NRI research highlights

NATIONAL RESEARCH INITIATIVE COMPETITIVE GRANTS PROGRAM

United States Department of Agriculture

Cooperative State Research, Education, and Extension Service

2004 No.4

New Fertility Test Yields Practical and Research Benefits

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Artificial insemination (AI), the collection, storage, and dispersal of semen from superior male animals to breed large numbers of females worldwide, has improved the health, genetic potential, and productive efficiency of several livestock species. Without the male present, the spread of infectious disease is reduced drastically. A male pig can breed fewer than 200 females per year naturally, but with AI over 1,500 can be bred, speeding genetic improvement many-fold. Using AI dairy bulls from high-producing lineages has more than doubled U.S. milk production per cow since the 1950s and reduced consumption of resources such as land, labor, machinery, and fuel per gallon of milk.

Semen quality testing is critical because each male is frequently bred to many females. However, current knowledge is limited. Existing technology examines fertility related to the number and motility (movement) of sperm. Infertility from another cause is discovered only when semen is used and females do not become pregnant. Non-pregnant females are at risk of long-term health problems such as obesity, resulting in increased labor and veterinary costs, in addition to lost production.

With grant support from USDA's National Research Initiative, researchers at the University of Illinois are finding clues to how a sperm binds to an egg, or ovum. In mammals, fertilization begins when a sperm protein binds to protein receptors on the egg.

The research team discovered this sperm protein in many important agricul-

CREDIT

SPERM BOUND TO OVA ARE COUNTED MANUALLY USING A MICROSCOPE THAT CAN DETECT THE SPERM STAINED RED OR GREEN (INSET)

"Researchers at the University of Illinois developed a unique, competitive semen fertility test that does more than simply count sperm"

tural species that use AI, and suspects it could help explain fertility problems.

To study these proteins and the ability of sperm to bind to eggs, or ova, they created their own test. Samples of sperm from two males were stained red or green, and mixed together with ova in the same test tube to "compete" for and bind to them. By counting the number of red or green sperm bound to the ova under a microscope, researchers can see which sperm are more fertile. More fertile sperm are more abundantly bound to the ova. This new competitive test of fertility may be important to farmers and semen vendors.

The unique test does more than simply count sperm; it evaluates how well sperm actually do their jobs…binding to the ovum. It checks multiple semen samples simultaneously, increasing test power and speed, eliminating normal variations in individual tests, and improving reproducibility of results. Different semen samples are easily identified using colored dyes. Semen with plenty of sperm, but low in fertility, can be identified in the laboratory and discarded, rather than discovering it is poor after its use.

The test is also enabling the research team to understand why sperm are fertile or not, and to compare characteristics of high-fertility sperm and defects of low-fertility sperm. They found more sperm proteins involved in fertilization than first suspected. Work is ongoing to identify these other proteins, leading to molecular tests of their abundance and function. Soon, molecular defects that cause low fertility could be identified and therapies to alleviate them developed.

Impact

Artificial insemination improves the health, genetic potential, and productive efficiency of livestock while conserving land, labor, and fuel. University of Illinois researchers developed a unique, competitive semen fertility test that does more than simply count sperm. The new test could enable the elimination of low-quality semen before it goes to market, saving time and money for farmers and semen vendors. Further research examines fertility on a molecular level, and could lead to development of easier, practical, and more accurate fertility testing methods; higher quality semen on the market; therapies to improve fertility; and greater success and use of artificial insemination.

The research reported in this factsheet was sponsored by the Plant Genome Program of the Plants Division of the National Research Initiative Competitive Grants Program. To be placed on the mailing list for this publication or to receive additional information, please contact the NRI (202-401-5022 or NRICGP@reeusda.gov). The factsheet also is accessible via the NRI section of the Cooperative State Research, Education, and Extension Service website (http://www.reeusda.gov/nri).

March 2004