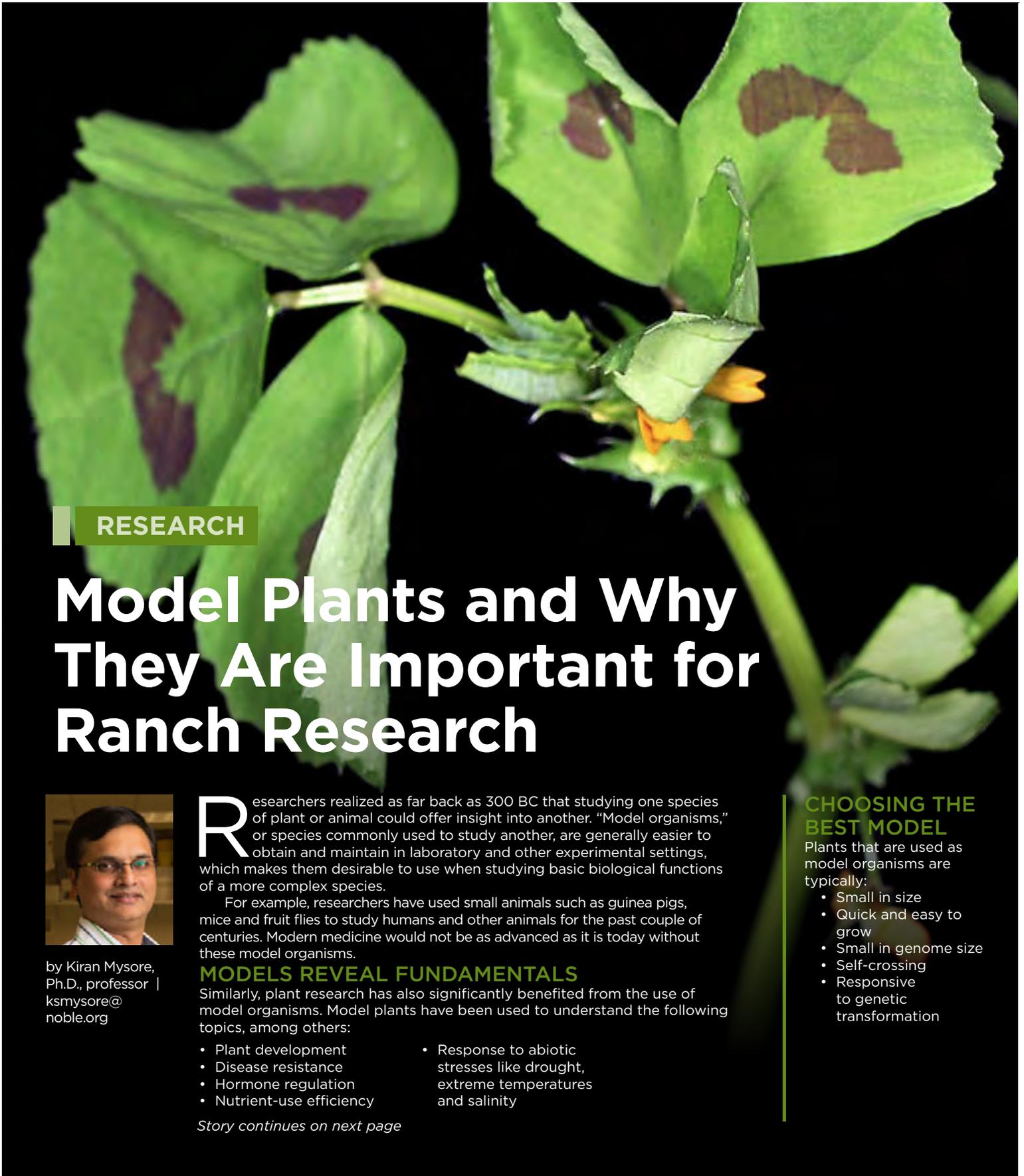


NOBLE NEWS & VIEWS



RESEARCH

Model Plants and Why They Are Important for Ranch Research



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Researchers realized as far back as 300 BC that studying one species of plant or animal could offer insight into another. “Model organisms,” or species commonly used to study another, are generally easier to obtain and maintain in laboratory and other experimental settings, which makes them desirable to use when studying basic biological functions of a more complex species.

