



Assessment of Produce Sticker Technologies

Ecology Publication 25-07-041 – September 2025

Legislative Direction

House Bill 2301, Section 401, passed by the Washington Legislature in 2024 states:

“(1) The department of ecology, in consultation with the department of agriculture, must carry out a study and submit a summary report to the legislature by September 1, 2025, addressing the status of produce sticker technologies, including produce sticker options that do not contain plastic stickers or adhesives or that otherwise meet compostability standards.

(2) The study required under this section must, at minimum, compare and consider the following features of produce stickers and adhesives:

- (a) Compostability, including toxic or hazardous substance content;
- (b) Performance;
- (c) Printability; and
- (d) Cost.

(3) In carrying out the study, input and information must be solicited and evaluated from:

- (a) Produce producers and packers;
- (b) Sticker and adhesive producers;
- (c) Other states, countries, or subnational jurisdictions that have adopted standards restricting plastic produce stickers; and
- (d) Other technical experts.”¹

Ecology is submitting this report in response to this directive.

¹Improving the outcomes associated with waste material management systems, including products affecting organic material management systems, H.B. 2301-S2, 2024 session.

[https://lawfilesexternal.wa.gov/biennium/2023-24/Pdf/Bills/Session percent 20Laws/House/2301-S2.SL.pdf?q=20250331084822](https://lawfilesexternal.wa.gov/biennium/2023-24/Pdf/Bills/Session%20percent%20Laws/House/2301-S2.SL.pdf?q=20250331084822)

Background

This report reviews plastic produce stickers and how they impact compost facilities and the environment. Stickers decrease the value of compost and add plastic to soil. In 2024, the Washington State Legislature considered a ban on plastic produce stickers and required this report on sticker technologies. In this report, Ecology examines plastic produce sticker alternatives with less environmental impact – like compostable stickers, laser etching, and ink printing – and recommends the next steps for Washington.

Washington State Department of Ecology (Ecology) wrote this report as a summary of findings from Greene Economics LLC (Battle Ground, WA). Greene Economics spoke with fruit growers and packers, sticker and adhesive manufacturers, the International Compost Alliance, and other experts. Their full research is appended as Ecology Publication 25-07-042.²

The Washington State Department of Agriculture (WSDA) participated during Greene’s research and reviewed both their findings and Ecology’s summary report.

One goal of the research for this report was to understand why produce stickers are so common. Most grocery stores require stickers, so fruits and vegetables meet federal Country of Origin Labeling (COOL) laws.³ Stickers also help stores charge the right price and quickly track produce in case of a recall. They show information like where the produce was grown or if it is organic. Compared to other options like plastic bags, bands, or tape, stickers use less plastic.

With Washington’s new Organic Management Laws, compost facilities will be getting more food waste, and some will have stickers still attached. These laws started with the 2022 Food Waste Reduction Act and aim to keep food out of landfills.⁴

Fruit stickers are a common and difficult contaminant for composters. Compost facilities receive food waste from both homes (post-consumer) and businesses like grocery stores (pre-consumer). If food waste has too much plastic or other contamination, a facility may have to reject it. When that happens, the food waste goes to a landfill where it breaks down and creates greenhouse gases.

If a facility accepts food waste, stickers often make it through the composting process. They are hard to remove and show up in the finished compost. This makes the compost less valuable and limits where it can be sold.

²<https://apps.ecology.wa.gov/publications/SummaryPages/2507042.html>

³Country of Origin Labeling (COOL). Title 7 Code of Federal Regulations, part 65.
<https://www.ecfr.gov/current/title-7/subtitle-B/chapter-I/subchapter-C/part-65>

⁴Landfill disposal of organic materials – Goal. Chapter 70A Revised Code of Washington, section 205, subsection 007. <https://app.leg.wa.gov/RCW/default.aspx?cite=70A.205.007>

Stickers that stay in compost break down into microplastics, which can harm human health and the environment. Research shows that microplastics move through soil and water, lower environmental quality, and may affect our health.⁵

Any alternative to plastic produce stickers must still protect food safety, be affordable for growers, and work within current packing systems. It is also important a new option does not affect international trade and keeps plastic out of compost.

