

PROTOCOLS FOR BROOMRAPE IMPACTED AREAS IN CALIFORNIA PROCESSING TOMATOES



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EXECUTIVE SUMMARY:

Both [Branched broomrape](#) and [Egyptian broomrape](#) have been found, reported, and positively identified in processing tomato fields in San Joaquin, Solano, and Yolo Counties in the last 10 years. Although the current known infestation includes 9 impacted growers in fields which total less than 1,000 acres, these growers account for ~16,000 tomato acres annually and delivered to a combined 10 processing tomato facilities in 2021. The industry as a whole and regulatory agencies (County Agricultural Commissioners, CDFA and USDA) consider these two species of broomrape to be a significant risk to the continued sustainable production of tomato products in California. They will continue to spread rapidly and unchecked without a robust plan for detection, reporting, sanitation, and control which is adopted by all parties within the industry.

WHY THIS MATTERS:

- Both species are registered as Federal Noxious Weeds, and both are Class A Pests in the State of California.
- In heavily infested areas, Branched broomrape can lead to a reduction in yield of up to 70% ([CDFA Pest Rating Profile](#)). The documented and expected yield losses associated with Egyptian broomrape, when seed banks are well established, is higher.
- The host range of these two species of broomrape is quite large, covering many economically important rotational row crops in the Central Valley of California, including but not limited to: tomato, pepper, carrot, potato, melons, and sunflowers.
- Both species are prolific seed producers (> 10,000 seeds per shoot) of very small seed which is easily transported on agricultural equipment and long lasting in the soil (documented 25 years +).
- Although broomrape has been found and reported across the acres described above we are at a low level of infestation today. The industry, working together, has the opportunity to severely limit the impact of these pests on additional operations, acres, and production regions if action is taken quickly to thwart its spread.

The below draft protocols are aimed at reducing the spread of these quarantine pests by providing guidelines around detection, reporting, delineation, sanitation, responsibility and vigilance which can be reviewed, referred to, and used as a baseline for action by all industry participants: growers, providers of contract operations in grower fields, processors, and trucking companies responsible for hauling harvested tomatoes from field to processing facility.

It is the expectation of those who have created this document that it be shared with those entities which growers or processors, respectively, partner with for operational activities in the field.

PROTOCOLS, IN BRIEF:

- **Detection and Reporting:**
 - In the case of a broomrape find, regardless of the individual who made the find, it is the responsibility of the Grower to report the find to the respective County Ag Commissioners office for regulatory action.
 - The grower should also report this find to all processors contracted to receive tomatoes from the impacted field and all growers managing adjacent properties (with current year tomatoes or other crop).
 - In addition, the team responsible for conducting in field research on broomrape in California should be contacted prior to field and broomrape burn down if the grower is interested in working with this group towards future solutions for these pests.
 - Finally, personnel not involved with delineation should be kept out of the field.
 - More information on detection and reporting can be found on pg. 5 of this document.
- **Delineation and harvest of delineated portions of impacted fields:**
 - The county Agricultural Commissioner's office will work with the Grower or Grower's Agents to provide possible partial delineation of fields, with a minimum buffer of 50 feet (to include the full length of all rows in the buffer area).
 - The process of delineation involves additional personnel and activity in and around impacted fields. These personnel must be trained and follow particular procedures associated with delineation.
 - More information on delineation can be found on pgs. 5-6 of this document.
 - If, through delineation, it is found that a portion of the impacted field is available for harvest, working with the Ag Commissioner in the respective County of the find, it is possible to harvest this portion of the field.
 - Any personnel associated with the harvest of a delineated portion of an impacted field must be trained and follow particular procedures associated with this harvest.
 - Any equipment (trucks, trailers, tractors, dollies, vine diverters, harvesters, personnel vehicles, etc.) utilized in the harvest of a delineated portion of an impacted field must follow stringent sanitation procedures associated with this harvest.
 - More information on the harvest of delineated fields can be found on pg. 7.
 - For the harvest of delineated portions of impacted fields processors will be responsible for ensuring that specific trucks and trailers are dedicated for this purpose and that the drivers of these vehicles be trained on the significance of these pests and the associated sanitation protocols.
 - More information on the trucking side of the harvest of delineated fields can be found on pg. 8.
 - Processing facility personnel associated with the acceptance of delivered loads of tomatoes from delineated portions of impacted fields should be trained on the significance of the issue and have protocols available to them for the management of these loads through the delivery, staging, unloading, sanitation, and reassignment process.

