Treatment Recommendations for Panicle Rice Mite (*Steneotarsonemus spinki*) by the Technical Working Group

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Options for handling infestations with *S. spinki* are outlined below. They include options for disinfesting greenhouse facilities, grain (rice for consumption), seed (rice for planting), and rice fields.

Infested Greenhouse:

1. Safeguard infested facilities by posting notices at entrances about the infestation. Restrict movement of personnel, plant material, and equipment into or out of the greenhouse. Access of personnel to infested greenhouses should be restricted, except if precautions are taken to prevent moving *S. spinki* outside of the infested greenhouse.
2. Seed may be harvested but must be treated according to instructions below for ***Seed (rice for planting, for either production or research use).***
3. After harvest, remove and dispose of harvested plant material, other than seed, by bagging and autoclaving, double bagging and deep burial, or by incineration.
4. Items in the infested greenhouse such as pots, tools, labcoats, etc. that may harbor *S. spinki* should be cleaned and disinfected to eliminate the mite.
5. Disinfest the entire facility by completing all of the steps in **ONE** of the following methods (A through C):

A. Plant free period:

1. Destroy, remove, and dispose of all plant material and potting medium in the infested greenhouse. Destroy, remove, and dispose of all plant material within 5 ft and all plant host plant material within a 25 ft buffer zone outside of the infested greenhouse.
2. Treat greenhouse with appropriate, labelled disinfectant.
3. Wait one month before planting hosts of *S. spinki* in these greenhouses to interrupt the life cycle of the mite and prevent re-infestation. During the waiting period, planting of non-infested dicotyledonous plants is permitted.
4. Continue safeguarding measures (see above: Infested Greenhouse steps 1-4) to prevent re-infestation.
5. Planting of hosts of *S. spinki* may resume after the one month waiting period.
6. Only treated seed (as outlined in this document) or seed that did not originate from an infested greenhouse can be used in the greenhouse to prevent re-infestation related to seed source.
7. Continued monitoring for the pest is recommended at the discretion of the greenhouse facility management.

B. Steam heat treatment (T408-f):

1. Destroy, remove, and dispose of all plant material and potting medium in the infested greenhouse. Destroy, remove, and dispose of all plant material within 5 ft and all plant host plant material within a 25 ft buffer zone outside of the infested greenhouse.

2. Continue safeguarding to prevent re-infestation.
3. Steam treatment can be used to treat infested surfaces and equipment in the greenhouse to provide quarantine security is T408-f.
4. Planting of hosts of *S. spinki* may resume after treatment as outlined in T408-f.
5. Only treated seed (as outlined in this document) or seed that did not originate from an infested greenhouse can be used in the greenhouse to prevent re-infestation related to seed source.
6. Continued monitoring for the pest is also recommended, at the discretion of the greenhouse facility management.

C. Methyl bromide treatment:

1. Destroy, remove, and dispose of all plant material and potting medium in the infested greenhouse. Destroy, remove, and dispose of all plant material within 5 ft and all plant host plant material within a 25 ft buffer zone outside of the infested greenhouse.
2. Continue safeguarding to prevent re-infestation.
3. Fumigate the greenhouse with methyl bromide to eliminate remaining mites in the structure. The methyl bromide treatment recommended to provide quarantine security is T403-e-1-1 (Table 1). The agency does not have any mortality data to reduce the exposure times listed on this treatment. Treatment rate is dependent upon temperatures during exposure. Treatment duration is 12 hours.
4. Planting of hosts of *S. spinki* may resume after the fumigation treatment has been completed.
5. Only treated seed (as outlined in this document) or seed that did not originate from an infested greenhouse can be used in the greenhouse to prevent re-infestation related to seed source.
6. Continued monitoring for the pest is also recommended, at the discretion of the greenhouse facility management.

Table 1: USDA APHIS PPQ Treatment T403-e-1-1: Methyl bromide ("Q" label only) at NAP (Normal atmospheric pressure) under tarpaulin

		Minimum concentration readings (ounces) at:		
Temperature	*Dosage rate (lb/ 1,000 ft^3)*	*0.5 hrs*	*2.0 hrs*	*12 hrs*
90ºF or above	2.5 lbs	30	20	15
80-89 ºF	3.5 lbs	42	30	20
70-79 ºF	4.5 lbs	54	40	25
60-69 ºF	6.0 lbs	72	50	30
50-59 ºF	7.5 lbs	90	60	35
40-49 ºF	9.0 lbs	108	70	40

Grain (rice for consumption):

