A STUDY OF INHERITANCE IN PHLOX HYBRIDS.

Thesis in Plant Breeding

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Study of Inheritance in Phlox.

Introduction.

After the performance of several experiments, Kölrenter[1] found that the hybrid offspring of two different plants generally resembled as closely the plant which yielded the pollen as that upon which the actual hybrid seed was borne. He found the result of reciprocal crosses generally the same. This was the first time that it was clearly shown that the pollen grain plays just as important a part in determining the characters of the offspring as does the ovule which the pollen grains fertilize.

Knight[1] carried on a series of experiments with the object in view of discovering whether a cross with a distinct race would produce the stimulus necessary to restore its lost vigor to a strain of plants which was supposed to have become debilitated, owing to its members having been bred exclusively by self-pollination for a long series of generations. At the end of this experiment he found hybrid offspring of two distinct races with a more vigorous habit of growth than either of the parents. His work was done with peas.

Naudin[1] found hybrids returning to forms of their parent when continually crossed with the parent is explained by the supposition of the separation of the two specific essences in the pollen grains and ovules of the hybrids.

Millardit[1], in his experiments with strawberries, obtained results different from those observed up to that time. He found the offspring resembled only one parent, while it showed no likeness of the other. Before this, the offsprings were usually more or less intermediate between the two parents from which they came. In some cases, he observed the offspring like the maternal species and others resembled the paternal species.

New Jersey Experiment Station[2] found that the older the plants, phlox, got there was a greater tendency to vary from the normal form. The most noticeable variation was in the green forms of phlox. After studying the greenish forms it was found that they carry only a very little of their characteristic color. They made several star crosses and on results found no two alike in size, shape and color of the blooms.

They[3] made a number of corsses with the star forms in 1902, which showed a number of variations of interest from the parent type.

In 1903 they[4] carried the work further in the star crossing, trying to get the fringed types to become reasonably stable.

Much attention has been given in recent years to the work in phlox, and especially Drummond phlox. Mr. Drummond collected the seed in Texas and sent them to England in 1835. Now it is a favorite in many countries.

Phlox is a very satisfactory ornamental plant to work with, giving a bed of very pretty and a constant supply of handsome blooms. One may have a single solid color or a mixture

of colors, as you may prefer. Its color is not hurt much by weather conditions, as other flowers. It is very hardy and withstands many weather and climatic conditions.

Rogers[5] from this station did work with phlox, using fiery scarlet, brilliant and white. He found in the F_1 that color was dominant to white and intensity of color to weaker. Fiery scarlet and brilliant rose were both dominant to white, while the fiery scarlet was dominant to brilliant rose. This was the same as we found.

This is an annual, erect or procumbent, with opposite entire leaves or some of the upper ones alternate. Flowers varying in color from white to scarlet, however, there are no true blue varieties of annual phlox. The flowers are located in terminal cymes or cymose panicles. Calyx tubular or tubular-campanulate, 5-ribbed, 5-cleft, the lobes or ovule, mostly scarious-margined and the sinuses commonly scarious. Corolla salver-form, the tubes narrow, the limb 5-lobbed, lobes obovate, spreading. Stamens straight short, unequally inserted on the corolla-tube. Ovary oblong or ovid, 3-celled, style usually slender; ovules 1-4 in each cavity. Capsule ovoid, 3-valved, at length distending and rupturing the calyx-tube. Seeds ovoid, wingless or narrowly winged, not emitting spiral threads when wetted.

Statement of Problem.

The object of this experiment is to determine first, the inheritance of the different primary colors found in phlox, second, to study the inheritance of halo and eye pattern color, third, to determine the inheritance of flower shape, such as star, fringe and normal forms, and fourth, to study the inheritance of singleness and doubleness.

Materials and Methods Used.

The following varieties of Drummond Dwarfed Phlox were used in our experiment - fiery scarlet, pure white, brilliant rose, orilliant, shell pink, lilac, doubles, purpled eyed white, violet, star, rose alba oculata, rose aurea stellata, cream and chamois rose white eye.

