the potential to change native ecosystems (adds a vegetative layer, affects ground or surface water levels, etc.)?	No ; Blue mustard prefers and is primarily associated with disturbed sites and is primarily an agricultural weed in cultivated or newly established crops in arid environments. Although blue mustard has been observed in conservation areas and is widely distributed across the western U.S., because it is primarily a problem in winter wheat, its management is fairly easy, and there have been no reports of ecological impacts, blue mustard has been given a U.S. Invasive Species Impact Rank (I-Rank) of Insignificant (NatureServe Explorer).	Go to Question F
	F. Does the plant have the potential to introduce or harbor another pest or serve as an alternate host?	No or unknown; No specific information found.	THE SPECIES IS NOT CURRENTLY BELIEVED TO BE A RISK; NO REGULATORY ACTION
9	The plant has clearly defined benefits that outweigh associated negative impacts.	<i>Mustards are sometimes used as cover crops and for intercropping in agricultural systems (Young-Mathews, 2012), but no references to blue mustard in this respect have been found.</i>	This text is provided as additional information and is not part of the decision tree process for this risk assessment.
	A. Is the plant currently being used or produced and/or sold in Minnesota or native to Minnesota?	<i>No; No evidence that blue mustard is intentionally grown or sold as a landscape plant or for other purposes in Minnesota has been found and blue mustard is not native to Minnesota; it is native to Eurasia.</i>	This text is provided as additional information and is not part of the decision tree process for this risk assessment.

Box	Question	Answer	Outcome
	B. 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?	<i>Yes; Blue mustard can be effectively controlled using pre- and post-emergent herbicides, cultivation, and planned crop rotations (Lyon et al., 2006; Lyon et al, 2006; DiTomaso et al, 2013). Herbicide-specific resistance has been reported (e.g., 2,4-D) and herbicides with different modes of action, alone or in combination, should be used to reduce the potential for resistance to specific modes of action (Lyon et al., 2018).</i>	This text is provided as additional information and is not part of the decision tree process for this risk assessment
	C. Is the plant native to Minnesota?		
	D. Is a non-invasive, alternative plant material commercially available that could serve the same purpose as the plant of concern?		
	E. Does the plant benefit Minnesota to a greater extent than the negative impacts identified at Box #8?		
10	Enforce control as a noxious weed to prevent introduction &/or dispersal; designate as Prohibited or Restricted.		
	A. Is the plant currently established in Minnesota?		
	B. Does the plant pose a serious human health threat?		
	C. Can the plant be reliably eradicated (entire plant) or controlled (top growth only to prevent pollen dispersal and seed production as appropriate) on a statewide basis using existing practices and available resources?	<i>Yes; See Box 9, Question B.</i>	This text is provided as additional information and is not part of the decision tree process for this risk assessment.
11	Allowed but controlled via a species-specific management plan; designate as Specially Regulated.		

Final Results of Risk Assessment		
Review Entity	Comments	Outcome
NWAC Listing Subcommittee	July 11, 2018	Recommended to not list/no regulatory action for blue mustard at this time.
NWAC Full-Committee	Vote on 12/19/18 was 16:0 in favor of not listing.	Do not list
MDA Commissioner	Commissioner agreed	Do not list

Risk Assessment Summary (07/11/2018):

Blue mustard (*Chorispora tenella*) is a non-native species that was likely introduced from its native range in Europe and Asia as a contaminant in grain. It is a winter or early spring annual and since its introduction to North America has become established primarily in arid regions as an agricultural weed in small grains and alfalfa and in disturbed, neglected areas in parts of central and western North America including 31 U.S. states, including Minnesota and the neighboring states of North and South Dakota and Iowa (very limited distribution; blue mustard has not been formally reported or documented in Wisconsin), several eastern states, and three southwestern Canadian provinces. Although present, reporting of blue mustard is very limited in eastern North America east of Montana and the central Great Plains (western Nebraska, Kansas, Oklahoma, and the panhandle of Texas). There have only been three reports of blue mustard in Minnesota and its ability to persist in Minnesota may be questionable.

Tentative Recommendation – Recommendation = no regulatory action, but more information about the distribution and crop (and possibly native ecosystem) effects should be gathered.

References

- Ahmann Hanson, G. 2008. Equines & Toxic Plants: Database of Toxic Plants in the United States. University of Idaho, Moscow, ID. http://www.webpages.uidaho.edu/range/toxicplants_horses/Toxic%20Plant%20Database.html (Accessed June 29, 2018).
- Arnold, O. 2018. Isothiocyanates from *Chorispora tenella* and Their Toxicity to Liver and Thyroid Cell Lines. Ph.D. Dissertation. Colorado State University, Fort Collins, Colorado. 119 pages. https://dspace.library.colostate.edu/bitstream/handle/10217/189336/Arnold_colostate_0053A_14713.pdf?sequence=1&isAllowed=y (Accessed June 29, 2018)
- Britton, N.L. and A. Brown. 1970. An Illustrated Flora of the Northern United States and Canada. Three Volumes. Second Edition. Dover Publications, Inc., New York, NY. Volumes I-III; 680, 735, and 637 pages, respectively.
- Cabin, R.J., A.S. Evans, D.L. Jennings, D.L. Marshall, R.J. Mitchell, and A.A. Sher. 1996. Using Bud Pollinations to Avoid Self-Incompatibility: Implications from Studies of Three Mustards. Canadian Journal of Botany 74(2):285-289. <https://doi.org/10.1139/b96-034>, <http://www.nrcresearchpress.com/doi/abs/10.1139/b96-034>

