August 26, 2013 CCN 231244

Mr. Matt Voile
Section Manager
Idaho State Department of Agriculture
2270 Old Penitentiary Road
P.O. Box 790
Boise, ID 83701

SUBJECT: Comments Regarding the IDAPA 02.06.09, Rules Governing Invasive Species, Docket No. 02-0609-1301, Proposed Rule

Dear Mr. Voile:

This letter transmits Idaho National Laboratory (INL) comments concerning the IDAPA 02.06.09, Rules Governing Invasive Species, Docket No. 02-0609-1301, Proposed Rule. The proposed rule will add permitting and reporting requirements for Energy Crop Invasive Species and Trap Crop Invasive Species. The INL performs research and development activities using plant species listed as Energy Crop Invasive Species and therefore, has an interest in this rulemaking.

The INL would like to thank you for the opportunity to comment. Below are general and specific comments for your consideration in regards to the proposed rule.

**General Comments:**

The proposed regulations, Section 105, are unnecessarily restrictive to small Research and Development activities. As an example, the regulations would require a permit for a laboratory to receive a shipment of 10-20 lbs of switchgrass through the mail, subject the material to testing at an indoor lab in which all of the material is consumed, destroyed, or otherwise rendered non-viable, and then dispose of residues to licensed landfills. Application of the permit regulations to this type of activity is burdensome to both the regulated community and the regulator; it does nothing to implement the goal of the regulation or purpose of the permit. It is suggested that the regulations be modified to exempt activities which have no likelihood to release seeds or spores to the environment.

Portions of the proposed rules, primarily Sections 105 and 106, lack detail and specificity regarding requirements and expectations on the part of the Department. While this degree of vagueness certainly allows flexibility and latitude on the part of the Department to address different field situations, it also allows the potential for allegations of arbitrariness and capriciousness if members of the regulated community are treated differently.

Economic Impacts: Have the economic impacts to Idaho been considered? If the permitting is required on a frequent basis, will that discourage biorefineries from building their facilities in Idaho? They could easily locate in a different state and possibly avoid frequent permitting. The same thing could apply to planting switchgrass in Idaho. Because several of the dedicated energy crops have been selected due to their ability to grow on marginal land, it could represent a missed opportunity for revenue for Idaho farmers.

**Specific Comments:**

Section 010: Definitions: Why switchgrass and miscanthus are considered "invasive" is not addressed in the definitions.

> 010.12: Invasive Species. Species not native to Idaho, including their seeds, eggs, spores, larvae or other biological material capable of propagation, that cause economic or environmental harm and are capable of spreading in the state. "Invasive species" does not include crops, improved forage grasses, domestic livestock, or other beneficial nonnative organisms.

Under this definition, an "invasive species" must be non-native and have the potential to cause economic or environmental harm and be capable of spreading in the state.

> 010.09: Energy Crop Invasive Species. An Energy Crop Invasive Species is a non-native plant grown to harvest for use in making biofuels, such as bioethanol, or combusted for its energy content to generate electricity or heat. Energy Crop Invasive Species are non-native plants that are cultivated for the purpose of producing (non-food) energy.

Under this definition, an "energy crop invasive species" is simply a dedicated energy crop that is not native. This does not identify criteria as to why the crop is invasive or harmful to Idaho's economy or environment. It is suggested that the definition should identify which properties for species such as switchgrass and miscanthus make them "invasive". There are other dedicated energy crops, in addition to the six species chosen in the proposed rule (Section 809), not included on this list.

Sections 101.03 and .04: These sections provide requirements for equipment, conveyances, plants, animals, etc. that are infested with an invasive species. However, there is no definition of "infested" in this rule. There are no required levels of detection or criteria for determining cross contamination between material runs of permitted and non-permitted materials. There are no methods identified for making the determination of whether something is infested or not. Suggest providing a definition of infested and providing clarification on how to determine whether an item is infested.

Section 103: For clarity, suggest changing the first sentence to read "Possession of invasive species is authorized only if the person possessing the species obtains a possession permit under this section or Sections 105 or 106".

Section 105: "Possession and/or production of Energy Crop Invasive Species is authorized…" – Suggest adding "identified in Section 809" to avoid confusion as to which species may be considered Energy Crop Invasive Species. The sentence would read "Possession and/or production of Energy Crop Invasive Species, identified in Section 809, is authorized…".

Section 105: Suggest adding a subsection for a permit renewal process. In the likely event the permitted activity will take more than one year, the permittee needs to be aware of the time and process required to re-permit the activity in order to ensure continued permit coverage.

Section 105. Energy Crop Possession/Production Permits: Will all cultivars, types, and quantities of energy crop invasive species require a permit, including non-viable material such as ground material, pelleted material, and pre-treated material?

Section 105.01: Application for Energy Crop Invasive Species Permits: Please define the expected time frame for submitting, reviewing, and approving an application and issuing the permit.

Section 105.01.b.v: "A detailed confinement plan, if applicable; and" – A confinement plan is not defined in the regulations. In the rule, please clarify the following: What are the elements and components of a confinement plan? What level of confinement (i.e., seeds, fiber, dust, etc.) is required? When is a confinement plan "applicable" and who decides? How is that decision rendered and how is the applicant informed? If the applicant determines the non-applicability of a confinement plan, how is the Department notified?

Section 105.01.b.vi: "A detailed plan outlining survey and reconnaissance for escaped Energy Crop Invasive Species and a detailed plan for their control or elimination." – Please provide guidance regarding the required content of such a plan. What are the minimum acceptable methods of "survey and reconnaissance"? Is aerial surveillance required? Must physical trespass on a neighbor's property be conducted? Will the plan require adjoining landowner approval and concurrence? Is there a defined process for reconciliation? Is there a defined process if the adjoining landowner, for whatever reason, decides they don't approve? What are the minimum acceptable distances, 100 yards or 10 miles? What methods of control or elimination are suggested/required? If, as an example, switchgrass escapes and grows on the permit-holder's property, is simple containment acceptable? Or must the switchgrass be eliminated? Who conducts the inspections to verify control or elimination? Please clearly define the intent, requirements, and limitations of this plan.

Section 105.02.a through h: Request providing more specific criteria that the Director will consider when reviewing the application. This will help ensure the permittee submits a complete application with all the required information.

Section 105.02.a: "Proximity of the facility to other agricultural operations and environmentally sensitive lands and waters." – Please define "environmentally sensitive lands and waters" in a way such that a common citizen can easily discern them.

As an alternative, please provide a written listing of these valuable resources for, without a clear definition or written listing, identification of these resources by the Department or regulated community becomes an arbitrary and capricious exercise subject to disagreements equally unsupported by either party.

Section 105.02.d: "Potential for the Energy Crop Invasive Species to escape or be released from the facility or field." Please identify the subjective and objective criteria by which this "potential to escape" will be evaluated so that both the Department and the regulated community can cooperate to achieve the goals and intent of the regulation.

Section 105.03: "Following review of the application and any other relevant information…" – It is requested that "relevant information" be formally limited to objective data and information. This would suppress efforts to sway permitting decisions by public groups and individual who rely on and prefer rumor, innuendo, unfounded allegations, and fear-mongering over rational discussion and scientific fact.

Section 105.04: "Duration of Possession Permit." A Possession Permit under Section 103.03 "is valid until the permitted person no longer possesses the invasive species, or until the invasive species leaves the state". This raises the question as to why the "Invasive Species" permit good for multiple years, while the "Energy Crop Invasive Species" permit is only good for 1 year. Suggest extending the length of the Energy Crop Invasive Species permit to reduce the burden on both the regulator and the regulated community.

Section 809: It is suggested that the criteria used to determine the list of Energy Crop Invasive Species list be identified in the rule. Is there a process for exempting a particular plant material?

If you have any questions, please call Mike Lewis of my staff at (208) 526-0623.

Sincerely,

for.

Carolyn S. Mascareñas, Interim Director
Environmental Support and Services

MGL:MR

cc: J. Alvarez, INL, MS 3695
S. E. Aumeier, MS 2211
P. K. Bowers, DOE-ID, MS 1226
S. D. Dossett, INL, MS 3405
V. Dugger, DOE-ID, MS 1216
J. J. Grossenbacher, INL, MS 3695
N. K. Hernandez, DOE-ID, MS 1216
L. A. Montgomery, INL, MS 3899
S. M. Olson, DOE-ID, MS 1221
T. L. Perkins, DOE-ID, MS 1216
R. Richardson, DOE-ID, MS 1240
D. M. Storms, INL, MS 3898

IDAHO POTATO COMMISSION

June 28, 2013

FAMOUS IDAHO POTATOES

Mr. Matt Voile
Section Manager, Noxious Weed and Invasive Species
Idaho State Department of Agriculture
2270 Old Penitentiary Road
Boise, ID 83701-0790

Subject: Comments regarding proposed rule amendment governing invasive species

Dear Mr. Voile:

This letter constitutes comments from the Idaho Potato Commission for the proposed rule IDAPA 02.06.09 to add "Invasive Plants-Trap Crops" to the Idaho Invasive Species list. The Idaho Potato Commission ("IPC") is a statutorily created state agency comprised of nine Commissioners appointed by the Governor of the State of Idaho. Five (5) of the Commissioners are potato growers, two (2) are potato shippers and two are potato processors. The IPC represents the interests of the Idaho potato industry. Due to scheduling conflicts, IPC was unable to participate in the two hearings held regarding the proposed rule.

As you are aware, the Pale Cyst Nematode (PCN) program is a cooperative effort between USDA, ISDA, the IPC and the potato industry in response to the April 19, 2006, detection of *Globodera pallida* in Eastern Idaho. This was the first detection of the pest in the United States. A technical workgroup was put together, consisting of domestic and international experts in their field to gather data and make recommendations as to a course of action. Because the infestation was believed to be relatively new and isolated, an aggressive set of Federal regulations and State Rules were enacted. The goals of the PCN program are to: prevent the spread of PCN; delimit the current infestation; eradicate the infestation; restore lost foreign markets and; preserve current markets. Currently, the PCN regulated area is 13,053 acres, of which 2,300 acres are considered infested.

The recommendations from the technical workgroup were adopted and continue to be followed today, with the exception of implementing trap crops in infested fields. Chemical eradication treatments utilizing Methyl Bromide (MeBr) have been the workhorse of eradication. Viability testing conducted by the PPQ lab has demonstrated a 95% viability reduction after just one application of MeBr, and over 99% reduction after a second application. This data has been supported by greenhouse bioassays at the University of Idaho in Moscow to date. Due to decreasing Federal budgets, and potential impacts of recent re-registration of MeBr, long term use of the fumigant to eradicate PCN is likely not feasible, although IPC is doing everything possible to maintain use of MeBr as the initial treatment used when a new infestation is discovered.

Even though *S. sisymbriifolium* has been used successfully to manage PCN in Europe, it has only been within the last 2 years, where using *Solanum sisymbriifolium* has demonstrated promise in trials in the Pacific Northwest. IPC hopes that trap crops may be a viable option to implement within the next few years in Eastern Idaho. Specific comments are as follows:

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Ph. (208) 334-2350 • Fax (208) 334-2274 • www.idahopotato.com

1. On page 18 of the draft rule, "ANTS-TRAP CROPS," *S. sisymbriifolium* is listed with the common name of Sticky Nightshade. While it is true that Sticky Nightshade is one of a number common names used, and also the name we have used previously, that is no longer the case. During the PCN end of year research meeting in Boise, March 5, 2013, in which ISDA participated, potato growers were present and recommended using a different common name because of the negative perceptions associated with nightshades. We have since adopted the common name of Litchi tomato for *S. sisymbriifolium*. IPC requests that ISDA consider revising the rule to reflect the common name currently being used.

2. According to the plant profile· *S. Sisymbriifolium* is found in 17 states, and as close as Oregon. The Consortium of Pacific Northwest Herbaria has at least 6 records in Multnomah County as far back as 1882 of *S. Sisymbrifolium*. An additional 9 records are from Oregon, but specific counties are unknown. Oregon Department of Agriculture does not list *S. sisymbriifolium* as a noxious weed or invasive species and has observed research trials near Powell Butte, Oregon in 2012. They have so far expressed no concern regarding what they have seen and have not required the safeguards as indicated in this draft rule. Similarly, Washington State Department of Agriculture has visited the Agriculture Research Service (ARS) facility in Prosser, Washington, where the selective breeding and seed multiplication is taking place both in a greenhouse and outdoors. WSDA has also demonstrated no concern with the work and has not required the safeguards as indicated in this draft rule. IPC requests that ISDA consult with counterparts in Oregon and Washington and that a consistent approach be undertaken in all three states since the previous and ongoing *S. sisymbriifolium* research is very similar, and plants and data are shared routinely within this small research group.

3. IPC has dedicated over $300,000 to the development of *S. sisymbriifolium* as a trap crop and IPC understands that USDA/ PPQ has dedicated approximately $280,000 to the development of *S. sisymbriifolium* as a viable PCN eradication tool since program inception in 2007. Because IPC shares ISDA's concern about potential invasive possibilities, the funding has gone toward not only determining the agronomic practices and PCN control needed to use this potential trap crop in Eastern Idaho, but funding has also been used to verify control methods, ability to eliminate flower and berry production, significantly reduce spine length of the plant and determine overwintering abilities. Additional funds have also gone toward the netting and fencing as determined necessary by ISDA in 2012. Results shared in the PCN end of year research meeting in Boise, March 5, 2013, in which ISDA participated, continued to indicate the *S. sisymbriifolium* is a potential eradication tool for PCN, can be controlled with traditional herbicides, and alternative farming practices (i.e. mowing) may provide the same PCN eradication effect while minimizing the invasive risk. Additional trials are planned in all three states in 2013, to replicate data from 2012, or answer additional questions. IPC requests that ISDA consider the least burdensome rule that addresses real concern about invasive potential, while still having minimal negative impact on the ongoing research. Any excessive regulation may unnecessarily delay or even prevent the development of a potential breakthrough technology that could benefit Idaho's valuable potato industry, an industry that generates billions of dollars for Idaho's economy each year.

Finally, IPC believes that this rule making could be more efficiently handled as a negotiated rule, given that there are a very small group of interested parties, pursuant to I. C.§67-5220. However, since that option is not now available, it is our hope that the rule essentially follow the MOU in place under which the current research has been conducted.

