



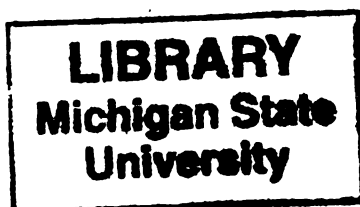
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THESIS.

To what extent the insect is
of aid in fertilizing the pomes.

Euther Hughes. 1896.

THESIS



-: T H E S I S :-

on

-: EXPERIMENTS TO LEARN TO WHAT EXTENT :-

the

-: INSECT IS OF AID IN FERTILIZING THE POMES :-

Luther Hughes.

August 15th, 1896.

Test

EXPERIMENTS TO LEARN TO WHAT EXTENT
the
Insect is of Aid in Fertilizing the Pomes.

Crossing as a means of causing variation in plants and affording opportunity to develop new varieties is by no means a new practice. Recent scientific investigation has given additional motives for crossing. Darwin showed that many plants are benefited by an occasional cross, in fact, seem to require it. But the sterility of some of our plants to their own pollen has attracted marked attention to this subject; for a few of our best fruits have been found to have this weakness.

From a scientific standpoint this need occasion no surprise. Our fruits have been improved by specializing certain parts, that is some part was developed at the expense of some other part. Not only does the orchardist seek the highest improved variety, but he is also careful to thin out the branches and prune back new growth that all possible energy may be thrown into the fruit. In the natural state roots, limbs, foliage and fruit were in balance with each other; no one part was specialized at the expense of another. Hence the plant was in the best condition to care for itself, but nature readily responding to man's touch has given him a host

of varieties as a reward for his labors. But each of these varieties is necessarily weaker in some respects than were the natural plants. Increased susceptibility to disease, shortness of life, etc., have been known to be inherent in some cultivated plants, but when the weakness shows itself in the pollen of the plant so that it is unable to bring about self fertilization, it becomes a question of importance to know by what means the plant is to be made to mature fruit. Pollen must be secured from some nearly related plant or such plants will have to be discarded for cultivation.

But nature has provided against such contingency by furnishing a host of insects to cross fertilize by carrying pollen from plant to plant; so much so is this the case that if one wishes to secure a true cross, the flower crossed must be covered to preclude the insect coordinating her work by furnishing other pollen.

But aside from the question of the weakness of the pollen in many cases it may be doubted as to whether nature intended that the pollen of a flower should go to fertilize that self-same flower. Indeed, with out large number of insects this would seem improbable; also many have their parts so that they tend to favor crossing. In the pomes under investigation the stigma is found to mature before the anthers do. This must greatly tend to favor crossing. Hence

if the weather be fair when the flowers begin to open it is likely that the insects will already have supplied the stigma with pollen before the anthers of the same flower have been able to do so. No sooner are our orchards in blossom than the insects begin to do their work of so much value. Occasionally we are made to realize the importance of their work, in a negative way, when prolonged cloudy weather keeps the insects away till the flowers have passed the critical state and a poor set in the fruit is the result.

To determine what would be the result if the insects were excluded from the flower and to gather suggestions relative thereto was largely the purpose of the experiments to be discussed in this paper.

For the carrying out of this plan a certain number of flower clusters were crossed and covered with paper bags, and an equal number merely covered and left to self fertilize. The crossed ones would represent the work which the insect would perform and the covered ones those which the insect never visits. These clusters were selected, so far as could be judged, in equally favorable locations on the tree. For convenience of reference each cluster was tagged and numbered. By this means when successive visits were made there was no confusion of one cluster with another and progress or retrograde was easily noted. From two to three weeks after

the flowers were covered, they were visited, bags removed, and results noted. No doubt some of these recorded at this date were not properly fertilized and would soon fall. Hence at the end of two more weeks they were again visited to get a final record as at this stage there could be no doubt as to the promise of fruit to come to maturity.

In crossing no especial attempt was made as to what pollen was used except that the trees were thought sufficiently nearly related to easily admit the crossing; the trees in blossom at the desired time generally determined the pollen used. In other words, the work was made so far as feasible, to correspond to that which would take place when insect passes from flower to flower.