Current Status: Plastic Produce Stickers

The grocery industry started using plastic stickers in 1990, when Price Lookup (PLU) Codes were created to help with inventory and checkout. These stickers are made of at least three layers, including an adhesive, facestock, and ink (Figure 1). All these layers are food-grade, but some can contain chemicals of concern, like PFAS (per- or polyfluoroalkyl substances).

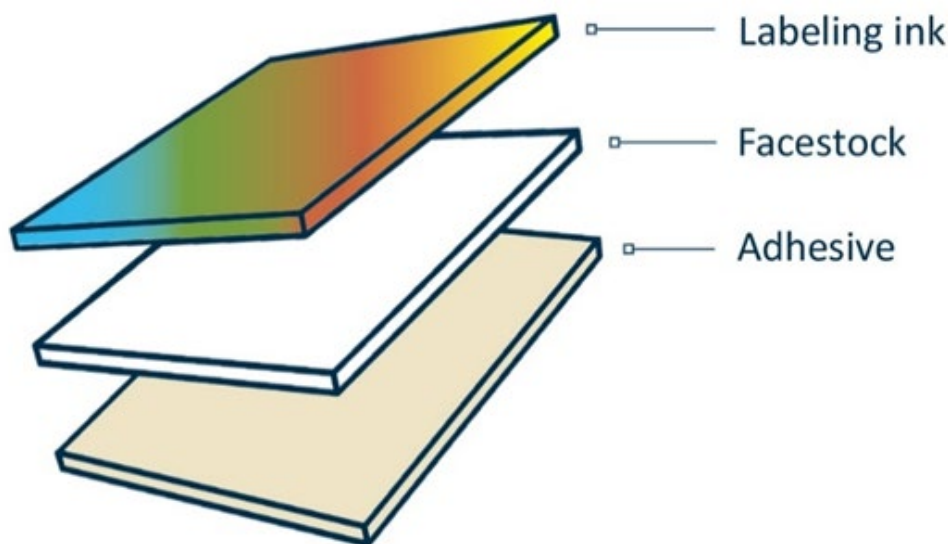


Figure 1 Produce stickers are made of several layers including an adhesive base, a facestock, and ink (Figure by Greene Economics).

After harvest, fruit and vegetables go to warehouses, or “packing houses.” Workers there label the produce before sending it to stores. Packing houses apply stickers to Washington-grown crops like apples and pears. In 2023, about 70 percent of the fall apple harvest – about 7 billion apples – had stickers applied.

Washington has about 100 packing houses, plus a few smaller roadside stands. Companies like Elevate, Sinclair, and Accu-Label make both the stickers and the machines used to apply them. These machines come in two main types: on-line and pattern labelers (Figure 2). On-line

⁵Li, Y. et al. 2023. Potential Health Impact of Microplastics: A Review of Environmental Distribution, Human Exposure, and Toxic Effects. *Environment & Health*, 1, 4, 249-257. doi: 10.1021/envhealth.3c00052

labeling sticks labels to loose fruit moving through lanes. Pattern labeling uses full trays of produce all at once.

Some packing houses also print their own stickers. These “print-on-demand” operations use special thermal printers and different types of stickers. Greene Economics and WSDA could not find a total number of print-on-demand sites, but there are about 15 in Yakima County alone.