Thank you for your consideration of these comments.

Sincerely,

Frank Muir
President/CEO
Idaho Potato Commission

# The Idaho Association of
# WEED CONTROL SUPERINTENDENTS


| Chair: | Vice- Chair: | Secretary – Treasure: |
|---|---|---|
| **Daniel Bertram** | **Bryce Fowler** | **Bonnie Davis** |
| Lemhi County | Fremont County | Washington County |
| 200 Fulton St. Ste 201 | 151 W 1st North | PO Box 865 |
| Salmon ID 83843 | St. Anthony ID 83445 | Weiser ID 83672 |
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June 24, 2013

Matt Voile
Idaho State Department of Agriculture
2270 Old Penitentiary Road
P.O. Box 790, Boise, Id. 83701

Dear Matt,

This letter is in regards to the ISDA Rulemaking Process 02.06.09 Rules Governing Invasive Species, 02.06.22 Noxious Weed Rules and 02.06.23 Noxious Weed Free Gravel and Rock Product Rules, with a specific emphasis on the impact that will be had on the Weed Superintendents represented by the Idaho Association of Weed Control Superintendents.

Thank you for giving us the opportunity to comment on this rule making process, I have sent a request to all members within our association and there have been no concerns expressed in regards to the rules Governing Invasive Species 02.06.22 and the Noxious Weed Rules 02.06.23 There has been discussion regarding the Noxious Weed Free Gravel and Rock Product Rules.

The topic of certified gravel has been discussed within our association on numerous occasions over the past two years. The primary driving force has been the requirement that agencies both State and Federal have placed on contractors requiring that gravel and rock products be certified as weed free. Currently there is not a specific guideline on how to certify such material and therefore our association requested the Idaho State Department of Agriculture consider reviewing the need for certified weed free gravel, (this request was sent on February 26th, 2013 to Director Gould). While there are no specific concerns as to the language written with the Noxious Weed Free Gravel and Rock Product Rules our association remains dedicated to ensuring that any additional certification process is done so in good faith. With the intent of preventing noxious and invasive weed dispersal, while taking into account the producer's ability to produce such a product in a fair and unbiased manner.

We look forward to working with you through this process and please don't hesitate to contact either myself or any member of our association should you have any questions.

Sincerely

Daniel Bertram
IAWCS – Chairman
Lemhi County Weed Superintendent

University of Idaho
College of Agricultural and Life Sciences
Aberdeen Research and Extension Center
1693 S. 2700 W.
Aberdeen, Idaho 83210-1749
Phone: (208) 397-4181
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June 11, 2013

Mr. Matt Voile
Section Manager, Invasive Species and Noxious Weeds
Idaho State Department of Agriculture
P.O. Box 790, Boise, Idaho 83701

Dear Mr. Voile:

I am the Potato Cropping Systems Weed Scientist with the University of Idaho located at the Aberdeen Research and Extension Center in southeastern Idaho. I have been and am currently conducting research with the Pale Cyst Nematode (PCN) trap crop – *Solanum sisymbriifolium* (common names Litchi tomato, sticky nightshade, and others). The purpose of this letter is to provide comment regarding the proposed rule amendments to IDAPA 02.06.09: adding two additional Invasive Species Lists – "Invasive Plants - Biofuels" and "Invasive Plants – Trap Crops" and creating two new related sections addressing research and possession permitting of "Biofuels" and "Trap Crops." I am specifically commenting on the Trap Crop listing and the permit section, and have a *suggestion* that the requirements for Litchi tomato research remain as is i.e. research and monitoring plan information sharing and communication between University of Idaho, ISDA, USDA-APPHIS, and USDA-ARS without formally adding ruling to IDA 02.06.09.

In this letter and at the June 13, 2013 public meeting I hope to convey to you the following:

- How University of Idaho Litchi tomato research currently being conducted is in compliance with ISDA requests for information sharing and 5 year trial-area monitoring
- What impacts to future Litchi tomato research could occur if a Trap Crop Invasive species list and research and possession permitting requirements are added to IDAPA 02.06.09
- How this rule change to formally make trap crops invasive species in Idaho could affect grower use of this control and eradication method
- Our research results showing we are developing a management plan to prevent Litchi tomato from becoming weedy.

The ultimate goal of these comments and presentations is to show how the arrangement we as researchers *currently have with the ISDA* can be *fluid* and *flexible* while still *successful* at preventing of Litchi tomato from becoming a threat to Idaho as more information is gained from our efforts. We will have a complete management plan in place for growers who want to use this trap crop. In the meantime, we are containing and monitoring our Litchi tomato research. Formally adding a Trap Crop – Invasive Species list and requiring research and possession

permits will lock us and growers into non-flexible and prohibitive rulings even if we can show our successes. The time and effort required to amend the rulings to less stringent requirements will restrict Litchi tomato research and be too late for successful grower use.

All University of Idaho researchers working with Litchi tomato, including myself, and Drs. Mike Thornton and Louise-Marie Dandurand have been closely cooperating with USDA-APHIS, potato growers in SE Idaho with PCN concerns, and the Idaho Potato Commission. We've also been voluntarily supplying the ISDA with our research plans and results as well as meeting requests for trial-area monitoring plans.

To date, our Litchi tomato research trials have been relatively small and either conducted at a secure University of Idaho research and extension center, or adjacent to a grower's remote field with transplants – not seeding, weekly flower/berry removal during the growing season, complete desiccation at season-end, and fencing and netting currently in place. These monitoring and fencing-netting requirements have been successfully deployed to date and we have been able to do so in part because or trials have been on a small scale.

- The 2012 Litchi tomato rooting depth trial near Shelley, ID with grower Brian Searle is 20 x 80 ft in size; 2012 Aberdeen R&E Litchi tomato herbicide screening trial size is 40 x 300 ft; area used for Litchi tomato research at the Parma R&E Center is approximately the same size as that used at the Aberdeen R&E Center.

However, as new trials are conducted at each R&E Center and with growers off-station, the area requiring fencing and netting will increase, especially if by necessity, the individual trials become larger.

- This requirement and the 5 year monitoring may be quite difficult to manage and cost prohibitive on a large scale.

In addition, U of I researchers may have to take the monitored trial areas at the R&E Centers totally out of use for other research trials *since the fencing and netting will be difficult to work around.*

- Land resources are limited at the R&E Centers where all research trial areas are already secure.
- *Loss of research ground will impact all research disciplines and extension output, not just those involved with Litchi tomato work.*
- Researchers conducting at each R&E Center pay annual field-use fees of up to $1,000 per acre. Fees still have to be paid Litchi tomato trial areas under fencing-netting even if no other research is being conducted in those areas.

Last but not least, if growers need to fence and net areas where they use Litchi tomato to eradicate PCN, they could very well not use this trap crop even though University of Idaho and other Pacific Northwest potato researchers funded by Federal and State entities have shown the crop's effectiveness and provide a plan to eliminate the risk of the crop becoming an invasive weed.

- Possession and permit requirements may not be as impactful as fencing-netting and monitoring laws, however, growers will need to comment more on this aspect of the rulings.

As you may or may not know from other comments, Litchi tomato has been widely utilized in Europe as a trap crop that stimulates PCN to hatch without allowing reproduction of the nematodes. European researchers and growers working with this trap crop since the '80's do not have concerns about it become weedy and have had no problems as such. Litchi tomato also has been introduced and is present in Oregon, California, most southern states, and areas in the eastern U.S. and Canada. The departments of agriculture in Washington and Oregon have not restricted ongoing Litchi tomato research.
The herbicide screening research I've conducted so far with Litchi tomato has shown us products successful at controlling weeds in the Litchi tomato crop itself – important for production and PCN alternate host prevention.

- *We've also determined herbicides effective at controlling the trap crop completely* and even possibly preventing flowering and berry production while still allowing adequate growth for PCN eradication.
    - Further work in this area is critical in order to develop a successful management plan for growers using Litchi tomato.
- As planned, our 2012 Litchi tomato research trials were sprayed with diquat at the end of the growing season and no re-growth has occurred this spring. We will of course continue to monitor and report on these and future Litchi tomato trials.

Attached to this letter is a .pdf file of the 2012 Litchi tomato herbicide screening and rooting depth trial results with brief description of 2013 research plans and continued monitoring, and some background information on Litchi tomato..

In conclusion, the University of Idaho researchers and extension educators working with Litchi tomato believe that *continuing the research plan and results information sharing and monitoring arrangements we currently have with ISDA will set us up for continued research trial success.* As we develop a Litchi tomato management plan complete with tools to prevent the trap crop from becoming weedy, we hope that the fencing-netting and monitoring requirements are *fluid* and *flexible*. If trap crops are added to IDAPA 02.06.09 as invasive species and containment, monitoring, and research possession and permitting become formal and non-changeable without further rule amendments, we believe that not only will we be *restricted with our research, but that growers will not be able to use Litchi tomato for PCN eradication.*

Thank you for your consideration of these comments and suggestions. I would be glad to address any questions or concerns via email or phone call, and if possible, at the public meeting at the ISDA offices in Boise.

Sincerely,

Pamela J S Hutchinson

Pamela J.S. Hutchinson, Ph.D.
Potato Cropping Systems Weed Scientist
University of Idaho Aberdeen R&E Center

1693 S. 2700 W. Aberdeen, ID 83210
Office ph. 208.397.4181 email phutch@uidaho.edu

cc: Mr. Patrick Kole, Idaho Potato Commission, Boise, ID
Dr. Donn Thill, Director, Idaho Agricultural Experiment Station, University of Idaho
Dr. James Johnson, Head, Dept. of Plant, Soil, and Entomological Sciences, Univ. of Idaho
Dr. Andy Jensen, Pacific Northwest Potato Regional Research Director, Boise, ID
Brian Marschman, State Plant Health Director, USDA APHIS PPQ, Boise, ID
Tina Gresham, PCN Program Director, USDA-APHIS, Idaho Falls, ID

# *S. Sisymbriifolium* Trap Crop for PCN eradication: Trap Crop Herbicide Management and Rooting Depth Research

Pamela J.S. Hutchinson
*Potato Cropping Systems Weed Scientist*
*Brent Beutler, T. Miera, B. Kendall*

University of Idaho
College of Agricultural and Life Sciences

Idaho Potato Commission

- Background
- Aberdeen R&E Center
  - 2012 Strip trial
    - Herbicide tolerance
    - *S. sisymbriifolium* control
  - Proposed research
- Shelley
  - 2012 Rooting depth
  - Proposed research

# *S. sisymbriifolium* Background

- Soil fumigation can be expensive and some fumigants have been in short supply – will eventually be "phased out"

- There is a need to develop eradication measures other than soil fumigation to eliminate this nematode pest

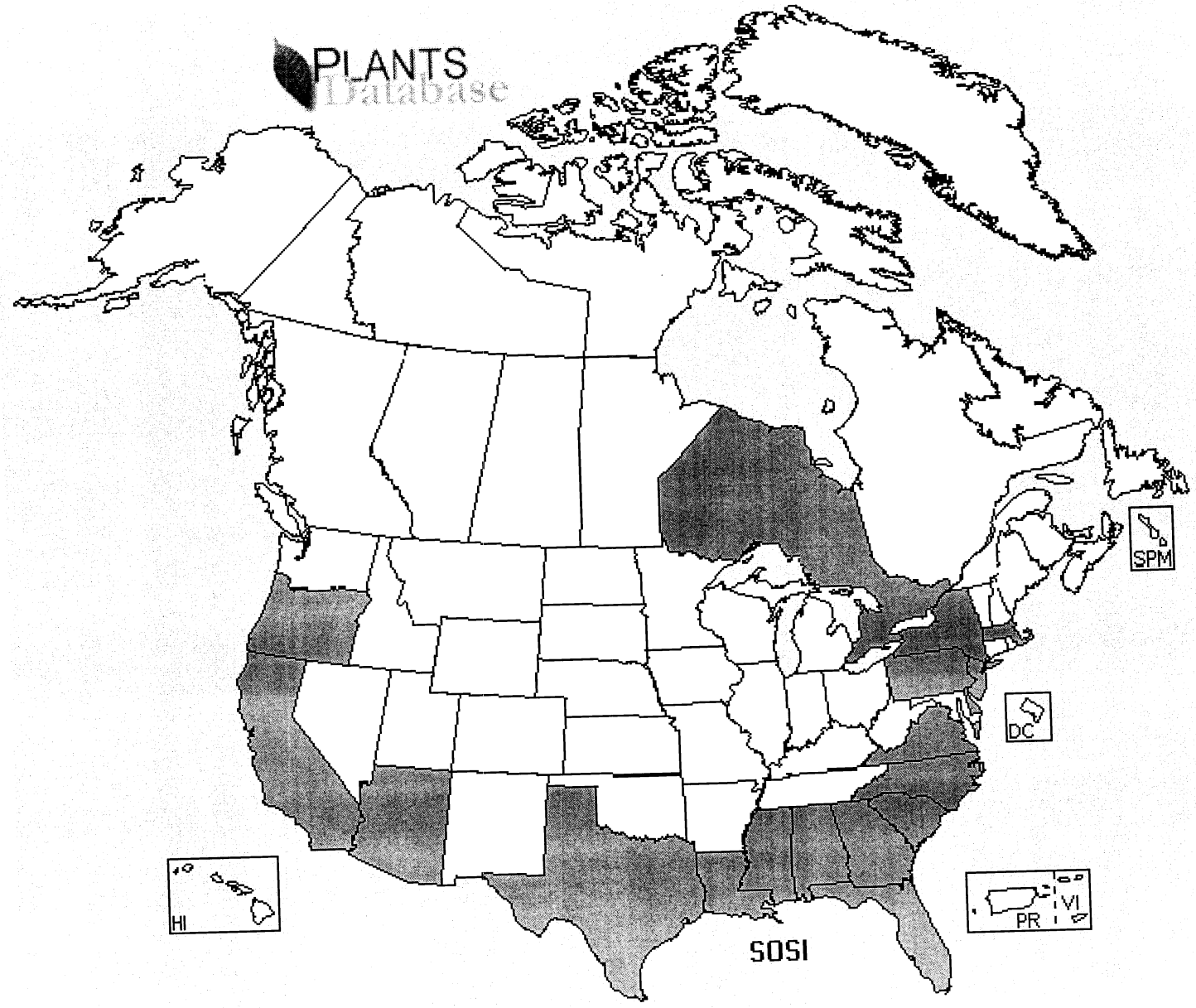
- **Trap crops** offer one of the best potential methods for eradication of *Globodera pallida* - Potato Cyst Nematodes (PCN) from infested fields.