It was found that the work of crossing could be best done at one operation-- that is to emasculate the flowers and apply the pollen at once, leaving it to do its part when the stigma became mature. This was a great saving of time and prevented danger of damaging the young parts by too much handling. It is true that the covers placed the flowers in somewhat abnormal conditions. However, no difference in those under cover and those not covered could be observed. As the bags much increased the surface of exposure, those thus covered must have been moved about somewhat more by the wind, so that if any difference existed between the self-fertilized ones under the covers and those not covered, the

balance would be in favor of the former as the wind shaking the twigs would aid in scattering the pollen. At any rate the good or ill effects of the bags were balanced in both crossed and self fertilized between which all comparisons were made.

We will now consider the experiments, considering the pears first.

Bartlett Pear crossed by pollen from Keiffer. Six clusters were crossed and six covered, each cluster having five blossoms.

Results observed on May 12th.

No. 1 emasculated-- fruit set 4

" 2	"	"	"	5
" 3	"	"	"	4
" 4	"	"	"	3
" 5	"	"	"	5
" 6	"	"	"	4
				<u>25</u>

No. 1 covered--- fruit set. 3(?)

" 2	"	"	"	2(?)
" 3	"	"	"	0
" 4	"	"	"	0
" 5	"	"	"	0
" 6	"	"	"	0
				<u>5</u>

On May 23rd, they were again visited. The five covered

ones marked doubtful, because of poor appearance, had fallen. Of the crossed ones seventeen remained and were sufficiently large and vigorous to leave no doubt as to their coming to maturity. Thus we have 57% of the crossed ones against none of the self-fertilized ones.

Pear, Flemish Beauty.

This was pollenized by the Bartlett pollen. The Flemish Beauty blossomed at about the same time as the Bartlett, but by selecting some of the clusters that were a little late in opening and taking the earliest of the Bartlett the cross was effected. Five were placed under each bag. May 12th, gave the following record:

No. 1 emasculated-- fruit set 3				No.1 covered ---fruit set 2			
" 2	"	"	" 2	" 2	"	"	" 2
" 3	"	"	" 3	" 3	"	"	" 1
" 4	"	"	" 1	" 4	"	"	" 2
" 5	"	"	<u>" 3</u>	" 5	"	"	<u>" 1</u>
Total			8	Total			12

At this early date it could not be told but that the self-fertilized ones were equally healthy as the covered ones. On May 23rd, they were again visited. It was found that the wind storm had so damaged the fruit that it was thought inadvisable to try any farther comparison. But aside from the fact that the crossed ones were 33 1/3% greater in set the fact

that the Bartlett pollen was enabled to fertilize the ovules of this tree shows that the failure of the Bartlett to self fertilize was not due to the fact that the pollen grain will not germinate.

Sheldon.

This was pollinated by Bloodgood. Six clusters each containing six flowers were crossed and as many covered. This tree was well filled with blossoms. On May 12th, the tree was visited, but comparatively few fruit on the tree were set. The result of the experiment was as follows on May 13th

No. 1 emasculated-- fruit set 0 No. 1 covered-- fruit set 0

" 2 " " 1 " 2 " " 1

" 3 " " 2 " 3 " " 0

" 4 " " 1 " 4 " " 1

" 5 " " 2 " 5 " " 0

" 6 " " 1 " 6 " " 0

$$\overline{36)7} (20\%$$
$$\begin{array}{r} 36 \overline{) 2} \\ \underline{6\%} \end{array}$$

In the case of the crossed ones 20% had set while the covered ones set but 6%. May 23rd, the record was four of the crossed ones to one of the covered. Perhaps it was owing to some defect in the tree that so few fruit were set. However the record shows that the crossed ones were greater in number as 7:2 in the first case and 4:1 on May 23rd. At this date the fruit was so large as to leave no doubt of maturity.

Bonssock.

Five clusters each having six blossom buds were crossed by Keiffer, and as many covered. May 12th, gave the following result.

No. 1 covered---fruit set.0				No. 1 emaculated-- fruit set 5			
" 2	"	"	" 2	" 2	"	"	" 4
" 3	"	"	" 1	" 3	"	"	" 5
" 4	"	"	" 2	" 4	"	"	" 4
" 5	"	"	" <u>1</u>	" 5	"	"	" <u>0</u>
			6				18

On May 23rd, the number set was 6 of the crossed and 0 of the self fertilized ones. This tree was fully exposed to the heavy wind which will account for the reason that so many failed to hang. However, the first record showed a ratio of 18:6 in favor of the crossed ones.