- More information on the processing facility side of the harvest of delineated fields can be found on pg. 8.
- **Cleaning and Disinfestation:**
 - All equipment moving within the infested field: service trucks, ranch trucks, field representative personnel vehicles, harvest personnel vehicles, tractors, trailers, harvesters, vine diverters, dollies, etc. must be cleaned and disinfected prior to leaving the field perimeter according to the procedures set forth in this document.
 - More information on cleaning and disinfestation can be found on pg. 7.
- **The Fate of Infested Fields:**
 - Host crops of broomrape (including tomato) must not be replanted in infested fields until these fields have been treated with methyl bromide and declared no longer under quarantine by the respective County Agricultural Commissioner.
 - More information on the reclamation of infested acres after quarantine can be found on pg. 9.
- **Areas Generally Impacted by Broomrape:**
 - For the purposes of this document, the “generally impacted area” is the area defined as fields which are not infested or known to be infested but which are in the same County as, or adjacent to a County or Counties which have reported finds in the prior 10 years – this would currently include Colusa, Sutter, Yolo, Solano, Sacramento, San Joaquin, Contra Costa, Alameda, and Stanislaus Counties.
 - It is important that growers and their personnel, processors, and allied industry follow heightened sanitation protocols in the areas generally impacted by broomrape. More information on these heightened protocols can be found on pgs. 10-13.

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IN THE CASE OF A BROOMRAPE FIND:

1. DETECTION & REPORTING:

- a. Grower or Grower's Agent will report the suspected find of broomrape to their respective county Agricultural Commissioner's office. The following should be done immediately following, and concurrently with reporting:
 - i. The Agricultural Commissioner's office will place the field under a regulatory hold and collect plant and seed samples from the impacted area to be analyzed at the CDFA Statewide Plant Pathology Laboratory.
 - ii. Pending positive confirmation from the CDFA Statewide Plant Pathology Laboratory the Agricultural Commissioner's office will include the field in its database of broomrape impacted areas and update its publicly available map of broomrape positive locations ([Yolo Counties public map is here](#)). If other counties begin to have broomrape reports they should build their own similar map. Once the Broomrape Control Program, under [AB 1620](#), is in effect this group will produce, publish, and maintain a multi-county map.
 - iii. All processors contracted to receive tomatoes from that field should be contacted by the Grower or Grower's Agent.
 - iv. Growers responsible for the management of all fields adjacent to the impacted field should be contacted by the Grower or Grower's Agent.
 - v. Signs must be placed around the perimeter of the field warning personnel to stay out.
 - vi. If Grower does not have internal cleaning and traceback procedures in place, these should be put in place immediately, by the Grower. See Section 4 for more details [here](#).
 - vii. Brad Hanson (Broomrape research lead out of UC Davis, 530-304-9528) or Zach Bagley (CTRI, 530-405-9469) should be contacted prior to field and broomrape burn down to inspect the field for determination of compatibility with future research plot needs and to conduct early detection research using aerial imagery.

2. DELINEATION:

- a. The county Agricultural Commissioner's office will work with the Grower or Grower's Agents to provide possible partial delineation of fields, with a minimum buffer of 50 feet (to include the full length of all rows in the buffer area). All delineated portions of the field, including the buffers, will be maintained under a regulatory hold. These areas must be conspicuously marked and all personnel and equipment must be kept from these areas.
- b. When delineation is being performed, the following procedures should be in place (See Figure 1 below):
 - i. All personnel entering the field must be trained in the identification of broomrape and instructed to flag and report the discovery of any additional plants outside of the established broomrape perimeter. These personnel should also be trained in the importance of sanitation.

- ii. A designated parking area must be established for vehicles of personnel working in or visiting the field. All vehicles should be parked at the exit side of the field, 30 feet or more from the field edge, and as far from the broomrape impacted areas as reasonably possible.
- iii. All personnel entering the field must wear disposable coveralls and shoe covers.
- iv. While scouting for broomrape plants in the field, walking in a "W" (or "M") pattern will provide a better detection rate. Assuming there will be multiple individuals performing this task, the field can be split into multiple "W"s or "M"s, with the pattern getting tighter as personnel get closer to the previously observed finds.
- v. Once delineation is complete, coveralls and boot covers must be disposed of within plastic bags at a designated location which is away from the field road.
- c. All portions of the field where broomrape has not been found, per the process described above, will be permitted to be harvested – as long as – the Grower abides by the procedures set forth in this document. If the Agricultural Commissioner's office is unavailable to provide certification of delineation prior to harvest, the Grower will self-certify the delineation.
- d. Grower or Grower's Agent should make and maintain a map of delineated areas.
- e. Once delineation is complete, the Grower or Grower's Agent must spray down the crop host and parasite within the delineated areas using a broad spectrum herbicide (glyphosate).