- California Department of Food & Agriculture (CDFA). 2016. California Noxious Weed List. Last updated July 15, 2016. https://www.cdffa.ca.gov/plant/ipc/encycloweedia/weedinfo/winfo_table-sciname.html, *Chorispora tenella* Information Page – <https://www.cdffa.ca.gov/plant/ipc/encycloweedia/weedinfo/chorispora.htm> (Accessed June 12, 2018)
- DiTomaso, J.M., and E.A. Healy. 2007. Weeds of California and Other Western States. UC ANR Publ. 3488. University of California, Division of Agriculture and Natural Resources, Davis, CA. 1,808 pages.
- DiTomaso, J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Control in Natural Areas in the Western United States. UC Davis Weed Research and Information Center. 544 pages. Includes: Treatment Options for *Chorispora tenella* – Blue Mustard; http://wric.ucdavis.edu/information/natural%20areas/wr_C/Chorispora.pdf (Accessed June 29, 2018)
- Flora Italiana. *Chorispora tenella* (Pall.) DC. <http://luirig.altavista.org/flora/taxa/index1.php?scientific-name=chorispora+tenella> (Accessed June 29, 2018)
- Gay, C.C. Undated. Congenital hypothyroid dysmaturity syndrome in foals. Field Disease Investigation Unit, Department of Veterinary Clinical Science, College of Veterinary Medicine, Washington State University, Pullman, WA. http://vcs.vetmed.wsu.edu/docs/librariesprovider18/Docs-FDIU/mustardfoalsreport.pdf?sfvrsn=8aa91e38_4 (Accessed June 29, 2018)
- Gómez, J.M. and M. Fuentes. 2001. Compensatory Responses of an Arid Land Crucifer, *Chorispora tenella* (Brassicaceae), to Experimental Flower Removal. Journal of Arid Environments 49(4):855–863. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.379.1480&rep=rep1&type=pdf>
- Hilty, J. 2017. Illinois Wildflowers. <http://www.illinoiswildflowers.info/>, http://www.illinoiswildflowers.info/weeds/plants/blue_mustard.htm (Accessed June 13, 2018)
- Kimball, J. 2018 (last updated). Kimball's Biology Pages. <http://biology-pages.info/W/Welcome.html>, <http://biology-pages.info/S/SelfIncompatibility.html> (Accessed June 13, 2018)
- Lyon, D.J., I.C. Burke, and J.M. Campbell. 2018. Integrated Management of Mustard Species in Wheat Production Systems. Pacific Northwest Extension (Washington State University, Oregon State University, and the University of Idaho) Publication PNW703. 9 pages. <http://hdl.handle.net/2376/12902>, <https://research.libraries.wsu.edu:8443/xmlui/handle/2376/12902> (Accessed June 12, 2018)
- Lyon, D.J., R.N. Klein, and R.G. Wilson. 2006 (Revised). Blue Mustard Control. University of Nebraska-Lincoln Extension: Lincoln, NE. Publication G1272. 2 pages. <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=5913&context=extensionhist>, <https://digitalcommons.unl.edu/extensionhist/4907/> (Accessed June 12, 2018)
- Minnesota Wildflowers. 2018. www.minnesotawildflowers.info/. Minnesota Wildflowers: A Field Guide to the Flora of Minnesota. (Accessed June 29, 2018)
- Morley, T. 1969. Spring Flora of Minnesota. University of Minnesota Press, Minneapolis, MN. 283 pages.
- Mulligan, G.A. Undated, but after 2006. Cruciferae (Brassicaceae) - Mustard Family. Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada. <http://weedscanada.ca/mustard.html> (Accessed June 13, 2018)
- Mulligan, G.A. 2002. Weedy Mustards (Brassicaceae) of Canada. Canadian Field-Naturalist 116(4):623-631. <https://www.biodiversitylibrary.org/item/109250#page/646/mode/1up>
- Nasrallah, J.B. 1997. Evolution of the Brassica Self-Incompatibility Locus: A Look Into S-Locus Gene Polymorphisms. PNAS 94(18):9516-

