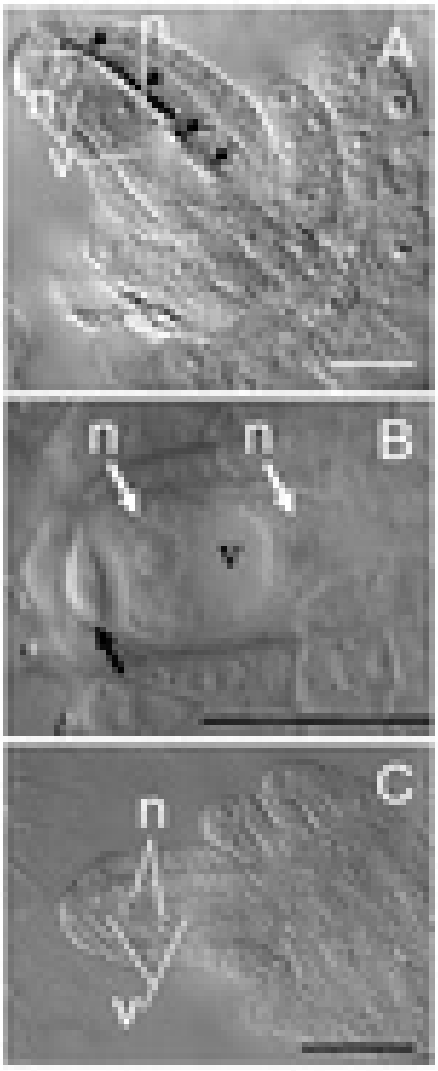
Methods for Inducing Sexual or Apomictic Reproduction

12/13/2024



Methods for Inducing Sexual or Apomictic Reproduction

Biotechnology & Life ScienceSeeds

Abstract

This technology enables crop hybrids to clone themselves through their own seed. It has the potential to disrupt the trillion dollar commercial seed industry by cutting seed production costs by 80% for crops currently produced as hybrids and enabling the commercial seed production of for superior hybrids of crops currently grown as important inbred varieties world crops. Hybridity will increase yields of such crops by 15-50%, opening the door to enhanced global food security.

Problem

Seed inbreeding decreases vitality. ybridization studies prove that inbred crops yield far below their genetic yield potentials.

Solution

Through gene expression profiling experiments and pharmacological studies, we can switch sexually reproducing plants to reproduce asexually, and vice versa.

Value Proposition

Decrease seed production costs, enable superior hybridity, increase yield and vitality, enhance global food security.

Benefit

Since the days of the Egyptian Pharaohs, people have known that inbreeding decreases vitality. However, today's crop breeding practices - including those used to develop hybrids -rely on long-term episodes of repeated inbreeding and single seed descent (which often takes 8-10 years) to achieve crop uniformity. For sexual crops, plant-to-plant uniformity is achieved in no other way. Today, yields are limited to what can be achieved by a single highly inbred genotype for inbred crops or by two (sometimes four) highly inbred genotypes for hybrid crops. Hybridization studies prove that inbred crops yield far below their genetic yield potentials and unfortunately, it currently remains economically impossible to produce commercial quantities of hybrid seed for inbred varietal crops.

Because there are many thousands of plant and animal species that can reproduce both sexually and asexually, the inventors hypothesized that the capacity to switch

between sexual and asexual reproduction remains imbedded in their genomes but has mostly been silenced. Through gene expression profiling experiments and pharmacological studies, metabolic and molecular regulators that reactivate sexual/asexual switching have been identified and procedures have been developed to switch sexually reproducing plants to reproduce asexually and asexually reproducing plants to reproduce sexually (Mateo de Arias et al., 2020; patent pending).

The use of this technology has already been proven successful in inducing apomeiosis (the first step of asexual seed formation) in multiple sexual plants, including maize, soybean and cowpea, through carefully timed pharmacological treatments applied laboriously in laboratory settings. The inventors suspect that the high penetrance needed for commercial seed production coupled with mechanisms to induce sexual seed formation for breeding will require genetic engineering. These transformation studies are underway.

This technology will remove uniformity-by-inbreeding requirements, thus enabling breeders to achieve full hybrid superiority for major world crops (without inbreeding constraints). Thus, it will allow seed companies to produce commercial quantities of seeds of their new, uniquely superior hybrid creations at much lower costs. Sexual crops could be engineered to reproduce asexually for uniform clonal seed production except when chemically induced to reproduce sexually for genetic recombination and selection purposes. The expected yield improvements worldwide are great enough to enhance global food security.

Market Application

This technology can be adapted one crop at a time and is most ideal for use in adapting the major world crops (corn, wheat, rice, soybean, cotton, etc.) to achieve crop uniformity and increase yield and vitality. Once fully implemented, this technology has the potential of revolutionizing food, feed, fiber, and timber production globally.

Inventors

John G. Carman

USU Department: **Plants, Soils & Climate**

Developed in cooperation with:
Autonomous Solutions, Inc.

Funding

This invention was made with government support under 70NANB4H3039 awarded by NIST. The government has certain rights in the invention.

USU Reference No. C17013

Publications

- Mateo de Arias, M.; Gao, L.; Sherwood, D.A.; Dwivedi, K.K.; Price, B.; Jamison, M.; Kowallis, B.; Carman, J.G. Whether gametophytes are reduced or unreduced in angiosperms might be determined metabolically. Genes 2020, 11, 1449, doi:10.3390/genes11121449

Intellectual Property

Date: Feb 11th, 2019
Number: 11,820,994

U.S. Patent No. 11,820,994 issued Nov. 21, 2023, entitled “Methods of Inducing Apomictic or Sexual Reproduction”. Pending Continuation-in-Part U.S. Patent Application published September 9, 2021 as US2021/0277408A1