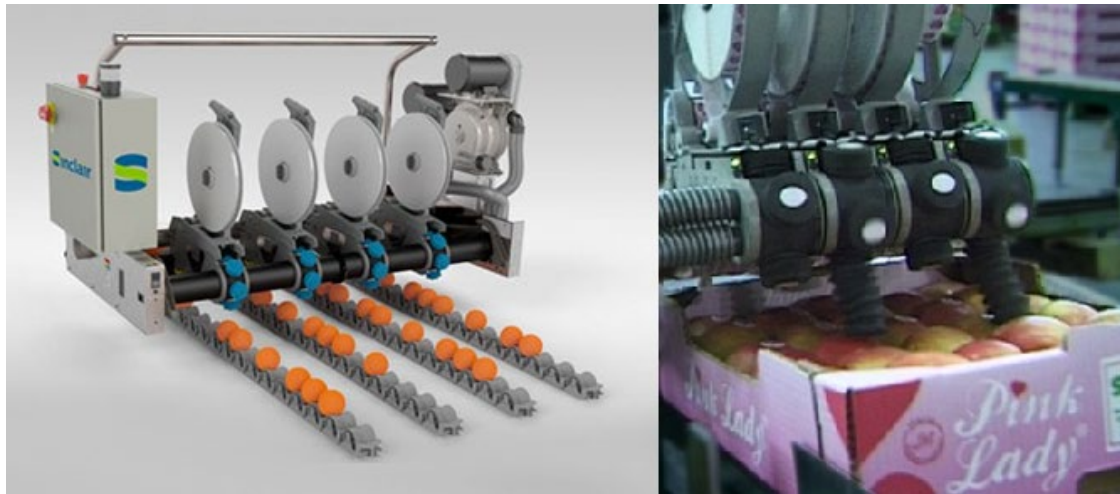


Figure 2 On-line labeling (left) with lanes of individual fruit and pattern labeling (right) with trays of produce. (Photos from Sinclair International).

Throughput and performance

The industry uses the term “throughput” to describe how many stickers a machine can apply per hour. On-line labelers can apply up to 43,200 plastic stickers per hour, per lane – and some machines have up to 20 lanes running at once. That is up to 864,000 stickers per hour.⁶

Pattern labelers work with full trays and can handle up to 2,640 trays per hour. Each tray holds up to 16 rows of fruit, although the number of fruits per tray varies. At minimum (one fruit per tray), this is 42,240 fruit per hour, so this method also labels many items quickly.⁷

Stickers need to stay on the fruit at least 95 percent of the time, through shipping, washing, and cold storage. They also need to work on many shapes and textures, so information stays readable when the item reaches the store.

Versatility

Plastic stickers work well on many kinds of produce, even when they are wet. They are also easy to scan at checkout.

⁶Sinclair Systems International. 2025. On-line Labelers: Sinclair RM6 Technology. <https://www.sinclair-intl.com/labeling-systems/on-line-labelers/rm6/>

⁷Sinclair Systems International. 2025. Pattern Labelers: Sinclair CR4 Pattern Labeler Technology. <https://www.sinclair-intl.com/labeling-systems/pattern-labelers/cr4/>

Costs

Plastic stickers are used on many Washington crops, including apples, apricots, melons, nectarines, onions, peaches, pears, plums, potatoes, and watermelons. The price for 1,000 plastic stickers currently ranges from \$1.00 to \$6.00, depending on size and design⁸. For apples, the average cost is \$1.57 to \$2.33 per 1,000 stickers, not including labor or equipment.

Print-on-demand operations likely have higher costs than packing houses using pre-printed stickers, but there isn't a clear estimate of how much more they pay.

Stickers also cost compost facilities. Even though composters could not estimate exactly how much stickers affect their operations, they spend about 21 percent of their budgets trying to remove other contamination using labor and machines.⁹

Concerns about Plastic Produce Stickers

Plastic in compost and eventual pollution

Produce stickers come to compost facilities with food waste. As the Organics Management Laws lead to more food being collected, composters expect more plastic and overall contamination.

Even though facilities can reject contaminated loads,¹⁰ stickers still often slip through unless every layer (Figure 1) is compostable. Once in the compost system, stickers can break into microplastics and contain per- or polyfluoroalkyl substances (PFAS), which are linked to long-term health and environmental problems.¹¹

Despite spending 21 percent of their budgets to remove contamination like plastic bags, composters say none of their current systems work well to remove stickers. They are too small to pick out by hand, resist vacuum systems and sieves, and pass-through sorting screens. As a result, any facility accepting food waste is likely to have at least some sticker residue in its final compost, even at the most well-run facilities.