1. Harvest grain from EAN fields. Implement safeguards for personnel working in the field and at the processor to minimize dispersal of mites. Sanitize harvesting equipment after EAN field harvest is completed or at the end of the work day, which ever is first.
2. Safeguard all aspects of transportation of grain.
3. Sanitize equipment used to transport, unload, and process the rice from infested fields. Sanitization should be by either high pressure washing or steam treatment (preferred).
4. Process the grain, including the hot air process, whereby the rough rice enters a concrete tumbler dryer which has hot air forced through it. Ideally, seed storage conditions should allow for seed to be maintained at a moisture content of 14% moisture or less. The temperature of seed is maintained at or near 100º F with humidity in the tumbler below 40% relative humidity (i.e. temperatures and relative humidity appropriate for commercial grain drying).
5. Hulls should not be introduced (e.g., spread as a mulch) back into the field. Dispose of rice hulls by deep burial at a minimum depth of six feet. Seed processing by-products must be safeguarded prior to and during transport for disposal.

Exposure to this level of heat for this time period is expected to kill any mites that are associated with the grain, and no further treatment of the processed grain or grain by-products is necessary. Processed grain and grain by-products will be sampled to confirm that hot air processing killed *S. spinki* from infested fields.

6. Sampling of processed grain and grain by-products harvested from each field:
    1. For grain:
        a. Randomly take 10- 50 g samples of processed grain to make up one approximately 500 g composite per field.
        b. Three sub-samples are drawn from these composites to confirm effectiveness of processing to kill *S. spinki* on harvested grain.
    2. For grain by-products (hulls, bran, and defective grains):
        a. Randomly take 10- 50 g samples of each by-product to create one 500 g composite of hulls, one 500 g composite of bran, and one 500 g composite of defective grains per field.
        b. Three sub-samples are drawn from these composites to confirm effectiveness of processing to kill *S. spinki* on grain by-products.

Seed (rice for planting, for either production or research use):

1. Harvest seed from the EAN fields. Implement safeguards for personnel working in the field and at the processor to minimize dispersal of mites.
2. Safeguard all aspects of transportation of seed.
3. Sanitize equipment used to transport, unload, and process the rice seed (if this equipment will be used again for non-infested grain or for seed). Sanitization should be by either high pressure washing or steam treatment (preferred)
4. Process the rice seed according to standard processing practices.
5. Treat seed (in individual, gas-permeable bags) by **ONE** of the following methods (A through D):

A. Phosphine treatment:

In recent efficacy trials, rice stems infested with live *S. spinki* were exposed to phosphine* at an initial dosage of 30-90g/1000 ft^3**,** at NAP (normal atmospheric pressure) in a chamber at > 83ºF for 72 hrs. To be effective, phosphine should be applied at a rate in the range of 750 to 2250 ppm/1000 ft^3 at the discretion of the fumigator dependent on the leakage of the fumigation structure. Treatment concentration readings should not fall below the minimum 350 ppm/1000 ft^3 over the 72 hours (readings should be taken at 24 48 and 72 hrs to document treatment).

No live mites were retrieved after phosphine treatment, nor were live mites detected after 6 days of incubation after treatment, indicating phosphine's effectiveness on adults, nymphs and eggs of *S. spinki*. Live mites were detected in untreated infested control stems up to 6 days after collection and initiation of experiments. The treatment would likely be similarly effective if used to treat infested rice seed, although experimental evidence for seed is not yet available. During fumigation, sacks of seed should be elevated off of the floor level and placed on pallets in a single layer to facilitate even application of the fumigant.

* The intent is to allow flexibility in the form of phosphine used for rice fumigation. Fumigators may use either the Aluminum or Magnesium forms of phosphine applied in gas, liquid or tablet form, as long as the guidelines for treatment outlined are met.

B. Methyl bromide treatment:

Rice stems infested with live *S. spinki* were treated with methyl bromide at 1.25 lbs /1000 ft^3, at NAP (normal atmospheric pressure) in a chamber, for 12 hours at > 80 ºF. Non-infested rice seed were exposed to each methyl bromide treatment to assess impact on germination. Germination tests resulted in a range from 1-82% with an overall average of 37% germination dependent on variety and % moisture of the seed. No live mites were retrieved after methyl bromide treatment or after 6 days of incubation after treatment, demonstrating methyl bromide's effectiveness on adults, nymphs and eggs of *S. spinki*. Live mites were detected in untreated infested control stems up to 6 days after collection and initiation of experiments. The treatment would likely be similarly effective if used to treat infested rice seed, although experimental evidence for seed is not yet available.