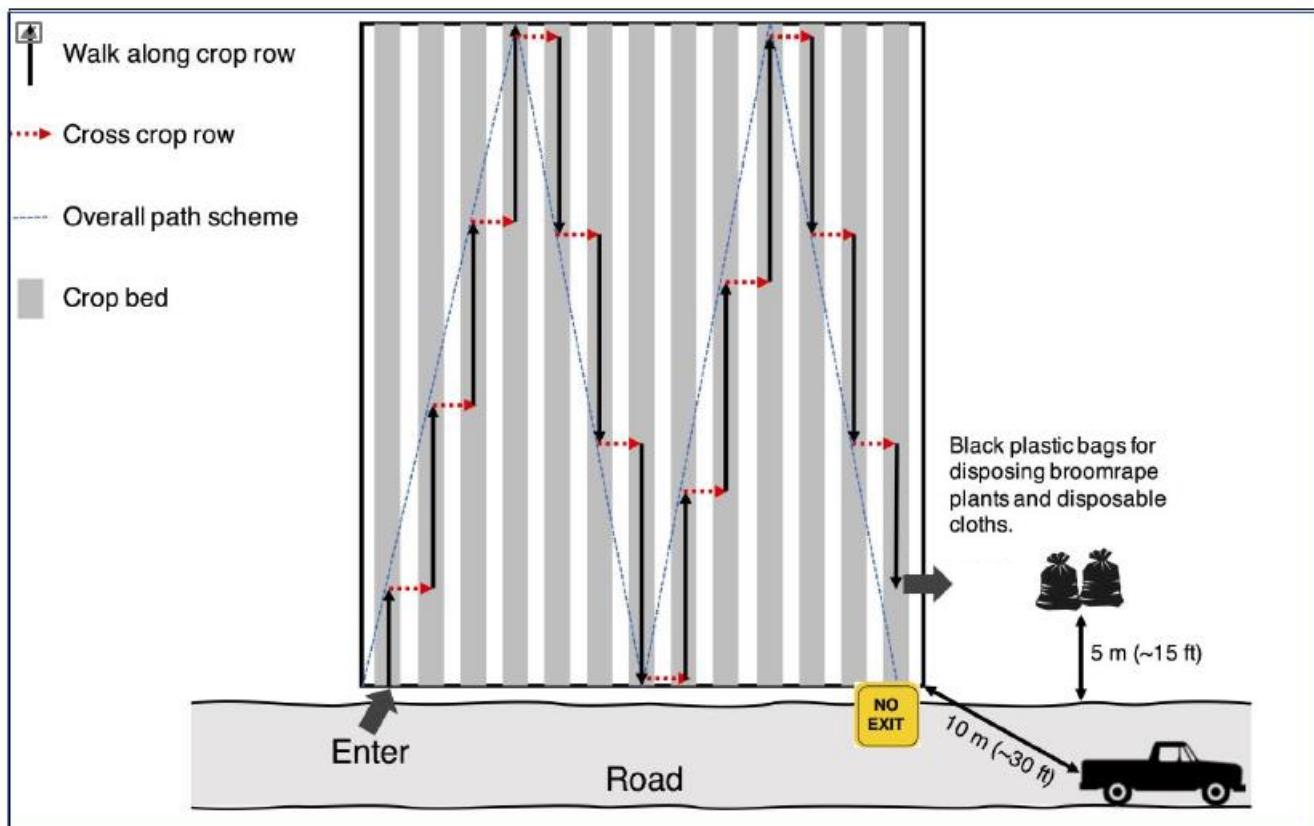


Figure 1: Schematic for scouting a broomrape infested field. Taken from the UCD Weed Science Group document, "Entering and Exiting a Field Infested with the Parasitic Weed, Broomrape".

