

HERBICIDE DAMAGE

Compiled by

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Since 2008 there have been many questions about herbicide plant damage submitted to the UC Weed Workgroup through ANR Collaborative Tools. Within the Weed Workgroup there are numerous experts who have lent their expertise identifying the damage with a high rate of success!

This document is a compilation of those photographs and conversations to help future efforts. The plants in this document are not in any particular order, but the document is fully searchable. Plants damaged or injured include: onions, strawberries, tomatoes, almonds, peppers, cabbage, spinach, mustard, lettuce, elderberries, and grass seedlings.

While often our experts are able to identify injury with one fuzzy photograph, the more detail and description provided only helps the process! An additional benefit of adding more details and photos is that it provides an excellent learning opportunity for others who are following the discussion in Collaborative Tools.

Suggestions for adding to the discussion:

- Details which help with an accurate identification:
 - Where is it growing? (ecotype, crop type, moisture, soil type, aspect)
 - Is it growing in a particular location in California? (desert, mountain, water)
 - How big is the plant, and how big are the leaves? (scale)
 - Are there any special attributes of the plant?
 - Why do you need to know what caused the damage?

- Photo Tips: When taking photos, the quality and quantity of photos matters. It is important to take clear photos on a good background that provide details of all plant parts available (flowers, stems, leaves, roots, fruits, old plant skeletons). When possible, it is also important to provide a picture of the habitat. One way to obtain clear images in the field is to face away from the sun, and hold the plant up in the sky. Pictures with a cell phone often come out very clearly and in focus. When plant samples are brought to the office and photographs are taken indoors, using a solid background (paper/posterboard) can help provide a good image.

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Elderberry Injury - I had a befuddling farm call last week to look at an established elderberry on the farm edge, along a water canal. It is the only elderberry, of several scattered along the canal edge, with these symptoms. Overall, the tree appearance is 'wilting', but the leaf symptoms and new (but some old) growth is unusual. The leaf margins are wavy, when they should be smooth, and the new growth could be described as epinastic. Please see the photos. The canal had recently been sprayed by the county using a mixture of Round Up and Garlon 3A. The symptoms are on all sides of the tree, not just the canal edge. Could herbicide toxicity cause those types of symptoms? Insects are another possibility, but I couldn't find significant evidence of insect presence.

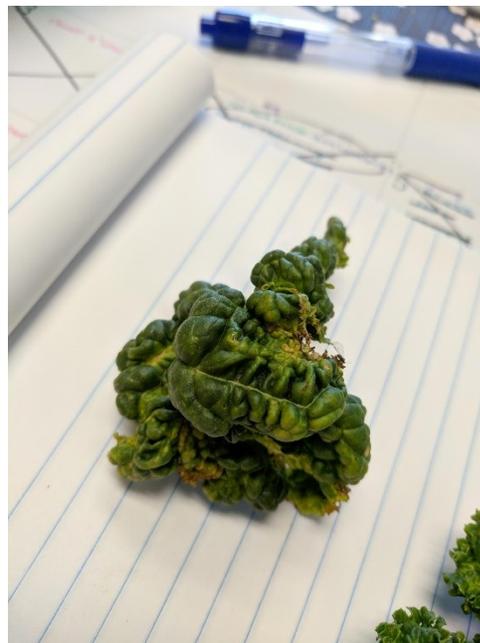
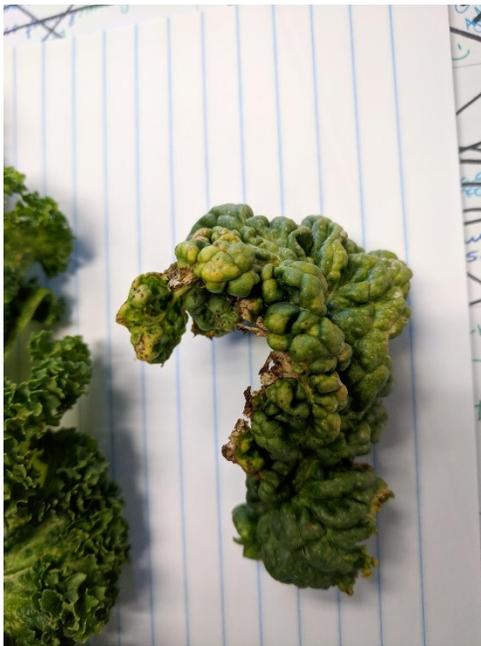
Answer: The symptoms are good fit with Garlon injury, although I have not witnessed such a substantial change in leaf margin. (6/12/2018)

