COTTON Innovate

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Apomeiosis a treasure for creating haploids in Plants

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Plants are reproduces through either of these three modes namely (i) self-pollination (ii) cross pollination and (iii) vegetative propagation, all flowering plants can choose between no less than above three mechanisms. These methods effect the variation and evolution of flowering species. Perennial plants diligently evolved to use a combination of all three modes to sustain their reproductive strategy to survive in changing ecological circumstances. Consequently, a propensity for asexual reproduction, apomixis, is a major feature of many flowering plant lifestyles. Apomixis is a reproductive mechanism that bypasses the sexual process and allows a plant to clone itself through seed. Meiosis is a key process in all reproductive plants that ensures proper genome distribution and fertility and creates genetic diversity through variation resulting of recombination between two sisters chromotids. Apomixis composed of three different phenomena namely apomeiosis, parthenogenesis, and functional endosperm development. Apomixis involves the production of unreduced female gametes (diploid) that retain the genotype of the parent (apomeiosis), followed by parthenogenetic development of the egg cell into an embryo and the formation of functional endosperm. The molecular mechanisms underlying apomixis are not understood clearly till now. The unreduced female gametes fully retain parental heterozygosity across the genome, which is characteristic of apomeiosis. The alteration of a single gene in a sexual plant can bring about functional apomeiosis, a major component of apomixis. Apomixis should be inducible in crops where meiosis could be switched on when new variation is needed and switched off when the best results are to be maintained.

Manipulation of Genes involved in apomeiosis

Genes that are expressed during embryo sac development, and thus putatively involved in differentiating sexual from apomictic pathways, are piquing our interest. An embryo sac develops through megaspore mother cell (MMC) differentiation, meiosis, determination of the functional megaspore, and embryo and endosperm development. Because meiosis is either completely bypassed (apospory) or extremely altered (diplospory) in apomixis, genes related to female sporogenesis are thought to be more specifically involved in diplosporic apomixis, and genes involved in embryo sac cell identity are presumably crucial for aposporic apomixis. Overall, genes associated with female gametogenesis and egg cell development are likely shared between sexual and apomictic pathways.

The greatest impact of apomeiosis may be realized by cloning and inserting the genes controlling apomictic reproduction into various sexual species by molecular methods. To be useful, a transferred gene must express itself and be stable in an alien genome. The gene controlling apomeiosis needs to be mapped before it can be cloned and used in other species. Few successful genes were identified for apomeiosis. In case of multiple archesporial cells genes namely MAC1 (maize), MSP1 and TDL1A (rice) were involved, while in diplospory-like (switch/turning meiosis into mitosis) mechanism genes viz., DYAD/SWITCH (SWI) and MiMe (SPO11-1, REC8 or SYN1 and OSD1 or TAM1)(arabidopsis) were responsible. Genes function as restitutional meiosis leading to diplospory-like were Elomgate (el1)(Maize), AGO104 (Maize), MOB1 (alfa alfa), DMT102 and DMT103(Arabidopsis). While in case of apospory-like (aposporic initials and embryo sacs) mechanism genes namely AGO9, RDR6, SGS3 and MNEME (MEM) (arabidopsis) were involved.

Successful example of apomeosis induction in cultivated crops

MiMe (Mitosis instead of Meiosis) in Rice

In *Arabidopsis MiMe* (*Mitosis instead of Meiosis*) genotype, in which meiosis is turned into a mitotic-like division, associated with both high fertility and production of clonal diploid gametes at a very high frequency . *MiMe* is the combination of mutations in three genes (*SPO11-1*, *REC8* and *OSD1*), each mutation impairing one of the three main processes that distinguish meiosis from mitosis. Meiosis in *MiMe* occurs without recombination and distributes sister chromatids in a single round of division, mimicking a mitotic division. Production of clonal male and female gametes which leads to doubling of ploidy at each generation when self-fertilization done. Crossing a *MiMe* plant as male or female with a normal line whose genome is eliminated following fertilization (lines expressing modified CENH3(Ravi and Chan, 2010) leads to the production of clonal generation. Using this MiMe gene combination, Mieulet et al. (2016) turned the meiosis into mitosis in Rice. This leads to the possible exploitation of these genes in other crops also.