3. HARVEST OF DELINEATED FIELDS:

- a. All personnel entering the field must be trained in the identification of broomrape and the importance of sanitation to insure no new plants are found outside of the delineated area and that no unintentional spread of seed happens during harvest due to personnel movement.
- b. The designated parking area established for delineation should be utilized for harvest.
- c. All personnel entering the field must wear disposable coveralls and shoe covers, to be disposed of prior to exiting the field, at the designated location described above.
- d. A designated area will be established to drop empty trailers and pick up loaded trailers on the field edge, of the impacted field. Loaded trailers are to be dropped in this area only and to be cleaned and disinfected (per Section 4) prior to leaving the field.
- e. Vehicles entering the field should be kept to a minimum. All vehicles including service trucks, ranch trucks, harvest personnel vehicles, etc. must be cleaned and disinfected (per Section 4) in the designated area described below before leaving the field perimeter.
- f. A designated area for equipment cleaning, within the field perimeter, should be assigned and solely utilized. This area will be an at risk location for future broomrape emergence and should be monitored carefully.
- g. Equipment must be either solely dedicated to and not removed from the field with the find, or if equipment is moved, decontamination of broomrape seed is required to leave the field.
- h. Upon completion of the field, all harvest equipment must be thoroughly cleaned and disinfected (per Section 4) within the designated area for equipment cleaning. This includes harvesters, tractors, dollies, and vine diverters.

4. CLEANING AND DISINFESTATION:

- a. All equipment moving within the infested field: service trucks, ranch trucks, field representative personnel vehicles, harvest personnel vehicles, tractors, trailers, harvesters, vine diverters, dollies, etc. must be cleaned and disinfected prior to leaving the field perimeter according to the following procedures:
 - i. A designated area for equipment cleaning, within the field perimeter, should be assigned and solely utilized. This area will be an at risk location for future broomrape emergence and should be monitored carefully.
 - ii. Soil and plant debris should be knocked off of all equipment using compressed air, scrapers, and pressure washers. This is the most important step in the cleaning process.
 - iii. If a pressure washer was unnecessary in debris removal or the surface is no longer wetted, the surface must be wetted down prior to application of the cleaning agent, quaternary ammonium.
 - iv. Quaternary ammonium, NOT BLEACH, is the cleaning agent which is proven to inhibit seed germination. Locally this can be bought under the labels: Clorox Pro Quaternary or MG 4-Quat. A solution of 1% is necessary for efficacy and should be used to spray down the equipment after soil and plant debris has been knocked

off and pressure washing is completed. To provide maximum germination inhibition washed equipment should be left to sun dry, not sprayed down with water or other cleaning agents. These quaternary ammonium products can be purchased at local farm supply outlets.

v. If seed is underneath soil or plant material no cleaning agent, including quaternary ammonium, will be effective in germination inhibition. No amount, or % of active ingredient, will make up for equipment which is not free of plant debris and soil.

5. **TRUCKING:** Although equipment (like harvesters) which collect significant volumes of plant debris and soil is of great concern for field to field spread, because of the distances traveled and the volume of traffic, trucks and trailers are also an important potential source of seed spread, particularly when operating in a field with known broomrape infestation.

- a. Processors will be responsible for ensuring that specific trucks and trailers are dedicated to the harvest of delineated, broomrape infested fields.
- b. Prior to being assigned to a delineated, broomrape infested field drivers will be notified of the problem and provided training on sanitation protocols.
- c. A designated area will be established to drop empty trailers and pick up loaded trailers on the field edge, of the impacted field.
- d. For movement outside of the truck, drivers must wear disposable shoe covers over their shoes. Drivers must remove disposable shoe covers before reentering cab and dispose of these in plastic garbage bags; which are to be sealed and disposed of.
- e. No detours are to be taken by drivers between delineated, broomrape infested fields and the processing facility.

6. **PROCESSING FACILITY:** Although equipment (like harvesters) which collect significant volumes of plant debris and soil is of great concern for field to field spread, because of the distances traveled and the volume of traffic, trucks and trailers are also an important potential source of seed spread, particularly when operating in a field with known broomrape infestation.

- a. Processing facility personnel, particularly those engaged in "Yard Management" should be trained in the following protocols and made aware of the significance of the issue.
- b. A designated area should be set aside and solely used for the staging of trailers arriving from broomrape infested fields.
- c. After unloading, and before returning to the field, trailers should submit to a cleaning and sanitation process consistent with Section 4 of this document.
- d. Trucks, after dropping full trailers, and before returning to the field, should submit to a cleaning and sanitation process consistent with Section 4 of this document.
- e. After delivery of the their last loads from the infested field both trailers and trucks should submit to a cleaning and sanitation process consistent with Section 4 of this document. Before being dispatched to fields which are not infested with broomrape these trucks and trailers should be inspected by Processing Facility personnel to ensure there is no dirt or plant material remaining.

