

# An increase in temperature by 2050 may be advantageous to the growth of forage plants

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A 2°C increase in temperature around the world by 2050, according to one of the scenarios predicted by the Intergovernmental Panel on Climate Change (IPCC), may be advantageous to the physiology and the biochemical and biophysical processes involved in the growth of forage plants such as *Stylosanthes capitata* Vogel, a legume utilized for livestock grazing in tropical countries such as Brazil.

The conclusion is from a study carried out by researchers in the Department of Biology at the Ribeirão Preto Faculty of Philosophy, Sciences and Languages and Literature at the University of São Paulo (USP).

The outcome of a thematic project conducted under the FAPESP Research Program on Global Climate Change (PFPMCG), the study has just been published in the journal *Environmental and Experimental Botany*.

"The 2°C increase in temperature in the environment in which *Stylosanthes capitata* Vogel was experimentally cultivated promoted photosynthesis, in addition to increasing the leaf area and biomass of the plant," said Carlos Alberto Martinez, project coordinator and first author of the study.

The thematic project coordinated by Martinez involves researchers from the University of Illinois, Columbia University and the US Department of Agriculture (USDA), in addition to the Consiglio Nazionale delle

Ricerche of Italy, the Universitat de Barcelona in Spain, and, in Brazil, the Federal University of São Carlos (UFSCar), the São Paulo State University (Unesp) and the North Fluminense State University (UENF), as well as the Cena at USP, the Botanical Institute and Embrapa.

According to Martinez, *Stylosanthes capitata* Vogel is a major forage legume in tropical and subtropical regions all over the world. This plant species is highly drought resistant and able to grow in sandy environments.

With global climate change, it is estimated that a moderate temperature increase of slightly greater than 2°C could have damaging effects on the plant's physiology and growth under cultivation in tropical environments such as Brazil.

To test these hypotheses, the researchers conducted an experiment in which they cultivated [plants](#) in open fields, in a normal-temperature environment, and in a temperature-controlled area using a temperature free-air controlled enhancement system known as T-FACE.

The system comes equipped to control heat emission from the crown of the plants through infrared heaters that enable the temperature of the growing environment to remain at a steady 2°C over [ambient temperature](#).

After cultivating the plants with these temperature differences for 30 days, the researchers measured photosynthetic energy dissipation and conducted aboveground biochemical and biomass analyses.

The results of the measurements and analyses indicated that a temperature increase of approximately 2°C was able to improve the plants' photosynthetic activity and level of antioxidant protection.

In addition, there was a 32% increase in the leaf area index and a 16% increase in aboveground biomass production compared with plants grown at normal temperature, according to Martinez.

"The increase in temperature during the period of the experiment was favorable for the development of the biochemical and biophysical processes involved in plant growth," he stated.

According to Martinez, some possible explanations for the increase in photosynthetic activity, in addition to the leaf area index and biomass production from samples of *Stylosanthes capitata* that experienced temperature increases, were the plant's thermal and photosynthetic acclimatization.

The plant adjusted its physiology to not only handle the potentially stressful increase in temperature during its growth phase but also conduct photosynthesis more efficiently and even increase growth under the new climate conditions.

"The results of the study indicated that a temperature increase of up to 2°C could be advantageous for growth of some species of tropical plants, such as *Stylosanthes capitata* Vogel," Martinez stated.

"We need to clarify the effects that warming will have on the reproductive phase to detect the possible impacts increased temperatures will have on flowering, pollination, fruit development and other developmental processes of these plants," she said.

In another experiment, the researchers cultivated the forage plant *Panicum maximum* at a temperature 2°C above normal, at a carbon concentration of 600 parts per million (ppm), equivalent to twice the amount there is today, an amount that is expected to be reached by 2050, according to projections from the IPCC.

The researchers found that there was less partitioning of biomass to the leaves relative to the stem of plants cultivated under these conditions.

Similar results were obtained by researchers at the Center for Nuclear Energy in Agriculture (Cena) at the Luiz de Queiroz College of Agriculture (Esalq) of USP, Piracicaba campus in an experiment conducted using *Brachiaria decumbens*, a common grass found on coffee plantations and the major forage plant in Brazil, commonly known as signal grass.

By cultivating the plant in an environment with 200 ppm carbon above current levels in a FACE system set up at the Embrapa Environmental Division in Jaguariúna, in inland São Paulo State, the researchers observed an increase in the production of stems and a decrease in biomass in the leaves of the plant.

"This could have a series of implications for the use of this plant as a forage plant found in over 80 million hectares of Brazilian pastureland," said Raquel Ghini, researcher at the Embrapa Environmental Division and one of the study's authors.

According to the assessment by Martinez, the potential impact of [global climate change](#) on plants used as pastureland needs to be investigated because plants represent the main food source for cattle in countries such as Brazil – one of the only countries in the world that produce meat and milk through the extensive farming of livestock, i.e., through livestock farming in pastures.

If climate change affects the yield of tropical crops and pastureland, there will be significant economic consequences for Brazil and for the world's food production, she said.

"The impacts of [climate change](#) on pasture areas are very serious and are

already occurring," said Martinez. "The solution for cultivating pastures in drought-susceptible areas may be through irrigation or the use of drought-resistant species that can adapt to climate changes," the researcher told.

**More information:** *Environmental and Experimental Botany* [DOI: 10.1016/j.envexpbot.2014.02.001](https://doi.org/10.1016/j.envexpbot.2014.02.001)

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