Using genetic markers to identify the Abnormal 10 chromosome in Southwest Maize Collections, and conveying the importance and meaning of its presence to the Native Americans who utilize native races of maize

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Abstract

Through its meiotic drive, or segregation distortion activity, the maize (corn) Abnormal 10 (Ab10) chromosomes may diminish and revise the genetic diversity or characteristics of maize, a spiritual and economic stalwart for Native Americans in the Southwestern United States.

Using SSR (single sequence repeat) molecular markers, the work described here will enable researchers to identify the presence of the Ab10 chromosome in maize to determine whether its presence threatens to alter the genetic profiles of conserved seed stocks. In addition, markers developed for this project can also be used to determine whether supplies of maize seed that are maintained by the North Central Regional Plant Introduction Station closely resemble the ancestral seed stocks that have been lost to Indigenous Southwest peoples. If so, repatriation of those nations' seed stocks will be made possible.

Potentially of even greater importance is a need to relate to the Southwest Indigenous people the importance of this genetic testing. Native Americans have long enjoyed a connection with aspects of nature including food that play an important role in the separate physical, mental and spiritual constructs of each Indigenous society. Food is utilized in their ceremonies - which are unique to each tribe and yet their similarities define and characterize the masses of Native American societies as distinct nations with an affinity for working with nature and not against it - as a means of both prayer and thankfulness. It must be conveyed to the Native Americans that research such as that described here does not constitute "meddling with nature" or to be misconstrued as affecting the spiritual balance of their association with nature to produce new and better versions of their sacred corn. The objectives of the experiments described here are identification and description so that the seed supplies can be maintained, repatriated if necessary, and then made available for future generations. In this manner, the spiritual basis, background, and means to perform the ceremonies, which have been passed down from their ancestors, can persist.

Grandsons may therefore continue to stand in the footsteps of their grandfathers, and see with their own eyes the wonders witnessed by the old ones.

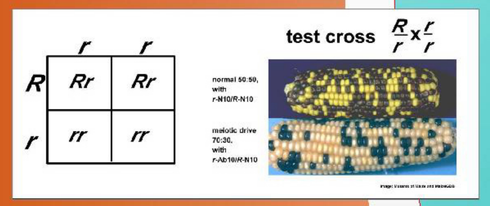


Fig. 1: If left unchecked, the Ab10 abnormal chromosome could eventually displace the N10 normal variant.

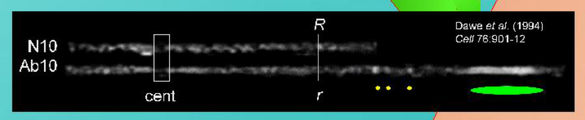


Fig. 2: Ab10 is longer than the N10 chromosome and the knobs which exist within the extra length act as a neocentromere to provide a distinct advantage for Ab10 during meiosis.

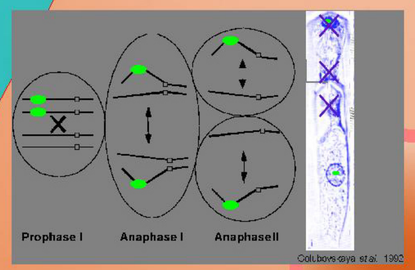


Fig. 3: Ab10, with the assist of the knobs, streaks to the favored spot to ensure that it will prevail as the egg.

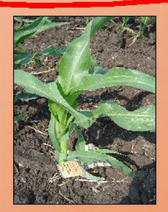


Fig. 4: A known Ab10 test subject grown to aid in identifying the abnormal chromosome.

Fig. 5: Collecting leaf samples for study in the lab.

Fig. 6: Preparing leaf samples for PCR analysis.

Background and Information

Maize leaf samples were collected at the North Central Regional Plant Introduction Station (NCR-PIS). These were taken back to the lab where the DNA samples were extracted then diluted. REDExtract-N-Amp PCR (Polymerase Chain Reaction) was added to two samples from each of 10 accessions in 10 microliter solutions. The SSR markers 4, 5, and 6 (forward and reverse primers) were also added. These 20 samples, along with five inbred control samples, were analyzed for simple sequence repeats using a PCR machine where a series of temperature increases (up to 94 °C) were alternated with cool down periods (as low as 45 °C) forcing the double-stranded DNA to separate allowing the primers to anneal to the strand, then the new copy is extended. This causes the section of DNA where the repeat is located to be amplified to about 68 billion copies. Once these samples are done, they can be run through an electrophoresis machine where an electrical current will carry the DNA fragments through a 4% agarose gel.

Once the gel images are photographed, such as the ones to the right, they can be compared in the hopes of finding a marker that will identify Ab10.