7. THE FATE OF INFESTED FIELDS:

- a. Broomrape (both Egyptian and Branched) are quarantine pests under CDFA regulations. See [here](#) and [here](#), respectively. Under this designation, host crops of broomrape (including tomato) must not be replanted in infested fields until these fields have been treated with methyl bromide and declared no longer under quarantine by the respective County Agricultural Commissioner.
- b. Upon placing the field under a regulatory hold, the respective County Agricultural Commissioner will provide the impacted Grower with a letter describing the extent of the find and the regulatory constraints of that hold. This letter will include a list of host crops not to be planted and a list of crops which can be planted and harvested from the impacted field during the period of the hold. In general, crops which are available for planting include grass crops, alfalfa, and perennial crops (almond, pistachio, walnut).
- c. To reclaim acres after quarantine, and protect acres which are currently not affected, the industry (Growers, Processors and Allied Industry) should act swiftly to collect dollars for the hiring of a third party fumigation contractor to perform methyl bromide fumigation treatment on the currently impacted acres.
 - i. Tarping, fumigation and tarp removal will be completed by this contractor.
 - ii. The Grower will be responsible for field preparation prior to fumigation.
 - iii. After fumigation, processing tomatoes should be planted to determine the efficacy of the treatments. The procedures in Section 4 should continue to take place during this initial planting. Prior to harvest, responsible parties (Grower and respective County Agricultural Commissioner representative(s)), will meet to release the regulatory hold on the field, assuming no broomrape is found.

IN THE GENERALLY IMPACTED AREA (the area defined as fields which are not infested or known to be infested but which are in the same County as, or adjacent to a County or Counties which have reported finds in the prior 10 years – this would currently include Colusa, Sutter, Yolo, Solano, Sacramento, San Joaquin, Contra Costa, Alameda, and Stanislaus Counties):

1. GROWER RESPONSIBILITY:

- a. **Detection & Reporting:** All Grower personnel entering the field must be trained in the identification of broomrape and the importance of sanitation to insure capture of new infestations and that no unintentional spread of seed happens during routine field operations. If broomrape is detected by Grower or Grower personnel it is the responsibility of the Grower to report this find to their respective County Agricultural Commissioner.
- b. **Sanitation:**
 - i. All Grower personnel involved in field operations must be trained in the importance of sanitation to insure no unintentional spread of seed happens during routine field operations.
 - ii. As a precautionary measure the following procedures, at least points 1 and 2 below, will reduce the risk of spread, even for those Growers who currently do not have impacted fields. For those Grower's with a known infested field or fields it is recommended that the following procedures from Section 4 are followed when there is movement between fields, even with Grower owned equipment which is only used internally.
 1. A designated area for equipment cleaning, within each field perimeter, should be assigned and solely utilized. This area will be an at risk location for future pathogen and weed emergence and should be monitored carefully.
 2. Soil and plant debris should be knocked off of all equipment using compressed air, scrapers, and pressure washers. This is the most important step in the cleaning process.
 3. If a pressure washer was unnecessary in debris removal or the surface is no longer wetted, the surface must be wetted down prior to application of the cleaning agent, quaternary ammonium.
 4. Quaternary ammonium, NOT BLEACH, is the cleaning agent which is proven to inhibit seed germination. Locally this can be bought under the labels: Clorox Pro Quaternary or MG 4-Quat. A solution of 1% is necessary for efficacy and should be used to spray down the equipment after soil and plant debris has been knocked off and pressure washing is completed. To provide maximum germination inhibition washed equipment should be left to sun dry, not sprayed down with water or other cleaning agents. These quaternary ammonium products can be purchased at local farm supply outlets.

5. If seed is underneath soil or plant material no cleaning agent, including quaternary ammonium, will be effective in germination inhibition. No amount, or % of active ingredient, will make up for equipment which is not free of plant debris and soil.

