

Introduction

I posted this issue originally on NZ Organic Gardening Facebook page to get some peer feedback, and haven't now decided to repost my experiences and findings to as many gardening forums as I can in an effort to educate and spare fellow growers failed crops.

This is intended to be an **informative warning** to gardeners about the possibilities of herbicide residues in composts and garden mixes that could negatively affect their vegetable crops.

My sob story

I am heartbroken.

- 120 heirloom tomato seedlings, each a different variety, for my own growing this year ... damaged!
- Over 150 extra heirloom tomato seedlings, again different varieties, for on-selling this year ... damaged!
- Approximately 7 cubic meters of garden soil for my new potager garden ... useless for tomatoes, peppers and chillies, potatoes, beans, broad beans, peas, sunflowers and more.



And not the least, the emotional upset, and yes, it's as important as the physical damage, this has caused me... This was going to be **THE** year, you know... my first year in my first OWN HOME, and my OWN GARDEN, and at that, an acre homestead too!

When all my lifelong dreams came true and we drove into our just-bought home in May this year, I had starry eyed dreams of all the produce I'd be able to grow, and preserve, and give away, and save seed from...

For those of you who know me and have followed my journey, you know how much growing food and medicine plants mean to me. This is not just my hobby, nor simply my day job, or my stay at home side hustle, this is my calling, my *ikigai*.

And I'm rather good at it too – doing talks, running workshops, and writing articles to inspire others to find the joy in soulful gardening.



Besides the hundreds of species of herbs and edible flowers I grow, and other vegetables to feed my family, as a member of the #CrazyTomatoClan, I envisioned baskets brimming with colourful heirloom tomatoes of all shapes and sizes (I have to date collected seeds of over 200 varieties of tomatoes), and chillies (seeds of over 120 different varieties) to excite every connoisseur.

Some of my 2017 summer harvest

I was going to name our farmlet “Abundance”, as that is what I foresaw for our family – finally being able to start living self-sufficientish from the land. The “good” dream.

The problem

But on Monday, I had quite a harsh wake-up call.

I noticed a week ago that after transplanting (potting on into brand new and clean PB2 bags and 20cm pots) that my homegrown, spray-free heirloom tomato seedlings, which I had grown from seed, and cared for daily, for months, had become a bit stunted in growth, with distorted new leaves and in general just not looking as flash as I’m used to tomato plants to look like at this stage.



“Shepherd’s crook” twisted apical meristem growth; contorted and misshapen leaves



Please note I’m a very well experienced home gardener, small home nursery owner, qualified horticulturist and hobby herbologist, and have been growing heirloom tomato plants for home use and for selling for many years - with customers always commenting on my outstanding stock... so I’m not a novice at growing tomatoes.

Me during a talk - notice the super healthy tomato plants!

Reasons for tomatoes to have leaf curl or misshapen leaves

I started doing research, ruling out all the obvious reasons for leaf curl and misshapen leaves:

1. Physiological damage due to watering issues

While overwatering or underwatering is probably the number one cause of leaf curl in tomatoes, the curl that watering issues cause looks a bit different to what I was seeing. Besides, they're in a controlled environment (out of the rain).

2. Physiological damage due to fluctuating temperatures

This had me wondering for a while as I'm only starting my first season in Canterbury, having lived in Auckland the previous 6 years. Still, climate didn't quite answer the issue, as only transplanted seedlings were affected, not the ones still in seedling trays (in the exact same environment).

3. Insect infestation (including big mite)

While I found an aphid or two on nearby plants, it was nothing I'd call an infestation, and the tomatoes had no visible insects at all. Not even with a really strong magnifying lens (I could see the stomata of the leaves, so I'm sure I'd have noticed even a tiny mite).

4. Viral infection

A definite possibility. If it was only one or two plants, and if I could see other signs of viral damage like necrosis of the leaves or discoloration, I'd have definitely put it down to viral. But each and every one of the transplanted seedlings were affected to some extent – spreading a large range of different cultivars, and from different seed suppliers. Also, as I said, no visible insects about that could have spread virus or disease. And again, only the transplanted tomatoes were affected, not the seedlings in trays still.

Herbicide Damage

The only thing left to me to check on was herbicide damage.