Methyl bromide treatment should be applied when the seed's moisture content is between 14.2% and 8.9% ensuring a germination rate of between 93% and 92%, respectively (see Table 2 for higher temperature recommendations and rates). During fumigation, sacks of seed should be elevated off of the floor level and placed on pallets in a single layer to facilitate even application of the fumigant.

Table 2: Methyl Bromide Fumigation of Rice Seed: Recommendations for Control of Insect Pests

		Minimum concentration readings (ounces) at:		
Temperature	*Dosage rate (lb/ 1,000 ft^3)*	*Duration*	*Seed moisture %*	*Germination %*

50ºF	5 lbs	12 hrs	17.0	9
50ºF	5 lbs	12 hrs	14.2	93
50ºF	5 lbs	12 hrs	8.9	92
51-65ºF	4 lbs	12 hrs	17.0	27
51-65ºF	4 lbs	12 hrs	14.2	95
51-65ºF	4 lbs	12 hrs	8.9	94
≥80ºF	1.25 lbs	12 hrs	---	80

In the interest of seed quality, the TQAU recommends all rice varieties be tested using the recommended Methyl Bromide treatments. Since these treatments have not been tested for *Steneotarsonemus spinki* Smiley, the TQAU does not accept legal responsibility for damage to rice seed or control failure resulting from the above recommended treatments.

C. Cold treatment: Rice stems infested with live *S. spinki* were treated at -8 º C for 72 hours. No live mites were retrieved after cold treatment or after 6 days of incubation after treatment, demonstrating the cold treatment's effectiveness on adults, nymphs and eggs of *S. spinki*. Live mites were detected in untreated infested control stems up to 6 days after collection and initiation of experiments. The treatment would likely be similarly effective if used to treat infested rice seed, although experimental evidence for seed is not yet available. This treatment would likely be most feasible for small scale seed treatment.

6. Processed seed will be sampled to confirm that the chosen treatment killed *S. spinki* from each of the infested fields.

Sampling of processed seed and seed by-products harvested from each field:

a. Randomly take 10- 50 g samples of processed seed to make up one approximately 500 g composite per field.

b. Three sub-samples are drawn from these composites to confirm effectiveness of processing to kill *S. spinki* on harvested seed and seed by-products

7. Implement safeguarding measures to prevent re-infestation of treated seed.
8. Ship seed as needed.
9. Dispose of seed processing by-products, including, but not limited to rice hulls, sweeps, broken and heavy grain by double bagging and deep burial, by bagging and autoclaving, or by incineration. Deep burial will be at a minimum depth of six feet. By-products of seed processing must be safeguarded prior to and during transport for disposal.

Fields (positive grain and seed fields)

1. Disk the stubble soon after harvest where the soil can be worked (Burning prior to disking is acceptable). Repeat disking at two-week intervals as needed to further break down stubble and kill volunteer plants and weeds.
2. Establish a host free area (buffer) at a minimum of 25 feet around the perimeter of each positive field, a greater distance is preferred when possible.

3. Control volunteer rice plants and alternate hosts (a list can be found in the New Pest Response Guidelines for *Steneotarsonemus spinki*) by applying an appropriate herbicide to the field and buffer area or by other mechanical means where chemicals are not permitted.
4. Ideally, do not plant rice after rice or use ratoon cropping.
5. Fields should be fallow and free of rice or alternate hosts of *S. spinki* for a minimum of 3 months. Rotate rice with a non-host crop, (*i.e.*, soybean, grain sorghum, etc.) or leave the field fallow for three months or longer. Scout fields at regular intervals during the fallow period to assure that no *S. spinki* hosts are growing.
6. Use appropriate sanitation for equipment used to harvest, till, etc. to prevent re-infestation of the crop. Sanitization should be by either high pressure washing or steam treatment (preferred). Also, personnel working in the field and at the processor should change their outer clothes* or spray themselves with 70% ethanol when working in areas/materials that were previously exposed to mites to minimize the potential of dispersal. Furthermore, workers should avoid entering "clean" fields (fields not known to contain *S. spinki*) once they have entered a greenhouse or field previously found positive for *S. spinki* without taking the appropriate safeguards.

*Clothes should be washed (hot water, long cycle >10 min.) after exposure to fields previously found positive for *S. spinki* before re-using them.

Prevention and Scouting:
Research facility employees or extension personnel should be aware of the mite and the symptoms it can cause on rice. Training materials should be designed for *S. spinki* early detection to be used at research facilities and in the field.