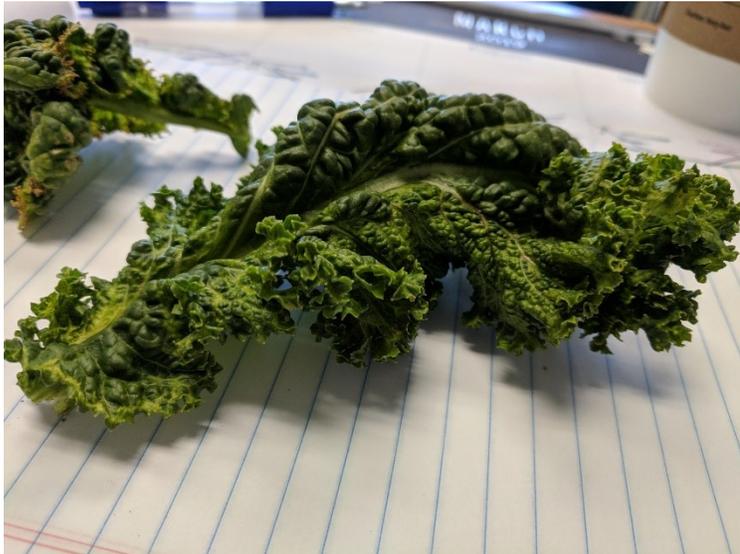




Mustard Injury - I need help figuring out what is going on with this mustard plant sample. The entire 10-acre field is affected (according to the PCA). The radish next to it tested positive for cucumber mosaic virus but only a few plants were affected and the symptoms were different than on the mustard. A pre-emergent herbicide was applied, the PCA could not remember which one and will get back to me after checking his notes. There has been a lot of water logging in the field too. I am trying to determine if it is an abiotic or biotic problem. Because the entire field looks like this, I am hesitant that it is an insect-vectored virus. This is a field in Colusa County and the mustard is being grown for seed.

Answer: We grow quite a bit of curled leaf kale in Monterey County. I have not seen this problem. At first glance, the symptoms look viral. Water logging would show up as yellowing/purpling on the older leaves. These leaves have mottling and distortion. Cassandra will be able to test for the common viruses. You can also get agdia strips. Now that Steve Koike has retired, I have a supply of CMV, TSWV, INSV and Potyvirus strips on hand for this type of situation.





Grass Seedling Injury - Trying to figure out what could have caused these symptoms. We're looking at cool-season grasses that were seeded mid-October in a golf course rough/naturalized area. The only herbicide applied to the area before seeding was glyphosate. However, on other parts of the golf course, and with the same spray rig, prodiamine (Barricade), dithiopyr (Dimension), and indaziflam (Specticle) have been applied in the last 9 months. I suspect the tank may have been contaminated when glyphosate was applied just prior to seeding. I dug through our Herbicide Symptom tool and found similar symptoms on corn + dinitroanilines, so I assume it's the prodiamine. Note, some pictures include unaffected seedlings for comparison.

Answer: The bulbous swelling near the root tips looks like classic mitotic inhibitor symptoms. You probably saw symptoms online of trifluralin symptoms on corn. I agree probably the prodiamine. Also consider the dithiopyr as a possible culprit as it also causes mitotic disruption. Either way, you can do a quick assay with the affected soil vs. untreated soil and some seeds to see if the herbicide is still around and make a decision about reseeding. (12/1/2017)





Spinach Injury - I looked at spinach planting (3 ages) that seem to have herbicide injury and my guess would be PPO herbicide like oxyfluorfen. Possibly it was applied to nearby ditch and drifted or/and co-distilled. In a non-sprayed part of the ditch there are weeds without symptoms and the nearby spinach looks ok. There are no broadleaf weeds in the ditch adjacent to injured spinach (I found just one lambsquarter with similar damage). If you have a suggestion based on what you see on images, I would appreciate your opinion.

