

## What will happen to our wine?

A study reveals how grapevines survive the dry heat of Israeli summers. Will they tolerate significantly worsened conditions due to climate change?

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As winter shifted into spring and colder temperatures gave way to warmer ones, the feeling of thirst came back to mind.

It is easy for humans to find and drink a glass of water to quench our thirst. For plants, this can be much more complicated, as they depend on resources in their immediate environment. Millions of years of evolution, however, have given plants a few tricks.

A new Israeli study examined grapevines (*Vitis vinifera*), a particularly popular local crop, and found that the plants can alter their hydraulic traits and internal structure over the course of a growing season to accommodate the hot, dry Israeli summer.

At the center of the new research is the plant's ability to utilize water.

"Plants are able to carry water to all their parts without any investment of energy, sometimes even to a height of 100 meters," said Dr. Uri Hochberg of the Institute of Soil, Water and Environment at the Volcani Center for Agricultural Research in Rishon LeZion.

"This is very different from the processes that take place in our body. For example, in order for nutrients and fluids to be transported from the heart to the rest of the body, we are required to burn energy, which is measured in calories."

A plant, however, transports water, nutrients and minerals upward from the roots to the stem and leaves – moving against gravity – without any investment of energy. The water moves in a fairly long and vertical path in a system of tubes called the xylem.

How exactly does this happen? It all starts when water evaporates from the leaves of the plant through the stomata – the microscopic openings on the leaves through which air from the environment enters the plant. Water molecules within the plant have tension between them that attracts them to each other. So, when some of the molecules evaporate through the stomata, a tension is created in these tubes, pulling the water upward.

"The weak point of the process is that when the plant is in severe drought conditions, the tension in the transport tubes increases to the point where the water molecules may even completely separate from each other," explained Hochberg. "When this happens, the liquid in the transport



RESEARCHERS PHOTOGRAPHED vine leaves and analyzed the subtle changes occurring due to the amount of light passing through the leaves, which indicated the presence of gas bubbles within the plant's transport system. (Wikimedia Commons)

tubes actually turns into gas in a process called cavitation, and when there is gas in the heart of the transport system, it damages the flow of water in the plant."

The study was conducted in Hochberg's laboratory by doctoral student Yonatan Sorek with the assistance of Dr. Yishai Netzer from Eastern Regional R&D and Ariel University. The researchers examined vines of the well-known Cabernet Sauvignon variety using an innovative method to examine the cavitation processes.

They photographed the vine leaves and analyzed the subtle changes occurring due to the amount of light passing through the leaves, which indicated the presence of gas bubbles within the plant's transport system. As the water turns from a liquid to a gas, a smaller amount of light reaches the camera, revealing the areas where there are

gas bubbles, which appear darker.

The researchers found that the "secret" vines use to deal with dryness is deformation. The leaves of the vines change their xylem structure in a way that prevents cavitation. Therefore, the water flow within the vines is not damaged or altered in any way, even in extreme conditions.

THE RESEARCHERS found that the changes in the internal structure of the vine gradually develop as the growing season progresses. This is because of the vines' life cycle. Every year as winter approaches, the vines sink into a deep dormancy until they regrow vigorously in early spring with the blossoming of new young leaves, and grapes afterward.

In early spring, the young leaves use the water that has accumulated in the soil during the rainy winter months. As a result,

they do not suffer from a significant lack of fluids. However, toward the end of the growing season, when the leaves are already mature, the reserves left for the plant are already thinner, forcing the plant to act in ways that will allow it to survive in drought conditions.

The researchers found that in addition to changing the xylem structure, the vines used another mechanism to adapt itself to the dry season: the accumulation of dissolved solids. Within the vines' leaves are dissolved solids such as salts, sugars, organic acids, amino acids and other minerals, which are present in high concentrations. Because the natural tendency of water is to flow from a place where the concentration of solutes is low to a place where their concentration is high (osmosis), raising the concentration of solutes in the leaf makes it

easier for the plant to attract water to it in dry periods.

According to Hochberg, vines are not the only crop in which relatively little cavitation is generated when there is a water shortage.

"In the past year, in addition to vines, we also examined other deciduous plants, such as pear, pomegranate and eucalyptus, and we also saw that they also adapt to dry conditions in this way," he reported.