Contamination lowers the quality and value of compost. Customers use compost to improve soil, and they do not want to add plastic. If compost has too much contamination, it cannot be

⁸Greene Economics. 2025. Fruit Sticker Final Report, Pub. 25-07-042.

<https://fortress.wa.gov/ecy/publications/SummaryPages/2507042.html>

⁹Cascadia Consulting. Sept. 2024. *Compostable Product Management in Washington State – Report to the Legislature*, (Pub. 24-07-028).

<https://apps.ecology.wa.gov/publications/SummaryPages/2407028.html>

¹⁰WAC 173-350 limits incoming contamination to 5 percent by volume unless the facility has a plan and the ability to clean it up, so that the contamination is below 5 percent before processing the material.

¹¹Groß, M., *et al.* 2024. Plastic Fruit Stickers in Industrial Composting – Surface and Structural Alterations Revealed by Electron Microscopy and Computed Tomography. doi: 10.1021/acs.est.3c08734

sold at all. As Closed Loop Partners says, “the price of compost directly corresponds to its cleanliness and quality.”¹²

Facilities also deal with complaints from customers. Home users complain about stickers in bagged products and may ask for refunds or replacements. This could harm the facility’s reputation and long-term sales. Moreover, large buyers like the Washington State Department of Transportation (the biggest purchaser of compost in the state) will not buy compost with any plastic contamination.

Limits on export markets

To prevent plastic pollution in compost, some countries have banned or are planning to ban plastic produce stickers, which affects Washington’s export markets. In 2023 and 2024, Washington exported about 30 percent of its apple harvest, so these rules matter to local growers.¹³

In January 2022, France became the first country to ban imports with plastic stickers. The European Union will require the same by 2028.

New Zealand will require imported produce to have certified home compostable stickers by 2028. Until 2028, South Australia will accept imported produce with stickers certified to any home or industrial composting standard. After, imports must have compostable stickers certified to Australian standards (AS 4736 or AS 5810).¹⁴

These upcoming rules mean Washington growers and packing houses will need to change their stickers if they want to sell in these international markets.

Leading Alternative: Compostable Stickers

The most practical replacement for plastic stickers right now is compostable produce stickers, especially for growers and packing houses. These stickers can run through existing sticker machines without big changes.¹⁵

In Washington and other states, compostable products must be certified by a third party. The certifier verifies the compostable claim according to a scientific standard. In the US, the two main compostability standards come from the American Society of Testing and Materials

¹²Closed Loop Partners. 2024. *Don’t Spoil the Soil: The Challenge of Contamination at Composting Sites*. <https://www.closedlooppartners.com/research/compostable-packaging-disintegration-at-composting-facilities/>

¹³ Northwest Horticultural Council. 2025. *Apple Fact Sheet*. <https://nwhort.org/industry-facts/apple-fact-sheet/>

¹⁴ Government of South Australia. 2024. Guide to the 2025 Ban on Single-Use Plastics. <https://www.replacethewaste.sa.gov.au/guideline-2025-bans>

¹⁵ Elevate Packaging. 2024, Oct. 1. *Stick to Sustainability: Compostable Produce Labels*, [Presentation]. Compostable Produce Stickers: Finding the Common Ground, Niagara Falls, Canada.

(ASTM).¹⁶ Standard D6400 is for plastics, and D6868 is for coatings on paper or other compostable materials.

Cost

Compostable stickers currently cost more than plastic ones. Sinclair International quoted \$3.00 for 1,000 plastic stickers and compared it to \$4.80 for 1,000 compostable stickers.

For an 80-count box of fruit, compostable stickers would add about 14 cents. Over a year, that adds up to about \$6,889 for a mid-sized Washington apple grower.

As more companies develop compostable adhesives and materials, these costs may go down over time.

Throughput and performance

Compostable stickers can run on the same labeling machines as the plastic ones currently used at packing houses, so throughput stays the same. However, print-on-demand sites do not have a compostable sticker option. Until one becomes available, they would need to switch to pre-printed stickers.