Answer: Here's a link to some discussion about a similar problem in 2013:
https://ucanr.edu/collaborate/posts_reader.cfm?threadnum=34958&cluster=6191

At that time, we thought it might be flumioxazin moving on dust off a nearby road coincidentally, onto spinach and lambsquarters). There are a few photos in that link but they are a lot less dramatic than yours which makes me think your case is more likely direct drift. It does look like PPO herbicide damage to me. If so, they should grow out of it since it looks relatively minor. (7/27/2015)





Cabbage Injury - Cabbage transplants were planted at a site that had been a nursery some time ago. The attached photos show symptoms on the cabbage.

Answer: I sent samples of excised tissue to Columbia Food Labs in Portland, OR. They have a "multi residue screen" that they run (\$300) and it showed that Arsenal residues were present. The symptoms seem to fit pretty with what we would expect from Arsenal on a *Brassica*. The growing point was severely stunted and turning necrotic which is the tissue affected by this herbicide. (6/29/2017)



Pepper Injury - I walked through a pepper field that has about a 10-15 acre block with 60-70 % injury and will likely be plowed down. It has no reasonable pattern. I think it is phytotoxicity since the weeds are dead in the affected zones too but thrive (nightshades, purslane, nettle) in zones where peppers are unaffected. I looked at potential spray patterns, drifts, co-distillation in that field and those all looked highly unlikely since there are several random areas with decline (and healthy plants in the middle of them sporadically). I think it was uptake from unevenly distributed soil. I have seen that with chlorides and that was my first guess, but will need to get test result (Sat paste EC looked high – 3- 3.5dS/m) but, of course, I had to also ask about herbicide history. They applied glyphosate 1-2 days prior to transplanting and the first 2 weeks of growth were fine. In the past they used oxyfluorfen in that field. The grower does in-house sprays and is certain there is no residue in tank and they used different rig for flumioxazin and other herbicides. The images show the dark lesions on stem and lack of new root development and, marginal leaf necrosis, upon closer inspection. Aside from testing for specific ions in soil, perhaps I can consider testing for oxyfluorfen, but the symptoms do not seem to support this.

Answer: Do you have information about fertilizer use, especially N? It doesn't look like herbicide and the pattern seems odd for a herbicide. Another thing to consider is airborne Phytophthora. I've seen similar symptoms years ago from sprinkler irrigation that was contaminated with the fungus; you get unusual foliar and stem lesions because the fungus is being delivered onto foliage by the water. That possibility could explain the pattern. I think tests for salt and specific ions is a good way to go and hopefully will shed some light on this situation. A couple of issues to be watching for: botrytis coming in with the transplants can cause issues on the tops, but it usually does its worst pretty early in the growth cycle (these plants look older). The other issue is physical damage from handling the transplants. Where the workers grab the plant you can get damage there that can really set the plants back. I cannot tell from the photo if that is a factor, but again, it seems a bit unlikely given the extensive nature of the issue.(6/4/2014)





Almond Injury - A PCA contacted me about odd symptoms that started with a few dying trees on the edge of an orchard. At first, they suspected drift or a misapplication from a roadside or canal bank weed control operation. Over a few weeks, the number of injured trees kept growing and expanding into a circular or semi-circular pattern into the orchard. The PCA decided to send some soil samples to look for a couple herbicides and finally noticed a "sewer gas" odor while digging into the root zone. That triggered the memory that a gas line had been put through that orchard several years earlier.

Answer: PGE was called and found the slow leak right away and it was a natural gas injury. Additionally: (1) Some colleagues down in OC and I were asked about a front yard where all of the grass and some trees mysteriously died very quickly. It was interesting to hear the ideas - the plant pathologist thought it was root disease, the horticulturist thought it was waterlogging, I (the herbicidist) thought it was a bad herbicide missapplication. Turns out that it was also a gas leak. Go figure. (2) I saw something very similar about 25 years ago in Bakersfield. The only difference was the soil was very black. Our digging in the soil was very helpful to finding the cause. (6/28/2012)





Tomato Injury - I looked at a tomato field today that has plants with severe leaf curling and cupping, and, at times deformation of leaves. In general, there is a pattern with greatest injury at edge of the field but at a couple areas in the center the symptoms will appear in 1-2 sections of the row. Overall, about 3-5 acres are affected for one of the main tomato producers in the county.