# *S. sisymbriifolium* Background

- A key characteristic of these trap crops is the ability to produce root exudates that stimulate cysts to hatch,
  - along with production of a deep, extensive root system
  - that does not allow infection or reproduction of the nematode,
  - resulting in mortality of all juvenile moving out of the hatched eggs.
    - "suicide hatch"

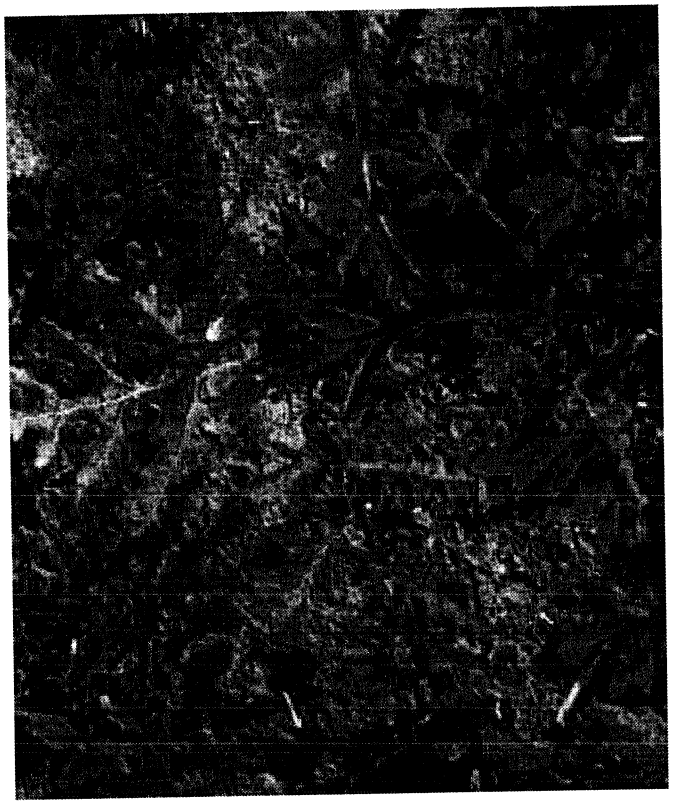
# *S. sisymbriifolium* Background

- *Solanum sisymbriifolium* - common names include litchi tomato, fire-and-ice-plant, sticky nightshade
- An annual species - native of South America
- Is already present in the United States and Canada




***Solanum sisymbriifolium*** Present Absent

http://plants.usda.gov/java/nameSearch



# *S. sisymbriifolium* Background

- *The leaves are highly dissected and both sides are covered with sharp prickles.*
  - *These are sometimes called spines or thorns, but technically they are prickles as they are outgrowths of the epidermis and not modified branches (spines).*
- *In addition to the large prickles, Ss has a covering of sticky hairs that are barely visible to the naked eye.*
- Can reach heights of at least 3 ft.

# *S. sisymbriifolium* Background

- Used as a trap crop for PCN in Europe especially the Netherlands
- This plant's roots exude compounds which stimulate PCN egg hatch – juveniles move toward roots to establish feeding sites
- However, unlike potatoes and some of the other other *Solanum* sp., *Ss* does not host the juvenile nematodes.
  - *Reports of 60-70% reduction of cysts in one growing season.*
  - *Fumigation may only provide 40% or less reduction in one season.*

# *S. sisymbriifolium* Background

- Most previous research done in the Netherlands
  - Sold commercially in the Netherlands and Great Britain as "White Star," "DeCyst," or "Foil-sis."
- Herbicides recommended in the Netherlands are Matrix and Prowl.
- Not much if any information on berry/seed production, regrowth from roots the following year, etc.
- Homeowners/gardeners can purchase seed on eBay and grow for ornamental, herbal remedies, berries, vegetative fence

# *S. sisymbriifolium* Background

- This trap crop grown the entire season
- Idea above-ground biomass is 700+ g per sq m.
  - This provides adequate root biomass and length to induce nematode egg hatching.
- In the Netherlands, the crop is destroyed or mowed when the first red berries begin to appear.
  - Mowing sometimes used for re-growth and more biomass/root production the same year.
  - **Growers and researchers in Europe do not seem to have problems – be concerned with weediness in subsequent years.**

# *S. sisymbriifolium* Background

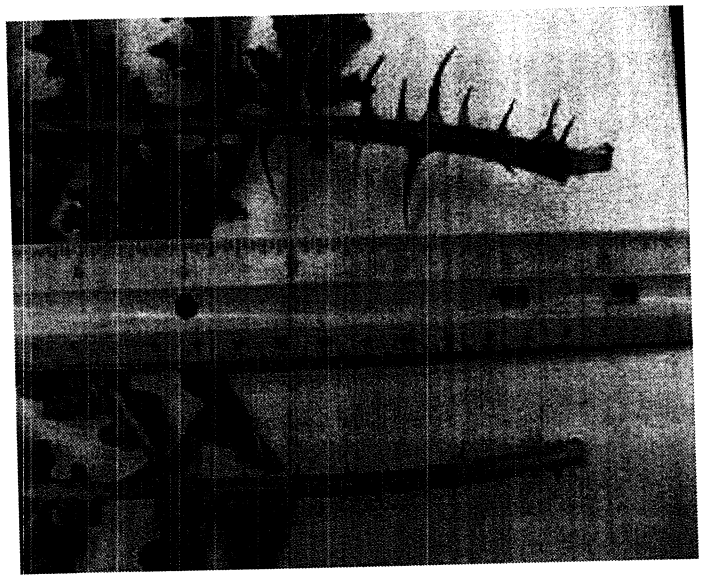
- *Ss* not particularly frost susceptible in Europe
  - Die-back did occur after 1st frost at the University of Idaho Aberdeen R & E Center

Observations by Chuck Brown, USDA Prosser, WA

- Becomes woody very quickly
- Does not lodge
- Extremely heat tolerant
- Whitefly, psyllid and thrips resistant
- Colorado potato beetles feed o the plants then die

Chuck Brown is making crosses to get less prickly plants and/or a biotype which does not produce flowers/berries – somehow sterile

Flowering plants at the
Univ. of Idaho Parma R&E Center



Prickle length on original biotype from Europe compared with biotype developed by Chuck Brown

Greenhouse selection by Chuck Brown for no prickles

# *S. Sisymbriifolium* University of Idaho Research at Parma

- Ongoing research at the Parma Research and Extension Center – Dr. Mike Thornton
  - Seeding times and rates, biomass production, fall planting similar to green manures
- Takes about a month after seeding for plants to emerge (Parma and Aberdeen)
- At least another 3 weeks before plants gain any height
- Not enough biomass/roots produced if planted in the fall

# *S. sisymbriifolium* Herbicide Research Needs

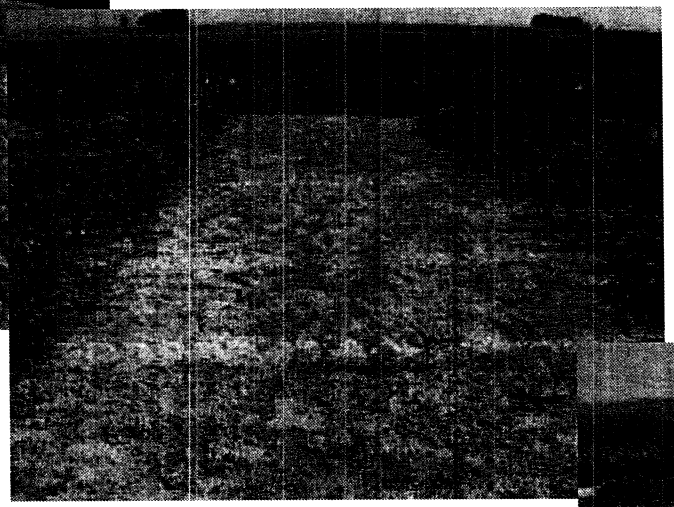
- How to manage weeds in the trap crop especially ones which can host PCN e.g. hairy nightshade
- How to kill the trap crop at the end of the season and manage the potential for these plants to spread and act as weeds
- Determine the most effective ways to control volunteers in succeeding crops
- Determine if the trap crop can overwinter and re-sprout from crown

# Aberdeen R & E Center 2012 Herbicide Trial: *S. sisymbriifolium* Tolerance and Control

- In 2012 the treatments were in non-replicated strips
  - S. sisymbriifolium was seeded with a small plot drill – 100 g per sq m mixed seed with "baked" mustard seed because seed so small
  - Applied potato herbicides preemergence, and potato - small grain – corn herbicides postemergence, vine-kill herbicide treatments also applied at season-end.

# Aberdeen 2012 *Ss* Herbicide Trial: Preemergence treatments

Overview of the trial

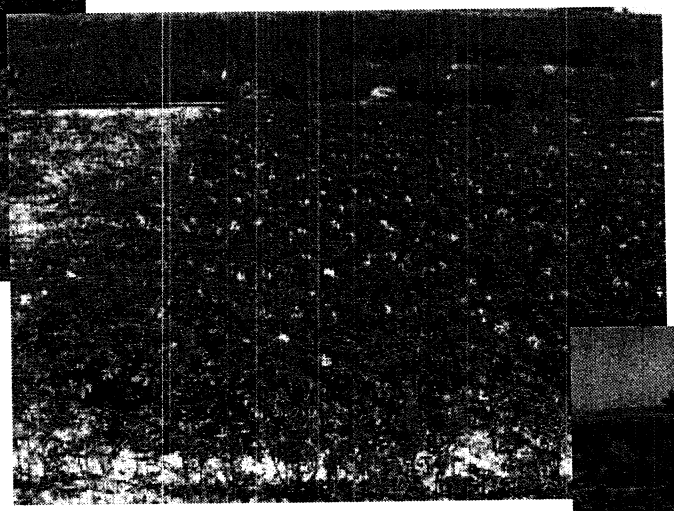


Matrix® 1.5 oz/A

Metribuzin 75DF 2/3 lb/A

# Aberdeen 2012 *Ss* Herbicide Trial: Preemergence treatments

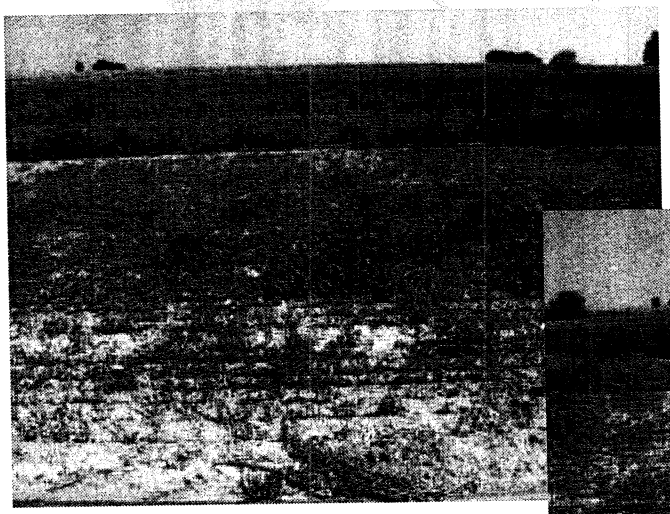
Outlook® 18 fl oz/A



Reflex® 2 pt/A

Eptam® 5 pt/A

# Aberdeen 2012 *Ss* Herbicide Trial: Postemergence treatments



Aim®

Matrix® 1.5 oz/A

Buctril®

# Aberdeen 2012 *Ss* Herbicide Trial

*S. sisymbriifolium* was tolerant

- fomesafen (Reflex®) applied preemergence (PRE)
- linuron (Lorox/Linex®) PRE
- ethalfluralin (Sonalan®) PRE
- s-metolachlor (Dual Magnum®) PRE

# Aberdeen 2012 *Ss* Herbicide Trial

*S. Sisymbriifolium* stunted and/or flowering prevented

- rimsulfuron (Matrix®) PRE and
- dimethenamid-p (Outlook®) PRE
- pendimethalin (Prowl H2O®) PRE
- 2,4-D postemergence (POST)
- Dicamba (Banvel® Clarity® ) POST
- thifensulfuron-methyl (Harmony®) POST
- carfentrazone (Aim®) postemergence (POST)

# Aberdeen 2012 *Ss* Herbicide Trial

*S. Sisymbriifolium* complete control - burndown

- EPTC (Eptam®) PRE
- metribuzin PRE and POST
- bromoxynil (Buctril®) POST
- MCPA POST
- fluroxypyr (Starane®) POST
- clopyralid (Stinger®) POST

**Note**: vine-kill desiccation treatments were applied however, a frost occurred a few days later so control/burndown ratings were not possible.

# Aberdeen 2012 *Ss* Herbicide Trial

- Any berries produced after flower drop was rated were pulled off plants
- At the end of the season the total area was sprayed with diquat
  - ½ strip disked and the other ½ no tillage
- Area was fenced and covered with netting
- Will monitor germination, regrowth
  - Grow spring wheat, apply herbicide(s) such as Buctril after observations
  - Monitor for at least 5 yrs
- **UPDATE: no regrowth from plants killed fall 2012 has occurred as of June 03, 2013.**

# 2013-14 Planned *Ss* Herbicide Trial

- Aberdeen R&E Center
- Replicated herbicide trial
  - Tolerance
  - Control
  - Flower drop
  - Potato preemergence herbicides; potato, small grains, sugar beet, corn postemergence herbicides; vine-kill products.
- **Same procedures as in 2012 trial including no berry production allowed, and fencing, netting, and monitoring will occur.**

# *S. sisymbriifolium* 2012 Rooting Depth Trial

- PCN present in E. Idaho fields with gravelly soil
  - If cysts "fall" deep in this type of soil will *S. sisymbriifolium* roots go to same depths
- How much biomass can be produced in shorter growing season in SE Idaho compared with that of Western Idaho?
  - Can an *S. sisymbriifolium* trap crop produce adequately by the end of August or will another 4 to 6 wks be advantageous?

