

Durum wheat can grow successfully in a closed, self-supporting ecosystem

What is this research about?

As part of their research into the possibility of long-term manned space missions, the European Space Agency (ESA) has developed the MELiSSA project (Micro-Ecological Life Support System Alternative). The aim of the MELiSSA project is to design a completely self-sufficient, sealed ecosystem that can recycle wastes, and produce food, water, and oxygen to support human life indefinitely. Essentially, the MELiSSA program is trying to recreate the complex relationships between bacteria, plants, animals, and the physical environment on Earth, but on a much smaller scale. Several different food plants have been suggested as possible components of a MELiSSA life support system, including durum wheat. Durum wheat is prized because of its high protein content and high growth yields (amount of wheat produced per area of land). The strength and flexibility of durum wheat also make it suitable for making pasta. Little research has been done to understand how durum wheat grows in sealed, recirculating systems like those of the MELiSSA project, and how this growth compares to regular field growth.

What did the researchers do?

The researchers chose four different varieties of durum wheat (Avonlea, Commander, Eurostar, and Strongfield), which contained different amounts of gluten (protein found in grains). Each variety was grown hydroponically (grown in liquid nutrient mixtures, without soil) in a sealed chamber. The air temperature, watering, acidity of nutrient mixture, light levels, carbon dioxide concentrations, and relative humidity were all controlled to ensure identical growth conditions. Following the end of the growing period, the wheat was ground up, or milled. Samples were tested to see how much total protein and gluten they contained. The amount of damage due to sprouting (seeds beginning to grow) was also measured.

What you need to know:

There were few differences between the nutrient and gluten contents of hydroponically- and field-grown durum wheat varieties. While Eurostar and Strongfield had higher yields, all varieties contained appropriate levels of gluten protein and were suitable for pasta-making. More research is needed to determine which wheat variety is best for closed life-support systems.

What did the researchers find?

The hydroponic wheat yields were 14% (Avonlea), 41% (Eurostar), and 87% (Strongfield) higher than yields from a regular field. All the varieties had similar fibre contents and nutrient profiles, but Avonlea and Strongfield had higher protein levels compared to Eurostar and Commander. Sprouting damage was higher in the hydroponic wheat than in the field wheat, but this may reflect a problem with the drying process used on the hydroponic wheat. The gluten levels for all varieties were similar in both hydroponic and field conditions.

How can you use this research?

Space scientists can use this research to further their understanding of how grain plants can be included in sealed, recirculating life support systems.

Hydroponic grain producers can use this research to select wheat varieties which grow well under hydroponic conditions.

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