Just to be sure, I'll send the plants to test for viruses but the grower thinks it is a herbicide damage from the ditches that have been sprayed nearby by PCA company. He even sent a plant sample to Primus lab testing for glyphosate but they did not recover it. This story makes sense to me since the injury does not look like Roundup but there is severity gradient from field edges towards the center. The grower attributes the couple field center areas that have injury symptoms to plants being over-sprayed while still in trays sitting on field edge. I do not have an access to the NOI from the PCA company but with *Conyza spp.* resistance to glyphosate that we have they may have added other modes of action to the mix. Do they use 2,4 and oxyfluorfen in to manage those in the Central Valley? I haven't seen what injury these herbicides will do to tomato but leaf cupping does happen in Cole crops with GoalTender. All the weeds in the field and ditches are controlled (except nutsedge and some flowering mustards).

Answer: It looks like a pretty definite case of phenoxy herbicide. If they were spraying *Conyza* on the ditch; they might have been using triclopyr (Garlon) or aminopyralid (Milestone), both of which can cause these types of symptoms. It might be glyphosate, it sometimes produces similar symptoms, but I strongly doubt it. I would expect more spotting or necrosis if it was Goal but I would also expect some stem cracking or callous and petiole epinasty from 2,4-D and similar herbicides. I agree that it's not likely from glyphosate. I wouldn't really expect to much 2,4-D or oxyfluorfen to be applied to ditchbanks this time of year due to either cost (Goal) or drift potential (2,4-D) but I don't know about Milestone. (6/26/2012)



Another Tomato Injury - Today I have observed what looks like another herbicide injury in tomato this year here. This affects close to 100 acres and is scarily uniform, with no pattern of drift or movement clearly identifiable. The larger/older planting looks fine but the intermediate one has all the tops affected (top 1-2 ft. of canopy) with twisting and cupping, as with phenoxy herbicides. The youngest planting has the same symptoms and most likely will not make it. PCA and I looked for potential sources of the problem. Creek with riparian area is full of healthy weeds, raspberry nearby has occasional new runners with symptoms but generally under plastic hoop cover canes look healthy. The nearest suspect is a field of sweet corn about 0.25 miles away from one affected tomato field and about $\frac{3}{4}$ miles from the other. Can it potentially be such a distant effect from an auxin?

Answer: (1) Looks like phenoxy herbicides. Any potential for herbicide contamination from composts that were applied to the field before planting? The symptoms look very much like a plant growth regulator. We have received samples that look just like this from home owners that purchased compost/topsoil. I am running pot tests in the greenhouse with and without activated charcoal to see if it was contaminated with a phenoxy herbicide. It would be good to do a tissue test for residue, but they should use a good lab that can go to very low concentrations, as we had a similar issue in Hollister this year on peppers and the lab results came back negative even though the symptoms were very clear for a phenoxy of some sort. I think the level of residues that can cause these types of symptoms must be very low. (2) It appears to be injury from some sort of auxinic herbicide. The amount of swelling at the nodes and twisting seems a bit less than normal. I have seen phenoxy herbicides drift for more than 2 miles, so 0.25 miles is not out of the range. If something was sprayed on the corn, the broadleaf weeds would also show symptoms. They should have also received a Restricted use permit to use a phenoxy, assuming a legal application. The fact that it is uniform over the whole field makes me wonder if they had some miss-application of something - treated with the wrong material. Have they made any applications of anything to this field prior to the symptoms appearing? How large are these fields? Could there have been something left in the tank from a previous application? (9/4/2012)



Strawberry Injury - A strawberry grower in Castroville (northern Monterey County), contacted me with the complaint that strawberries in one area of her ranch were doing very poorly. As you can see from the attached photos, the area of poor performance manifests itself as a large yellow patch, with some OK looking plants dispersed within. Other growers report having seen the same problem in the same field with strawberries seven years ago, and in every strawberry crop since. Interestingly, the previous year's (2006) lettuce crop showed no signs of debilitation. My question to this group is if this problem could be long term carryover of an herbicide?