Scope of Apomixis in Agriculture

Introgression of apomixis from wild relatives into cultivated crops and transformation of sexual genotypes into apomictically reproducing genotypes are dream come reality in plant breeding. Plant Breeders trust that the introduction of apomixis into agronomically important crops will have greater implications for agriculture. The potential benefits of harnessing apomixis are many and vary from full exploitation of heterosis by reusing the best hybrids into clonal propagation of the superior genotypes in seed propagated outcrossing crops. The impact of apomictic crops in agriculture would be massive in this gene revolution era.

Reference

Mieulet, D., Jolivet, S., Rivard, M., Cromer, L., Vernet, A., Mayonove, P., Pereira,L., Droc,g., Courtois,B., Guiderdoni,E. and Mercier, R. 2016. Turning rice meiosis into mitosis. *Cell Research*, **26(11):** 1242-1254.

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Newspaper coverage

कम पानी में कॉटन तैयार करने के लिए किया जाएगा कार्य

जागरण विशेष

महेंद्र सिंह मेहरा, सिरसा

केंद्रीय कपास अनुसंधान संस्थान सिरसा के वैज्ञानिक पांच साल तक कम पानी में ही कॉटन पैदा करने के लिए शोध करेंगे।

फसलों में सिंचाई पानी के अभाव में हर साल किसानों को परेशानी झेलनी पड़ती है। आगे भी पानी के संसाधन कम होते जा रहे हैं। कॉटन की खेती को तैयार करने में अधिक पानी की वजह से दायरा घट सकता है। इसी को लेकर केंद्रीय कपास अनुसंधान संस्थान, सिरसा ने कॉटन की फसल को कम पानी में तैयार करने के लिए प्रोजेक्ट तैयार किया गया है। केंद्र के वैज्ञानिक पांच साल कम पानी में कॉटन पैदा करने के लिए शोध करेंगे।

सिरसा का कॉटन उत्पादन में है रिकॉर्ड : सिरसा जिले का नाम देशभर में कॉटन के उत्पादन में भी प्रदेश में टॉप है। जिले में कॉटन की 2 लाख 8 हजार हेक्टेयर पर बिजाई की जाती है। जिले में वर्ष 2012-13 में 48 लाख क्विंटल की आवक हुई थी जो अब तक का रिकॉर्ड है। हालांकि उसके बाद सिरसा जिले में नरमा कपास उत्पादन में निरंतर गिरावट भी दर्ज हुई है। वर्ष 2011-12 में 37 लाख क्विंटल, 2013-14 में 33 लाख, वर्ष 2014-15 में 24 लाख के करीब आवक हुई थी। जबकि वर्ष 2015-16 में 30 लाख के करीब आवक हुई।

पहले साल 20 फीसद पानी की की जाएगी बचत

केंद्रीय कपास अनुसंधान केंद्र के वैज्ञानिक कम पानी में कॉटन की फसल तैयार करने के लिए कार्य किया जाएगा। केंद्र के वैज्ञानिक कॉटन की यू आकृति मेड में बिजाई की जाएगी। इसके बाद सिंचाई मेड के अंदर सिंचाई की जाएगी। इससे सिंचाई पानी कॉटन के पौधों में जड़ तक जाएगा। इससे प्रथम साल के अंदर 20 फीसद तक पानी की बचत होगी। इसके बाद प्रतिवर्ष कॉटन का उत्पादन देखा जाएगा।

अवशेष को मिलाया जाएगा भूमि में

कॉटन की फसल उत्पादन लेने के बाद गेहूं, जौ, सरसों, चना, ग्वार की बदल-बदल कर बिजाई की जाएगी। इसके बाद फसलों के अवशेष को मिलाया जाएगा। इससे भूमि की उपजाऊ शक्ति बढ़ेगी। इन फसलों में सिंचाई कम मात्रा में की जाएगी। क्योंकि फसल में सिंचाई पानी का अभाव हो रहा है। जिससे समय पर सिंचाई पानी उपलब्ध नहीं होने से उत्पादन भी घट जाता है।

केंद्रीय कपास अनुसंधान केंद्र में कम पानी में कॉटन की फसल तैयार करने के लिए कार्य किया जाएगा। जिसके लिए कॉटन की फसल कम पानी में तैयार करने के लिए प्रोजेक्ट तैयार किया गया है। जिसके तहत कम पानी में फसल तैयार करने के लिए शोध किया जाएगा।

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