Despite the grapevine's impressive weather-coping strategy, it is unclear whether the plant will be able to properly adapt to harsher drought conditions projected for the future. The climate crisis has already led to a rise of almost one degree Celsius in the world average temperature, with the minimum expectation being a warming of 1.5°-2°C (2.7°-3.6°F) on average. In addition, extreme weather events, such as droughts and heat waves, are expected to continue becoming more frequent and severe.

"In Israel, many heat waves occur in the spring, the period when vine leaves are still relatively young and therefore more sensitive to dry conditions," explained Hochberg. "Last year, for example, we experienced a 10-day heat wave in May, in which temperatures reached more than 40°C [104°F]. Therefore, if the heat waves become more frequent, there is a reasonable chance that the plant will have more difficulty coping with extreme temperatures," he warns.

Heat accelerates the ripening of sugar, which grapes turn into alcohol during the fermentation process. Phenols (the substances that give wine its unique properties like color, feel and smell), however, need time to ripen. Therefore, by the time the phenols mature under high heat conditions, the squeezed grape juice might already have too much sugar, resulting in an unbalanced wine with too much alcohol for the palates of most consumers. As Hochberg put it, "Grapevine crops and the farmers who grow them are greatly affected by rising global temperatures."

In order to better handle the situation, options are currently being considered in Israel, such as replacing the cultivated varieties (mainly French varieties, such as Cabernet Sauvignon, Merlot and Chardonnay) with varieties that better suit the new conditions. It is very possible that it will soon be much more difficult to grow wine grapes in warmer areas where wine grapes are grown today, such as Gedera or Zichron Ya'acov.

## Once 'green' plug-in hybrids suddenly look like dinosaurs in Europe

• BY NICK CAREY AND KATE ARNETT

LONDON/RUSSELS (Reuters) – Remember when plug-in hybrid cars were the go-to technology for the climate-conscious driver? Turns out, they're not good for the environment, according to some experts, and they could be phased out by carmakers in the face of tougher European rules.

EU policy plans for plug-in hybrid vehicles (PHEVs), which contain an electric battery and a combustion engine, could mean the "transition" technology has a shorter lifespan than envisaged by some leading automakers.

Draft green finance regulations would ban manufacturers from labeling them as "sustainable investments" beyond 2025, potentially affecting investors. Meanwhile, planned rules on emissions of pollutants like nitrogen oxides could increase the cost of producing these cars.

The aim of such reforms is to speed the transit to fully electric vehicles and meet climate goals. Yet they would mark a shift from existing EU policies, such as CO2 standards, which have treated hybrids on a par with all-electric cars and helped spur the auto industry to invest tens of billions of euros in the technology.

Some carmakers had envisaged selling hybrids until at least the end of this decade as a bridge to fully battery electric vehicles (BEVs) – although their shift away from the technology looks to be underway.

An analysis of car production plans in Europe through to 2028 compiled for Reuters by AutoForecast Solutions (AFS), which tracks industry production plans, shows only 28 PHEV models versus 86 BEV models. That is a turnaround for an industry where PHEVs on the market have outnumbered BEV models every year since 2015, often significantly.

Now some carmakers fear the EU could prematurely cut short that transition. They warn upcoming rules could make it hard to sell PHEVs in European markets in just a few years' time, despite consumer concerns about the range of fully electric cars and a lack of charging infrastructure.

"It's crazy to do this by 2025 because effectively you kill demand today," said Aletian Hallmark, CEO of British luxury carmaker Bentley, a unit of Volkswagen, referring to proposals to not classify PHEVs as sustainable investments. He plans to sell PHEVs until 2030 before going all-electric.

"For most people, a battery electric car is not yet practical," he told Reuters.

A European Commission official declined to comment on the green finance rules specifically, but said its policies were "technology neutral," adding that PHEVs were "a transition technology towards zero-emission mobility." To reach an overall climate neutrality target in 2050, nearly all cars on the roads must be zero emissions by that time, the Commission added.

The rules, which are still being drafted, come against the backdrop of a shift in the position of some leading environmental groups which are pushing to dispel PHEVs' green credentials and to away



A BMW X5 plug-in hybrid awaits an emissions study last month. (Emissions Analytic/Handout by Reuters)

with their subsidies.