Beann Gin Ahines.

This was crossed by Keiffer pollen. The tree was especially full of bloom, so that eight were placed under each cover.

May 12th.

1 cov.	0 frt. set.	No.1	Fer.	frt. set	1
2 "	0	" 2	"	"	" 5
3 "	0	" 3	"	"	" 3
4 "	0	" 4	"	"	" 4
5 "	<u>0</u>	" 5	"	"	" <u>1</u>
	0				14

The above would indicate that this tree is infertile

to its own pollen. The large amount of blossoms which it produced no doubt weakened the tree to some extent and may have played some part in decreasing the yield of fruit. On May 23rd, five of the crossed fruit still remained. As this tree was also exposed to the windstorm it may be reasoned that the loss of the other nine may have been largely due to this cause.

Sovernia De Espe.

This tree was crossed by pollen from another dwarf tree of a different variety but the name was unknown. Each cluster had four flowers under cover.

1	crossed	fruit	set	2	1	covered	fruit	set	0
2	"	"	"	0	2	"	"	"	0
3	"	"	"	3	3	"	"	"	0
4	"	"	"	<u>2</u>	4	"	"	"	0
				7					

This tree was fully exposed to the wind storm yet three of the crossed ones were found in good condition May 23rd.

Out of the total 186 flowers crossed 82 were set on May 12th. 38 on May 23rd. On May 12th, there 21 of the 183 covered ones set. On May 23rd, but one of the covered ones remained. While the severe windstorm tended to decrease the number of fruit, it must be remembered that the crossed and self-fertilized ones were equally exposed. Hence if there

was a greater decrease of the self fertilized ones owing to the wind, it would go to show that they were of weaker growth

Apples.

Crab in Asboretier.

This was crossed by pollen by a crab of another variety.

Five under each cluster.

1 emasculated 1 fruit set.					1 covered fruit set 2(?)				
2	"	2	"	"	2	"	"	"	0
3	"	1	"	"	3	"	"	"	0
4	"	<u>3</u>	"	"	4	"	"	"	<u>0</u>
		7							2

On May 23rd, there were six crossed ones remaining.

The two self fertilized ones which were weak appearing on May 12th had dropped by May 23rd. At the present time the fruits have shown no superiority over the others on the tree, and probably will not show any noticeable difference.

Wild Crab.

This was crossed by pollen from another crab about 1/4 mile removed from the former.

1 crossed fruit set 6					1 covered 4				
2	"	"	"	4	2	"	"	"	5
3	"	"	"	4	3	"	"	"	4
4	"	"	"	4	4	"	"	"	5
5	"	"	"	<u>5</u>	5	"	"	"	<u>5</u>
				23					23

Then the crossed and covered ones were equally balanced.
On May 23rd, it stood 12 to 8 in favor of the crossed.

Siberian Crab.

The name of this tree unknown. The pollen for crossing
was taken from another variety of crab. Five clusters each.

1	crossed	fruit	3.
2	"	"	2
3	"	"	2
4	"	"	3
5	"	"	5
6	"	"	<u>1</u>
			16

The covered ones set none. This tree being exposed
to the wind storm no farther record could be taken.

Greening Sweet.

This was crossed by pollen from "Seek No Farther,"
When the first record was taken but two each of the crossed
and self fertilized could be found. These gave 4:0 in favor
of the crossed. May 23rd, gave the same record.

Golden Sweet.

This was fertilized by Greening Sweet. May 12th.

1	crossed	fruit	set	0
2	"	"	"	4
3	"	"	"	1
4	"	"	"	4

5 crossed fruit set 2

6 " " " 4
15

Five in each cluster. None of the covered ones showed any signs of setting fruit, as on May 12th, the young fruit had turned yellow and wilted. On May 23 five of the covered ones were hanging and appeared perfectly healthful.

Apples of Unknown Name.

This was crossed by taking pollen from an apple tree of unknown name. Four were taken under each cover. May 11th, showed the following results.

No. 1	crossed	fruit set 3	1 self fertilized	fruit set 0
" 2	"	" " 4	2 " "	" " 1
" 3	"	" " 1	3 " "	" " 0
" 4	"	" " 4	4 " "	" " 0
		12		1

They were again visited May 22nd, but the wind storm had damaged the fruit clusters so that no farther comparisons were made.