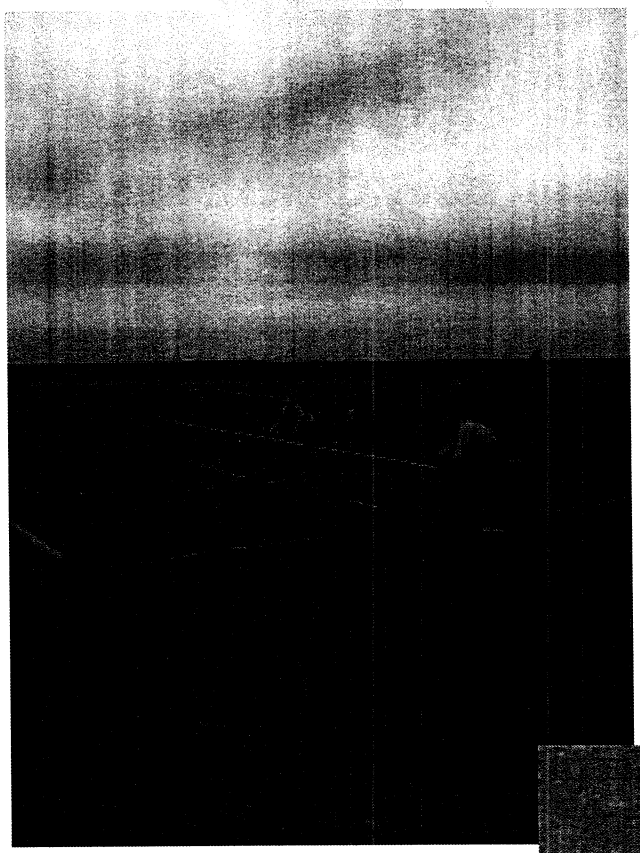
# Shelley, ID 2012 Rooting Depth Trial

- Strip not replicated.
- Transplanted greenhouse-grown *S. sisymbriifolium*, not seeded/drilled – therefore, no germination from seed in subsequent years can occur.
- ***No mature berry production was allowed.***
- Determined rooting depth twice: early August and late September.
- Crop destruct - applied diquat after final measurements.
  - **All remaining plants died as a result of this application.**
- Fenced and covered with netting.
- Will monitor for 5 yrs.

**UPDATE:**

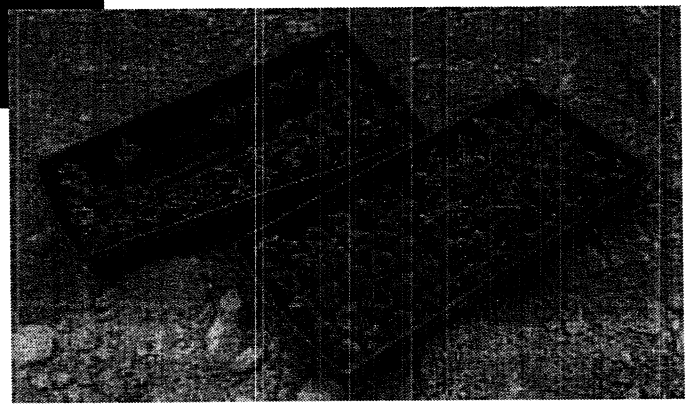
**No regrowth has occurred as of June 03, 2013**

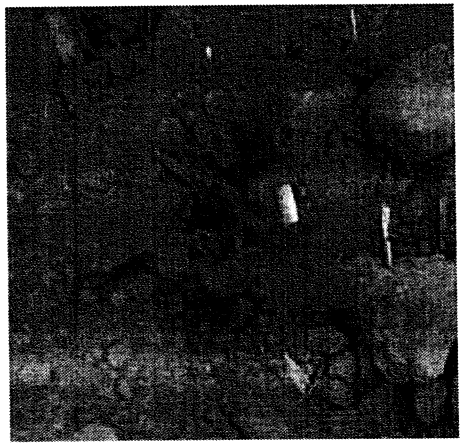
# Shelley, ID 2012 Rooting Depth Trial



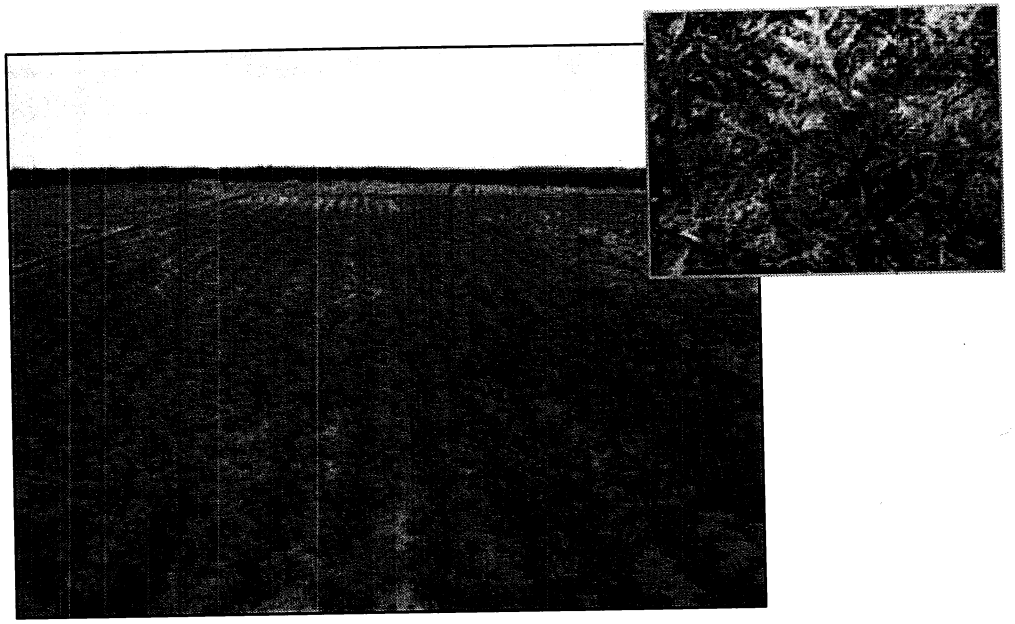
On June 15, 2012, approximately 1,700 *S. sisymbriifolium* plants grown in an Aberdeen R&E Center greenhouse were transplanted into a 20 x 80 ft area in a field near Shelley, ID.

Target plant density was 1 per sq ft.

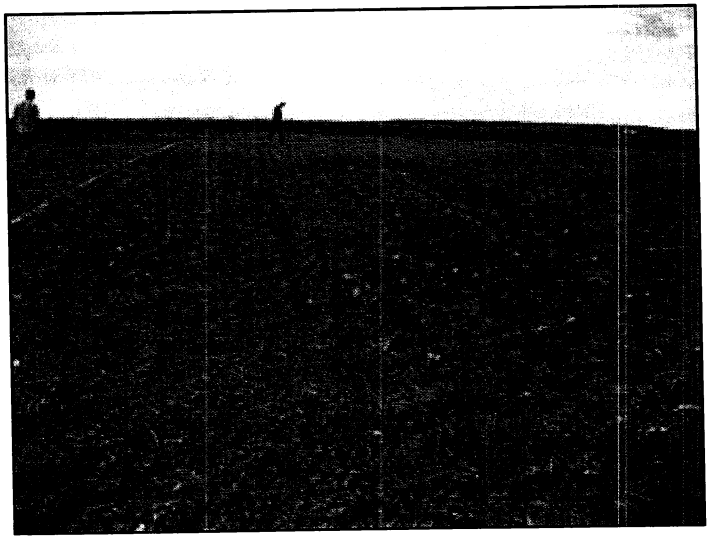




July 3rd 2.5 wks after transplanting



July 10th 3.5 wks after transplanting



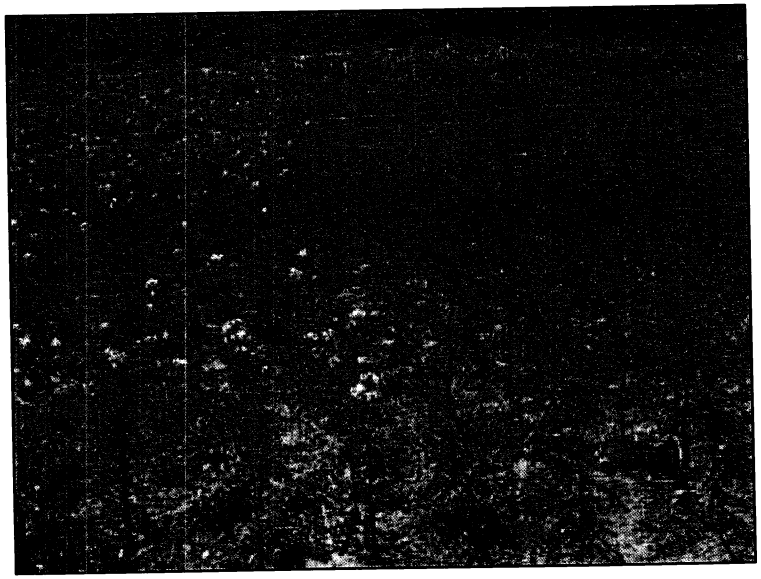
July 16th 4.5 wks after transplanting


July 23rd 5.5 wks after transplanting

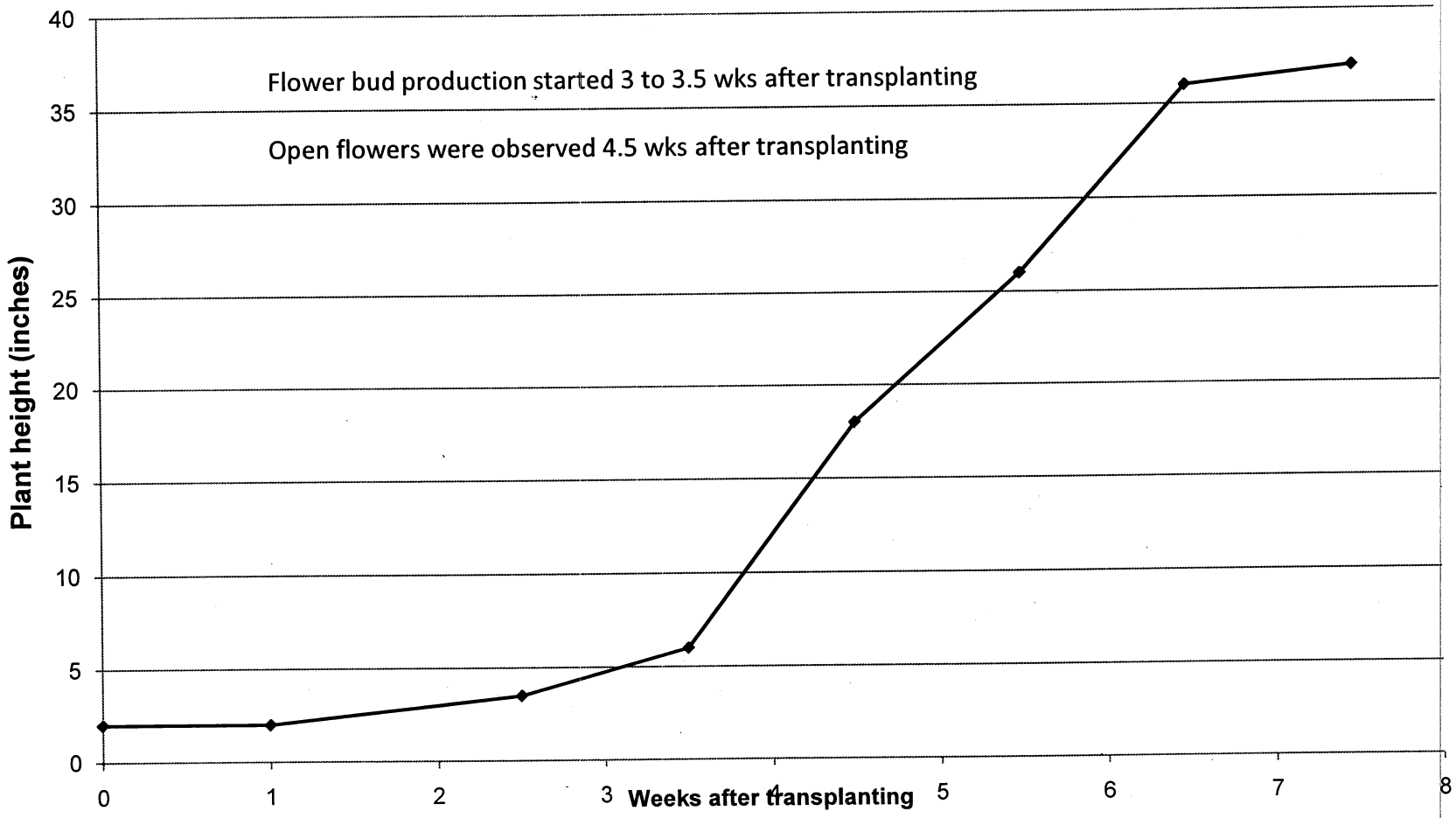
## Weekly height measurement

*Flowers, buds, and berries were pulled or cut off plants on a weekly basis so that no mature berries were allowed to form while the plants continued to grow.*

**August 1st 6.5 wks after transplanting**



# Shelley, ID 2012 Rooting Depth Trial: Height measurements



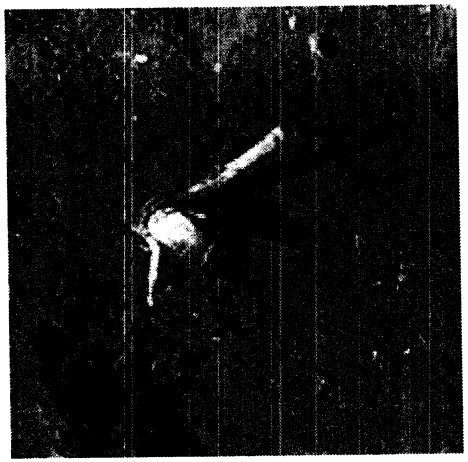

Greenhouse-grown *S. sisymbriifolium* plants were transplanted June 15, 2012 when 1 to 2 inches tall.