9519. <http://www.pnas.org/content/94/18/9516.full>
- NatureServe Explorer. Comprehensive Report Species *Chorispora tenella* - (Pallas) DC.
<http://explorer.natureserve.org/servlet/NatureServe?searchName=Chorispora+tenella> (Accessed June 29, 2018)
- North Central Regional Technical Committee NC-121. 1981. Weeds of the North Central United States. North Central Regional Research Publication No. 281. Agricultural Experiment Stations of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin, and the U.S. Department of Agriculture; Urbana, IL. 303 pages.
- Parchoma, G. (ed.) 2002. Guide to Weeds in British Columbia. Province of British Columbia; Ministry of Agriculture, Food and Fisheries. 199 pages. <https://www.for.gov.bc.ca/hra/Plants/weedsbc/GuidetoWeeds.pdf>; Blue Mustard – *Chorispora tenella* (Pallas) DC.; https://www.for.gov.bc.ca/hra/plants/weedsbc/blue_mustard.pdf (Accessed June 29, 2018)
- Plants For A Future. *Chorispora tenella* - (Pall.) DC. <https://www.pfaf.org/user/Plant.aspx?LatinName=Chorispora+tenella> (Accessed June 29, 2018)
- Rollins, R.C. 1981. Weeds of the Cruciferae (Brassicaceae) in North America. Journal Arnold Arboretum 62:517-540.
<https://www.biodiversitylibrary.org/page/9256512#page/533/mode/1up> (Accessed June 29, 2018)
- Schneider, A. 2018 (last updated). Wildflowers, Ferns, and Trees of the Four Corners Region of Colorado, New Mexico, Arizona, & Utah.
<http://www.swcoloradowildflowers.com/>,
<https://www.swcoloradowildflowers.com/Blue%20Purple%20Enlarged%20Photo%20Pages/chorispora%20tenella.htm> (Accessed June 12, 2018)
- Schuster, C. 2013. Weed of the Week - Blue Mustard. University of Maryland Extension; April 19, 2013.
<https://extension.umd.edu/learn/weed-week-blue-mustard> (Accessed June 29, 2018)
- Stubbenieck, J., G.Y. Friisoe, and M.R. Bolick. 1995. Weeds of Nebraska and the Great Plains (Second Edition). Nebraska Department of Agriculture, Bureau of Plant Industry. 589 pages.
- Swan, D.G. 1971. Competition of Blue Mustard with Winter Wheat. Weed Science 19(4):340-342.
<https://www.cambridge.org/core/journals/weed-science/article/competition-of-blue-mustard-with-winter-wheat/66FD8753D9D810AA8927EF91E2E9218A> (abstract and references only)
- Undersander, D.J., A.R. Kaminski, E.A. Oelke, L.H. Smith, J.D. Doll, E.E. Schulte, and E.S. Oplinger. 1991. Turnip. In: Alternative Field Crops Manual. Wisconsin and Minnesota Cooperative Extension, University of Wisconsin, Madison, WI and University of Minnesota, St. Paul, MN. www.hort.purdue.edu/newcrop/afcm/turnip.html (Accessed June 29, 2018)
- United States Department of Agriculture (USDA) Agricultural Research Service (ARS). 1971. Common Weeds of the United States. Dover Publications, Inc.; New York, NY. 463 pages.
- Walters, D.S. 2011. Identification Tool to Weed Disseminules of California Central Valley Table Grape Production Areas. 11th Edition. 641 pages. USDA APHIS PPQ CPHST Identification Technology Program, Fort Collins, CO. http://idtools.org/id/table_grape/weed-tool/key/GrapeSeedKey/Media/Html/fact_sheets/Cho-ten.html (Accessed June 13, 2018)
- Whitson, T.D. (ed.), L.C. Burrill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R.D. Lee, and R. Parker. 1996. Blue Mustard. Weeds of the West. Western Society of Weed Science, in cooperation with the Western United States Land Grant Universities Cooperative Extension

Services, Newark, CA. http://www.wyoextension.org/publications/Search_Details.php?pubid=696&pub=WSWS-1,
<http://www.wyoextension.org/agpubs/pubs/wsws-1.pdf> (Accessed June 13, 2018)

Uva, R.H., J.C. Neal, and J.M. DiTomaso. 1997. Weeds of the Northeast. Comstock Publishing Associates, Cornell University Press, Ithaca, NY. 397 pages.

Young-Mathews, A. 2012. Plant Guide for Field Mustard (*Brassica rapa* var. *rapa*). USDA-Natural Resources Conservation Service, Corvallis Plant Materials Center, Corvallis, OR. https://plants.usda.gov/plantguide/pdf/pg_brrar.pdf (Accessed June 13, 2018)

