

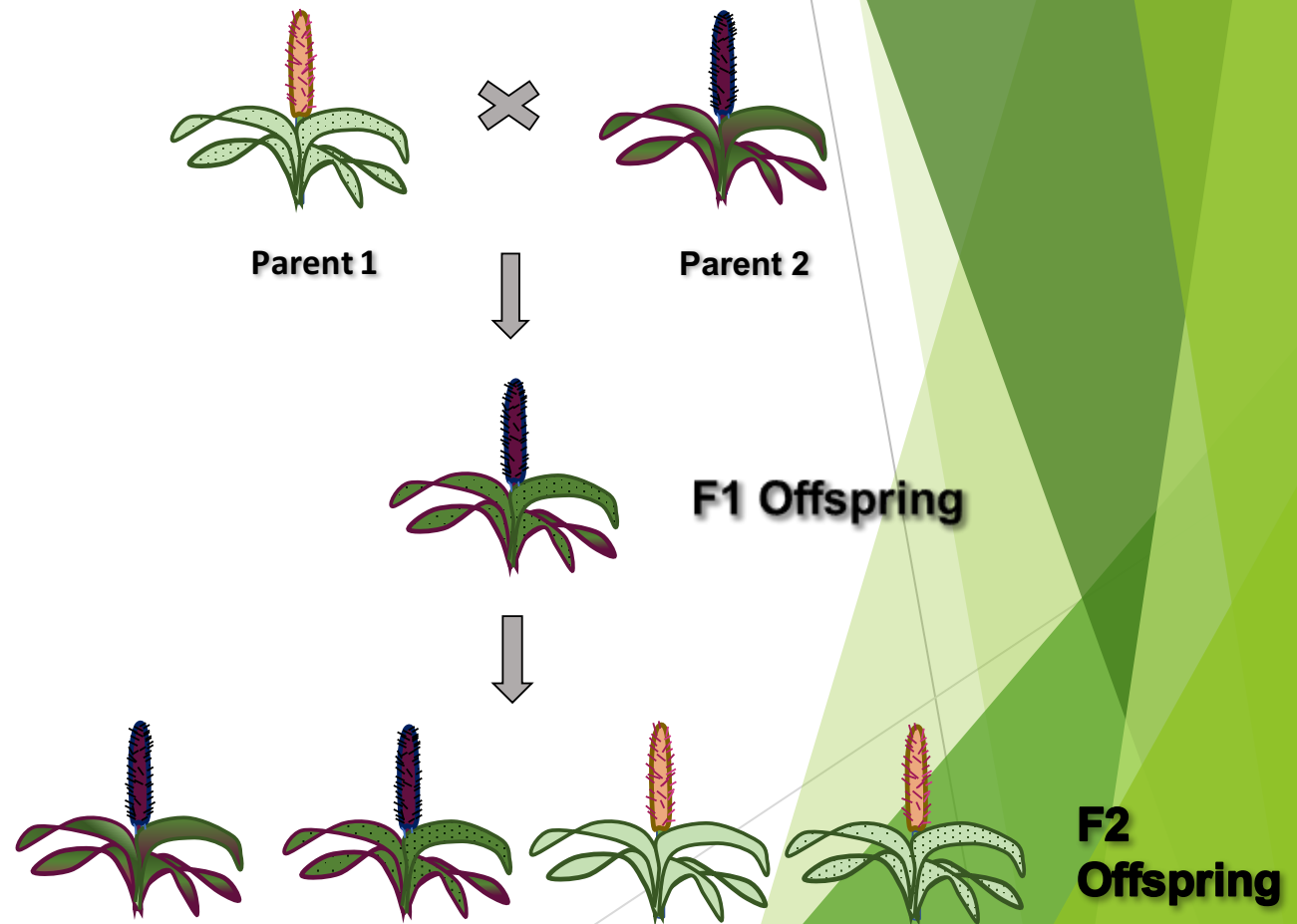
Ornamental Pearl Millet: An Introduction to Plant Breeding