Most compostable stickers now on the market meet the industry requirement of 95 percent good adhesion, meaning they stay on the item through handling, shipping, washing, and storage.

Versatility

Compostable stickers work like plastic stickers. They stick to many different types of produce and hold up during washing, cold storage, and transport.

Limits for Compostable Produce Stickers

Costly and less available

Right now, compostable stickers are more expensive than plastic ones, and not many companies make them. Some sticker companies have paper-based products that almost meet compostability standards – but the adhesive is often a problem. Compostable adhesives are limited.

Currently, only two companies – Sinclair Systems International and Elevate Packaging – have stickers that are fully certified compostable. Elevate holds the exclusive rights to the only certified compostable adhesive in the world. Accu-Label offers stickers where some, but not all, layers are compostable.

Print-on-demand operations do not yet have a compostable option. Sticker manufacturers believe one could be ready within five years. Until then, these packing houses would need to

¹⁶ Plastic Product Degradability. Chapter 70A Revised Code of Washington, section 455.

<https://app.leg.wa.gov/rcw/default.aspx?cite=70A.455>

switch equipment and use pre-printed stickers. This would be costly, especially for sites that manage a wide variety of products.

No sales to organic farms

Organic farms buy a lot of compost. For compost to be used on organic farms, it cannot be made with compostable plastics, including fruit stickers.¹⁷ The National Organic Program's current rules allow compost that includes plastic stickers as long as total contamination is 1 percent or less and film plastic makes up less than 0.25 percent.

The National Organic Standards Board (NOSB) decides which materials are allowed in organic farming. Whether compostable products should be allowed as a feedstock for compost is being debated. In 2024, the Biodegradable Products Institute petitioned the NOSB to allow compostable products,¹⁸ arguing the rules were written before these products existed.¹⁹

Other groups like the National Organic Coalition are against allowing compostable products as compost feedstock. They say current compostability standards are not strong enough, and the risk of untested chemicals getting into soil is too high.²⁰

Competing standards internationally

Scientific standards set minimum criteria for how a compostable product should break down. Third-party certifiers test products and verify that they meet the relevant standard. Certification is a sign of trust for compost facilities and consumers.

Different countries have their own compostability standards, which makes it harder to choose a sticker that works in all markets. However, all standards look at four things: toxics and heavy metals, whether the product breaks down, how fast it breaks down, and whether it affects plant health.

Different regions tend to prefer their own standards. For example, Australia will require stickers meet Australian standards AS 5810 or 4736. The European Union uses EN-13432, and the U.S. uses ASTM D6400 and D6868.

The lack of shared global standard creates confusion – especially for Washington exporters trying to comply with multiple laws.

¹⁷ USDA Organic Regulations. Title 7 Code of Federal Regulations, part 205.

<https://www.ecfr.gov/current/title-7/subtitle-B/chapter-I/subchapter-M/part-205>

¹⁸ USDA. 2023, Oct. 11. "Work Agenda Request: Compost Production for Organic Agriculture," [Memo to the National Organic Standards Board].

<https://www.ams.usda.gov/sites/default/files/media/NOSBMemoCompostWorkAgenda23.pdf>

¹⁹ BioCycle. 2023, Sept. 26. "BPI Petitions USDA, NOP To Update Compost Definition to Include Compostable Products," [Blog]. <https://www.biocycle.net/bpi-petitions-usda-nop-to-update-compost-definition-to-include-compostable-products/>

²⁰ National Organic Coalition. 2024, April 9. "Synthetic compostable packaging does not belong in organic compost," [Blog]. <https://www.nationalorganiccoalition.org/blog/2024/4/9/synthetic-compostable-packaging-does-not-belong-in-organic-compost>

As the National Organic Council points out, scientific standards and certification have limits, since both are based on lab testing. Even when a product passes lab tests, it might not break down properly at a compost facility. In Washington, some composters process food waste in just 15 days, which may be too short for a compostable sticker to break down.