Appendix

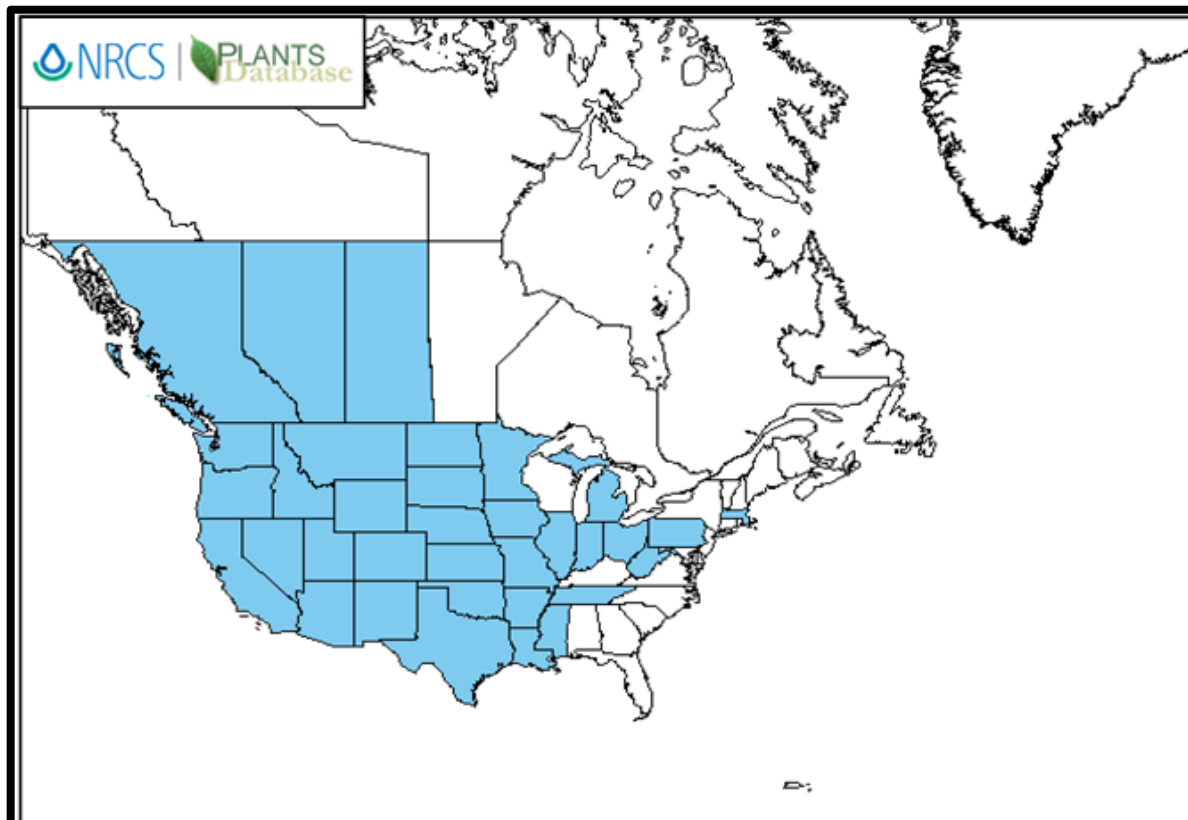


Figure 1. USDA, NRCS State Distribution / Blue Mustard (*Chorispora tenella*); Map downloaded on June 12, 2018;

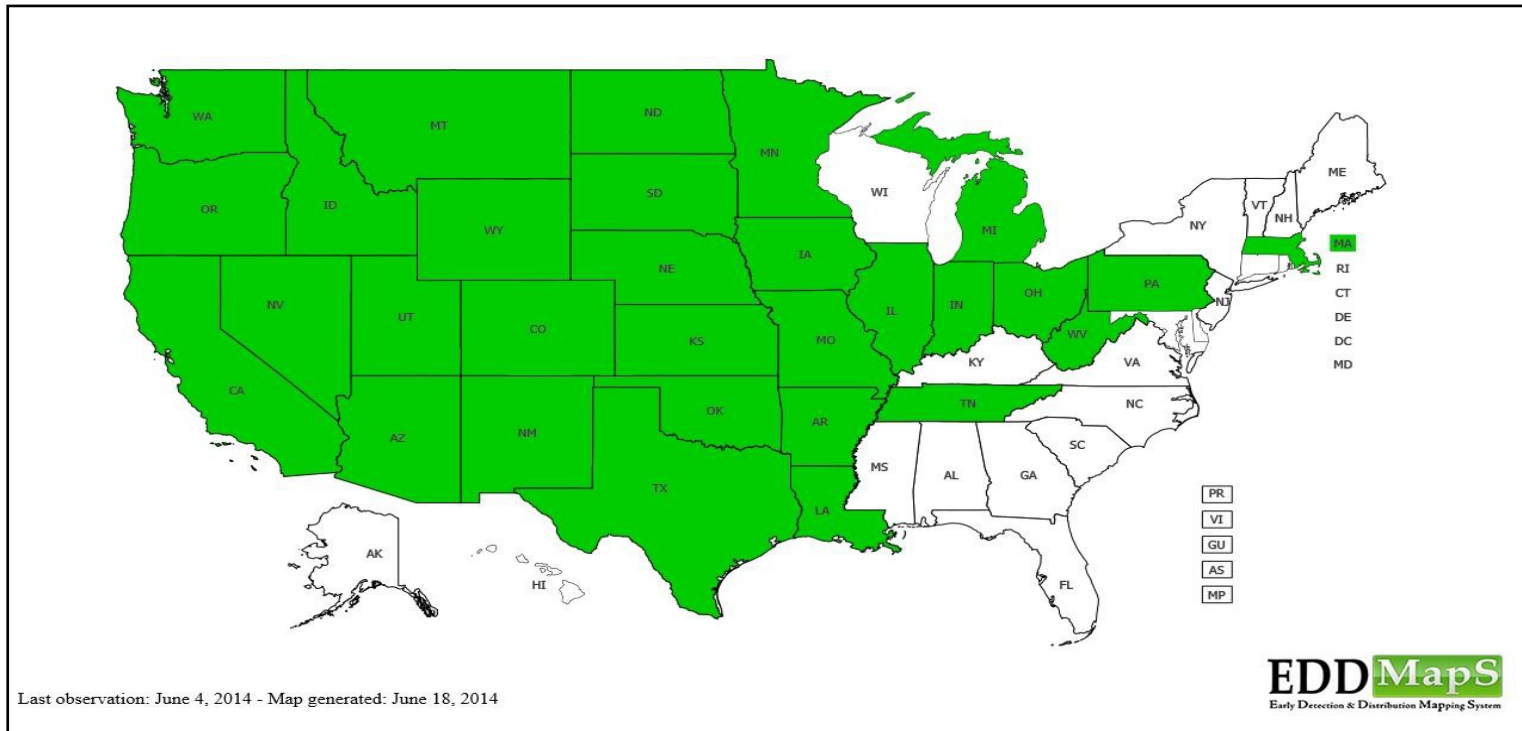


Figure 2. EDDMapS U.S.A. Distribution / Blue Mustard (*Chorispora tenella*); Map downloaded on June 28, 2018; <http://www.eddmaps.org/distribution/usstate.cfm?sub=5317>.