By: Alyssa Converse



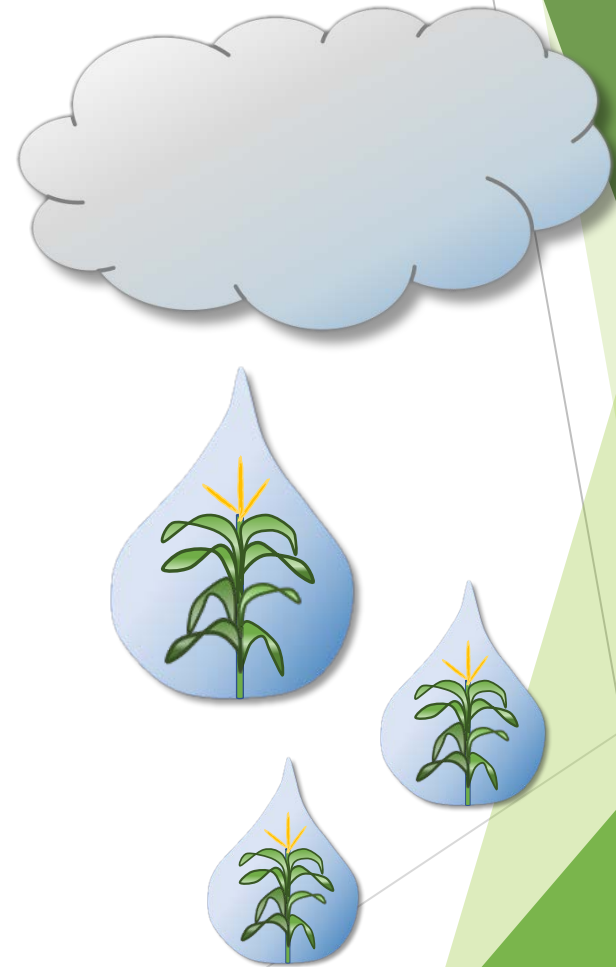
What is modern plant breeding?

- ▶ Two parent plants with the desired characteristics are cross pollinated. If the cross is successful, then the first offspring will be produced, called F1's (F= filial)
- ▶ Self pollination of the F1 offspring produces the F2 offspring. Here we begin to see segregation of different traits
- ▶ Utilized by gardeners, farmers, biotechnology companies and individuals
- ▶ Biotech companies, such as Monsanto and Syngenta, use technology to modify specific genes. This is where the term GMO (genetically modified organism) comes from



Global Importance

- ▶ 9.8 billion worldwide population projected for 2050. Plant breeding will be necessary to feed everyone on Earth
- ▶ Selecting for specific traits in agronomic crops can increase yield by reducing pest damage and increasing disease resistance, drought tolerance, production sustainability
- ▶ Climate change: plant will need to adapt as drought and flooding events become more frequent. Conserving water while maintaining or increasing yield will be crucial



Background on Pearl Millet

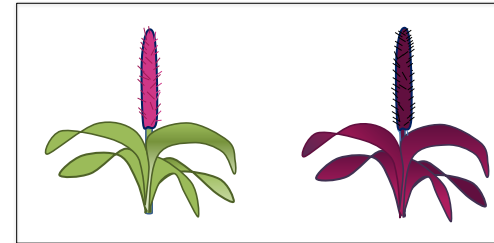
- ▶ Ornamental Pearl millet (*Pennisetum glaucum*) is an annual, monocotyledonous plant used in landscapes and gardens across the world
- ▶ Developed as an ornamental at UNL within the last 25 years. Thrives because does not require a lot of water or fertilizer
- ▶ Pearl millet as an agronomic crop has been cultivated for thousands of years. Largely grown in arid regions like Africa and South Asia where rainfall, soil moisture and nutrient availability are low
- ▶ Subsistence farming of the crop provides food, feed and fuel



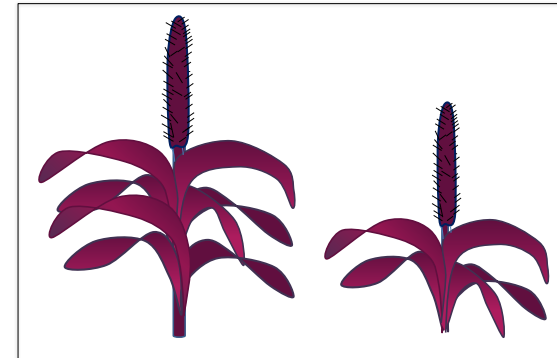
Breeding for Ornamental Purposes: Pearl Millet

- ▶ To develop ornamental cultivars of pearl millet, various traits are selected
- ▶ Varying foliage color, height and head characteristics achieve different overall aesthetic
- ▶ Traits of this study are trichomeless vs trichomes, virescent vs green foliage and purple leaf margins
- ▶ Trichomeless trait does not have aesthetic relevance. Could be used to improve plant performance as an ornamental, agronomic crop and forage
- ▶ Tr gene has been shown to increase insect resistance and palatability for cattle

