



Biotechnology for Sustainability

What is Nitrogen Use Efficiency?

Nitrogen use efficiency (NUE) relates to the fraction of applied nitrogen fertilizer that is taken up by the plant. As excess fertilizer has a negative impact on the environment, improving a plant's ability to utilize nitrogen is a key component in enhancing sustainability. Various growing practices, including plant rotations and forage production systems, have helped to counteract loss of nitrogen from the agricultural system. However, given that the available nitrogen in the soil changes greatly from year to year, farmers are often hesitant to reduce their fertilizer use and risk lower yields. Today, improved plant breeding through the use of genetic engineering has the greatest potential to produce plants that will utilize fertilizer more efficiently than conventional varieties.

Significance

Plants need nitrogen to grow, develop and produce usable products. Nitrogen is most commonly applied through fertilizers and its use has produced large increases in crop yield. However, nitrogen fertilizers that are not taken up by plants can also have a negative impact on the environment, as the excess nitrogen can contaminate rivers and streams. For example, with cereal crops only about 30 to 40% of the nitrogen fertilizer applied is taken up by the plant. Crops that use nitrogen more efficiently have the potential to significantly enhance agricultural sustainability while reducing negative environmental impacts. Continued research and eventual commercialization of NUE crop varieties will make a critical contribution to the long term sustainability of agriculture and the preservation of non-agricultural lands.

Crops to Watch

Advances in genetic engineering are allowing plant breeders to produce plants with yields that are similar to conventional varieties, but which require significantly less nitrogen fertilizer. In addition to decreasing environmental pressures, these crops offer farmers the opportunity to reduce their nitrogen costs. Once NUE crops are widely available, growers will have a strong incentive to use this technology, which will increase both profitability and environmental stewardship.

RICE – Over 660 million tons of rice were produced worldwide in 2008, providing more than one-fifth of the calories consumed worldwide by humans. Field trials are in progress to test NUE traits in this crop. The results thus far over five growing seasons have demonstrated significant yield improvements over the control variety using much less nitrogen fertilizer.

CORN – Nitrogen is generally the most limiting mineral element for corn producers and is the largest expense for farmers in fertilizing this crop. Commercial plant breeding companies are developing transgenic corn varieties that can maintain or improve yields while requiring reduced quantities of nitrogen fertilizer. Recent predictions show a global opportunity for up to 150 million acres of NUE corn.



UCDAVIS
DEPARTMENT OF PLANT SCIENCES
College of Agricultural and Environmental Sciences

ASPB education
foundation