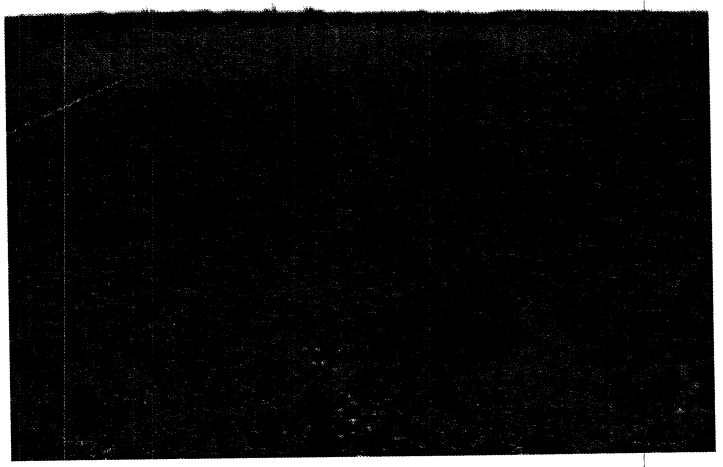
Plants in the early-dig 1/2 of block were grown until August 06, 2012, 7.5 wks after transplanting.

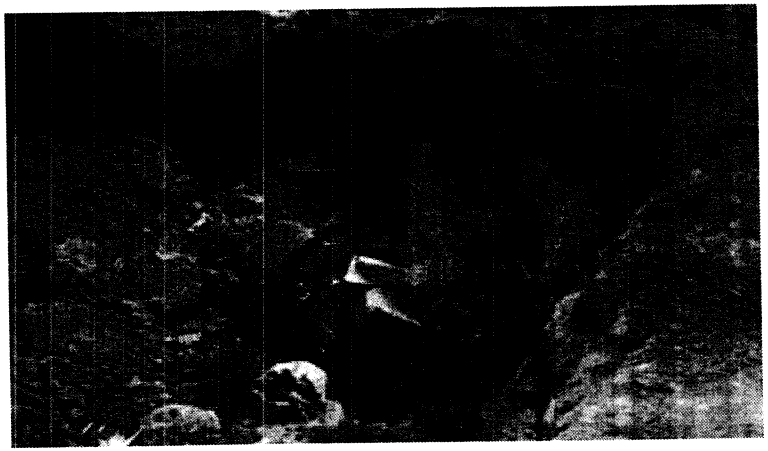
# Shelley, ID 2012 Rooting Depth Trial

August 6th 7.5 wks after transplanting:

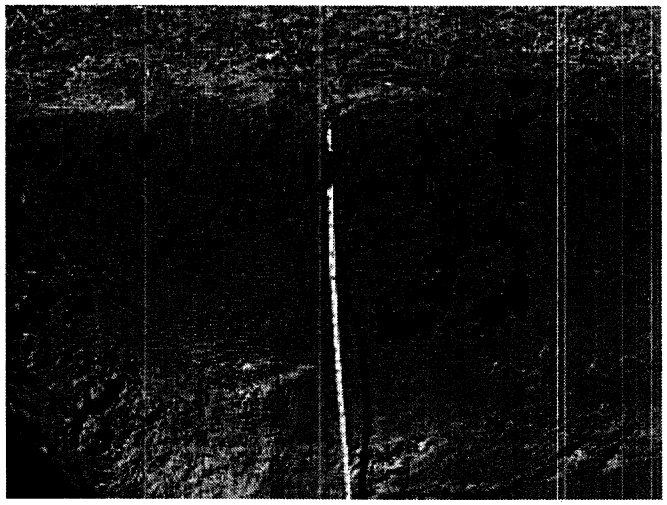
**Plants were cut off at the soil surface in the area to be trenched for 1st rooting depth measurement and burned.**







# Shelley, ID 2012 Rooting Depth Trial

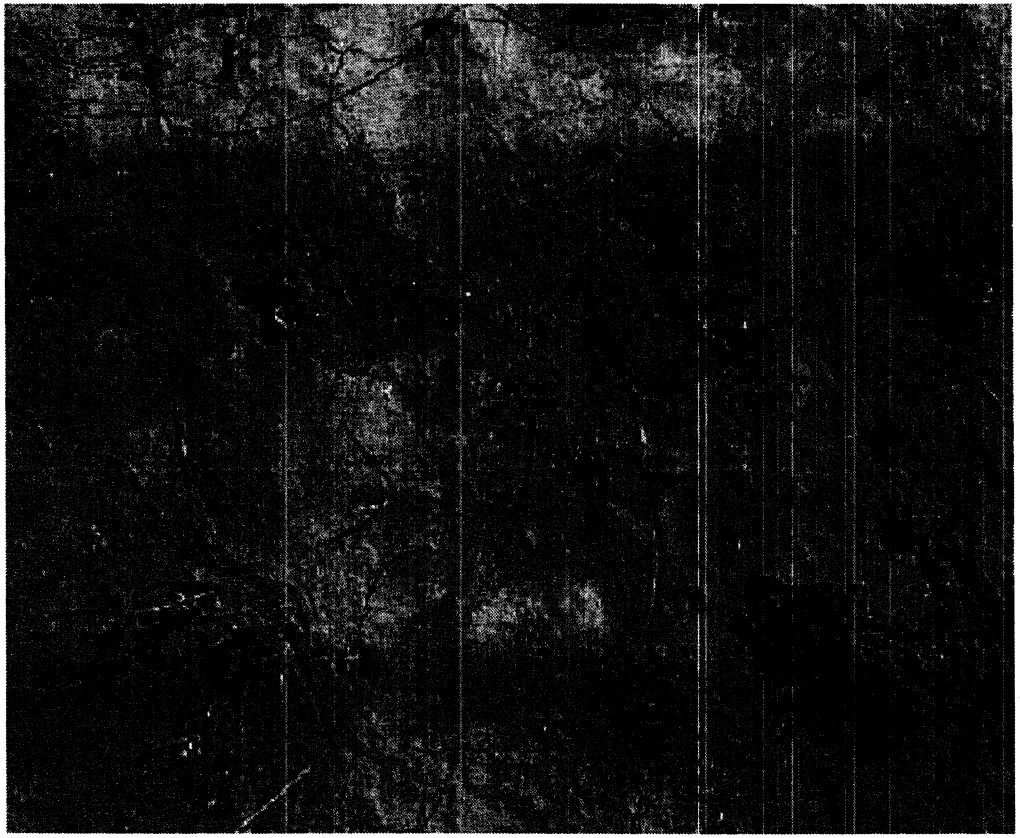
# Shelley, ID 2012 Rooting Depth Trial

- First root depth measurement – after August 6th removal (7.5 wks after transplanting)
  - Avg plant ht 31 inches
  - Total dry wt biomass of above-ground vegetation was 244.2 g per sq m
  - Main roots were found as deep as 16 inches; avg 13 inches
  - Fine roots as deep as 41 inches; avg 29.2 inches

# Shelley 2012 Rooting Depth Trial

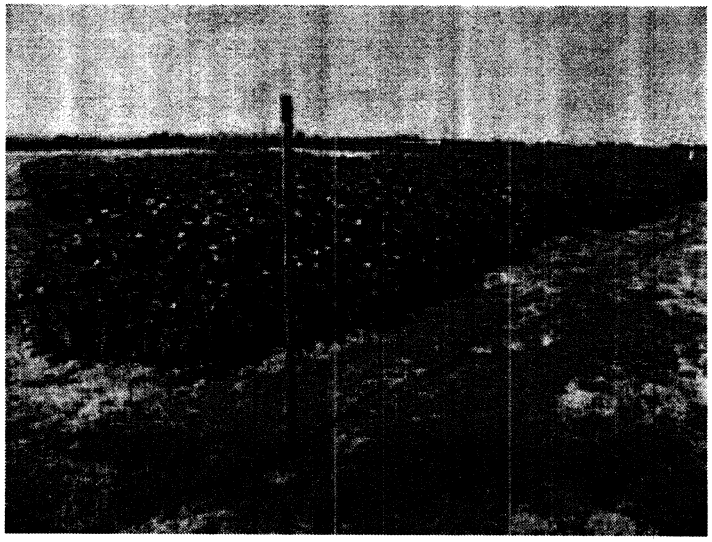
- Second root depth measurement – *after September 26th plant removal (7 wks after 1st root measurement; 14.5 wks after transplanting).*
  - *As with the 1st rooting depth measurement, plants were cut off at the soil surface in the rooting depth area to be trenched and burned.*
  - Avg height was 24.3 (less than 1st rooting depth timing of 31 inches)
  - Total dry wt biomass of above-ground vegetation was 267.4 g per sq m (similar to 1st rooting depth timing)
  - Main roots were found as deep as 17.5 inches; avg 13.8 inches (similar)
  - Fine roots as deep as 38 inches; avg 28.9 inches (similar)

# Shelley, ID 2012 Rooting Depth Trial

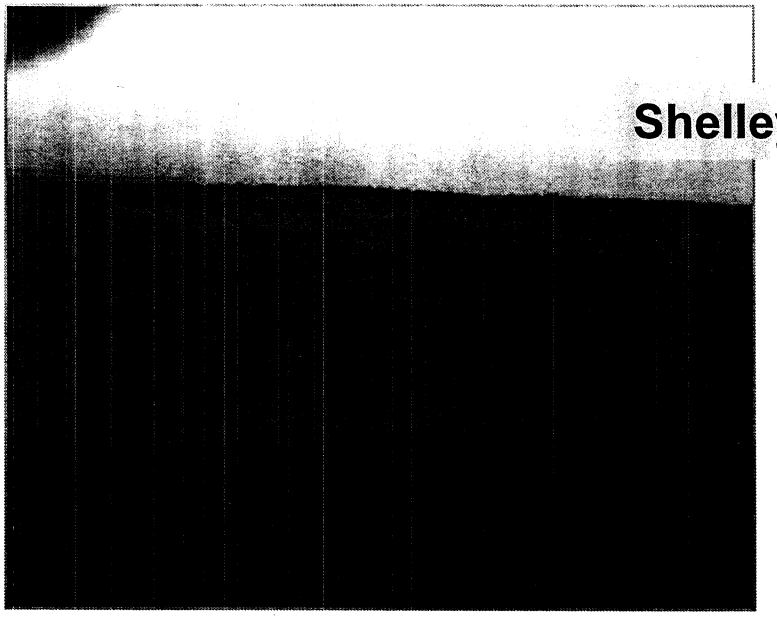


After biomass collection and rooting depth measurement, the entire trial area was sprayed with diquat resulting in kill of all remaining plants.

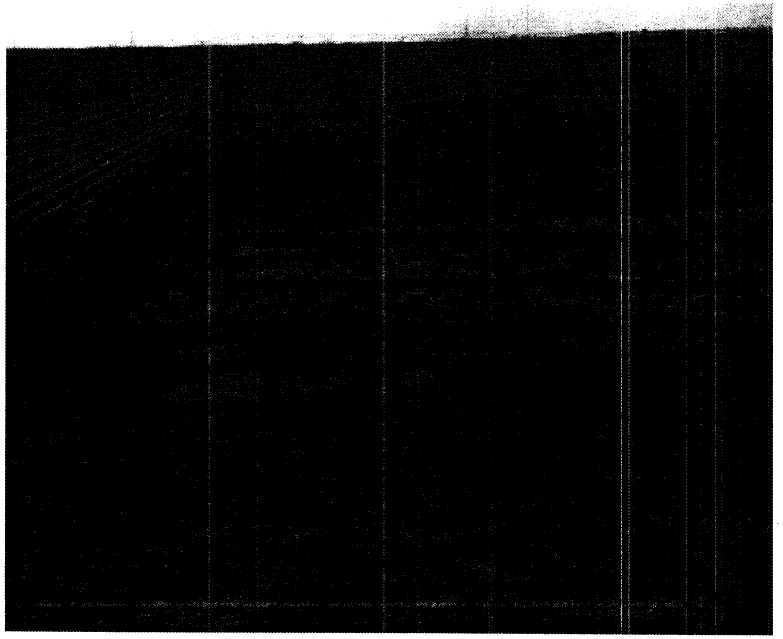
**As mentioned, no regrowth has occurred as of June 03, 2013**

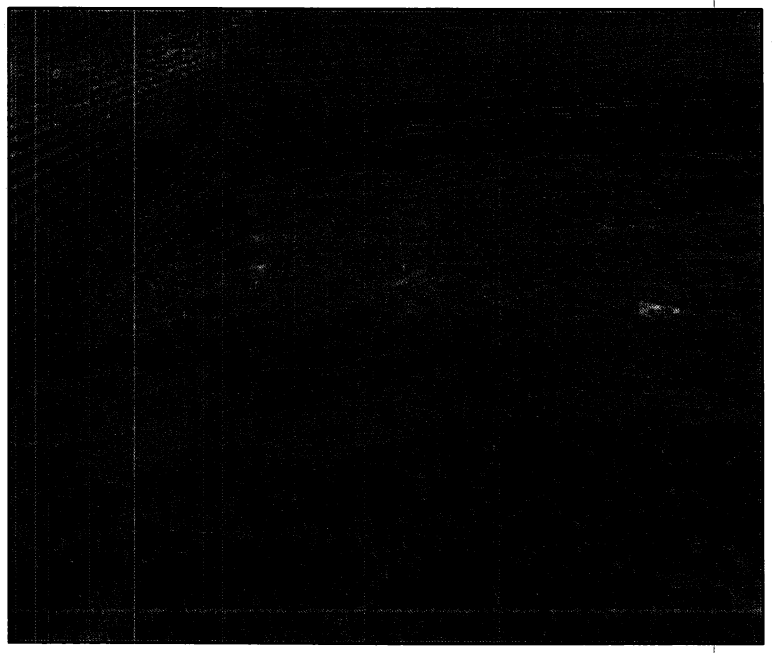


Parma 2012



Shelley 2012





Shelley 2012

# 2013-14 Planned *Ss* Rooting Depth Trial

- Shelley, ID area field location
  - This research should be repeated in an area with gravelly soil to determine if roots can grow deeper than 41 inches.
  - In addition, another year with perhaps different growing conditions may reveal different growth habits of this plant in the short, eastern Idaho growing season.
- **Transplant greenhouse-grown *S. sisymbriifolium***
- **The same procedure for removing buds, flowers, berries will be followed on a weekly (or shorter if necessary) interval basis.**
  - **Similar to the 2012 trial, since the trial area will be transplanted not seeded, no germination from seed in subsequent years will be possible.**
- Fencing, netting, season-end kill with diquat will occur.
- Trial area will be monitored for 5 years.