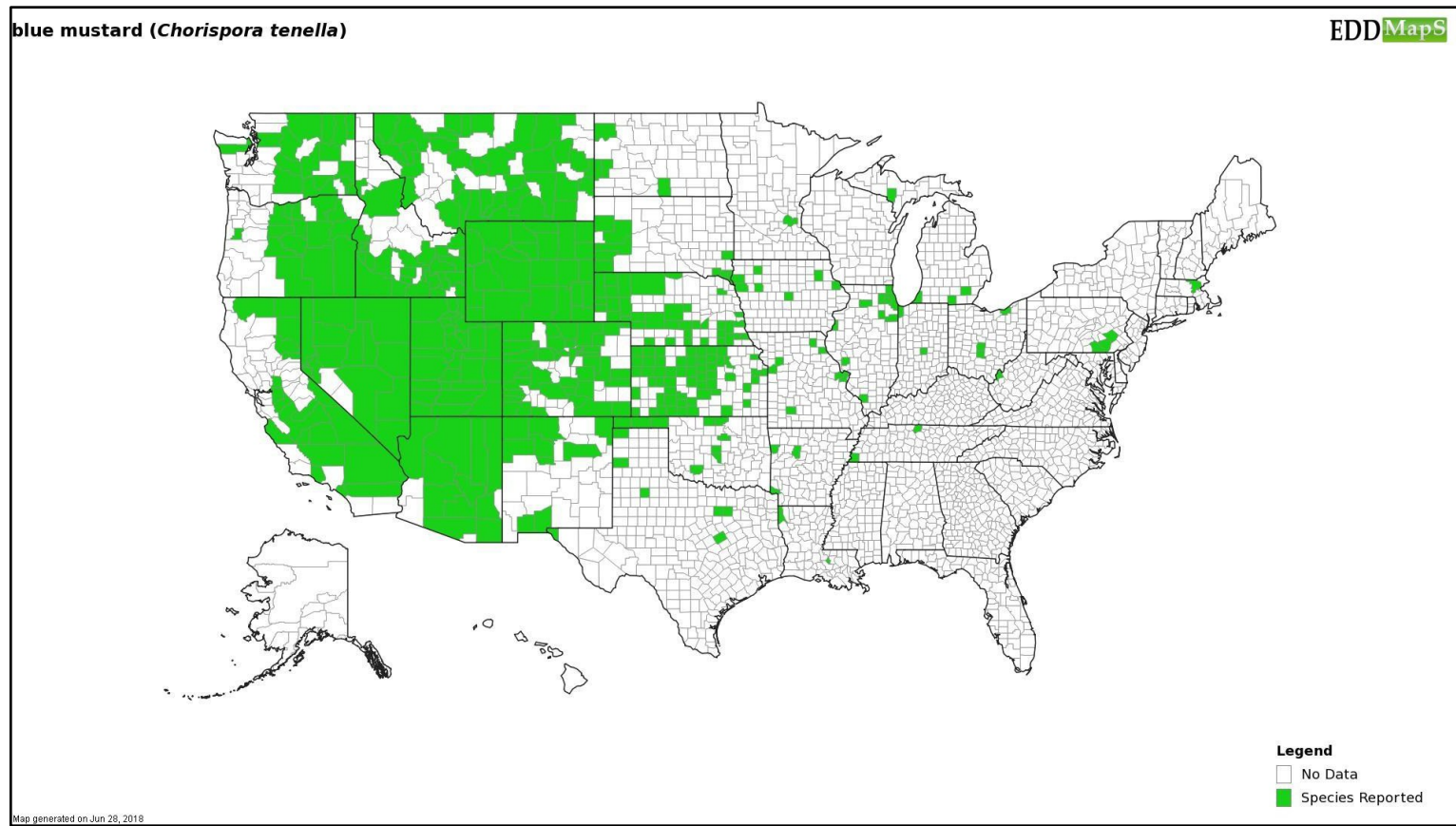


Figure 3. EDDMapS County Distribution / Blue Mustard (*Chorispora tenella*); Map downloaded on June 28, 2018; <http://www.eddmaps.org/distribution/uscounty.cfm?sub=5317>.