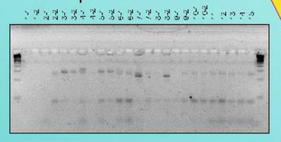


Fig. 7: Gel image for SSR-4.

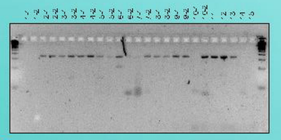


Fig. 8: Gel image for SSR-5.

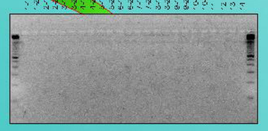


Fig. 9: Gel image for SSR-6 (SSR6 did not amplify).

Accession	Description of Genotype and Background	Ab10 Present?
1-1 sample 1-2 sample	**C1 r1 N10 homozygous** (Dawe lab; JM 9 sib W23)	No
2-1 sample 2-2 sample	**R1 Ab10-I/r1 N10** (Dawe lab; JM 2-3 x 1-2 backcrossed 9x to W23)	Yes
3-1 sample 3-2 sample	**R1-nj N10/r1 N10** (Dawe lab; CL04AI 9-2 W23)	No
4-1 sample 4-2 sample	**R1-st N10/r1 N10** (Dawe lab; CL04AI 13-1 W23)	No
5-1 sample 5-2 sample	**C1 sh1 wx1 R1 K9S-I Ab10-I homozygous** (stock ID 905D, mongrel background)	Yes
6-1 sample 6-2 sample	**r1 Ab10-I** (stock ID X16B, mongrel backgound)	Yes
7-1 sample 7-2 sample	**R1 Ab10-II / r1 N10** (stock ID X16F, mongrel background)	Yes
8-1 sample 8-2 sample	**r1 Ab10-II / r1 N10** (stock ID X16E, mongrel background)	Yes
9-1 sample 9-2 sample	**R1 N10/r1-x1 in W22** (Weber lab; CL04AI 19-2)	No
10-1 sample 10-2 sample	**R1 N10/r1-x1 in W22** (Weber lab; CL04AI 19-2)	No
11 sample	**H99** inbred control	No
12 sample	**B73** inbred control	No
13 sample	**Mo17** inbred control	No
14 sample	**Tx303** inbred control	No
15 sample	**CO159** inbred control	No

Table 1: Maize accessions and their backgrounds.

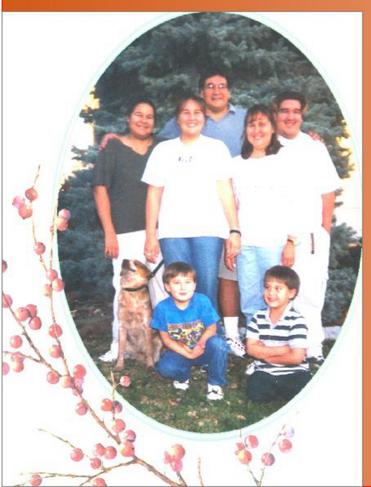
Conclusions

Of the thirteen SSR's analyzed in this experiment, none seemed to help identify Ab10. There are other SSR's that might hold more promise for researchers in their attempts to isolate the Ab10 chromosome.

In any event, the search for a marker a to identify the Ab10 allele must continue so that it can be picked out and potentially controlled.

About The Author

I am a senior at Haskell Indian Nations University in Lawrence, Kansas. But my life's journey began in a land far, far away with people of my core tribe, the Minneconjou band of the Lakota in the great plains region of South Dakota.



After being spirited away to Rapid City, S.D., my hometown during my youth and most of my adulthood near the beautiful Black Hills, I met my wife Cynthia (second from the right) who it turns out is half-Yupik Eskimo. We began our own multi-cultural clan, the T-Tribe.

To save the viewer from a long and boring review of my life, one only needs to know that the people in the T-Tribe constitute the most important individuals in my life, and possibly the best contributions I can make to the human race as a whole.

Kneeling l-r: Rocky, Jacob, Joseph. Standing: Jessica, Jerica, Delbert, Cynthia and Joshua.

Acknowledgements

Many thanks must be given to many people for this truly eye-opening experience. For the people who funded and administered this opportunity: the National Science Foundation; the George Washingon Carver Internship Program and Iowa State University

Credit must also be given to all of the dedicated individuals at the NCR-PIS.

It goes without saying, but will be said anyway, that Candice Gardner and Carolyn Lawrence, with an assist from Von Mark Cruz, have provided a wonderful chance for Native American students to learn in the best possible way for us, with our hands and our minds tuned in so our spirits can learn.

And finally, to my second set of five kids. Kneeling l-r: Nate and Regina. Standing: Alexandra, Delbert, Titus and Sharon.

Reference Materials

Dawe, R. Kelly. "Plant neocentromeres: fast, focused and driven." Chromosome Research 12 2004: 655-669.