University of Idaho
College of Agricultural and Life Sciences

Department of Plant, Soil and Entomological Sciences

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Moscow, Idaho 83844-2339

Phone: 208-885-6274
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www.cals.uidaho.edu/pses

June 10, 2013

Mr. Matt Voile
Section Manager, Invasive Species and Noxious Weeds
Idaho State Department of Agriculture
P.O. Box 790, Boise, Idaho 83701

Dear Mr. Voile:

Following are comments regarding the proposed rule changes to IDAPA 02.06.09, "Rules Governing Invasive Species," specifically those sections addressing research and possession permitting of "Invasive Plants – Trap Crops," and, in particular, the plant species *Solanum sisymbriifolium* Lam. (common names including 'sticky nightshade' and 'Litchi tomato').

I am in the position of Director of the University of Idaho PCN (pale cyst nematode) Project, in the College of Agricultural and Life Sciences, University of Idaho, Moscow. The focus of this project is the eradication of PCN, a USDA-APHIS quarantine plant pest that poses a serious threat to the Idaho potato industry.

In recent years, USDA-APHIS is eradicating PCN from the Idaho fields where it has been found, using the fumigant methyl bromide (MeBr). Because of stringent buffer zone requirements for the use of phase II-labeled methyl bromide, eradication with methyl bromide is becoming more tenuous. Idaho potato growers face the prospect of being unable to eradicate PCN, with potentially severe agricultural and trade consequences. Our research at the University of Idaho focuses in large part on finding, as quickly as possible, alternative eradicative measures that can be used against PCN. We have both an extensive and intensive research effort dedicated to that goal. Perhaps the most promising alternative eradicative measure for use by the Idaho potato industry is the use of *S. sisymbriifolium* as a trap crop for the nematode

*S. sisymbriifolium* has been widely utilized in Europe as a trap crop that stimulates PCN to hatch without allowing reproduction of the nematodes. The species also has been introduced and is present in Oregon, California, most southern states, and other parts of the eastern U.S. and Canada.[1] In our program, we are evaluating the efficacy of this trap crap against PCN, effects on the nematode life cycle, and compatibility with other eradication measures. Our USDA-ARS

[1] http://plants.usda.gov/java/profile?symbol=SOSI&mapType=nativity&photoID=sosi_001_avd.tif#

collaborators conduct research including plant breeding to produce lines (of the same species) that produce additional hatching factor, fewer thorns, or other desirable characteristics.

Our initial results are very encouraging, for example:

A line of *Solanum sisymbriifolium* selected on the basis of having fewer spines was tested and confirmed to cause PCN hatch and remain a non-host. PCN did not reproduce on *S. sisymbriifolium* synII (Table 1).

**Table 1. Mean number of cysts in potato vs *Solanum sisymbriifolium* after 16 weeks**

| | | | |
|---|---|---|---|
| Potato | 412 | *S. sisymbriifolium* | 0 |

In another long range study that is just being completed, we measured the ability of *S. sisymbriifolium* to decrease populations of PCN under greenhouse conditions in soil infested with PCN. Potato was planted following treatments of fallow, *S. sisymbriifolium*, or potato, and nematode cysts were counted on the final potato crop. As can be seen in Table 2 below, *S. sysimbriifolium* almost entirely eliminated reproduction of the nematode population on the succeeding potato crop. We have observed similar results in other laboratory and greenhouse experiments. However, it will be very important to repeat this type of experiment in the field, in order to verify these findings.

**Table 2. Effect of *S. sisymbriifolium* on PCN reproduction in a subsequent potato crop**

| Treatment | PCN cysts per pot |
|---|---|
| Potato after *S. sisymbriifolium* | 1 |
| Potato after fallow | 271 |
| Potato after potato | 1021 |

We have also observed that maximum hatch of the nematode occurs from diffusate of six to eight-week-old potato or *S. sisymbriifolium* plants. Experiments to optimize the length of time that the trap crop needs to be grown for maximum destruction of PCN populations are underway.

I wish to emphasize that proposed field research with *S. sisymbriifolium* already is being planned with stringent conditions: Currently planned trials, to be conducted in collaboration with Dr. Pam Hutchinson (UI weed scientist) and USDA-APHIS regulatory personnel, include the following measures: fencing any field trial with *S. sisymbriifolium*, and trimming plants periodically to prevent flower-bud formation, and if flower-buds should form, exercising them from the plants and destroyed. After 8 weeks, all plants will be killed with a desiccant, or with other herbicides;

desiccated or killed plant material will be burned within the plot area, or bagged and autoclaved. The plot area will be monitored for volunteer plants for a period of 5 years (see additional comments submitted separately by Dr. Hutchinson) If, within this time, any volunteers are found, they will be destroyed and reported to both ISDA and USDA-APHIS.

As we proceed with testing *S. sisymbriifolium* under field conditions, the requirement to fence and cover large scale field trials may be cost prohibitive. This may also prove to be the case for growers wishing to plant *S. sisymbriifolium* in an infested field. Once Dr. Pam Hutchinson has determined which herbicides are effective against *S. sisymbriifolium* we think that less stringent containment protocols would be more effective for research experimentation with *S. sisymbriifolium* for eradication of PCN. Under this framework, as the research and agronomic knowledge base for working with this plant increases, it will be possible to design additional effective protocols to ensure the environmentally responsible use of this pest control measure. We are very concerned that more stringent regulation at this time would have the unfortunate effect of hampering research with *S. sisymbriifolium*, to the detriment of the Idaho potato industry as we strive to eradicate the serious pest organism PCN.

Thank you for your consideration of these comments, I would be glad to address any questions or concerns.

Sincerely,

Louise-Marie Dandurand

Louise-Marie Dandurand, Ph.D.
Research Scientist; Director UI PCN Project
PSES Dept., University of Idaho
874 Perimeter Drive MS 2339
Moscow, ID 83844-2339

tel. (208) 885-6080 email: lmd@uidaho.edu

cc: Mr. Patrick Kole, Idaho Potato Commission
Dr. Andy Jensen, Pacific Northwest Potato Regional Research Director
Dr. Donn Thill, Director, Idaho Agricultural Experiment Station, University of Idaho
Dr. James Johnson, Head, Dept. of Plant, Soil, and Entomological Sciences, Univ. of Idaho

## Angel O'Brien

**From:** Sean Costello
**Sent:** Wednesday, June 12, 2013 1:41 PM
**To:** Angel O'Brien; Angela Kaufmann
**Subject:** FW: Invasive Plants – Trap Crops comment letter
**Attachments:** Dandurand ISDA comment letter.docx

Angela - FYI.

Angel - Please print this e-mail and the attached comment for the record.

Sean Costello
Deputy Attorney General
Idaho State Department of Agriculture
(208) 332-8504

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**From:** Matt K. Voile
**Sent:** Wednesday, June 12, 2013 12:46 PM
**To:** Sean Costello
**Cc:** Lloyd Knight
**Subject:** FW: Invasive Plants – Trap Crops comment letter

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**From:** Dandurand, Louise-Marie [mailto:lmd@uidaho.edu]
**Sent:** Wednesday, June 12, 2013 12:30 PM
**To:** Matt K. Voile
**Cc:** Tina.Gresham@aphis.usda.gov; Marschman, Brian L - APHIS; Johnson, James Ding; Thill, Donn; Andy Jensen; Patrick Kole; Frank W. Muir (Frank.Muir@potato.idaho.gov); Travis Blacker; Bulluck, Russ - APHIS; Hutchinson, Pam
**Subject:** Invasive Plants – Trap Crops comment letter

Hi Matt, please find attached a comment letter re: the proposed rule changes to IDAPA 02.06.09, "Rules Governing Invasive Species," specifically those sections addressing research and possession permitting of "Invasive Plants – Trap Crops," and, in particular, the plant species *Solanum sisymbriifolium*. Please let me know if I can provide further information.
Sincerely,
Louise-Marie

Louise-Marie Dandurand, PhD
Director, UI PCN Project
PSES Department
University of Idaho
Moscow Idaho 8344
208-885-6080

# Weed Risk Assessment for *Solanum sisymbriifolium* Lam. (Solanaceae) – Sticky nightshade

United States Department of Agriculture

Animal and Plant Health Inspection Service

March 26, 2013

Version 1

*Solanum sisymbriifolium* leaves and fruit (source: Technische Universität Braunschweig, 2012).


**Agency Contact**:

Plant Epidemiology and Risk Analysis Laboratory
Center for Plant Health Science and Technology

Plant Protection and Quarantine
Animal and Plant Health Inspection Service
United States Department of Agriculture
1730 Varsity Drive, Suite 300
Raleigh, NC 27606

**Introduction** Plant Protection and Quarantine (PPQ) regulates noxious weeds under the authority of the Plant Protection Act (7 U.S.C. § 7701-7786, 2000) and the Federal Seed Act (7 U.S.C. § 1581-1610, 1939). A noxious weed is defined 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, the natural resources of the United States, the public health, or the environment" (7 U.S.C. § 7701-7786, 2000). We use weed risk assessment (WRA)—specifically, the PPQ WRA model (Koop et al., 2012)—to evaluate the risk potential of plants, including those newly detected in the United States, those proposed for import, and those emerging as weeds elsewhere in the world.

Because the PPQ WRA model is geographically and climatically neutral, it can be used to evaluate the baseline invasive/weed potential of any plant species for the entire United States or for any area within it. As part of this analysis, we use a stochastic simulation to evaluate how much the uncertainty associated with the analysis affects the model outcomes. We also use GIS overlays to evaluate those areas of the United States that may be suitable for the establishment of the plant. For more information on the PPQ WRA process, please refer to the document, *Background information on the PPQ Weed Risk Assessment*, which is available upon request.

***Solanum sisymbriifolium* Lam. – Sticky nightshade**

**Species Information**

Family: Solanaceae

Initiation: On January 3, 2012, Amy Ferriter, Invasive Species Coordinator for the Idaho State Department of Agriculture, contacted the PERAL Weed Team to request a weed risk assessment on *Solanum sisymbriifolium*. *Solanum sisymbriifolium* is not known to occur in Idaho, but it is under consideration there for use as a trap crop for the pale potato cyst nematode *Globodera pallida* (Koop, 2012).

Foreign distribution: Native to South America. *Solanum sisymbriifolium* is naturalized in Europe, parts of Africa, and Australia (Karaer and Kutbay, 2007).

U.S. distribution and status: This species is not widely cultivated, but it has become naturalized in Alabama, Arizona, California, Delaware, Florida, Georgia, Iowa, Louisiana, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Oregon, Pennsylvania, South Carolina, and Texas (Kartesz, 2012).

WRA area[1]: Entire United States, including territories

[1] "WRA area" is the area in relation to which the weed risk assessment is conducted [definition modified from that for "PRA area" (IPPC, 2012).

1. *Solanum sisymbriifolium* analysis

**Establishment/Spread Potential**

*Solanum sisymbriifolium* is a pioneer species (Byrne et al., 2002) that colonizes disturbed habitats (Karaer and Kutbay, 2007). In South Africa, *Solanum sisymbriifolium* occurs in localized dense, infestations (Hill and Hulley, 2000), some of which are eventually replaced by exotic *Acacia* species and native species (Byrne et al., 2002). *Solanum sisymbriifolium* mainly spreads by seed (Hill and Hulley, 1995); plants can produce up to 45,000 seeds each year in tomato-like, fleshy, red fruit that are dispersed by birds (Hill and Hulley, 2000) and mice (Bryson, 2011). Seed can also be spread to new areas as contaminants in hay (Bryson, 2011; Byrne et al., 2002). This element had average (moderate) uncertainty.
Risk score = 18 Uncertainty index = 0.19

**Impact Potential**

Although *S. sisymbriifolium* occurs in disturbed areas, such as along roadsides and fences (Karaer and Kutbay, 2007), it is primarily a weed of productions systems. In South Africa, it invades and reduces the carrying capacity and value of pastureland (Byrne et al., 2002), possibly because the stems and leaves of this species are covered in prickles and spines (Karaer and Kutbay, 2007) which make them unpalatable to cattle. Although it is not widely distributed in South Africa (Hill and Hulley, 2000), its impacts have prompted the release of biocontrol agents (King et al., 2011). In South Africa, *S. sisymbriifolium* also makes forestry management more difficult by invading forestry fire breaks (Hill and Hulley, 1995).
Risk score = 2.4 Uncertainty index = 0.15

**Geographic Potential**

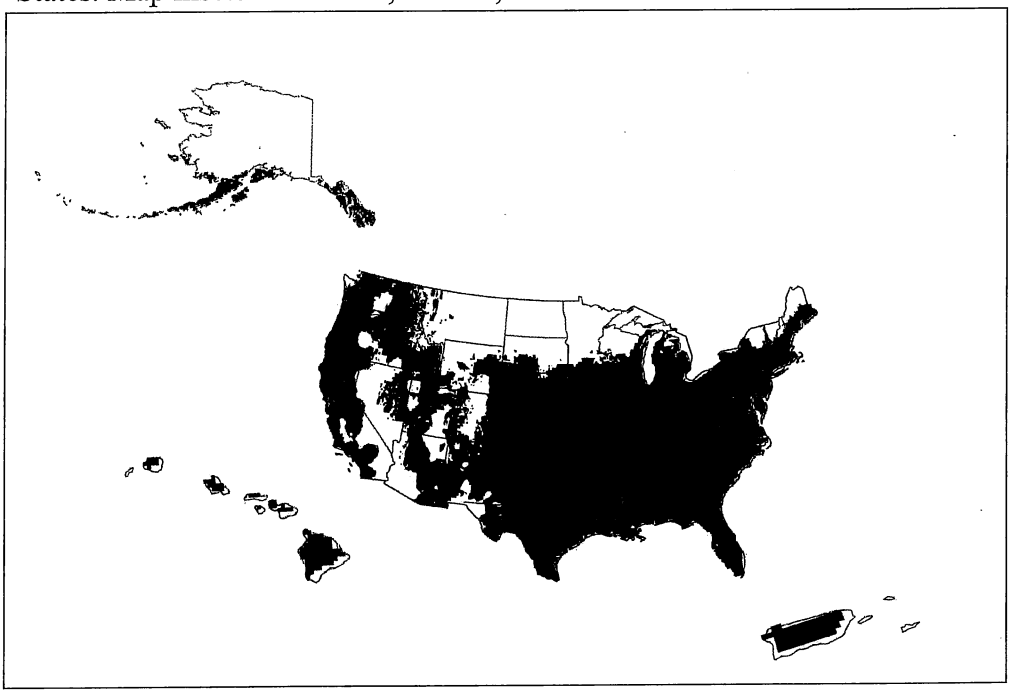
Based on three climatic variables, we estimate that about 64 percent of the United States is suitable for the establishment of *Solanum sisymbriifolium* (Fig. 1). We based this on the species' known distribution elsewhere in the world, including point-referenced localities and areas of occurrence. The map for *S. sisymbriifolium* represents the joint distribution of Plant Hardiness Zones 5-13, areas with 10-90 inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, steppe, mediterranean, humid subtropical, humid continental warm summers, humid continental cool summers, and subarctic.