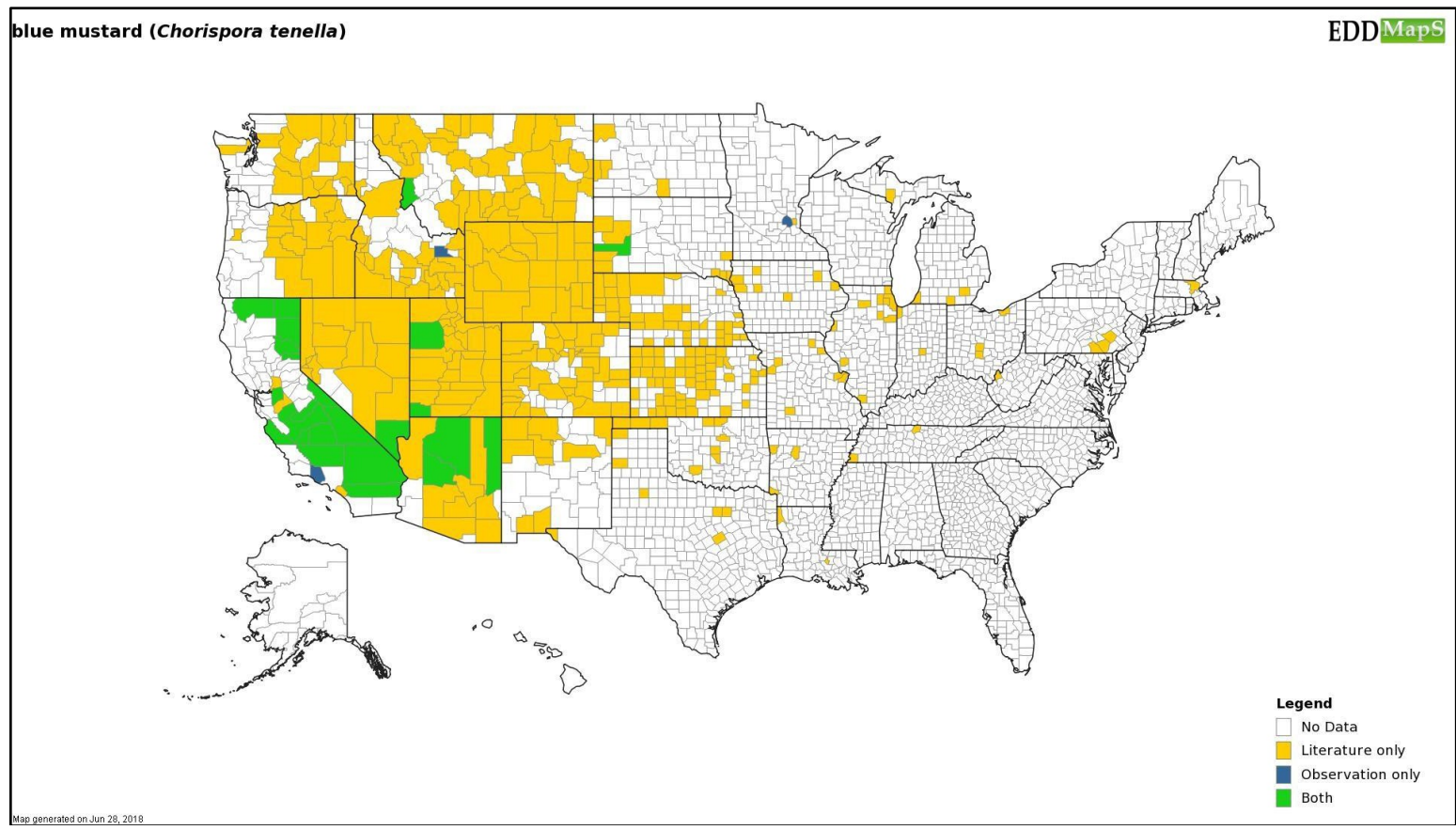


Figure 4. EDDMapS USA County Distribution/Literature vs. Observation / Blue Mustard (*Chorispora tenella*); Map downloaded on June 28, 2018; <http://www.eddmaps.org/distribution/uscounty.cfm?sub=5317&map=literature>.