2. PROCESSOR RESPONSIBILITY:

- a. **Detection & Reporting:** All Processor personnel entering fields must be trained in the identification of broomrape. If broomrape is detected by Processor personnel it is the responsibility of these individuals to report this finding directly to the Grower.
- b. **Sanitation:**
 - i. All Processor, or processor contracted, personnel (including Field Representatives and Truck Drivers) entering fields must be trained in the importance of sanitation to insure no unintentional spread of seed happens during routine operations.
 - ii. Because Processor personnel are moving between grower fields these personnel should take the following precautions when moving from one grower field to the next:
 1. All personnel entering the field should wear disposable shoe covers, to be changed between separate Grower operations. Shoe covers should be taken off before re-entering vehicles and disposed of in plastic bags.
 2. Field vehicles should be washed regularly and effort taken to reduce the amount of soil and plant debris accumulated and transported from one field to the next. After washing, while vehicle is still wetted, a solution of 1% of quaternary ammonium should be applied to the wheels, wheel well, and underside of the vehicle.
 - iii. All trucks and trailers delivering loads from the generally impacted area, before returning to the field, should submit to a cleaning and sanitation process consistent with Section 4, points ii – v of this document.
 - iv. If deliveries are being accepted from both impacted and non-impacted areas effort should be taken to not intermingle trucks and trailers.

3. ALLIED INDUSTRY FIELD REPRESENTATIVE RESPONSIBILITY:

- a. **Detection & Reporting:** All representatives of allied industry entering fields must be trained in the identification of broomrape. If broomrape is detected by allied industry personnel it is the responsibility of these individuals to report this finding directly to the Grower.
- b. **Sanitation:**
 - i. All allied industry, or allied industry contracted personnel entering fields must be trained in the importance of sanitation to insure no unintentional spread of seed happens during routine operations.

- ii. Because allied industry personnel are moving between grower fields these personnel should take the following precautions when moving from one grower field to the next:
 - 1. All personnel entering the field should wear disposable shoe covers, to be changed between separate Grower operations. Shoe covers should be taken off before re-entering vehicles and disposed of in plastic bags.
 - 2. Field vehicles should be washed regularly and effort taken to reduce the amount of soil and plant debris accumulated and transported from one field to the next. After washing, while vehicle is still wetted, a solution of 1% of quaternary ammonium should be applied to the wheels, wheel well, and underside of the vehicle.

4. CONTRACT OPERATIONS (TRANSPLANTING, HARVEST, CROP PROTECTION OR FERTILITY PRODUCT APPLICATORS, ETC.) RESPONSIBILITY:

- a. **Detection & Reporting:** All contract operations representatives entering fields must be trained in the identification of broomrape. If broomrape is detected by allied industry personnel it is the responsibility of these individuals to report this finding directly to the Grower.
- b. **Sanitation:**
 - i. All contract operations personnel entering fields must be trained in the importance of sanitation to insure no unintentional spread of seed happens during routine operations.
 - ii. Because contract operations personnel are moving between grower fields these personnel should take the following precautions when moving from one grower field to the next:
 - 1. All personnel entering the field should wear disposable shoe covers, to be changed between separate Grower operations. Shoe covers should be taken off before re-entering vehicles and disposed of in plastic bags.
 - 2. Field vehicles should be washed regularly and effort taken to reduce the amount of soil and plant debris accumulated and transported from one field to the next. After washing, while vehicle is still wetted, a solution of 1% of quaternary ammonium should be applied to the wheels, wheel well, and underside of the vehicle.
 - iii. All equipment moving from one Grower operation to the next: service trucks, field personnel vehicles, transplanters, tractors, water trucks, spray rigs, trailers, harvesters, vine diverters, dollies, etc. should be cleaned and disinfected prior to moving from one Grower's operation and going to the next, according to the following procedures. If requested by Grower, contract operations should perform the below between fields within the Grower's operation.
 - 1. A designated area for equipment cleaning, within that Grower's management area, should be assigned and solely utilized.

2. Soil and plant debris should be knocked off of all equipment using compressed air, scrapers, and pressure washers. This is the most important step in the cleaning process.
3. If a pressure washer was unnecessary in debris removal or the surface is no longer wetted, the surface must be wetted down prior to application of the cleaning agent, quaternary ammonium.
4. Quaternary ammonium, NOT BLEACH, is the cleaning agent which is proven to inhibit seed germination. Locally this can be bought under the labels: Clorox Pro Quaternary or MG 4-Quat. A solution of 1% is necessary for efficacy and should be used to spray down the equipment after soil and plant debris has been knocked off and pressure washing is completed. To provide maximum germination inhibition washed equipment should be left to sun dry, not sprayed down with water or other cleaning agents. These quaternary ammonium products can be purchased at local farm supply outlets.
5. If seed is underneath soil or plant material no cleaning agent, including quaternary ammonium, will be effective in germination inhibition. No amount, or % of active ingredient, will make up for equipment which is not free of plant debris and soil.