One study, from the International Council on Clean Transportation last September, said PHEVs' fuel consumption and CO2 emissions are up to four times the level they are approved for because people do not charge them often enough.

Julia Poliscanova, senior director for vehicles and mobility at European NGO Transport & Environment, said its own research showed that when driven in combustion-engine mode, hybrids' CO2 emissions were higher than that of conventional cars – they're heavier than combustion-only cars so used more fuel.

"From the perspective of environment and climate, today's plug-in hybrid technology is worse than what it is replacing."

This is a change in the group's position from as recently as 2018, when it saw PHEVs as a transition technology.

CARMAKERS SAY hybrids, used properly with electric as the primary power source and combustion as a backup, emit far less than conventional cars. They add that PHEVs are a popular transitional choice for consumers who want greener travel.

PHEV sales in the EU more than tripled to 507,000

vehicles in 2020, almost as many as the nearly 539,000 all-electric vehicles sold.

Gauging carmakers' investments on PHEVs is hard because they only announce broad "electrification" plans. Consultancy AlixPartners estimates carmakers and suppliers will invest \$200 billion in electrification from 2020 to 2024.

German engineering specialists FEV estimates fitting a battery, motor and electronics to a combustion engine car to make a PHEV costs up to 4,000 euros (\$4,700) per vehicle.

European automakers are dividing over whether to fight for PHEVs, or spend their financial and political capital accelerating the leap to fully electric vehicles and pushing for better charging infrastructure across the continent.

Stephan Neugebauer, chairman of the European Green Vehicles Initiative Association, told Reuters technology improvements will mean future PHEVs rely less on their combustion engines, making them fit for the green transition over the next decade and even beyond.

"Will all customers buy battery electric vehicles in 10 years, or nine years? We don't think so," said Neugebauer, who is also BMW's director of global research

cooperation.

"Why? Because sometimes you have to make a long-distance trip, you go on holidays, you have to pull a trailer. And for this, you need public charging infrastructure. And this will still be a critical issue."

BMW and Renault SA, which have not set a date for going all-electric, are among the companies firm in the hybrids camp.

BMW boss Oliver Zipse said last month that they were "a great consumer product" and there would be a market for them even without subsidies. Renault CEO Luca de Meo said in February that PHEVs "will be part of the landscape for the next 10 years easily" and were more profitable than conventional cars.

Volvo Cars CEO Hakan Samuelsson told Reuters, "It's a bit disappointing they [Brussels policy makers] don't see the value of a plug-in hybrid." But he said his company, which aims to be all-electric by 2030, was more focused on pushing the EU to make member states invest heavily in charging infrastructure.

"If we in the car industry invest in electric cars, and do that very rapidly, I think our credibility to ask for investments in the charging network increases," he said.

The European Commission is due to propose at least a dozen pieces of legislation to slash emissions across all sectors this year.

Current drafts of the EU's sustainable finance taxonomy, a list of economic activities that from next year will determine what can be marketed as a sustainable investment, exclude manufacturing of PHEVs from 2026.

That could deter the army of investors seeking assets with green credentials. It could also potentially restrict public funding, if governments moved to align their spending with the taxonomy.

While many countries still subsidize PHEVs, the Netherlands scaled back tax breaks for them in 2016. By 2020, eight times as many BEVs were sold in the country as PHEVs, compared with four times as many PHEVs as BEVs four years before, showing how government policy on vehicle technology can have a major effect on consumer behavior.

A consortium of researchers, commissioned by the EU and known as CLOVE, this month recommended that so-called Euro 7 rules should tighten car emission limits for pollutants including nitrogen oxides and carbon monoxide from 2025. Its recommendations are not binding, but aim to inform the European Commission's proposals, due later this year.

Transport & Environment, part of the Commission's expert group working on the standards, said the proposals would force carmakers to fit PHEVs with expensive technology to curb emissions from their combustion engines.

Hildegard Mueller, president of German auto industry association VDA, said the proposals were "at the limit of what is technologically achievable."

"We still have to be very careful that the internal combustion engine is not made impossible by Euro 7," she said.