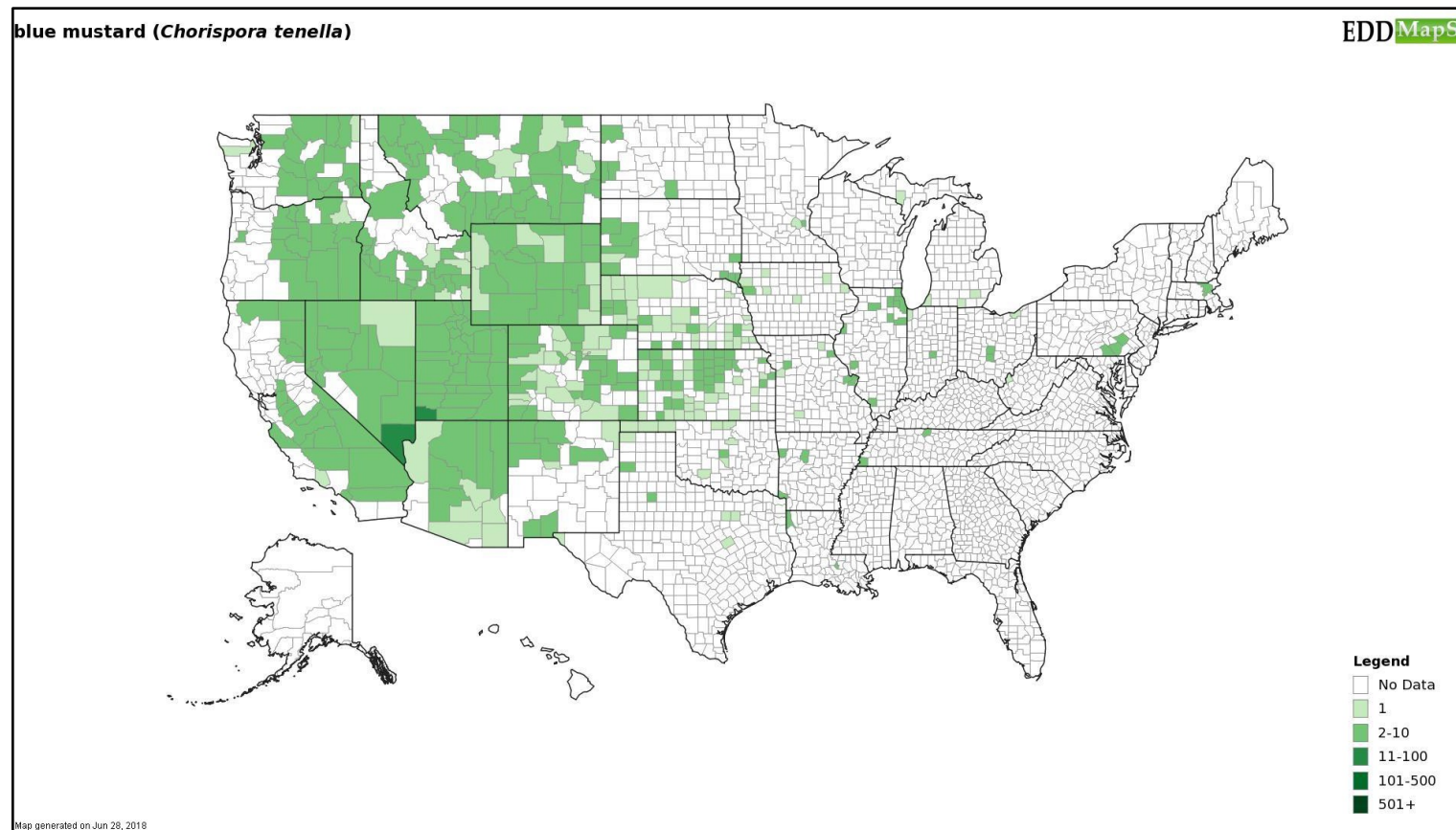


Figure 5. EDDMapS USA County Record Density / Blue Mustard (*Chorispora tenella*); Map downloaded on June 28, 2018; <http://www.eddmaps.org/distribution/uscounty.cfm?sub=5317&map=density>.