The area estimated likely is a conservative (i.e., overstated) estimate. Other environmental variables, such as soil and habitat type, may further limit the areas in which this species is likely to establish.

**Entry Potential**

We did not assess the entry potential of *S. sisymbriifolium* because it is already present in the United States (see above).

**Figure 1**. Predicted distribution of *Solanum sisymbriifolium* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.



2. Results and Conclusion

Model Probabilities: P(Major Invader) = 82.5%
P(Minor Invader) = 16.9%
P(Non-Invader) = 0.6%

Risk Result = High Risk

Secondary Screening = Not Applicable

**Figure 2.** *Solanum sisymbriifolium* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

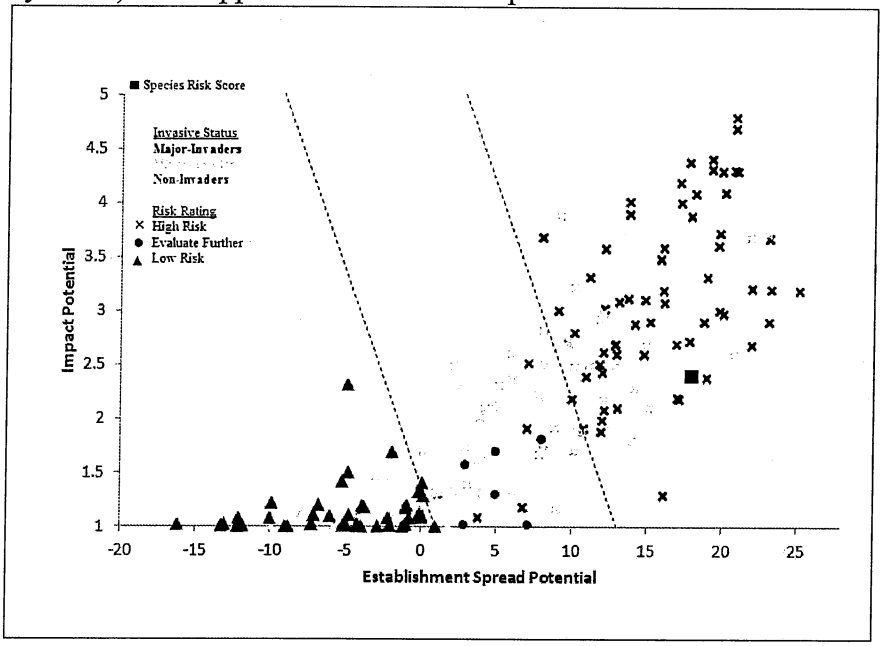
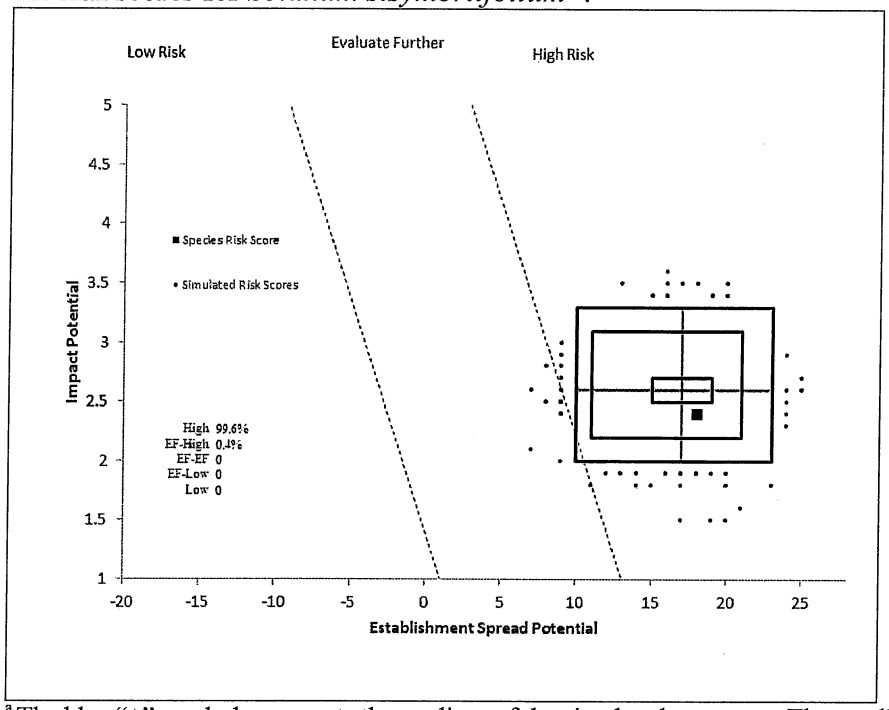



**Figure 3.** Monte Carlo simulation results (N=5,000) for uncertainty around the risk scores for *Solanum sisymbriifolium* [a].




[a] The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

3. Discussion

The result of the weed risk assessment for *S. sisymbriifolium* is High Risk (Fig. 2). In the uncertainty analysis, 99.6 percent of the simulated risk scores resulted in a conclusion of High Risk (Fig. 3), indicating that the overall model conclusion is highly robust. This result is based on the ability of *S. sisymbriifolium* seed to spread to new locations, as well as the impacts this species has in agricultural production systems, especially pastureland. *Solanum sisymbriifolium* is not widely cultivated in the United States, but this species has become naturalized in 17 states (Kartesz, 2012), demonstrating the ability of this species to easily spread to new areas.

Because *S. sisymbriifolium* is used as a trap crop for potato cyst nematodes (Scholte, 2000), the risk of establishment is very high as entire *S. sisymbriifolium* populations are intentionally planted in fields. This plant stimulates nematode hatching, but prevents nematode development and reproduction, resulting in a reduction of the potato cyst nematode population in infested fields (Dias et al., 2012). *Solanum sisymbriifolium* has a seed bank (Byrne et al., 2002) and spreads primarily through seeds produced in fleshy, red fruits dispersed by birds (Hill and Hulley, 2000) and mice (Bryson, 2011). To reduce the risk of naturalization where they are grown as nematode trap crops, growers should harvest or till plants prior to fruit production. Ultimately, land managers will have to weigh the benefits of growing *S. sisymbriifolium* with its potential impacts and the cost of preventing this plant from becoming naturalized.

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**Appendix A**. Weed risk assessment for *Solanum sisymbriifolium* Lam. (Solanaceae). The following information was obtained from the species' risk assessment, which was conducted using Microsoft Excel. The information shown in this appendix was modified to fit on the page. The original Excel file, the full questions, and the guidance to answer the questions are available upon request.