Answer: Given the length of time that this problem has been ongoing it seems very unlikely for any of the residual herbicides that may have been used in this type of situation (i.e. Karmex and Goal). I would take a look at the pH of the soil to see if there is not something out of the norm there. Herbicide carryover injury will usually be in a pattern related to how it was applied in the previous crop; ie. strips or rectangular areas; not a patch with an irregular boundary. I would look at disease, micronutrient, or left-over crop residue. It looks like some sort of inner veinal chlorosis similar to that of the triazines. However, I think we would see some marginal burn of the older leaves? I would look into sandy streaks, micronutrients, disease, stress, or some other factor as the cause(s). (5/17/2007)





Onion Herbicide Injury - Onions exhibiting a poor stand and curling leaves. Goal was applied, and may have been applied too early? Any thoughts?

Answer: Sure looks like classic Goal injury on onion. Injury to one side of the leaf which causes curling. Cool conditions this spring may have increased injury due to slow recovery. The leaves look thickened and shortened in the photo. I'm also wondering if there was some Buctril added to cause some of the tip curling or "pig tailing". I also saw onions similar to this in 2004 that were treated with Goal and Buctril at the 2-leaf stage, then a neighbor drifted Roundup across part of the field, giving the onions a severely stunted appearance. In that case, about 40% of the onions eventually died and the rest were severely stunted like these. Also, I did see some bulb swelling (larger than what would be considered normal) in those plants, which I don't see here. Do you know what was in the field before the onions? corn, beans or tomatoes by chance?- could it be metolachlor carryover? In response to the question about the onion field history: The previous crop was lettuce to which Kerb (propyzamide) was applied (plant-back restrictions were observed). The onion roots, basal plate and bulb all look normal. The damage is more severe in one half of the field that has lighter soil, so I was initially thinking it might have been carryover from the previous crop. Also, the stand is poor- the plants died after coming up. The distribution could also reflect drift from a broccoli field across the road but they say nothing was applied to that field. Also, I found out that Buctril was combined with the Goal application to the young onions (they hadn't mentioned Buctril before). (5/29/2007)



Lettuce Injury - I visited a field yesterday where some lettuce along the edge of the field got a bit of overspray of glyphosate from a spray job on an adjacent ditch. The tops of the plants had classic yellowing and dieback. However, we noticed also that the tips of the roots were dying on some plants (see photo). We do have a pathogen on lettuce, *Pythium* wilt, that can cause the same type of symptom and I have sent samples in to see if that might be the rotting organism. The question I have for the group is, does glyphosate cause the roots tips to also die as the tops of the plants decline? I have never heard any discussion of that effect on plants treated with glyphosate. The other question that I am wondering, is the stress that the herbicide is causing on the lettuce plant making it more susceptible to *Pythium* - very interesting. Hopefully the lab analysis will shed some light on that question. In the meantime, I like to get your input on the effect of glyphosate on plant roots. Thank you.

Answers: (1) Glyphosate translocation "primarily translocates in the symplast with accumulation in underground tissues." So, it appears yes it can damage roots. Glyphosate is moving in the phloem from the leaves along with the sugars that the roots need to grow. (2) While glyphosate translocates to roots, its action is not in the root. Glyphosate inhibits EPSPS that existed only in the chloroplast. Inhibition of EPSPS will lead to inhibition of shikimate pathway and that reduces carbohydrate and metabolites translocation to the roots. Consequently, it may make roots more vulnerable to *pythium* and other soilborne diseases. It has indirect effect but the outcome is the same. The reason we apply glyphosate on perennial weeds at booting or flowering stage is to kill green foliage and also allows glyphosate to move to underground parts. It is not going to kill underground part but when plant regrows again from underground part, glyphosate will come up with new growth killing or inhibiting the new growth. It is difficult to control fieldbind weed with glyphosate. Most the time we mix 2,4-D to get better activity. Another good herbicide on field bindweed is quinclorac. Sometimes you find quinclorac in department stores to control weeds in turf. I do not think quinclorac is registered in California for other uses.