Before any danger of pollination had taken place, the buds were cut, stamens removed and the flower bagged to avoid any possible chance of cross pollination. In from one to three days the pollen from the desired plants was taken and placed upon the stigma of the plant which you want to cross upon the removal of the bag, then the bag is replaced on the flower where it remains until the seed have set.

Only a very few seeds were obtained from the first flowers we crossed, but later we received great abundance of good seed. Our first flowers did not seem to set very well, probably this was due to the weather or moisture conditions of the pots which hindered or prevented the formation of the seed.

Best results were obtained when the seeds were allowed to remain on the stem of the flower until the hull surrounding the seed was white. If seed is plucked in this stage it is not very likely to mold or decay, but if it is plucked too green there is much danger in losing the seed from decay. We gathered our seeds from the plants as soon as the hulls turned white and placed them in small envelopes to dry thoroughly. After the seed were dry, we sterilized soil in a number of pots sufficient to plant the seed gathered.

F_1 Generation Crosses.

Below is a list of the crosses made throughout the experiment.

1. Fiery Scarlet X Pure White.
2. White X Brilliant Rose.
3. Scarlet X Brilliant Rose.
4. Rose alba oculata X Violacea.
5. Brilliant X Violet.
6. Violet X Scarlet.
7. Cream X Purple-Eyed White.
8. Cream X Shell Pink.
9. Cream X Double White.
10. Cream X White.
11. Cream X Scarlet.
12. Lilac X Cream.
13. Shell Pink X Lilac.

14. Star crosses.
15. Brilliant Rose X Scarlet.
16. White X Scarlet.
17. Scarlet X Violet.
18. Cream X Lilac.
19. Scarlet X Cream.
20. Cream X Double White.
21. Brilliant Rose X Cream.

Comparison of colors of my own nomenclature and those from color standard and color nomenclature by Robert Ridgway.

Note:

Halo - center or position of petals around edge of corolla tube. The halo varies in size and excludes eye.

Eye - Corolla tube as seen from top.

Stars - are dominant in all star crosses except where noted to contrary.

Brilliant X Violet.

Complete dominance of brilliant which is rose color with dahlia purple, white halo and white eye.

White X Brilliant Rose.

Dominance of brilliant rose. Whitish eye, crimson overlies white, but white shows around crimson which is deep rose pink, tryian rose eye, white halo and white eye - diluted brilliant rose.

Rose Alba Oculata X Violacea.

Purple with purple eye and halo.

Violet with purple eye and white halo that is dark

rhodamine purple with pansy violet halo and white eye.

White X Scarlet.

Scarlet dominant with bluish center and white splashes running through petals. The bluish eye and halo are probably due to the fact that the white (from white parent) is mixed with scarlet. The white splashes come from the white parent also. This is rose red with deeper rose red and halo, white eye.

Brilliant Rose X Scarlet.

Complete dominance of scarlet. Some have scarlet and some purple eye and halo which is rose red with deep rose red halo. White eye.

Violet X Scarlet.

Purple with deeper purple eye and halo. Some seem to be white overlaid with purple, which is dark dahlia purple with pansy purple halo. White eye.

Scarlet X Violet.

Purple, some have scarlet and some deeper purple eyes and halos which is dark dahlia purple with pansy purple and halo. White eye.

Cream X Purple Eyed White.

White with true purple halo, white eye, with phlox purple star radiating from the halo. One fringe on each petal. Some are without the radiating phlox purple star.

Cream X Shell Pink.

Shell pink dominant, white halo and white eye, that is rose color, white eye, rose red halo. White shows around the rose red halo.

Cream X White.

Cream in this instance is dominant. This is probably a false cross, as in all other crosses of this parentage, white has been dominant, purple eyed white dominant being white with white eye, true purple halo with phlox purple star radiating from halo, one fringe on each petal.

Fiery Scarlet X White.

Scarlet dominant with bluish center and white splashes running through petals. The bluish eye and halo is probably due to the fact that the white (from the white parent) is mixed with scarlet. The white splashes come from the white parent also.