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| **Establishment/Spread Potential** | | | |
| ES-1 (Status/invasiveness outside its native range) | f - high | 5 | Native to South America (D'Arcy, 1974), where the plant "is associated with localized, short-term disturbances" (Hill and Hulley, 1995). "[A] noxious invader" in South Africa (Hill and Hulley, 2000). Has invaded pasture lands and forestry firebreaks after being introduced to South Africa (Hill and Hulley, 1995). "Although the weed has a limited distribution in South Africa, several localised dense infestations exist" (Hill and Hulley, 2000). "Although seemingly well established in local populations, these introductions [of *S. sisymbriifolium*] have been unable to expand beyond scattered sites" in Florida (D'Arcy, 1974). Has become "established in Australia, India, the United States, and China" (Byrne et al., 2002) and Turkey (Karaer and Kutbay, 2007). Weed infestations are "ephemeral" because "*S. sisymbriifolium* often behaves as a pioneer species, persisting for relatively short periods of time before being displaced by perennial weeds (notably Australian *Acacia* species) and native plant species" (Byrne et al., 2002). *Solanum sisymbriifolium* is not widely cultivated but it has become naturalized in 17 states in the United States (Kartesz, 2012). We are answering "f" because this species has spread to new locations in South Africa and the United States but we are using high uncertainty based on the references that describe this plant being limited to localized patches. The alternate answers for the Monte Carlo simulation are both "e." |
| ES-2 (Is the species highly domesticated) | n - mod | 0 | Several different cultivars exist (Vandijke Semo, 2012), such as the cultivar 'White Star,' which appears to have been selected for its ability to control nematodes rather than reduced weed potential (Petersen, 2012). Desirable cultivars are also able to grow in a range of different soil types (Petersen, 2012). Timmermans et al. (2009) recommend breeding *S. sisymbriifolium* cultivars with cold tolerance so the plant can be grown as a nematode trap crop in northern climates. Because we were unable to find evidence that *S. sisymbriifolium* cultivars are being bred for reduced weed potential, we are answering no with moderate uncertainty. |
| ES-3 (Weedy congeners) | y - negl | 1 | Several species of *Solanum* are listed as significant weeds by Holm et al. (1979) including *S. elaeagnifolium*, *S. nigrum*, *S. nodiflorum*, *S. rostratum*, *S. torvum*, and *S. villosum* (Holm et al., 1979). Additionally, South Africa is using biological control against *S. mauritianum*, *S. seaforthianum* is invasive in the tropics, and *S. tampicense* and *Solanum viarum* are Federal Noxious Weeds in the United States (ISSG, 2012a). |
| ES-4 (Shade tolerant at some stage of its life cycle) | n - mod | 0 | "It can grow in semi-shade (light woodland) or no shade" (Plants For A Future, 2012). "[C]onditions of constant darkness inhibit germination" (Hill and Hulley, 2000). "[F]ound on railroads and along sandy, barren roadside" in Florida (D'Arcy, 1974). No evidence that this species grows in shady conditions, so we are answering "no" for this question. |
| ES-5 (Climbing or smothering growth form) | n - negl | 0 | Plant is an erect shrub that can grow to 60 cm tall (D'Arcy, 1974). No evidence of climbing or smothering growth habit. |
| ES-6 (Forms dense thickets) | y - mod | 2 | "[D]ense infestations" in South Africa (Hill and Hulley, 2000). |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| ES-7 (Aquatic) | n - negl | 0 | Terrestrial herb in the family Solanaceae (D'Arcy, 1974; NGRP, 2012). |
| ES-8 (Grass) | n - negl | 0 | Not a grass. Herb in the family Solanaceae (D'Arcy, 1974; NGRP, 2012). |
| ES-9 (Nitrogen-fixing woody plant) | n - negl | 0 | No evidence that *S. sisymbriifolium* fixes nitrogen. Because no Solanaceae are known to fix nitrogen (Martin and Dowd, 1990), using "negl" uncertainty. |
| ES-10 (Does it produce viable seeds or spores) | y - negl | 1 | "Propagation is mainly through seeds" (Hill and Hulley, 1995). |
| ES-11 (Self-compatible or apomictic) | n - mod | -1 | "A number of self-pollination trials suggest that this species is self-sterile" (D'Arcy, 1974). |
| ES-12 (Requires special pollinators) | n - low | 0 | Pollinated by several different species of solitary bees in South Africa (Hill and Hulley, 2000). |
| ES-13 (Minimum generation time) | b - negl | 1 | First flowers are produced 43 days after emergence from seed in the southern United States (Bryson et al., 2012). In many parts of the world, *S. sisymbriifolium* behaves as a short-lived annual or a biennial (Hill and Hulley, 2000). In South Africa, flowers first open in July. Green fruit appears in August (late winter/early spring) and September, turning red by November. The plants continue to produce fruit into the winter (Hill and Hulley, 2000). "[P]lant[s] persist in cold regions of the country where they die back in winter and then resprout from the previous season's rootstocks or via new recruitment from seed" (King et al., 2011). Based on this evidence, *S. sisymbriifolium* appears to have a minimum generation time of one year, with fruit and seeds being produced over a single growing season, and new plants being produced during the following season. Thus, answering "b" with low uncertainty. Alternate answers for the Monte Carlo analysis are "a" and "c." |
| ES-14 (Prolific reproduction) | y - low | 1 | Hill and Hulley (2000) studied fruit and seed set in a wild population of *S. sisymbriifolium*, observing that "[P]ropagation is enhanced by high fruit production (about 300 fruit per plant per year). Each fruit contains between 140 and 200 seeds of which around 80% are viable...This means that each plant at the site...produced around 45,000 seeds per year" (Hill and Hulley, 2000). Based on this evidence, answering "yes" with low uncertainty. |
| ES-15 (Propagules likely to be dispersed unintentionally by people) | ? - max | 0 | Unknown. |
| ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers) | y - low | 2 | Thought to have been introduced into South Africa as a contaminant of horse fodder (Byrne et al., 2002). Has been observed in truck crops and contaminated hay seed is a primary means of seed dispersal (Bryson, 2011). "[G]rows near sea ports in waste places" in the southeastern United States (Karaer and Kutbay, 2007). |
| ES-17 (Number of natural dispersal vectors) | 2 | 0 | Berry and seed descriptions used to answer questions ES17a-ES17e: "Berry bright shiny scarlet, juicy, 8 mm across, loosely enveloped until maturity by the calyx with its enlarged spines which ruptures to expose the fruit; seeds 3 mm across, compressed-lenticular" (D'Arcy, 1974) and "1.6–2.0 cm diam., round, green [fruit], turning yellow then bright red at maturity; calyx prickly, loosely surrounds fruit until maturity, then splits to expose fruit" (Bryson et al., 2012). |
| ES-17a (Wind dispersal) | n - mod | | No evidence for wind dispersal. Seeds are enclosed in a 1.6-2.0 cm diameter fleshy fruit (Bryson et al., 2012; D'Arcy, 1974). |
| ES-17b (Water dispersal) | n - mod | | No evidence that water plays a major role in seed dispersal. |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| ES-17c (Bird dispersal) | y - negl | | In South Africa, *S. sisymbriifolium* is spread by indigenous birds such as bulbuls, starlings, thrushes, and barbets, which are fond of the fleshy fruits (Hill and Hulley, 1995) and the seeds remain viable after passing through the guts of birds (Hill and Hulley, 2000). |
| ES-17d (Animal external dispersal) | n - mod | | No evidence. Seeds are enclosed in a 1.6-2.0 cm diameter fleshy fruit (Bryson et al., 2012; D'Arcy, 1974) that lacks any adaptations to adhere to the fur of animals. |
| ES-17e (Animal internal dispersal) | y - low | | Mice are one of the primary methods of seed dispersal in the southern United States (Bryson, 2011). |
| ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed) | y - mod | 1 | Has a "resilient seed bank" (Byrne et al., 2002). |
| ES-19 (Tolerates/benefits from mutilation, cultivation or fire) | y - low | 1 | "Attempts at mechanical and chemical controls have been thwarted by the weed's ability to coppice after being cut" (Byrne et al., 2002). "[T]he weed is associated with short-term disturbance such as fire; ploughed fields; waste-, cultivated- and pastoral lands" (King et al., 2011). |
| ES-20 (Is resistant to some herbicides or has the potential to become resistant) | yes - high | 1 | Other species of *Solanum* have acquired resistance to some herbicides (WSSA, 2012) and chemical control methods in South Africa have not been effective at controlling this plant (Hill and Hulley, 1995). Answering "yes" with high uncertainty because this answer is based on congeneric information. |
| ES-21 (Number of cold hardiness zones suitable for its survival) | 9 | 0 | |
| ES-22 (Number of climate types suitable for its survival) | 9 | 2 | |
| ES-23 (Number of precipitation bands suitable for its survival) | 8 | 1 | |
| **Impact Potential** | | | |
| **General Impacts** | | | |
| Imp-G1 (Allelopathic) | n - mod | 0 | No evidence. |
| Imp-G2 (Parasitic) | n - negl | 0 | *Solanum sisymbriifolium* is in the family Solanaceae (D'Arcy, 1974; NGRP, 2012), a family not known to contain parasitic plants (Heide-Jørgensen, 2008; Nickrent, 2009). |
| **Impacts to Natural Systems** | | | |
| Imp-N1 (Change ecosystem processes and parameters that affect other species) | n - mod | 0 | No evidence. *Solanum sisymbriifolium* is an ephemeral pioneer species (Byrne et al., 2002) that is unlikely to have a long-term impact on an ecosystem. |
| Imp-N2 (Change community structure) | n - mod | 0 | No evidence. |
| Imp-N3 (Change community composition) | n - mod | 0 | No evidence. A population of *S. sisymbriifolium* being studied in South Africa was almost completely replaced by non-native *Acacia* species in just a few years (Hill and Hulley, 2000). "*S. sisymbriifolium* often behaves as a pioneer species, persisting for relatively short periods of time before being displaced by perennial weeds...and native plant species" (Byrne et al., 2002). Due to the ephemeral nature of this species, answering "no" with moderate uncertainty. |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| Imp-N4 (Is it likely to affect federal Threatened and Endangered species) | n - mod | 0 | This species mainly grows in disturbed areas such as "waste areas, roadsides, fence rows, and dykes" (Karaer and Kutbay, 2007), so it seems unlikely that *S. sisymbriifolium* would affect Threatened and Endangered species in natural areas. |
| Imp-N5 (Is it likely to affect any globally outstanding ecoregions) | n - mod | 0 | This species mainly grows in disturbed areas such as "waste areas, roadsides, fence rows, and dykes" (Karaer and Kutbay, 2007), so it seems unlikely that *S. sisymbriifolium* would invade globally outstanding ecoregions. |
| Imp-N6 (Weed status in natural systems) | a - mod | 0 | In Australia, *S. sisymbriifolium* occurs in "shrubby eucalypt woodland" but no information about impact was given in this reference (Bean, 2012). Because we found no information about *S. sisymbriifolium* causing any impacts in natural areas, we are answering "a" with moderate uncertainty. The alternate answers for the Monte Carlo simulation are both "b." |
| **Impact to Anthropogenic Systems (cities, suburbs, roadways)** | | | |
| Imp-A1 (Impacts human property, processes, civilization, or safety) | n - mod | 0 | No evidence. |
| Imp-A2 (Changes or limits recreational use of an area) | n - mod | 0 | No evidence. |
| Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation) | n - mod | 0 | No evidence. |
| Imp-A4 (Weed status in anthropogenic systems) | a - mod | 0 | Grows in disturbed areas such as "waste areas, roadsides, fence rows, and dykes" (Karaer and Kutbay, 2007) but no evidence that this species is perceived to be a weed in urban and suburban settings, so answering "a." The alternate answers for the Monte Carlo simulation are both "b." |
| **Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)** | | | |
| Imp-P1 (Reduces crop/product yield) | y - low | 0.4 | Vegetative plant parts are not desirable for consumption by animals because they are covered in prickles and spines (Karaer and Kutbay, 2007), so this plant reduces the carrying capacity of pastureland in South Africa (Byrne et al., 2002; King et al., 2011). |
| Imp-P2 (Lowers commodity value) | y - low | 0.2 | Reduces value of pastureland in South Africa (Byrne et al., 2002; King et al., 2011). |
| Imp-P3 (Is it likely to impact trade) | y - low | 0.2 | Regulated by South Africa and Namibia (APHIS, 2012) and contaminates hay seed (Bryson, 2011) so *S. sisymbriifolium* could impact trade activities. |
| Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water) | n - mod | 0 | No evidence. |
| Imp-P5 (Toxic to animals, including livestock/range animals and poultry) | ? - max | | Stem and leaves of *Solanum* species contain toxic compounds (Burrows and Tyrl, 2001). Listed as toxic by Randall (2012). However, fresh fruits are non-toxic and are consumed by the Chorote Indians of Argentina (Arenas and Scarpa, 2007). "[H]igh densities of glandular trichomes on the leaves which preclude adventitious attacks from...herbivorous insect species" (King et al., 2011). While the vegetative parts of this plant are toxic, it is not clear that they would be consumed by animals, so answering "unknown." |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| Imp-P6 (Weed status in production systems) | c - low | 0.6 | In South Africa, *Gratiana spadicea* tortoise beetles were released as biological control agents for *S. sisymbriifolium* (Hill and Hulley, 1995). Has "invaded good quality pasture lands and forestry firebreaks" in South Africa (Hill and Hulley, 1995). "[A] noxious invader of agricultural lands, fire breaks, and forestry plantations" in South Africa (Hill and Hulley, 2000). Listed as a weed of rice in India (Moody, 1989). Associated with cultivated crops (Hill and Hulley, 1995). Listed as a Watch List A plant (exotic plant species causing severe problems in surrounding states but not yet present in TN) by Tennessee (Bowen et al., 2002). "This species is considered as a threat for irrigated crops in Sardinia" (ISSG, 2012b). Alternate answers for the Monte Carlo simulation are both "b." |
| **Geographic Potential** | | | Below, p.s. refers to Point Source data (i.e., geo-referenced data points) and occ. refers to occurrence-only data (i.e., presence in a region). |
| **Plant cold hardiness zones** | | | |
| Geo-Z1 (Zone 1) | n - negl | N/A | No evidence. |
| Geo-Z2 (Zone 2) | n - negl | N/A | No evidence. |
| Geo-Z3 (Zone 3) | n - negl | N/A | No evidence. |
| Geo-Z4 (Zone 4) | n - low | N/A | No evidence. |
| Geo-Z5 (Zone 5) | y - low | N/A | New York (p.s. GBIF, 2012; Kartesz, 2012), Finland (p.s. Timmermans et al., 2009). |
| Geo-Z6 (Zone 6) | y - negl | N/A | South Korea (occur. ISSG, 2012b), Norway, Sweden (p.s. GBIF, 2012). |
| Geo-Z7 (Zone 7) | y - negl | N/A | South Korea (occur. ISSG, 2012b), Norway, Sweden (p.s. GBIF, 2012). |
| Geo-Z8 (Zone 8) | y - negl | N/A | South Africa, France, Ireland, Texas (p.s. GBIF, 2012). |
| Geo-Z9 (Zone 9) | y - negl | N/A | Chile, South Africa, Australia (p.s. GBIF, 2012). |
| Geo-Z10 (Zone 10) | y - negl | N/A | Argentina, South Africa, Australia (p.s. GBIF, 2012). |
| Geo-Z11 (Zone 11) | y - negl | N/A | Brazil (p.s. GBIF, 2012). |
| Geo-Z12 (Zone 12) | y - negl | N/A | Brazil (p.s. GBIF, 2012). |
| Geo-Z13 (Zone 13) | y - negl | N/A | Brazil (p.s. GBIF, 2012). |
| **Köppen-Geiger climate classes** | | | |
| Geo-C1 (Tropical rainforest) | y - negl | N/A | Brazil, Bolivia (p.s. GBIF, 2012). |
| Geo-C2 (Tropical savanna) | y - negl | N/A | Brazil, Bolivia, Benin (p.s. GBIF, 2012). |
| Geo-C3 (Steppe) | y - negl | N/A | Bolivia, South Africa (p.s. GBIF, 2012). |
| Geo-C4 (Desert) | n - low | N/A | No evidence. |
| Geo-C5 (Mediterranean) | y - negl | N/A | Oregon, Australia (p.s. GBIF, 2012). |
| Geo-C6 (Humid subtropical) | y - negl | N/A | Florida, Georgia, Argentina (p.s. GBIF, 2012). |
| Geo-C7 (Marine west coast) | y - negl | N/A | Bolivia, South Africa, France (p.s. GBIF, 2012). |
| Geo-C8 (Humid cont. warm sum.) | y - low | N/A | South Korea (occur. ISSG, 2012b). |
| Geo-C9 (Humid cont. cool sum.) | y - negl | N/A | Sweden, Norway (p.s. GBIF, 2012). |
| Geo-C10 (Subarctic) | y - mod | N/A | Grown in research plots in Finland (p.s. Timmermans et al., 2009), multiple naturalized points in Norway (p.s. GBIF, 2012). Using moderate uncertainty because Timmermans et al. (2009) say that *S. sisymbriifolium* is not well-adapted to this region. |
| Geo-C11 (Tundra) | n - mod | N/A | One point found in this climate type, occurring in Colombia (GBIF, |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| | | | 2012) but because we found no other evidence that *S. sisymbriifolium* grows in this climate type, answering "no" with moderate uncertainty. |
| Geo-C12 (Icecap) | n - low | N/A | No evidence. |
| **10-inch precipitation bands** | | | |
| Geo-R1 (0-10 inches; 0-25 cm) | n - mod | N/A | No evidence. |
| Geo-R2 (10-20 inches; 25-51 cm) | y - negl | N/A | Argentina, Bolivia (p.s. GBIF, 2012). |
| Geo-R3 (20-30 inches; 51-76 cm) | y - negl | N/A | Paraguay, Argentina, South Africa (p.s. GBIF, 2012). |
| Geo-R4 (30-40 inches; 76-102 cm) | y - negl | N/A | Brazil, Argentina, South Africa (p.s. GBIF, 2012). |
| Geo-R5 (40-50 inches; 102-127 cm) | y - negl | N/A | Brazil, Benin (p.s. GBIF, 2012). |
| Geo-R6 (50-60 inches; 127-152 cm) | y - negl | N/A | Florida, Georgia, Brazil (p.s. GBIF, 2012). |
| Geo-R7 (60-70 inches; 152-178 cm) | y - negl | N/A | Louisiana, Brazil (p.s. GBIF, 2012). |
| Geo-R8 (70-80 inches; 178-203 cm) | y - negl | N/A | Brazil (p.s. GBIF, 2012). |
| Geo-R9 (80-90 inches; 203-229 cm) | y - negl | N/A | Bolivia, Taiwan (p.s. GBIF, 2012). |
| Geo-R10 (90-100 inches; 229-254 cm) | n - high | N/A | No evidence. |
| Geo-R11 (100+ inches; 254+ cm)) | n - high | N/A | One point in Peru (GBIF, 2012), but because we found no other evidence that this species grows in this rainfall band or in the 90-100 inches of rainfall band, answering "no" with high uncertainty. |
| **Entry Potential** | | | |
| Ent-1 (Plant already here) | y - negl | 1 | Present in Alabama, Arizona, California, Delaware, Florida, Georgia, Iowa, Louisiana, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Oregon, Pennsylvania, South Carolina, and Texas (Kartesz, 2012). |
| Ent-2 (Plant proposed for entry, or entry is imminent ) | - | N/A | |
| Ent-3 (Human value & cultivation/trade status) | - | N/A | |
| Ent-4 (Entry as a contaminant) | | | |
| Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China ) | - | N/A | |
| Ent-4b (Contaminant of plant propagative material (except seeds)) | - | N/A | |
| Ent-4c (Contaminant of seeds for planting) | - | N/A | |
| Ent-4d (Contaminant of ballast water) | - | N/A | |
| Ent-4e (Contaminant of | - | N/A | |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| aquarium plants or other aquarium products) | | | |
| Ent-4f (Contaminant of landscape products) | - | N/A | |
| Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances) | - | N/A | |
| Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing) | - | N/A | |
| Ent-4i (Contaminant of some other pathway) | - | N/A | |
| Ent-5 (Likely to enter through natural dispersal) | - | N/A | |