Options with more plastic

Requiring compostable produce stickers may get unplanned responses. Some packing houses or growers may choose a packaging method that increases plastic use. For example, instead of compostable stickers, they may put produce in plastic bags. They could also use plastic bands or tape.

Compared to other options, plastic stickers are less harmful to the environment. In other words, if compostable stickers are not available, banning plastic stickers may backfire and lead to more plastic waste instead of less.

Concern about toxicity

Compostable plastics are often made from renewable materials like corn stalks or sugarcane instead of oil. But these materials can still contain pesticides or other chemicals of concern. That means there is risk that the product could carry over those chemicals into compost.²¹

In some cases, compostable plastics use the same chemicals as traditional plastic, or they include new ones that have not been well studied. Since many plastic recipes are proprietary, it is difficult to test individual ingredients or know what is inside.

Other Alternatives: Laser Etching and Ink Printing

Laser etching

Laser etching uses a low-intensity laser to mark the outside of produce. The U.S. Food and Drug Administration has approved this method for citrus fruit.²²

Laser etching is appealing because it does not use paper, plastic, ink, or adhesive, so the environmental impact is low. However, Greene Economics and WSDA did not find any laser etching equipment or facilities in Washington.

Laser etching works best on fruit with thick peels like avocados, grapefruits, and oranges. For softer fruit like tomatoes, pears, and stone fruits, lasers break the skin. This risks fruit quality and safety and shortens the shelf-life. Some items like pomegranates and lemons can heal over etchings, so the marks cannot be used at checkout.

²¹ Ferrell, Cami. 2024. Bioplastics are Inadequately Defined, Poorly Regulated, and Potentially Toxic. *Environmental Health News*. <https://www.ehn.org/problems-with-bioplastics>

²² Carbon Dioxide Laser for Food Etching. Title 21 Code of Federal Regulations, 179.43. 2012. <https://www.ecfr.gov/current/title-21/chapter-I/subchapter-B/part-179/subpart-B/section-179.43>

Laser etches on apples hold up well, but there are risks. The etched area grows microbes and loses moisture.²³ Some of the microbes are known to cause illness.

Ink printing

Ink-based printing, or “vegetable tattoos,” is another option to replace stickers. It uses food-grade ink to stamp codes directly on the item. The ink must dry quickly, or it will smear.

Like laser etching, no ink-printing facilities or equipment were found in Washington.

Ink printing works best on smooth-skinned produce with an even shape like apples and mangoes. Rough or fuzzy skin (e.g., pineapples, avocados, kiwis, peaches) disrupts the ink. Ink printing might work with some Washington apples but not with pears, onions, or stone fruit.

Costs

Using laser etching or ink printing would be more expensive than using stickers. Growers and packing houses would see big costs from replacing equipment, redesigning supply chains, training staff, and absorbing food safety risks.

Laser etching could lead to higher spoilage, especially if it breaks the protective skin of fruit. Even for woody and waxed surfaces, “laser engraving compromises the protective barrier of the produce surface.”²⁴ Larger etchings or stamps are also more expensive to apply.

In one study, laser-etched apples, bell peppers, and cucumbers, had more bacterial growth than those that did not get etchings. Damaging the produce surface increases risks for foodborne illness, food waste, and higher food prices.

Performance

Stickers are more versatile than laser or ink methods. Lasers and ink have many limits. For example, in a study where scientists etched barcodes on dragon fruit, the “scanner could not distinguish the barcode from the fruit surface due to insufficient color contrast.”²⁵ With ink printing, no external label can come off, but ink can smear or wash off before fruit gets to market.

The research team found no studies on how consumers feel about ink or laser markings, but some interviewees guessed these methods might hurt sales if customers are wary of these technologies.

²³ Khadka, D., et. al. 2024. CO2 Laser-labeling on Fresh Produce: Evaluating the Postharvest Quality, Microbial Safety, and Economic Analysis. doi: 10.1016/j.jfp.2024.100329

²⁴ Khadka, D., et. al. 2024. CO2 Laser-labeling on Fresh Produce: Evaluating the Postharvest Quality, Microbial Safety, and Economic Analysis. doi: 10.1016/j.jfp.2024.100329

²⁵ Sree, T.K., and Natarajan, V. 2022. Laser Labeling on Dragon Fruit with Different Codes and their Impact on Surface Characteristics. *The Pharma Innovation Journal*, 11, 7, 4717-4723.