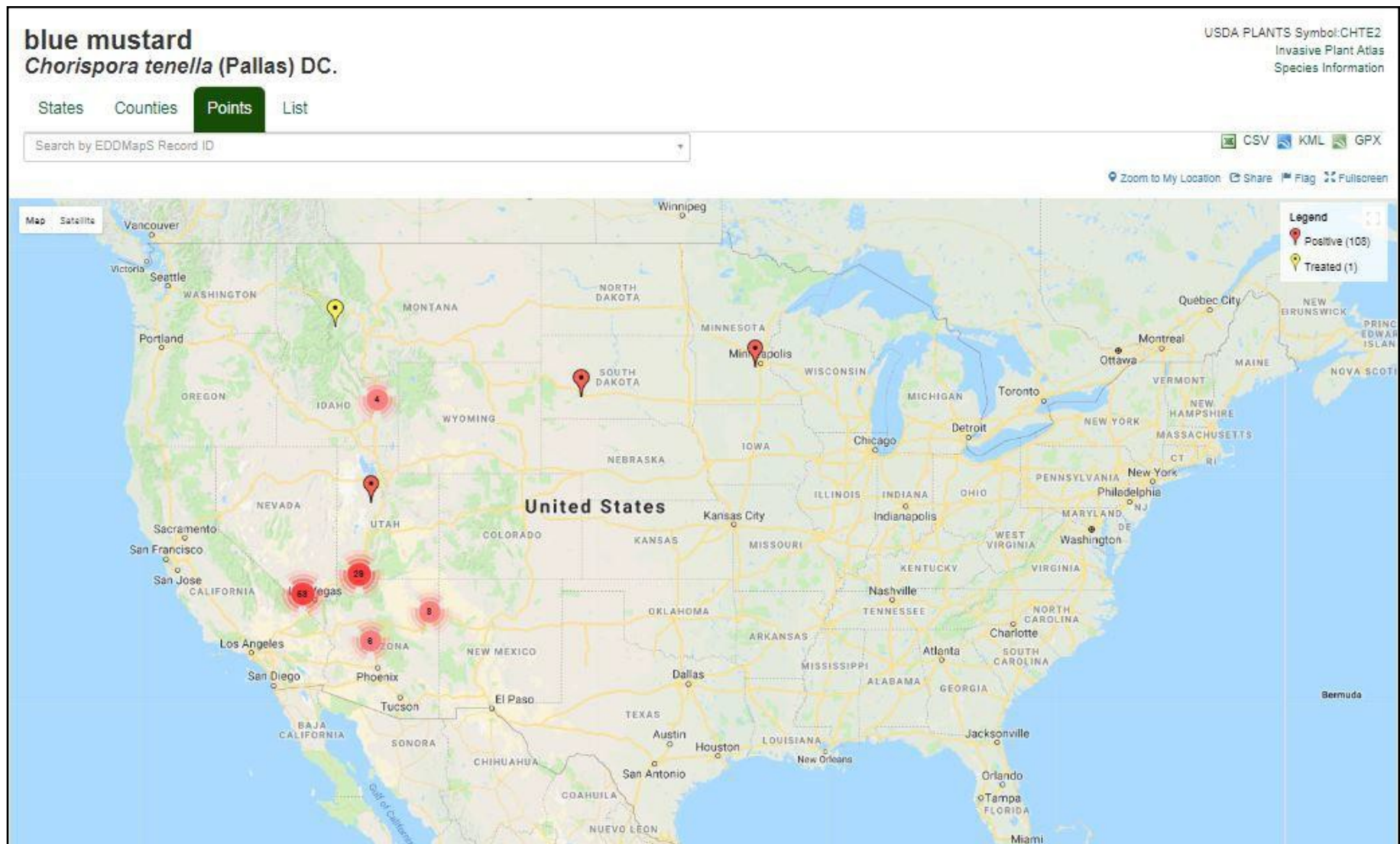


Figure 6. EDDMapS USA Points Distribution / Blue Mustard (*Chorispora tenella*); Map downloaded on June 28, 2018;
<http://www.eddmaps.org/distribution/viewmap.cfm?sub=5317>.

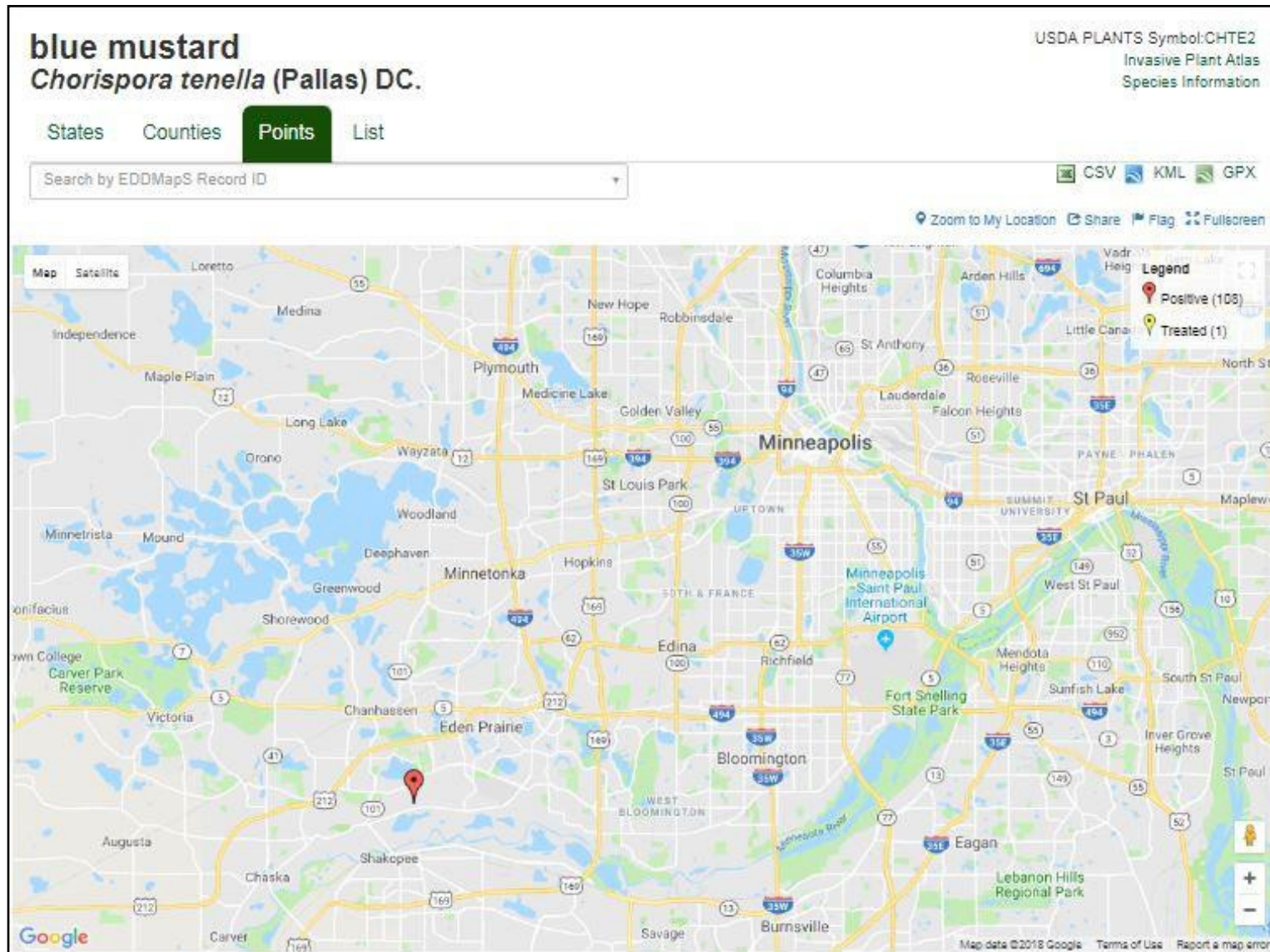


Figure 7. EDDMapS Minnesota Points Distribution / Blue Mustard (*Chorispora tenella*); Map downloaded on June 28, 2018; <http://www.eddmaps.org/distribution/viewmap.cfm?sub=5317>.