I decided to look into herbicide damage after remembering someone on Facebook mention it when I was bemoaning the terrible growth of my broad beans at the time. (Had I only listened more closely to that person all those weeks ago...) I went back to read the thread and saw them mentioning a particular herbicide, clopyralid, so I did some online and library research, comparing my contorted tomato leaves against known damage to tomatoes from clopyralid damage, and lo and behold, it was the same. I actually even found a New Zealand article showing how tomato seedlings are used as an indicator plant for soils that may be contaminated with clopyralid herbicide.

Pyridine carboxylic acids

My investigating quickly brought another herbicide with similar effects to my attention – aminopyralid. And then another – picloram. These herbicides are known as pyridine carboxylic acids and are often registered for application on pasture, grain crops, residential lawns (banned in NZ), commercial turf, certain vegetables and fruits, and roadside maintenance.

Source of contamination

So, where did the herbicide damage on my tomatoes come from?

- Home application
I'm a huge proponent of spray free and organic gardening. There are no weed killers anywhere near me, as a matter of fact, I even buycot places that sell them as far as I possibly can. This did not come from me.
- Spray drift
The quick and easy answer, but not in my instance - the seedlings, while they were growing, and the tomatoes when potted up, are in a closed plastic-and-metal walk-in greenhouse to protect them from the elements. Far away and barriered from any fields, or neighbours, and yet again I have to defer to the fact that both the seedlings in trays (unaffected) and the potted-on seedlings (affected) are basically next to each other, so if there was some kind of herbicide drift, it should have affected both.
- Tainted soil
I started emailing and phoning some other experts in the field, and showed them photographs, and firstly, every single one of them concurred that I had suffered herbicide damage, and after explaining my situation, all of them, without a doubt said the most likely cause for this was the mix that I planted the new seedlings into.

Tomato Killer Composts and Manures

Apparently, it has been quite a common thing – and research shows many cases in New Zealand as far back as 2003, and even more overseas, of tomato killing herbicides finding their way into commercially available composts and garden soil mixes. Just at the start of the 2018 season, The Otago Daily News ran an article warning people not to use clopyralid for lawns.

Remembering my broad beans that were suffering, I checked their symptoms against herbicide damage too, and found it correlated, as did the problems I had with my peas. Sadly too, a whole 4 trays of sunflowers (sunflowers being quintessential to a farmyard vegetable garden in my mind, so I wanted lots and lots and lots!) and punnets of heirloom beans I bought specially for this season.

Double checking facts

Still I doubted - why where my brassica bed doing so well? Why did my potatoes (which is in the same family as tomatoes and just as susceptible to herbicides) not have any problems? Luckily, I am a stickler at keeping records as I wanted to blog about our journey to self-sufficiency, and it turns out the potato bed was the one on which we used pure compost (same supplier), and further research shows that clopyralid and aminopyralid herbicides do not affect brassicas.

My data shows that it was when we switched from buying compost to buying the “Veggie Mix” that problems started happening. The veggie mix, when we asked, was a certified compost with added manure - which sounded just perfect for a healthy dose of nutrients to build up a brand-new garden.

Bioassay

I am currently doing a bioassay (basically an in-soil grow test with beans to check the suspect soil against other soils for herbicide contamination). Once this is complete, I'll have my 100% answer, but so far, all signs point to the soil being the culprit.

I am from now on going to do a test on the soil each and every time before I use it.

See [this link](#) and [this link](#) for more information.

How does this contamination happen?

Why does this happen though? How do herbicides make it into soils available for gardeners from landscape suppliers?

- Home owners
Both herbicides (clopyralid and aminopyralid) are banned for sale to homeowners, so it is highly unlikely the contamination comes from people treating their lawns and disposing of the clippings into green waste, which eventually becomes compost for resale.

But sometimes, if people are using old stock weed killers (pre-ban), it could just maybe contain these herbicides and end up in council green waste recoveries.

I also checked current allowed-for home-use weed killers and the herbicides they contain such as Dicamba and MCPA, as well as 2,4-D are not the best friends of vegetable growing either.