Scarlet X Brilliant Rose.

Scarlet dominant with pinkish eye and purplish white halo that is rose red with pinkish eye and rose red halo.

Cream X Double White.

Single white, very few are double.

Cream X Scarlet.

Majority purple with white eye and deeper purple halo. Purple seems to overlay white in center, that is dark dahlia purple with aurecular purple halo and white eye.

Lilac X Cream.

Lilac completely dominant that is phlox purple with true purple, white halo and white eye.

Shell Pink X Lilac.

Lilac dominant, large white halo and purple around edge of corolla tube that is true purple, white eye and white halo.

Chamois Rose White Eye X Star.

Rose Aurea Stellata X Star.

Brilliant X Star.

Rose Alba Oculata X Star.

Cream X Star.

Shell Pink X Star.

In all these crosses the star was dominant, but owing to the fact that the seed were mixed, no attempt was made to describe the colors.

Cream X Lilac.

Lilac dominant. The lilac seems to have an inhibition factor which prevents lilac from affecting the entire flower - they are white tinged. Phlox purple, intergrading into white, true purple, white halo and white eye.

Scarlet X Cream.

Scarlet with deeper scarlet halo that is rose red with pinkish eye and deeper rose red halo.

Cream X Double White.

Single white very few are double.

Brilliant Rose X Cream.

Brilliant rose completely dominant which is deep rose pink, pinkish eye and rose red halo.

Discussion of F_1 Generation Crosses.

Where scarlet was crossed with white or white with scarlet, scarlet was dominant in all cases. Scarlet is dominant to brilliant rose, White is recessive to both scarlet and brilliant rose.

White is dominant to cream in all crosses except one, in which case, cream is dominant. This latter cross was probably false since cream was used as the pistillate parent and was no doubt self-fertilized. However, this remains to be seen in the next generation.

Shell pink is dominant to cream.

Lilac is dominant to cream and shell pink.

In the rose alba oculata violacea crosses, dominance was absent. A purple flower was the result in every case.

When brilliant was crossed with violet, brilliant is completely dominant with the exception of the eye character which is inherited from the violet parent.

Where violet was crossed with scarlet, neither parent was dominant; a purple flower was obtained. This result cannot be explained until the next generation.

Where cream and purple eyed white are crossed, purple eyed white is completely dominant.

Where cream is crossed with scarlet in some cases, the flowers in this generation were purple and some scarlet like the scarlet parent.

Brilliant rose is completely dominant to cream.

In all star crosses, the star is dominant, but owing

to the fact that the seed were mixed, we did not classify the colors.

There was an incomplete dominance of double. Only a very few double were obtained in their crosses.

In all crosses where scarlet was dominant, the deeper scarlet halo was also dominant to the halo of the other parent.

The scarlet halo of shell pink and brilliant rose is dominant in all crosses which were made.

The white and purple halo of violet and lilac are dominant to all halos even those of scarlet and shell pink.

The purple halo of purple eyed white is dominant in those crosses in which this variety was used as a parent. It might be well to mention that some of the flowers obtained from this cross were lilac in the entire. This is probably due to the lack of inhibition of color in some flowrs and the absence of color in the periphery of some flowers is brought about by the presence of a factor which suppresses pigment formation.

Conclusions.

1. Scarlet is dominant to brilliant rose and white. White is recessive to both.

2. White is dominant to cream in all instances, except one.

3. Lilac is dominant to cream and shell pink.

4. Brilliant rose is dominant to cream.

5. There is a lack of dominance when scarlet is crossed with violet and in some cases when it is crossed with cream. In those cases where there is a lack of dominance, a

purple color becomes apparent.

6. Brilliant is domiant to violet with the exception of the halo character.

7. Star forms are completely dominant to non-star forms.

8. The halo character of violet and lilac is dominant in all crossesrin which they have been used.

9. For scarlet halos are dominant in some instances.

10. The purple halos of purple eyed white are dominant.

11. There is an incomplete dominance of singleness over doubleness.

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