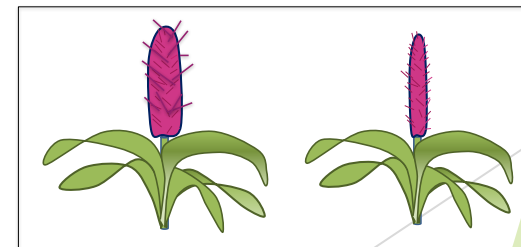
Foliage color



Height



Head characteristics



Ornamental Pearl Millet Cultivars



Purple Majesty



Jade Princess (center)



Purple Baron

Punnett Square: Representation of Gene Segregation

	T	t
T	TT	Tt
t	Tt	tt

	T	T
t	Tt	Tt
t	Tt	Tt

Experimental Design and Methods

- One of the parents (14B) has virescent and purple leaf margins
 - Seed heads are bigger, have bristles
- The other parent (Tr) has trichomeless trait
 - Green, taller, has wider canopy, shorter seed heads without bristles
- F2 offspring were planted in several rows plus one row of F1 offspring and one row of each parent for trait comparison
- Seedlings were watered once daily, given full sunlight in the greenhouse
- After germination and 2 inches of growth, plants were evaluated for purple margin, virescent, trichomeless traits
- Replicated in a second trial



Pictures of Millet in Greenhouse & Field



Trichomeless (Tr) parent

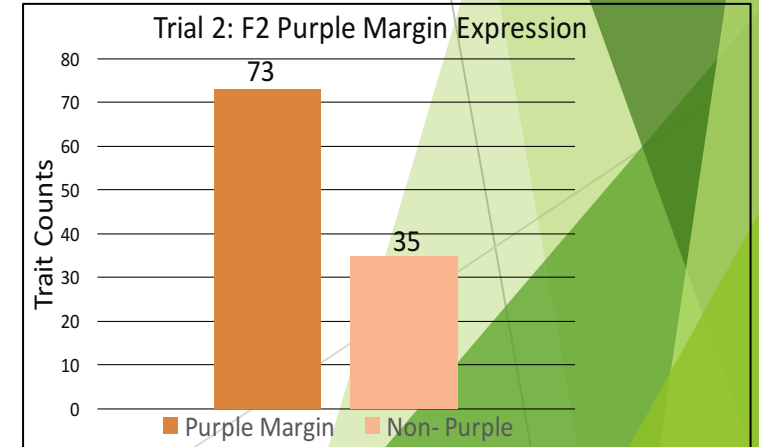
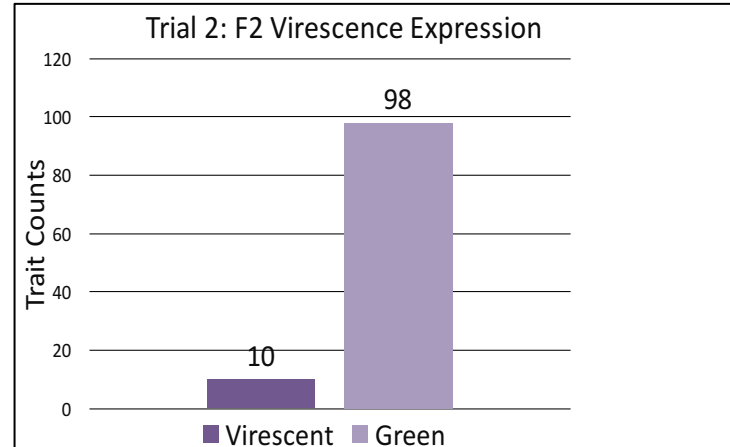
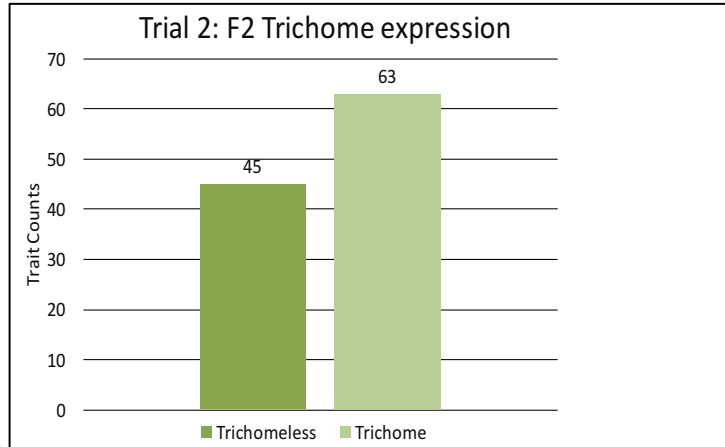
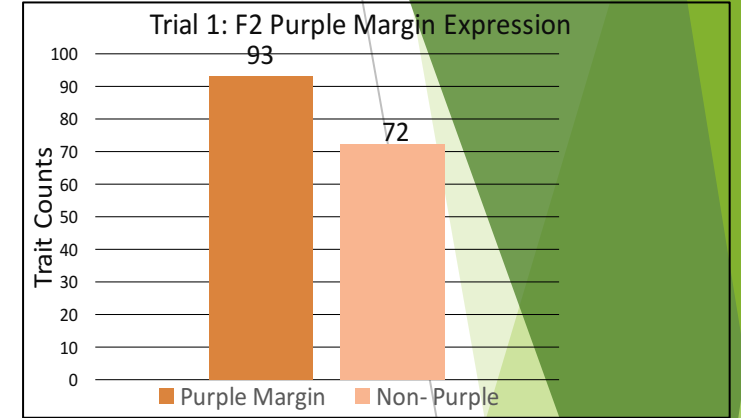
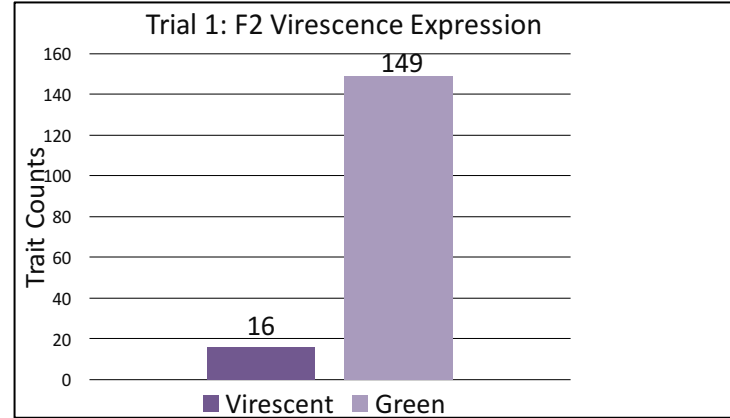
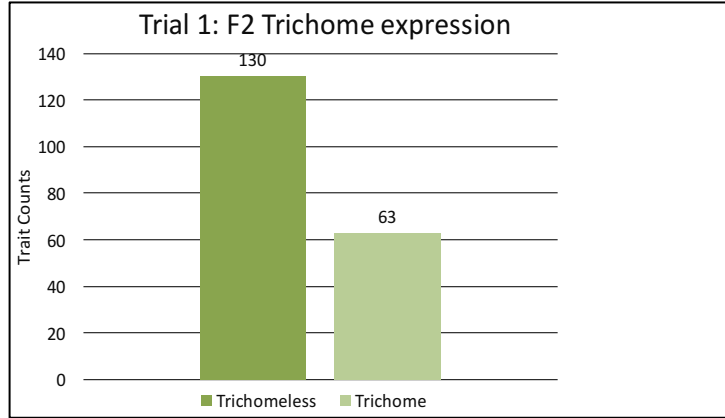