For example, researchers have used small animals such as guinea pigs, mice and fruit flies to study humans and other animals for the past couple of centuries. Modern medicine would not be as advanced as it is today without these model organisms.

MODELS REVEAL FUNDAMENTALS

Similarly, plant research has also significantly benefited from the use of model organisms. Model plants have been used to understand the following topics, among others:

- Plant development
- Disease resistance
- Hormone regulation
- Nutrient-use efficiency
- Response to abiotic stresses like drought, extreme temperatures and salinity

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CHOOSING THE BEST MODEL

Plants that are used as model organisms are typically:

- Small in size
- Quick and easy to grow
- Small in genome size
- Self-crossing
- Responsive to genetic transformation

The use of plant models dates back to the 18th century, when Austrian monk Gregor Mendel used green peas as a model to study heredity. Based on experiments done in peas, Mendel discovered the fundamental laws of inheritance, which is the basis of genetic studies in humans, animals and plants.

Several model plant species have been developed and are widely used, however the type of plant must also be taken into consideration when choosing a model. Below I will describe three model plants used at Noble Research Institute, each representing a different type of forage we study: broadleaf plants (forbs), monocots (grasses) and legumes.



ARABIDOPSIS THALIANA

Arabidopsis thaliana (commonly known as thale cress) is a broadleaf eudicot plant belonging to the mustard family. It is one of the most popular and widely used models to study plant biology. Lately, it has even become a model to study biochemical and molecular processes involved in human diseases.

Excellent genomic and genetic resources have been developed for this model plant. In 2000, it became the first plant species ever to have its complete genome (set of genes) revealed.

One of the reasons *Arabidopsis* became popular is due to the availability of a large collection of gene knockout lines that is useful for determining gene function. This was mainly possible due to the establishment of a high throughput transformation system. More than 70,000 research articles published to date include experiments done in *Arabidopsis*.

Due to excellent resources available to study *Arabidopsis*, researchers at Noble Research Institute use *Arabidopsis* to study basic science pertaining to plant growth/development, plant disease resistance, abiotic stress, etc.

A STEP IN DELIVERING PRACTICAL SOLUTIONS

The use of model plants is critical to advancing plant research, which, for us at Noble, is ultimately about learning more about how plants interact with their environments and using that knowledge to develop new tools for ranchers to use when



BRACHYPODIUM DISTACHYON

Brachypodium distachyon (commonly known as purple false brome or stiff brome) is a monocot (grass) that uses C3 photosynthesis similar to cool-season grasses, such as wheat and tall fescue. When compared to other grasses that provide food and forage, *Brachypodium* is smaller and has a small/simple genome and short life-cycle. These factors make it an excellent model for cool-season grasses.

Since *Brachypodium* is a relatively new model species, many genomic and genetic resources are still being developed. Noble Research Institute is contributing to the development of these resources so that they can be used to study cool-season grasses more robustly.

regenerating the health of the land and to increase their profitability.

While most well-known forage and crop plants have very complex and big genomes, model species are simpler. This allows for easier, less time-consuming research that can be later translated into the plants grown by farmers and ranchers, enabling us to get practical solutions into their hands. 🐮



MEDICAGO TRUNCATULA

Medicago truncatula (commonly known as barrel medic) is a clover-like plant that has been developed as one of the models to study legumes. Legumes are plant species that can form symbiotic relationships with a bacteria called Rhizobia to fix atmospheric nitrogen. Growing legumes can decrease or eliminate application of nitrogen fertilizer, thus reducing nutrient runoff, greenhouse gas production and input costs while contributing to regenerative ranching.

M. truncatula is closely related to alfalfa, which is referred to as the queen of forages. Noble Research Institute contributed significantly to developing *M. truncatula* as a successful model by initiating genome sequencing project and developing a large collection of gene knockout lines that are used by many researchers worldwide to study gene function.

Other legumes that could be studied using *Medicago* as a model include species used as cover crops or in multispecies grazing, such as hairy vetch, clovers and peas.