- Parks, Reserves and Sportsgrounds

Clopyralid is easily available to commercial enterprises working in upkeeping parks, reserves and sportsgrounds. Contractors dealing to weeds even in native plant conservation areas, use brand name herbicides (basically different dilutions of clopyralid) as a way to deal to broad leaf weeds such as thistles and clovers.

➤ **Farmers**

Similarly, it is a very popular product to use by farmers to rid their pastures of weeds as it doesn't affect the feed crops such as grass, ryegrasses, or fodder brassicas.

There are warnings on these products and their safety data sheets, typically to the effect of: 'Not for use in home gardens' and 'Do not use for treating turf that will be mown and the clippings used for making compost; or made available for collection for, or deposited at, a municipal green waste recycling depot'.

But who reads labels these days?

Foul manure

And sometimes it's not the tainted green waste that makes it into mixes, but rather the manure of animals who had been feeding on pastures that were sprayed with herbicides. Which is exactly where I think my problem came in, as the compost I used from my supplier had no issues (potatoes growing fine in it), but the "Veggie Mix" with its added MANURE being the indicated culprit.

These herbicides pass through the animal's digestive tract and are excreted in urine and manure. The herbicides remain active in the manure even if it is well composted for an unusually long time, and can then leach into soils and be taken up by non-target plants (such as my tomatoes). One report says that three years after storage, tainted hay still had residual herbicide activity and that the degradation of these herbicides are much slower in piles of manure and compost, which means it may remain active in manure for even longer than three years...



Symptoms:

Common symptoms of herbicide damage include reduced seed germination, twisted and misshapen or distorted young leaf growth and stems, generally stunted growth of the whole plant, low yields, and death.

Clopyralid product names in NZ

According to an Agcarm statement in 2018, the following are all registered trade names for herbicides containing copyralid in NZ:

- Archer
- Broadleaf Kill Clopic

- Cloralid 300
- Cloram
- Cobber
- Cronus
- Duality
- Element
- Korvetto
- Monarch
- Multiple
- Prestige
- PURGE
- RADIATE
- RALID
- Smart Slay
- Tango
- Versatill PowerFlo
- Vivendi 300
- Void

Plants affected by pyridine carboxylic acids:

Most vegetable and flower families are damaged in some way by clopyralid and aminopyralid, including:

- Solanaceae (tomato, potato, eggplant, peppers, tobacco, etc.),
- Leguminosae or Fabaceae (beans, broad beans, peas, clovers, etc.),
- Umbelliferae (carrots, celery, parsley, parsnip, etc),
- Compositae or Asteraceae (artichoke, lettuce, dandelion, daisies, calendula, echinacea, dahlia, zinnia etc.),
- Vitaceae (grapes),
- Rosaceae (roses),
- and even mushrooms.

I have read that tomatoes are affected by herbicides **levels as low as 3-5 parts per billion**.

Plants unaffected by pyridine carboxylic acids:

Cabbage family, Brassicaceae, remains unaffected, so cabbage, kohlrabi, mizuna, mustard, broccoli, cauliflower etc. will be fine grown in the soil with residual herbicide. Grasses and cereal grains, Poaceae, including sweetcorn, is also not affected by the herbicide and most fruit trees, berries and other woody herbaceous perennials should not show any damage when grown with these herbicides.

Cost to me

While I can't put a price to my sadness and irritation at this, I can try to put it a value to the time and effort, the cost of goods, and the lack of produce this herbicide poisoning may have cost me. Please note that this is based on everything I put in, if I had to do it all from the start:

7 cubic meters of mix (yes, I can grow other stuff in it, but its herbicide tainted, a bad thing for my "natural and organic approach")	\$66/cubic meter	\$462.00
500 Tomato seeds, beans, broad beans, sunflowers, peas etc.	\$0.25/ seed *	\$125.00
Cost of production (seed trays + seedling mix)	\$15 seed raising mix and I used about 3 bags	\$45.00
Cost of my time	At less than minimum wage, say \$15/hr and I spend at least 1 hour per day looking after the seedlings as they grow up) and they were sown first week in August. 1 hr a day for 7 days per week, for approximately 80 days.	\$1,200.00
Cost of running a HotBox to raise the seedlings in	Setup and electricity	\$50.00
Repotting of the seedlings into bought mix and PB bags	More or less 5 minutes per seedling, assuming 400 seedlings	\$500.00
PB bags for potting seedlings into	Based on new PB3/4 bags, assuming 400 seedlings	\$40.00
2 bottles of Seasol concentrate which, with the Powerfeed below, is the only amendment I normally add to my vegetable growing	\$11.00	\$22.00
1 bottle of Seasol Tomato Powerfeed	\$14.00	\$14.00
Loss of income selling tomato seedlings, assuming sales of 150 seedlings	\$4/seedling	\$600.00
Loss of produce	Assuming a well looked after heirloom tomato plant produces between 5-8kg of fruit per season, and taking PaknSave prices peak season of 99c per kilogram on common Truss tomatoes, my personal stock of 120 plants should have produced no less than 600kg of fruit.	\$595.00
		\$3600 (rounded)