<https://www.thepharmajournal.com/archives/2022/vol11issue7S/PartBC/S-11-7-619-961.pdf>

Throughput

The information about how fast these methods work is mixed. One source claimed laser etching was fast enough to offset installation costs, while others said lasers are much slower than sticker machines. For example, one study found that lasering six apples per second was “extremely fast,” but this is less than half the speed of a standard sticker line.

There was no data available on speed or throughput for ink printing.

Recommendations

The best current alternative to plastic stickers is compostable produce stickers. Laser etching and ink printing are not ready for large-scale use in Washington, according to Greene’s research. They do not work on all produce types and could raise food safety concerns.

Still, the supply of compostable options is limited. Ecology recommends waiting to ban plastic produce stickers or require compostable ones in Washington until more compostable options are available. This would make the transition more affordable and easier for agricultural producers and packing houses. It also gives Washington a chance to observe the impact of similar policies in other places. As other countries enforce new rules, manufacturers are investing in new adhesives and better compostable options, including a print-on-demand option expected within five years.

Groups like the International Compost Alliance and U.S. Composting Council have asked states to refrain from new laws until there is a global standard for compostable stickers. This work is already underway. Ecology recommends Washington policymakers track this project and its outcomes, follow the progress of sticker and adhesive manufacturers, and support export growers as they prepare for global changes.

A global standard would make it easier for growers and packing houses to choose a sticker that meets every country’s rule and help manufacturers serve international markets. A global standard could also reduce the chances of harmful chemicals and microplastics getting into compost.

International standard status

On October 1, 2024, industry leaders met in Niagara Falls, Ontario, Canada, to begin designing a global standard for compostable produce stickers. The Canadian Produce Marketing Association and Compost Council of Canada led the meeting. Other members included International Fresh Produce Standards, International Compost Alliance, United States Department of Agriculture, and agencies from Australia, New Zealand, the United States, Ireland, the United Kingdom, Italy, and the European Union.

The group drafted a plan to create a global standard and aims to involve more partners in the future.²⁶ A draft standard is already being finalized.

Conclusion

Produce stickers are important for pricing, food safety, and tracking how and where food is grown. They're low-cost and widely used—but they cause problems for compost facilities and add plastic to the environment.

Several countries, including France, New Zealand, and members of the European Union, have already passed laws to ban plastic produce stickers by 2028.

The best alternative is compostable stickers, which most packing houses in Washington can use with their current equipment. The main barrier is cost and limited supply—especially for print-on-demand operations, which would need new equipment until they have a compostable sticker option.

Ecology recommends waiting before banning plastic produce stickers or requiring compostable versions in Washington. Ecology recommends first letting the global standard develop for compostable produce stickers and allowing time for the industry to release more compostable options on the market.

Compostable stickers can still support food safety, and with more development, they could become cheaper and more widely available. They would also reduce plastic in compost. Their biggest barrier is current federal rules that say compost made with compostable plastics cannot be used on organic farms. This may change as the National Organic Standards Board is considering new rules. Meanwhile, by staying involved in the global conversation, Washington can help shape solutions that work for growers, composters, and the environment.

²⁶ International Compost Alliance. 2024, Oct. 8. Global Meeting Advances Transition to Certified Compostable Produce Stickers, [Press release]. https://www.compost.org/wp-content/uploads/2024/10/Press_Release_Certified_Compostable_PLU_Stickers.pdf

Publication information

This report is available on the Department of Ecology's website at <https://apps.ecology.wa.gov/ecy/publications/SummaryPages/2507041.html>

Related Information

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²⁷ <https://fortress.wa.gov/ecy/publications/SummaryPages/2507042.html>

²⁸ www.ecology.wa.gov/contact