New research explores theories about aging and death in plants

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(Phys.org) —According to Benjamin Franklin, "nothing can be said to be certain, except death and taxes." But what if Franklin had it wrong—at least about death? University of Georgia ecologist Richard P. Shefferson explored this question in the *Journal of Ecology* in a special issue he coedited about the latest research on senescence—the physical process of aging and death—in plants and, in particular, the idea that certain plants might be immune from this seemingly universal phenomenon.

"Senescence is one of the oldest topics of study in biology, particularly evolutionary biology," said Shefferson, an assistant professor in the UGA Odum School of Ecology. "All of the early work, and most of the current research, is focused on senescence in humans. But some of the more interesting theoretical work that's come out in the last few decades suggests that everything we know about senescence may not apply to plants."

In animals, Shefferson explained, senescence is tied to age. Scientists believe that animals die or lose fertility at a certain age so they can avoid passing on genetic mutations that occur late in life-mutations that therefore couldn't be weeded out of the population through the process of natural selection. Plants, however, are different.

"In plant senescence, age is still important," he said, "but it interacts with size, with size having an overwhelming dominance."

Size, Shefferson said, is generally strongly positively correlated with plant survival and reproductive success. But size can be affected by environmental stresses.

"Plants are really strongly plastic, meaning they respond to the environment in term of size and architecture," he said.

Some evidence suggests that, in the absence of environmental stresses, plants wouldn't senesce at all. They would just keep growing older and larger. One theoretical model suggests that some organisms could even experience negative senescence—not merely avoiding deterioration and death but becoming fitter with age.

"It's a model that works really well, at least on paper, for plants and fungi," Shefferson said. "It's all based on strong relationships between size and demographic rates, fecundity and survival in particular. But there was still a dearth of study on plants that could be used for testing it."

That was the focus of the special section, which contained an overview of current research as well as five new papers—including one by Shefferson—that explore theories of plant senescence in terms of physiology, population statistics, modeling and comparative analysis.

Shefferson's paper focused on the herbaceous perennial Plantago lanceolata. Also known as ribwort plantain, P. lanceolata is a common weed found in fields and disturbed areas throughout North America. Shefferson and coauthor Deborah Roach of the University of Virginia explored the relationship between age, size and environmental factors on senescence in ribwort plantain.

From October 2000 to October 2002, they planted thousands of ribwort plantains in four cohorts. For the next 10 years, they collected data at

regular intervals from more than 8,000 of the plants, measuring survival, size, seed production, field germination and field seedling survival.

Their analysis showed, first, that senescence does occur in ribwort plantain. Size and flowering rates declined starting at about three years before plant death, regardless of the age of the plant.

They also found that environmental factors played a larger role than age or even size. While larger plants generally produced more flowers, the rates varied depending upon the plant's cohort, suggesting that variable environmental stresses were influencing the onset of senescence.

The findings support the idea that senescence, at least in certain plants, is linked to the accumulating wear and tear that accompanies age, rather than to age itself.

"In people, and in a lot of organisms, we can actually define a rough age at which senescence kicks in," Shefferson said. "In plants we can't do that, and one of the big reasons is that plants are so strongly plastic that the environmental context is going to be a strong determinant."

Shefferson is continuing to study plant senescence, using data about longer-lived plants and fungi. "I'm very curious about whether or not we'll get the same sorts of patterns of physiological decline there," he said.

He's also interested in exploring the effects of environmental stresses on human senescence.

"The age perspective rules so strongly in the human literature, and some have ruled out environment as a factor, but people are plastic too. It's just not as obvious as it is with plants," he said.

More information: onlinelibrary.wiley.com/doi/10 … 1365-2745.12079/full

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