14B parent



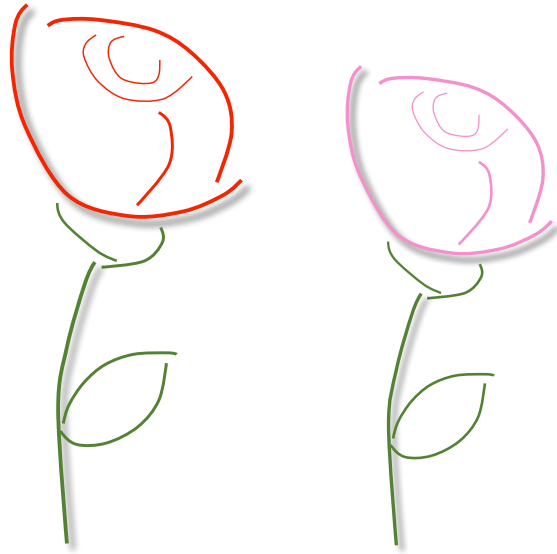
F2 Offspring

Results of F2's



Application: Punnett Square Example

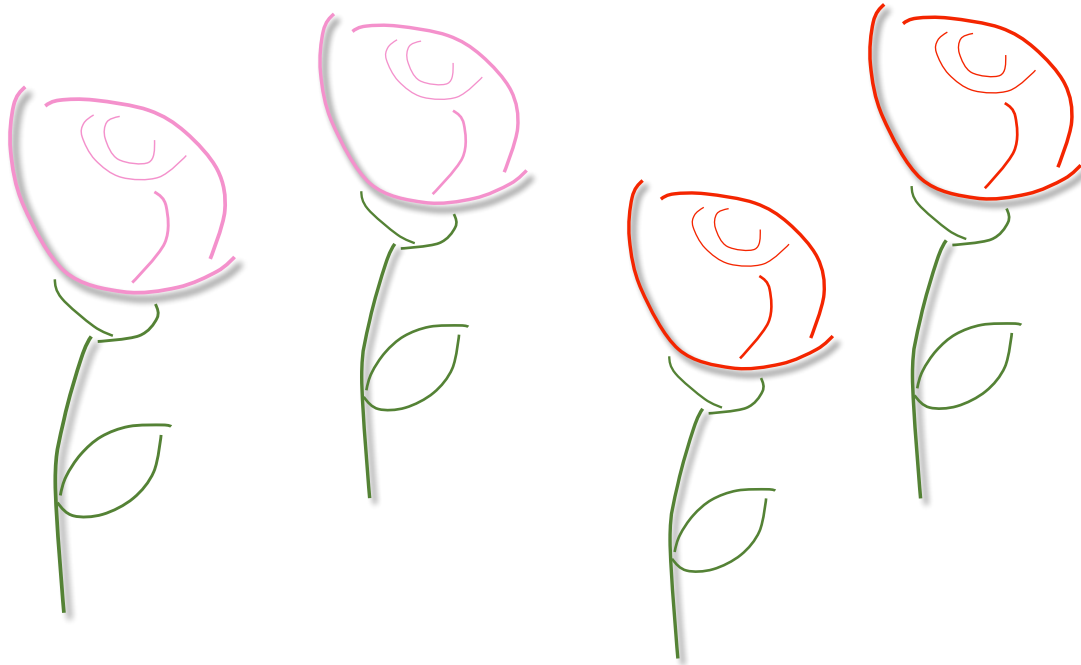
- ▶ A breeder wants to cross pollinate two rose plants of the same species which exhibit different colors, red and pink. The red parent plant (dominant color) is heterozygous for red. The other pink parent plant, carrying the recessive pink trait, is homozygous for pink. If these two parents are crossed, what ratio of pink to red offspring will be expected?



	R	r
r		
r		

Application: Explained

- ▶ The traits would segregate in a 1:1 ratio, with half of the offspring expressing the dominant red heterozygous trait and the other half expressing the recessive pink homozygous trait.



	R	r
r	Rr	rr
r	Rr	rr

Plant Breeding as a Career

- ▶ Plant breeding is a very diverse subject that can lead to many interesting, rewarding careers
- ▶ Breeding needed for almost every marketable plant that is sold today, from house plants to flowers to fruits and vegetables sold in grocery stores
- ▶ Gain capability to improve people's lives all around the world, especially in third world countries where improved agriculture is a matter of life or death
- ▶ To pursue a career in plant breeding, common degrees that can be pursued at the collegiate level include horticulture, plant biology, plant sciences, and agronomy
- ▶ All of these degrees are offered at UNL and many different universities across the country



Career Example

▶ Research Associate

- ▶ Education requirement: Bachelor's, Master's and Doctoral degree in plant breeding or similar field
- ▶ Job duties: Work for universities or private companies
 - ▶ Analyze DNA and physical characteristics of plants
 - ▶ Manage greenhouse/field/lab breeding procedures
 - ▶ Communicate results with superiors and public through data presentations and peer-reviewed journals
 - ▶ Writing grant applications
 - ▶ Supervise and delegate tasks for team assistants

References & Credits

****Thank you to Dr. Keenan Amundsen for providing mentorship on this project. Projects made possible by CASNR Department of Agronomy and Horticulture, National Institute of Food and Agriculture of the USDA, UNL Office of Graduate Studies, and APS associates***

- ▶ Andrews, D.J. and Rai, K.N. Pearl Millet: An Interpretive Review. 2009. Unpublished.
- ▶ Kumar, K. A., and D. J. Andrews. 1993. Genetics of Qualitative Traits in Pearl Millet: A Review. *Crop Sci.* 33:1-20.
- ▶ Burton, G. W., W. W. Hanna, J. C. Johnson, D. B. Leuck, W. G. Monson, J. B. Powell, H. D. Wells, and N. W. Widstrom. 1977. Pleiotropic Effects of the *tr* Trichomeless Gene in Pearl Millet on Transpiration, Forage Quality, and Pest Resistance¹. *Crop Sci.* 17:613-616.
- ▶ Andrews, David J. Pearl millet line 53-1-1 with PP3 gene and all derivatives produced by any method. Board Of Regents Of The University Of Nebraska, Chrysantis, Inc., assignee. Patent US 7,750,214B2. 6 July 2010. Print.
- ▶ United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248.