Siberian Crab.

This cross was made by using pollen from an unknown variety. Five blossoms were placed under each cover.

1	crossed	fruit set 3	No. 1 self fertilized	0
2	"	" " 3	" 2 " "	1
3	"	" " 4	" 3 " "	1
4	"	" " 3	" " " "	2
		13		4

This was likewise injured by the wind.

Falcon Sweet.

Crossed by pollen from "Seek No Farther."

No.1	crossed	fruit	set	4	1	self	fertilized	fruit	set	0
"	2	"	"	3	2	"	"	"	"	0
"	3	"	"	5	3	"	"	"	"	0
"	4	"	"	2	4	"	"	"	"	0
"	5	"	"	3	5	"	"	"	"	0
				<u>17</u>						

The above would indicate that this tree was somewhat infertile to its own pollen. The cross was somewhat a wide one but yet gave good results so far as number of fruit sets were concerned. On May 23rd, the fruit was examined. The crossed were all in good condition. 15 yet remained.

Early Harvest.

Pollen used for the cross was obtained from the Falcon Sweet. Four were placed under each cover. May 11th, gave the following record.

No. 1	crossed	fruit	2	set.	No. 1	self	fertilized	2	set.
"	2	"	"	1	"	2	"	"	0
"	3	"	"	3	"	3	"	"	0
"	4	"	"	<u>2</u>	"	4	"	"	<u>0</u>
				8					2

On May 21st, five of the crossed ones were still hanging and the self fertilized ones also. These all came to maturity but no noticeable difference was observed between them and the fruit of the rest of the tree. The ratio of

fruit would be 5:1.

Fall Junetia.

This was crossed by using pollen of Seek No Farther.

Four blossoms were placed under each cover.

1	crossed	3	fruit set.	1	self fertilized	fruit set	0
2	"	2	" "	2	"	" "	0
3	"	<u>3</u>	" "	3	"	" "	<u>0</u>
		8					

But three out of the eight were left on May 23rd, but these were in excellent condition somewhat superior to the rest of the fruit so far as could be judged.

Northern Spy.

Pollen for cross was gotten from Fall on Sweet. This tree was highly set in blossom. Three were placed under each cover. On May 11th, the following record was gotten.

No. 1	crossed	fruit set	3	1	self fertilized	0	set
" 2	"	" "	3	2	"	0	"
" 3	"	" "	<u>3</u>	3	"	<u>0</u>	"
			9				

On May 23rd, five of the nine remained. These were plump and healthful, but the fruit of this tree was hardly far enough advanced to make any comparison in size of fruit.

Out of the total 200 apple blossoms crossed 132 were hanging May 12th. Of the self fertilized 200 but 32 remained on the same date. The ratio is nearly 4:1 favor of the

crossed ones. May 23rd, there were 73 of the crossed and 15 of the self fertilized ones or a ratio of nearly 5:1 in favor of the crossed ones. The high degree of self fertility in the wild crab helps sustain the above record. If we were to subtract from both sides the records which it gave us would have a final ratio of 85:1.

If we recur to the figures given on the pear there is left no doubt as to the good to be derived from crossing. The improvement noted was of a double character.

1st, An increase in the number of fruit sets.

2nd, Increased vigor over the self fertilized ones, which in almost every instance lost a good share of those which were found to be hanging on May 12th. The highest degree of self fertility was found in the wild crab. But even here time showed a gain in favor of the crossed ones, as May 23rd, gave a ratio of 3:2 in favor of the crossed ones.

If such good is to be gotten from cross-fertilization it stands the orchardist in hand to, so far as practicable, open up the way for the insect to perform her important work. Perhaps the greatest hinderance to crossing has been the practice of planting together those trees of the same variety, so that the distance for the insect to carry pollen was so great that few, if any of the flowers were crossed. In planting out an orchard generally there are sufficient varieties

so that where the rectangular planting is used, one half of those trees adjacent to any one tree could be of a different variety. Under any circumstances a judicious scattering of the trees should be practiced. The inconvenience of having the varieties scattered when harvesting or giving some especial care is of small consideration when increased vigor and number of fruits are concerned.

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