*based on costs of specialist heirloom tomato seeds from online vendors (generally between \$2.50 and \$4 for 10 seeds)

Conclusion

Don't use herbicides.

Read labels.

Test your soil by doing a [bioassay](#) before you plant your susceptible plants. It could save you much heartache.

Test all manure, no matter where you get it from, before adding it as a soil amendment or enrichment.

Don't trust soil you have not made yourself. Even if you make it yourself, trust your raw material sources FIRST.

Even if it turns out the herbicide was not present in the soil mix I bought and I have to investigate an other source (highly unlikely), I think my research has shown that it is an issue that is still prevalent today, and can cause enough problems for it to be made much more public.

Links and References

I have consulted with specialists in the field, and with their permission, can pass on their information to anyone needing to speak with them, but respectfully keep their names unpublicised on this forum.

You can do your own google search and gape at the astounding number of results, but here's a few articles I have used in my research (in no particular order):

- <https://www.wasteminz.org.nz/wp-content/uploads/Clopyralid-Sampling-and-Growth-Trials-Protocol-May-2015.pdf>
- <https://extension.umd.edu/learn/gardener-alert-beware-herbicide-contaminated-compost-and-manure>
- https://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=3510649
- <https://www.odt.co.nz/lifestyle/home-garden/reminder-not-spray-lawns-clopyralid>
- <https://organicnz.org.nz/magazine-articles/update-ge-brassicas-terminated-methyl-bromide-nanotech-clopyralid-contamination/?fbclid=IwAR0kCa9LF6aAyVLBJNEfqrHJemKqamsGICpkqusKF3dz74TBG1r3HrjJBQ>
- <https://lee.ces.ncsu.edu/2016/03/herbicide-carryover-in-hay-manure-compost-and-grass-clippings/>
- <https://ask.extension.org/questions/408265>
- <http://whatcom.wsu.edu/ag/aminopyralid/bioassay.html>
- <http://www.stuff.co.nz/dominion-post/news/local-papers/kapiti-observer/9043607/Compost-row-unresolved>
- <https://piwakawakavalley.co.nz/help-my-tomatoes/>
- <https://www.hortidaily.com/article/6034166/tomato-leaf-distortion-unintended-herbicide-drift/>
- <http://blog.landscape-design.co.nz/gardening-advice/pest-control/herbicide-damage/archives/2259/>
- <https://ag.tennessee.edu/herbicidestewardship/Pages/Herbicide-Damage-in-Tomatoes.aspx>
- <http://www.thesurvivalgardener.com/compost-will-destroy-garden/>
- <https://www.holesonline.com/blog/tomato-leaf-curling>
- <https://ask.extension.org/questions/202633>
- <https://ask.extension.org/questions/332528>
- <https://charlesdowding.co.uk/august-2019-new-sowings-planting-tips-seed-saving-pest-protection-onions-tomatoes-pyralids/>
- http://agcarm.co.nz/?page_id=9162
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https://www.google.com/search?q=clopyralid+damage+tomatoes&safe=active&rlz=1C1CHBF_enNZ836NZ837&sxsrf=ACYBGNSUv6MrwpwRDJNkthBJoA985qkG5A:1571002121168&source=Inms&tbnm=isch&sa=X&ved=0ahUKEwjBoP76lprlAhVBfisKHXCOCnIQ_AUIEigB&biw=1920&bih=888#imgdii=QqfmEZDwhR-3eM:&imgrc=dYxC-1sr8UqcFM: