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on

A STUDY IN PLUM POLLINATION

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STUDY IN PLUM POLLINATION

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INTRODUCTION.

A great many phases of the orchard pollination question have been investigated during the past two decades. The investigators have, for the most part, chosen those fruits to work upon, or certain phases of the problem, which most closely correlated with the horticulture of their respective territories. Since the Pacific Coast is the only section of this country producing prunes in commercial quantities, it would naturally be fitting for someone of this region to take up the problem of prune pollination. Phases of the pollination question have been studied at this Station for several years, but for various reasons the prune has not been considered, although many investigators have cited the prune industry of the Pacific Coast as one in which it was essential to mix varieties in order to insure full crops of fruit from year to year. This has been done without authority. More or less work of this nature has been done with the varieties of Prunus domestica in England, but only a few of the varieties grown there are grown here commercially.

REVIEW OF LITERATURE.

No attempt is made to give here a complete history of the pollination problems, but a brief review of some of the pollination work more closely connected and leading up to the present problem is presented.

It would be almost impossible to say with any degree of certainty just who first advanced the idea that cross-pollination is necessary in some species of plants. However, we do know that Sprengel, as early as 1793, observed that cross-pollination took place in certain species of plants and that insects played a very important part in it. Even though he did observe this, he did not realize the importance of his discovery. Later, Andrew Knight (1799) remarked that Nature intended that cross-pollination should take place between plants of the same species, and that in no plant does self-fertilization take place for an unlimited number of generations.

A letter written by Rev. George Swayne, dated August 2d, 1822, only recently published by Chittenden (1913), may be interesting at this point. It is, in part, as follows: "In the following spring of 1822, on attending the blossoms of this tree, which blooms earlier than any other tree I have, they appeared to me to remain much longer in a globular state, without ex-

panding, than any other variety of pear which I have had opportunity of noticing. I fancied, likewise, that the pointal was fit for impregnation before the anthers were ripe, and even before the petals had expanded; and from the peculiarly slender and delicate make of the latter, as it struck me. I supposed that it ceased to be in a proper state as soon as it became exposed to the sun and air; I therefore concluded that there might possibly be a chance of obtaining fruit, by depriving the blossoms of their petals before they expanded, and inclosing with each floret in this state, within a paper envelope (as is my mode in effecting artificial impregnation), a riper blossom; viz:- one that had just begun to diffuse its farina, either one of its own or, preferably, of some other variety of pear. Accordingly, on March 27, 1822, I began this operation, and in a day or two had tied up in the manner just mentioned twenty-seven blossoms. Ten of the envelopes contained blossoms of the Beurre Pear, which (it not blossoming so early as the Gansell) were the only ones I could find in a state of expansion. Fourteen (to make up, with the former number, two dozen) contained blossoms from the same tree, and three blossoms of the Pound Pear.-- Of the ten blossoms treated with the Beurre Pear, <u>eight set</u>, two of which afterwards fell off, but I suspect not fairly, and six are now proceeding to maturity.

One only of the fourteen, where its own blossoms were used, now remains. Of the three wherein the Pound was concerned, the whole failed.----"

A note by the Secretary of the Royal Horticultural Society in speaking of the pears harvested, says: "They were unusually large, and very handsome. The cross-impregnation had not produced any change in the appearance of the fruit, nor was any difference in flavour discovered."

It seems perfectly clear that Mr. Swayne realized the value of cross-pollination in the case of some varieties of pears. A Mr. Harrison published A Treatise on the Culture and Management of Fruit Trees the following year in which he advocates the hand-pollination of some pears which flower abundantly but fail to set fruit. He does not, however, state whether or not he uses pollen of other varieties. Just how much we may depend upon the above citation is questionable.

Most writers on the pollination question, however, give Darwin credit for being the first to fully realize the benefits of cross-pollination. It was he who first emphasized its importance in his Origin of Species in 1859. A much greater interest was aroused in 1862 when he published his work on Various Contrivances by Which British and Foreign Orchids are Fertilized by Insects.

In these and later publications Darwin has pointed out that "Nature abhors perpetual self-fertilization;" that in many cases "It is injurious and results in inferior and less fertile offspring," and that "Plants are endlessly modified to insure cross-fertilization."

Although it was quite generally known that orchard fruits did better when the varieties were mixed, it was not conclusively shown that the real cause of barrenness, in some varieties, was due to self-pollination until Waite published his work in 1894. His results show that many varieties of pears require cross-pollination, while some are capable of self-fertilization. After a study of the secondary effects of cross-pollination, he concludes that while there are slight differences between the crosses, their variations are not to be ascribed with certainty to differences in pollen. He found the largest and finest specimens of either self-fertile or self-sterile sorts to be the result of crosses.

While we may give Waite credit for inaugurating the pollination work with orchard or tree fruits, we must remember that Beach and Green were each working with the grape at the same time. Beach continued his investigations along this line until 1902, concluding that "Grapes which are self-sterile or nearly so have shown about as little ability to fertilize other self-sterile sorts as they have for fertilizing themselves" and that "they have

usually likewise failed to fertilize self-fertile varieties."

Heidman (1895) divides the plums into three groups of two forms each, following an old classification of Darwin's, as follows:-

Dichogamous Group:

Proterogynous, on which the stigma is ready for fertilization and passes the receptive stage before the pollen matures.

Proterandrous, on which the pollen ripens and matures before the stigma is ready for fertilization.

Heterostyled Group:

Long-styled, on which the pistil is nearly twice the length of the stamens.

Short-styled, on which the stamens are nearly twice the length of the pistil.

Bisexual Group:

Gynodioecious, on which the flowers are mostly females with aborted anthers and pollen grains.

Andromonoecious, on which the flowers are mostly males with most of the pistils wanting or present in a rudimentary form.

Heidman says that "Self-sterility of Prunus americana in the heterostyled and bisexual forms is caused by great

differentiations of the sexual elements." By the above classification, he says we are prepared to understand "why cross-fertilization is possible in a certain direction, while the reciprocal cross may be sterile."

Waugh (1896) in discussing Heideman's classification says, "It is probably that each of these six forms occasionally appears in plum blossoms, particularly in varieties of the American Group; but, aside from bearing imperfect pistils, I am inclined to believe that these diversities have little immediate significance," and later he adds that it "remains quite unverified." Waugh shows by a table that Prunus domestica is more free from defective pistils than any of the other plum species. Later (1897) he points out the fact that defective pistils play a more or less important part in the size of the fruit crop in the American group of plums, but, except in uncommon cases of total defectiveness, exert no appreciable influence. In a later experiment station report Waugh (1899) calls attention to the "June Drop" in plums, suggesting that it is largely due to failures in pollination, and raises the question as to whether there may not be degrees of fecundation in the plum. The plum ordinarily develops but one of its two ovules and it is supposed that it is fertilized by one pollen grain, in which case, "there would be no such thing as imperfect fertilization.

Either a seed is fecundated, or it is not." Since "it would be possible evidently, for a germ to be weak or for the fecundating pollen grain to be weak, or for the fusion of the two to be in some way imperfect," he says that this must explain why some plum germs are weaker than others. Waugh (1900) also found that the amount of pollen transported by wind, even under the most favorable conditions, was far too small for effective pollination.

Fletcher (1900) states that in the case of Wild Goose, which is self-sterile, "the pollen grain actually germinates and the pollen tube passes down to the ovule. Why the sexes are unable to unite after having got this far, the embryologist has not yet told us." He also says that among our common orchard fruits cross-pollination seldom has an immediate influence on the fruit itself," and that "cross-pollination probably gives better results than self-pollination with nearly all varieties."

Powell (1902) in his pear work found "that the Kieffer may be somewhat more self-fertile in one orchard than in another; that a cross-fertilized pear started into growth with more vigor and developed more rapidly than a self-fertilized one." Green (1902) grouped the apples with which he worked according to the variety of pollen used, and found that some varieties of apples possess more potency in their pollen than others.

Cummings (1904) says the determining factors in the case of abnormal fertilization are:-

A. Incomplete development of the pollen-tubes, due to--

(1) Impotent pollen, or poisonous stigmatic fluid, or

(2) Lack of nourishment of pollen tube.

B. Non-fusion of nuclei.

In some cases the pollen-tube grows down to the ovule but no union takes place; again, the pollen may not even germinate, and all stages between these extremes may be found.

It was a few years later when the work was taken up at this Station. The first report, by Lewis and Vincent (1909) gave fifty-nine out of eighty-seven varieties of apples tested as being self-sterile. Only fifteen proved self-fertile and even they gave better results when cross-pollinated.

About this time Fletcher (1911), in continuing his work with the Bartlett and Kieffer pears, noted that "The cross-fertilized fruits averaged about the same in size, shape, color and quality, regardless of pollen used." Results with a peach variety indicated "no advantage to Gold Drop from cross-pollination."

Backhouse published his first report on pollination studies of European plums in 1911, in which he desig-

nated nine of the twenty-one varieties worked with as being self-fertile. In concluding he says, "One interesting fact was that if in one of these self-sterile varieties the flowers were not pollinated at all, they fall off from three to four days after opening. If, on the other hand, they are self-pollinated, the fruit may swell until it reaches the size of a culinary pea, but sooner or later drops, generally within three weeks.

"It seems probably that the trouble known as the 'June Drop' of the Americans, and also the 'early stoning' of cherries and Green Gages, which takes place before a single stone begins to form, are to be explained as consequences of self-pollination."

Kraus (1912) arrives at the conclusion that in general cross-pollination does not affect the flavor, quality or color of the fruit, but merely its size, percentage of and uniformity of crop. Instances of apparent affect are attributed to bud variation.

Hooper (1912) found eleven out of sixty-seven varieties of apples tested to be self-sterile. He also suggested that since Green Gage Plums are frequently shy bearers, though they blossom well, it may be due to some peculiarity in pollination.

Gardner (1913) found that sweet cherry varieties are not only self-sterile, but some of the best commercial varieties are inter-sterile and that it is impos-

sible to tell which varieties are inter-fertile until they have been tried out.

Mr. Backhouse's complete list of self-fertile and self-sterile plums, as he found them to be at the John Innes Horticultural Institute, is reported in an article by Hooper (1913). He finds only about forty per cent of the plum varieties to be self-fertile. Some of the common self-sterile varieties are Coe, Green Gage, Pond, French Prune and Washington. He says, "Coe Golden Drop is considered most difficult to get to fruit."

Whitten (1914) confirms other reports on peach pollination, saying that "The results show that during the year all the leading varieties of peaches grown on the Horticultural grounds proved to be self-fertile."

FAILURE OF FRUIT TO SET MAY BE DUE TO SEVERAL FACTORS

There are many causes other than lack of pollination which may render trees fruitless at times. It is quite characteristic of some varieties to naturally drop or thin their fruit. These varieties ordinarily set heavily and thinning is necessary to enable the tree to bear its load without breaking. If the previous season has been rather dry, fruit buds may not have developed in as large numbers or as strongly as they would have developed under normal conditions. The injury from frosts or freezes, either winter or spring,

scarcely need be mentioned. When trees are poorly nourished they fail to set fruit as heavily as those liberally supplied with the necessary foods. Occasionally we find barren orchards which are really starving. On the other hand, if growth is encouraged too much, the vegetative part of the tree develops at the expense of fruit production. Rains or snows during the blooming season are always feared by fruitgrowers of any experience. Cold rains throughout the Northwest during the blooming season of 1914 reduced the Italian prune crop to about one-fourth its usual quantity. Pollen carrying insects do not work during such weather and then it is probably that the vitality of the pollen is destroyed, the stigma injured or perhaps the temperature is too low for pollen germination or fertilization. Strong and drying winds during the blooming season are rather disastrous at times, probably due to the drying up of the stigmatic juices. When conditions are favorable fungi play quite an important part in cutting down the fruit crop. It is known that the brown-rot fungus known as Sclerotinia fructigena causes a blossom infection and blight which probably lessens the set. These are some of the more important factors which must always be considered before we can lay all the blame for a poor set of fruit to improper pollination.

OBJECT

The recent results of Gardner of this Station with cherries, the self-sterility of several other orchard fruits, and the fact that several writers have referred to need of cross-pollination in the prune orchards of the Pacific Coast, have been the factors which have encouraged the investigation of this subject, it being the desire to obtain, as near as possible, answers to the following questions:- To what extent are each of the several varieties of prunes self-sterile? Is there a physiological selection between prune varieties? Or, in other words, to what extent are they inter-sterile? Several other minor questions will be discussed, but the original idea was to answer the above questions as nearly as possible. Since the Italian and Petite or French Prune are the two leading varieties used for drying, it was thought advisable to make as many cross-pollinations with each of these varieties as possible.

GENERAL PLAN AND LOCATION

It was deemed advisable to do part of the work in some locality in which the season is either earlier or later than here at Corvallis, so that a larger number of crosses could be made. It is also known that in some cases varieties are self-sterile in one locality and self-fertile in another. The Umpqua Valley was

chosen as the second location for the following reasons:- It is some eight to twelve days earlier than this part of the Willamette Valley. The Umpqua Valley is one of the leading prune producing valleys of the State, and, furthermore, some parts of it are wholly dependent upon the prune. Only the Italian is grown commercially in the Willamette Valley, while the Italian and Petite are each commercial varieties in the Umpqua Valley. As soon as it was decided in what locality the other part of the work would be conducted, the factors to consider in choosing a definite orchard were accessibility, total number of varieties in the orchard, number of varieties other than those in the College orchard at Corvallis, and the age of trees. Considering these factors, Abner Riddle's orchard at Riddle was selected.

ENVIRONMENTAL FACTORS

The work at Corvallis was done in the Station orchard and in the orchard of Mr. Geo. Tinker, about one and one-half miles west of Corvallis. Italian was the only variety worked on at the Tinker Orchard. The trees in the Station Orchard are vigorous and healthy and all were planted in the spring of 1909, with the exception of Quackenboss and Green Gage, which are probably over twenty years old and only moderately vigorous. The soil

is a heavy clay. The orchard has been given clean cultivation during spring and summer and cover crops are grown during the fall and winter. The elevation is about two hundred fifty feet. The Tinker Orchard is perhaps twenty years old and has been more or less neglected until the last two or three years, since which time it has been well pruned, sprayed and cultivated throughout the season. The trees selected for this work are moderately vigorous. They are on a rolling, well drained, moderately heavy clay. The elevation is approximately the same as that at the College Orchard.

The pollination work was begun at Corvallis March 12th and continued until April 2d. The first half of this period was fairly warm and forced the blossoms out rapidly. It was very good "pollination weather" as the sun was quite warm for a while each day, and the bees were relatively busy. However, on March 24th a cold rain began which continued until April 2d. This was at the time the Italians were coming into full bloom. The blossoms were at a standstill all this time. Only occasionally would one see a bee. The following table, copied from the weather records of the Station, will bear out the above notes:

TABLE I

Showing Weather Conditions--March 11th to April 9th, 1914.

Date	Temperature		Precipitation	Character of Day
	Maximum	Minimum		
11	65	37	--	Clear
12	69	45	00	Cloudy
13	65	45	.02	"
14	57	39	--	"
15	64	47	--	"
16	65	43	--	Clear
17	66	43	--	"
18	71	40	--	"
19	73	--	--	"
20	73	--	--	"
21	69	45	--	"
22	62	36	--	Part Cloudy
23	54	35	--	Cloudy
24	48	37	.11	"
25	49	32	.08	"
26	47	34	.10	"
27	36	37	.57	"
28	56	38	.03	Clear
29	55	34	.39	Cloudy
30	45	37	.55	"
31	52	37	.21	"
1	58	40	--	"
2	68	49	.03	"
3	69	54	.07	"
4	64	53	.02	"
5	63	40	--	Clear
6	66	36	--	"
7	66	40	--	"
8	69	49	--	Part Cloudy
9	60	52	.74	Cloudy

As previously stated, the work at Riddle was done in the orchard of Abner Riddle. His orchard extends from the north border of the town up the hill to the

north, about one-half mile. It is about twenty years old and the trees are in very good condition, generally speaking. Some of the Golden Drop (Silver) trees are evidently dying of old age. The Pond (Hungarian) trees were all top grafted two years previously. However, few of the grafts took, so that the fruit is all borne on the new, vigorous growing, but stocky shoots. The soil in the upper part of this orchard, where the work was done, is a hill clay with a slight admixture of sand, making it a well drained and comparatively easily worked soil. It is much lighter than the soil at Corvallis. Clean cultivation is practiced throughout the season. The trees are planted eighteen feet apart. The elevation is a little over seven hundred feet.

All of the emasculation and pollination at Riddle was done from March 19th to March 23d inclusive. The Golden Drop (Silver) prunes were in full bloom; in fact, they were so far along that it was necessary to pick trees more or less influenced by the shade of the prune dryer in order to find unopened blossoms in large enough quantities to emasculate. Other varieties were in the best possible condition for the work. During the first three days there were heavy fogs in the forenoons which began to lift about 9:00 a.m. and from that

time until about 4:00 p.m. it was exceedingly hot, as shown by Table II. This tended to force the blossoms out very rapidly. March 22d and 23d were cooler and the blossoms seemed to be at a standstill. On March 25th the temperature was reported as being below freezing by several parties in and about Riddle. The following table gives the weather conditions at Roseburg, a weather station about twenty-five miles north of Riddle, but having practically the same conditions.

TABLE II

Showing Weather Conditions at Roseburg, March 18-31,1914

Date	Temperature			Precipitation.	Character of day	Hours of sunshine
	Max.	Min.	Mean			
18	69	42	56	--	Pt. Cloudy	6.2
19	77	40	62	--	" "	8.2
20	79	41	60	--	Clear	9.6
21	71	40	56	--	"	10.0
22	63	38	50	T	"	10.4
23	53	41	47	T	Pt. Cloudy	6.7
24	54	35	44	.01	" "	6.4
25	52	30	41	T	" "	9.3
26	53	32	42	.06	" "	6.2
27	53	38	46	.15	" "	7.1
28	54	37	46	.04	" "	6.3
29	56	35	46	.11	" "	6.6
30	52	41	46	.16	Cloudy	3.6
31	56	41	48	.02	"	7.5

METHODS

The methods used throughout the season in collecting, forcing, germinating, and applying the pollen, the emasculating, re-pollinating, etc., were largely those recommended by Fletcher (1908), Sandsten (1909), and members of the Division of Horticulture of this Station.

Collecting Pollen:- Small branches bearing a number of fruit buds were cut from trees of the varieties from which pollen was desired and these branches placed in water in a warm room. The condition or stage of development of the buds at the time of collecting varied greatly. Some were taken indoors to force out when the cluster buds were just beginning to break, while some branches were out so far that a number of flowers had to be removed for fear that insects had already visited the flower.

Forcing of Pollen:- When the flowers began to open the anthers were stripped from the flowers and placed in an ordinary watch glass, where they remained until dehisced. When practically all the anthers had dehisced, the pollen and dehisced anthers were placed in half-inch vials, and loosely stoppered with cotton. These vials were labeled and kept in a dry place when not in use.

Germination:- As many germination tests were made as time would permit. Several germination media were used which are referred to later in this report. Chamber rings were secured on slides by means of paraffin. These were filled about one-third full with water to prevent the evaporation of the germination medium. A drop of the latter was placed on a cover glass and a number of pollen grains from several anthers were added. The cover was turned up so as to let the drop hang. Vaseline served to hold the cover on the chamber ring. Only those pollen grains were counted as germinated which sent out a definite tube.

Emasculation:- The buds should be emasculated just before they open. It is impossible to have all the buds of a cluster or all those that would be covered by one bag in this condition. It was endeavored to do the emasculating of each variety when most of its flowers were in the stage just mentioned. This meant that a few open flowers always had to be removed and some buds not far enough along to work picked off in order to make sure that all blossoms in a cluster were pollinated with the variety designated.

It is almost impossible to use the same methods of emasculation for different orchard fruits, owing to the difference in the structure of the flower.

Even in the plums there is a great variation. In some the tissue is more tender than others, and again there is a great difference in the size of the floral parts of different varieties of the same species. Different investigators do not use the same method on the same fruits, due to various reasons. The writer, after trying several methods, found that he could do the work more readily by using the nails of the thumb and middle finger. The stem of the flower is held in the left hand and then bringing the nails of the two fingers of the right hand together so as to cut across the receptacle at either side, just below the intersection of the stamens (the nails must be long and sharp), lift up the upper portion which has been severed and all the floral parts are removed except the pistil, which is not molested in the least. After a little practice the writer found that he was emasculating and pollinating from fifteen hundred to sixteen hundred blossoms a day. One may emasculate four hundred blossoms an hour by this method. The same method may be used equally successfully with the sweet cherry, peach, and probably other drupaceous fruits.

In some cases it was found convenient to apply the pollen at the time of emasculation, but in others it was necessary to cover the emasculated blossoms with a

paper sack and leave them for several days before pollination, in which event the date of emasculation was recorded on the bag.

Application of Pollen:- When pollinating, the glass vials containing the pollen, and a small pointed camel's hair brush in each, were taken into the field. Having a separate brush for each variety eliminated chance of getting the varieties of pollen mixed in any way. As stated before, when convenient, the pollination was done at the time of emasculation. In such cases a small branch of some ten to forty buds were emasculated and then the pollen applied to the stigma. The small branch was then covered with a two pound paper bag, which was tied securely and labeled with a metal rim tag. On the tag was written the variety of pollen used, the date of emasculation, date of pollination, and the number of flowers pollinated. In case the emasculation had been done a few days previously, the bags were removed and pollen applied to all healthy stigmas. Otherwise, the methods were the same.

No doubt, there is time saved when the pollen is applied at the time of emasculation, and in most cases the stigmas are in a receptive condition at this time. However, one objection was noted in regard to this method, and that is that even though the pistils may appear

sound at the time, and are pollinated and counted as such, it was found that frequently when the pollination was done at a later date pistils thought to be sound at the time of emasculation had evidently been injured in some way and had died. Even though this injury probably did not, in any case, amount to more than five per cent, it is a matter not to be overlooked.

Three or four weeks after pollinating, the paper bags were removed. At this time a count was also made of the apparently developing plums. In some cases it was absolutely impossible to draw any sharp line between those fruits which were to continue development and those which would fall, ~~drop.~~ These counts, such as they were, were recorded on the metal rim tags.

Another count of the developing plums was made May 13th to 18th inclusive, in order to ascertain the number of plums which dropped during the so-called "June Drop". The number of developing fruits at this time was also recorded on the tags.

The final checking-up came at harvesting time. The fruits resulting from each cross were placed in separate bags with the tags of the same cross. In case the fruits were not fully ripe they were allowed to stand until such a condition was reached, when the flesh was removed and the stones allowed to dry. When all the

stones were dry enough to handle, they were cracked and the number and condition of the seeds contained noted.

GERMINABILITY OF THE POLLEN

The methods employed in making germination tests of the pollen previously have been explained. The tests were made at several different periods during the pollination season, so that there is apparently no reason to believe that the pollen was not in as good condition throughout the season as is indicated by the germination tests. Most of it came from branches on which the buds were evidently a little more advanced than the average of the variety. It is possible that the percentage may have been higher had the flowers been allowed to reach a more mature condition on the tree rather than under artificial conditions.

Following is a table presenting the results of the germination tests with the various germination media used:-

TABLE III

Germinability of Pollen Used

Variety	Source	3% cane sugar	4% cane sugar	5% cane sugar	6% cane sugar	6% cane sugar 1% gelatin	3% cane sugar 2% gelatin	4% cane sugar 2% gelatin	5% cane sugar 2% gelatin	Maximum test
Bavay	Corvallis	25	-	-	-	-	-	-	-	25
Bulgarian	Riddle	-	-	-	-	30	-	10	15	30
Burbank	Corvallis	-	-	0	-	-	-	-	0	0
Clyman	Corvallis	-	-	-	-	-	-	5	5	5
Giant	Corvallis	3	25	-	-	12	-	-	-	25
Golden	Riddle	-	-	-	-	-	-	18	18	18
Golden Drop (Silver)	Riddle	-	-	-	-	-	-	25	60	60
Imperial Epineuse	Corvallis	-	-	-	-	-	-	50	90	90
Italian	Corvallis	2	15	5	-	80	80	50	55	80
Italian	Riddle	-	-	-	-	85	-	-	70	85
Golden Drop (Silver)	Corvallis	-	-	-	-	7	12	3	25	25
Green Gage	Corvallis	-	-	-	-	20	-	20	25	25
Miracle	Corvallis	-	-	-	-	-	-	-	70	70
Peach	Corvallis	-	-	-	-	50	30	40	35	40
Petite	Riddle	0	10	0	0	15	0	16	12	16
Petite	Corvallis	-	-	40	-	-	-	-	45	45
Pond (Hungarian)	Corvallis	5	65	-	50	50	40	25	45	65
Prunus passerdii	Corvallis	-	-	0	-	-	-	-	0	0
Red Magnum Bonum (Red Egg)	Corvallis	-	-	-	-	22	-	20	40	40
Roberts		-	-	-	-	-	-	35	40	40
Satsuma	Corvallis	-	-	2	-	-	-	-	2	2
Simon	Corvallis	-	-	4	-	-	-	-	2	4
Sugar	Corvallis	-	-	-	-	-	-	25	37	37
Tennant	Corvallis	-	-	25	-	-	-	-	15	25
Tragedy	Corvallis	-	-	-	-	3	-	5	-	5
Wickson	Corvallis	-	-	5	-	-	-	-	5	5

It will be noticed from this table that the counts showed rather varying results; the percentage of germinability ranging from 0 to 90%. The lowest testing pollen is from the varieties of Prunus triflora. The germination tests of the varieties of Prunus domestica are, generally speaking, satisfactory. Three or four varieties gave rather low percentages, but, in light of this, sufficient pollen of these varieties was used on the stigma so that it seems reasonable that at least some of it was viable and that a failure of some crosses to set fruit cannot be entirely attributed to a lack of germinability of the pollen.

DETERMINATION OF NORMAL SET OF FRUIT FOR THE PLUM

When the blooming season is over, one may notice that practically every flower is succeeded by a miniature plum. However, within two or three weeks great numbers of these small fruits turn yellow, wither and fall off. Those persisting on the tree remain a bright green and continue their growth. It is very essential that this fall of young fruits take place. If for some reason they were all held on until maturity, the tree would be bearing so many fruits that it could not properly nourish them. Just what really determines which of these numerous little fruits shall fall is problematical. It is probable that part of

it is due to a lack of fertilization of the ovules.

Later in the season, usually in June, there is another "drop." Fruits from one-eighth developed to almost full grown may drop at this time. Since this shedding of fruit usually comes in June, it is known as the "June Drop." After this drop the remaining fruits may be expected to reach maturity, provided climatic conditions are favorable.

The number of flowers which should develop into mature fruits, then, is dependent upon a number of factors which, according to Gardner (1913) are "The age, vigor, and general condition of the tree; the available food and moisture supply in the soil; the relative heaviness or lightness of bloom; the purpose for which the fruits are being grown--size or number of fruits--are all important considerations." Fletcher (1900) found that a set of approximately 13%, or about one fruit from every eight flowers, gave a good crop. His conclusions are based on counts made of apples, pears, plums, and apricots. It is often remarked that if one blossom in ten sets a good crop may be expected.

Before discussing the results tabulated below, it will first be necessary to offer some explanations. With the exception of Italian, the estimated percentage of a full crop borne on all the varieties at Corvallis is a result

of the average of estimates made by four members of this division. In the case of Italian at Corvallis, Mr. Geo. Tinker and the writer made the estimates, and at Riddle they were made by Mr. Abner Riddle and the writer. These estimates of Messrs. Tinker and Riddle were made after the crop had been harvested and they are based on the performance of their respective orchards in previous years. It should be added that the branches chosen from which to determine the normal set for the varieties were average branches and open to insect pollination. In many cases the flowers were all on one large branch.

Judging from the results shown in Table IV, one flower out of every five should mature a fruit to insure a full crop of all varieties considered. However, there seems to be a great variety variation; some varieties would seem to bear a full crop when only one flower in twenty fruits, while in some other cases it appears that as many as one of every two or three should mature fruit. It may be that in these latter varieties the trees did not bloom as profusely as older trees may have bloomed.

TABLE VI

Normal Set of Fruit Among Plum Varieties, 1914.

Variety	Location	Flowers counted April 7	Plums apparently set April 16	Per cent apparently set April 16	Plums apparently set May 18	Per cent apparently set May 18	Date gathered	Number gathered	Per cent flowers maturing plums	Estimated per cent of full crop borne by tree.
Bavay	Corvallis	500	248	49.6	12	2.4	9-7	7	1.4	6
Burbank	Corvallis	430	116	27.0	24	5.5	7-17	9	2.0	5
Clyman	Corvallis	500	120	24.0	69	13.8	7-13	66	13.2	15
Giant	Corvallis	600	320	53.2	178	29.6	8-20	130	21.6	100
Golden Drop (Silver)	Corvallis	100	62	6.2	8	8.0	Tree broken			
Golden Drop (Silver)	Riddle	900	310	34.4	93	10.3	8-24	26	2.8	70
Green Gage	Corvallis	600	400	66.6	34	5.6	8-3	13	2.1	17
Imperial Epineuse	Corvallis	450	100	22.2	7	1.5	8-20	7	1.5	5
Italian	Corvallis	1000	73	7.3	43	4.3	9-10	3.7	3.7	20
Italian	Riddle	1200	2	.16	0	0	8-24	0	0	20
Petite	Corvallis	520	223	42.8	66	12.6	9-24	56	10.7	48
Petite	Riddle	1200	450	27.5	185	15.4	8-24	155	12.9	100
Pond (Hungarian)	Corvallis	416	228	54.7	37	8.8	8-15	26	6.2	18
Pond (Hungarian)	Riddle	144	9	6.2	2	1.3	8-24	2	1.3	20
Quackenbos	Corvallis	700	168	24.0	58	8.2	8-3	34	4.8	18
Satsuma	Corvallis	1000	70	7.0	9	.9	8-5	3	.3	11
Sugar	Corvallis	600	251	42.8	142	23.6	9-4	105	17.5	68
Sultana	Corvallis	600	168	28.0	5	.8	8-5	3	.5	9
Tennant	Corvallis	560	216	38.5	49	8.7	8-1	41	7.3	17
Tragedy	Corvallis	500	180	36.0	9	1.8	7-21	9	1.8	18
Wickson	Corvallis	565	0	0	0	0	----	0	0	0

It will be noticed from this table that the amount of "June Drop" apparently varies with varieties. In the case of a few varieties, evidently one may not expect a "June Drop" and may consequently make early estimates of the crop, providing that climatic conditions are favorable. It is also noticed in a later table that the number of fruits marked as apparently set before the "June Drop" was little reduced by it in the varieties Italian and Petite, regardless of pollen used. With the exception of Golden Drop (Silver), none of the varieties seemed to lose many fruits by this late drop. It is entirely possible that the type of season has a great deal to do with this phenomenon.

TO What Extent are our Varieties of Plums Self-Fruitful?

The term "self-fertility" has been very loosely applied in two distinct senses, during the past fifteen years; one in a wide sense meaning the production of a fruit or fleshy pericarp, which may or may not contain a seed; and in a restricted sense meaning the production of a viable seed. It has recently been proposed that the term suitable for the former class is self-fruitful rather than self-fertile and that the term self-fertile be restricted to those cases where viable seed is produced. Self-sterile then, would mean that that a variety would not be capable of producing viable seed when self-pollinated. It is readily seen that a variety may be self-

fruitful and self-fertile at the same time or self-fruitful and self-sterile, and these are conditions that actually do exist in practically all our pollination work. In case no fruits are produced, the variety may be said to be self-barren.

The methods followed in the self-pollination work were essentially the same as those previously described, except that in some cases large muslin bags were used instead of the two pound paper bags, and since emasculation was not necessary, the bags were placed over unopened clusters of flowers. These bags, with the flowers enclosed, were not touched until after the flowering season was past, when the bags were removed and the branches were properly labeled. Table V presents the results of the self-pollination tests.

TABLE V

Results of Self-Pollination, 1914.

Variety	Location	No. sacks	Date sacked	No. flowers sacked	Plums apparently set Apr.16-24	Per cent apparently set Apr.16-24	Plums apparently set May 18-21	Per cent apparently May 18-21	Date gathered	No. gathered	Per cent set
Bavay	Corvallis	9	3-17	82	72	87.8	0	0	9-6	0	0
Blue Damson	Corvallis	7	3-16	106	50	47.1	53	50	8-20	45	42.4
Burbank	Corvallis	10	3-13	100	15	15.0	0	0	7-17	0	0
Clyman	Corvallis	10	3-13	127	27	21.2	0	0	7-13	0	0
Giant	Corvallis	6	3-23	56	24	30.2	7	3.2	9-4	5	2.3
Golden	Riddle	7	3-21	173	50	29.0	14	8.1	8-24	10	5.2
Golden Drop (Silver)	Riddle	30	3-19	600	227	37.8	0	0	8-24	0	0
Green Gage	Corvallis	9	3-16	246	146	59.3	4	1.6	9-6	6	2.4
Italian (m)	Corvallis	2	4-2	628	212	37.5	46	7.3	9-10	19	3.0
Italian (Riddle)	Corvallis	50	4-1	609	50	8.4	7	1.1	9-10	5	.8
Italian	Riddle	24	3-21	684	188	27.4	147	21.4	8-24	57	8.3
Italian (Corvallis)	Riddle	9	3-22	196	1	.5	1	.5	8-24	1	.5
Petite	Riddle	25	3-21	623	127	20.6	38	6.1	8-24	30	4.9
Pond (Hungarian)	Corvallis	5	3-21	38	17	44.7	0	0	8-16	0	0
Pond (Hungarian)	Riddle	13	3-23	300	193	38.2	0	0	8-24	0	0
Quackenboss	Corvallis	11	3-17	278	137	49.2	0	0	8-3	0	0
Red Magnum Bonum(Red Egg)	Corvallis	10	3-18	259	129	49.8	0	0		0	0
Satsuma	Corvallis	10	3-11	510	14	2.7	0	0	8-5	0	0
Simon	Corvallis	4	3-9	85	24	28.2	15	17.6	7-21	1	11
Sugar	Corvallis	10	3-27	218	66	30.2	7	3.2	9-4	5	23
Sultana	Corvallis	10	3-12	544	52	9.5	0	0	8-5	0	0
Tragedy	Corvallis	12	3-16	204	45	22.0	0	0	7-21	0	0
Wickson	Corvallis	11	3-16	309	0	0	0	0		0	0

Note (m)--covered with muslin sack
1 -- indicating source of pollen.

The last column of the above table gives the per cent of bagged flowers which matured fruit. The results as given in this column indicate that of the nineteen varieties tested, nine are completely self-barren. Blue Damson is the only decidedly self-fruitful variety in the list, over two-fifths of its flowers maturing fruit. Three other varieties, Italian, Petite and Golden are partially self-fruitful. It would seem that a variety would be entirely self-barren, self-fruitful or self-fertile, but since these varieties would have had to have set two or three times as heavy to have produced a full crop, it is reasonable to assume that there may be degrees of self-fruitfulness.

This brings up the question, What is the cause of self-sterility? It has been suggested by Waugh (1897) that it may be due to malformations which are of frequent occurrence in some plum varieties, but that these malformations do not exert any appreciable influence on the crop of most varieties. In determining the per cent of defections of plum flowers, he found the flowers of the varieties of Prunus domestica to be least defective of any species. If the cause is not one of morphology, it must then be physiological. This physiological cause may, as has been suggested, be a lack of nutrition of

the pollen tube in some cases, and since it is probably that the degree of such nutrition will vary under different conditions, too much stress should not be placed upon the tests carried out under one set of conditions. Another suggested physiological factor is that of chemotaxis.

Referring to Table V again, it will be noticed that the nine evidently self-barren varieties had shed all self-pollinated fruits by May 18th or approximately two months after the blossoming season, indicating that one may early predict his crop as far as this factor is concerned. Those varieties which gave a low per cent of set seemed to lose more or less fruits all through the season. In the case of the Italian, only about 40% of the self-pollinated plums counted May 18th reached maturity. Judging from the number and size of the plums lying on the ground immediately under these self-pollinated Italians, most of them had evidently fallen rather late in the season.

A comparatively large number of half to two-thirds grown fruits may be noticed on the ground in Italian prune orchards during mid-summer. The writer picked up a number of these partially developed prunes and cracked the stones to see if they contained sound seeds. The results are presented in the latter part of Table VI.

TABLE VI

Showing Relation of Self-fruitfulness to Self-Sterility.

Variety	Location	No. fruits maturing	No. normal seeds in matured fruits	Per cent set	Per cent normal seeds in mature fruits	Per cent normal seeds resulting from self-pollination
Blue Damson	Corvallis	44	11	42.4	25.0	10.8
Giant	Corvallis	1	0	2.3	0	0
Golden	Riddle	2	2	5.2	100.0	5.2
Green Gage	Corvallis	6	2	2.4	33.3	.8
Italian[1]	Corvallis	19	17	3.0	89.5	2.6
Italian[1]	Corvallis	5	5	.8	100.0	.8
Italian	Riddle	53	53	8.3	100.0	8.3
Italian	Riddle	1	1	.5	100.0	.5
Petite	Riddle	19	19	4.9	100.0	4.9
Sugar	Corvallis	5	4	2.3	80.0	1.8
Italian#	Corvallis	56	4	3.7	7.1	.27
Italian#	Riddle	75	4	1.5E	5.3	.07
Italian!	Corvallis	269	266	---	98.8	---

Note--1--Pollen from Riddle
#--"June Drops" picked from ground at random
E--Estimated
!--Prunes from market

These results show that practically every fruit of this variety which falls from the tree during the summer contains an aborted seed. This is again emphasized in the last line of **Table VI.** In this case the stones were saved from a half-bushel of Italian prunes purchased on the market. The 269 stones were cracked and all but 3 contained apparently sound seeds. Referring again to this table, it is noted that practically all the self-pollinated Italians, which reached maturity on the tree, contained apparently normal seeds. This means that the terms self-fertile and self-fruitful are practically synonymous when applied to this particular variety, and that if the ovule is not properly fertilized the fruit may be expected to drop before maturity. The same may apparently be said of all the other varieties included in this table, with the exception of Blue Damson and possibly Green Gage. Blue Damson is the best example of a variety which is self-fruitful to a much greater degree than it is self-fertile. Only one-fourth of its stones contained normal seeds. If it was self-fertile to an equal degree, only the fruits containing normal seeds would have matured fully.

In order to show that the several varieties may be expected to do, in yield, when self-pollinated, the following table (Table VII) has been compiled from Tables IV and V.

Table VII

Table showing per cent of a full crop given by Self-Pollination.

Variety	Location	Per cent plums developed from self-pollination	Normal set for season	Estimated per cent full crop borne	Per cent estimated full crop given by self-pollination
Bavay	Corvallis	0	1.4	6	0
Blue Damson	Corvallis	42.4	Almost Full Crop		
Burbank	Corvallis	0	2.0	5	0
Clyman	Corvallis	0	13.2	15	0
Giant	Corvallis	2.3	21.6	100	10
Golden	Riddle	5.2	Half crop		
Golden Drop (Silver)	Riddle	0	2.8	70	0
Green Gage	Corvallis	2.4	2.1	17	19
Italian(m)	Corvallis	3.0	3.7	20	16
Italian (Riddle)	Corvallis	.8	3.7	20	4
Italian	Riddle	8.3	2.5(E)	20	68
Italian (Corvallis)	Riddle	.5	2.5(E)	20	4
Petite	Riddle	4.9	12.9	100	38
Pond (Hungarian)	Corvallis	0	6.2	18	0
Pond (Hungarian)	Riddle	0	1.3	15	0
Quackenboss	Corvallis	0	4.8	18	0
Red Magnum Bonum (Red Egg)	Corvallis	0	2.2	17	0
Satsuma	Corvallis	0	.3	11	0
Simon	Corvallis	1.1	Few Scattering Fruits		
Sugar	Corvallis	2.3	17.5	68	11
Sultana	Corvallis	0	.5	9	0
Tragedy	Corvallis	0	1.8	18	0
Wickson	Corvallis	0	0	0	0

Note--(m)--covered with muslin sack.
(l)--Indicating source of Pollen.
(E)--Estimated.

It is noticed that Green Gage and Italian each gave larger crops from self-pollination than from open insect pollination. It is unfair to consider either as significant since such low yields may be attributed to unfavorable weather conditions, especially during the blooming season of Italian. All other varieties gave larger crops when subject to cross-pollination by insects than when self-pollinated.

To What Extent are Varieties of European Plums Inter-Fruitful?

The pollination work carried out by Gardner of this Station with sweet cherry varieties showed conclusively that the three leading varieties were not only self-sterile, but inter-sterile. In view of this fact, the same question is asked regarding prune varieties. The following table (Table VIII) is intended to partially answer this question and at the same time give some idea as to the relative value of different cross-pollinations as far as per cent of set is concerned.

Table VIII

Results of Cross-pollination of Varieties of Prunus domestica, 1914.

		No. Sacks	Date emasculated	Date pollinated	No. flowers pollinated	Plums apparently set April 16-24	% apparently set April 16-24	Plums apparently set May 18-21	% apparently set May 18-21	Date gathered	No. gathered	Per cent set
Bavay x Italian	Corvallis	11	3-17	3-26	60	45	75.0	2	3.3	9-6	4	6.6
Giant x Italian	Corvallis	20	3-23	3-26	100	48	48.0	3	3.0	8-16	3	3.0
Golden Drop x Bavay	Riddle	4	3-19	3-21	128	50	39.0	14	10.9	8-24	10	7.8
Golden Drop x Pond	Riddle	6	3-19	3-21	96	18	18.7	8	8.3	8-24	8	8.3
Golden Drop x Italian	Riddle	9	3-19	3-21	202	52	25.7	40	19.8	8-24	27	13.3
Golden Drop x Petite(1)	Riddle	7	3-19	3-23	170	65	38.2	29	17.0	8-24	21	12.3
Green Gage x Bavay	Corvallis	7	3-17	3-26	82	45	54.8	0	0	8-10	0	0
Green Gage x Italian	Corvallis	9	3-17	3-25	191	119	62.3	7	3.6	8-10	7	3.6
Green Gage x Petite(1)	Corvallis	9	3-17	3-25	140	104	74.2	6	4.3	8-10	6	4.3
Imperial Epineuse x Italian	Corvallis	8	3-23	3-26	85	16	18.8	8	9.4	8-20	5	5.8
Imperial Epineuse x Petite (1)	Corvallis	4	3-23	3-26	26	2	7.6	0	0	8-20	0	0
Italian x Bavay	Riddle	4	3-22	3-22	84	0	0			8-24	0	0
Italian x Bradshaw	Riddle	7	3-23	3-23	100	6	6.0	0	0	8-24	0	0
Italian x Bulgarian(1)	Corvallis	12	3-22	4-1	205	5	2.4	1	.5	9-10	0	0
Italian x Clyman	Corvallis	8	3-22	4-1	145	0	0	0	0	9-10	0	0
Italian x Clyman	Riddle	5	3-22	3-22	116	1	.8	2	1.7	8-24	2	1.7
Italian x Giant	Corvallis	7	3-22	4-2	142	2	1.4	1	.7	9-10	0	0
Italian x Giant	Riddle	8	3-23	3-23	104	4	3.8	2	1.9	8-24	2	1.9
Italian x Golden(1)	Corvallis	10	3-22	4-1	203	0	0	1	.5	9-10	0	0
Italian x Green Gage	Corvallis	12	3-22	4-1	200	14	7.0	9	4.5	9-10	9	4.5
Italian x Green Gage	Riddle	10	3-23	3-23	196	4	2.0	4	2.0	8-24	4	2.0
Italian x Pond	Corvallis	13	3-22	4-2	170	2	1.1	1	.5	9-10	2	1.1
Italian x Pond	Riddle	9	3-22	3-22	177	6	3.3	5	2.8	8-24	4	2.2
Italian x Imperial Epineuse	Corvallis	10	3-22	4-1	197	3	1.5	1	.5	9-10	0	0
Italian x Petite	Corvallis	13	3-22	4-2	224	7	3.1	2	.9	9-10	1	.4
Italian x Petite(1)	Corvallis	12	3-22	4-1	200	3	1.5	1	.5	9-10	0	0
Italian x Petite(1)	Riddle	10	3-22	3-22	209	2	.9	2	.9	8-24	1	.4
Italian x Peach	Corvallis	12	3-22	4-1	203	5	2.4	4	1.9	9-10	1	.5
Italian x Peach	Riddle	10	3-22	3-22	188	8	4.2	2	1.0	8-24	2	1.0
Italian x Red Magnum Bonum	Corvallis	14	3-22	4-1	217	5	2.3	4	1.8	9-10	4	1.8

Table VIII-cont'd.

Italian x Red Magnum Bonum	Riddle	8	3-22	4-1	164	5	3.0	4	2.4	8-24	3	1.8
Italian x Roberts	Corvallis	16	3-22	4-1	250	13	5.2	4	1.6	9-10	1	.4
Italian x Golden Drop(1)	Corvallis	15	3-22	4-1	199	5	2.5	5	2.5	9-10	3	1.5
Italian x Golden Drop	Riddle	8	3-22	3-22	205	2	.9	2	.9	8-24	1	.5
Italian x Sugar	Corvallis	16	3-22	4-1	193	2	1.0	2	1.0	9-10	1	.5
Italian x Tennant	Corvallis	12	3-22	4-2	196	6	3.0	3	1.5	9-10	2	1.0
Italian x Tragedy	Riddle	5	3-22	4-2	70	2	2.9	0	0	9-10	0	0
Italian x Tragedy	Riddle	9	3-23	3-23	167	2	1.2	1	.6	8-24	0	0
Petite x Bavay	Riddle	5	3-20	3-20	176	8	4.5	7	3.9	8-24	7	3.9
Petite x Clyman	Riddle	3	3-21	3-21	190	43	22.6	19	10.0	8-24	16	8.4
Petite x Giant	Riddle	3	3-20	3-20	102	23	22.3	9	8.8	8-24	7	6.8
Petite & Green Gage	Riddle	5	3-20	3-20	139	28	20.1	20	14.4	8-24	15	10.7
Petite x Pond	Riddle	5	3-20	3-20	214	30	14.0	25	11.6	8-24	23	10.7
Petite x Imperial Epineuse	Corvallis	13	3-25	3-29	152	62	40.7	28	18.4	9-4	20	13.1
Petite x Italian	Riddle	7	3-20	3-20	220	48	21.8	19	8.6	8-24	19	8.6
Petite x Italian(1)	Riddle	6	3-21	3-21	183	13	7.1	12	6.5	8-24	10	5.4
Petite x Peach	Riddle	4	3-20	3-20	170	8	4.7	8	4.7	8-24	6	3.5
Petite x Red Magnum Bonum	Riddle	5	3-20	3-20	208	33	15.8	22	10.5	8-24	20	9.6
Petite x Roberts	Corvallis	9	3-25	3-29	127	34	26.7	19	14.9	9-4	18	14.1
Petite x Golden Drop	Riddle	5	3-20	3-20	203	16	7.8	13	6.4	8-24	10	4.9
Petite x Golden Drop	Riddle	4	3-21	3-21	174	20	11.5	13	7.4	8-24	11	6.4
Petite x Sugar	Corvallis	12	3-25	3-29	157	48	30.5	18	11.2	9-4	16	10.2
Petite x Tragedy	Riddle	3	3-20	3-20	131	31	23.8	17	12.9	8-24	15	11.4
Pond x Giant	Corvallis	20	3-23	3-26	100	48	48.0	3	3.0	8-16	3	3.0
Pond x Italian(1)	Riddle	11	3-19	3-23	212	89	42.1	56	26.4	8-24	40	18.8
Pond x Petite(1)	Riddle	5	3-19	3-23	109	37	33.9	21	19.2	8-24	16	14.6
Pond x Golden Drop	Riddle	6	3-19	3-23	116	44	37.9	19	16.3	8-24	10	8.6
Quackenboss x Italian	Corvallis	11	3-17	3-25	220	112	50.9	13	5.9	8-3	11	5.0
Quackenboss x Petite (1)	Corvallis	12	3-17	3-25	209	147	70.3	24	11.5	8-3	14	6.7
Red Magnum Bonum x Italian	Corvallis	8	3-18	3-26	143	72	50.3	32	22.3	8-16	23	16.0
Red Magnum Bonum x Golden Drop	Corvallis	29	3-18	3-26	174	99	56.8	11	6.3	8-16	9	5.2
Sugar x Italian	Corvallis	11	3-27	3-27	203	58	28.6	28	13.8	9-4	25	12.3
Sugar x Petite(1)	Corvallis	15	3-27	3-27	201	58	28.8	6	2.9	9-4	6	2.9
Sugar x Golden Drop	Corvallis	13	3-28	3-28	193	34	17.6	3	1.5	9-4	1	.5
Tennant x Italian	Corvallis	7	3-18	3-18	200	69	34.5	35	17.5	8-1	25	12.5
Tennant x Petite(1)	Corvallis	6	3-18	3-26	120	36	30.0	1	.8	8-1	1	.8
Tennant x Golden Drop	Corvallis	4	3-18	3-26	60	15	25.0	0	0	8-1	0	0
Tragedy x Italian	Corvallis	14	3-16	3-18	139	61	44.2	32	23.0	7-21	24	17.2
Tragedy x Petite(1)	Corvallis	11	3-17	3-26	115	42	36.5	2	1.7	7-21	2	1.7

It is noticed that two varieties, Italian and Petite, were given the greatest consideration. This was due to their commercial importance in this state. The table may be justly criticized for containing so few combinations of the varieties used as it does not contain many of the better varieties now grown in parts of the Northwest. It should be stated that many times the number of combinations presented in this table were outlined, but, due to the limited length of the blooming season of each variety and the number of varieties blooming at the same time, it was necessary to limit the work to the more important crosses. It was intended to make at least two hundred individual pollinations with each combination attempted, but this was sometimes impossible, due to a limited number of available flowers on the female of the cross, lack of time, or limited pollen supply.

While a number of Italian crosses are included here they should not be regarded as significant. It will be remembered that the Italian crop was much reduced in 1914 by a prolonged period of cold, rainy weather at the zenith of the blooming season. This period of unfavorable weather came several days after most other varieties had been pollinated, so it is assumed that the ovules had been fertilized before this period. This may account for the fact that varieties other than Italian bore fair

crops during the season. Because of the unsatisfactory results in the work where Italian was used as the female of the cross, the variety will not be considered further in this connection.

The varieties of European plums seem to behave much in the same manner as do apples and pears, with respect to interfruitfulness. Leaving Italians out of consideration, there are only two crosses which did not mature a few fruits, and in these two cases the number of crosses made was not sufficient to warrant a statement to the effect that these varieties are inter-barren. The number of fruits setting in many cases would not be sufficient to produce a crop. However, the results would indicate that the varieties of this species may be considered interfruitful in degree.

The Petite, or French Prune, of second importance in the state, seems to be quite fruitful when pollinated with most varieties. Roberts, Imperial Epineuse, Tragedy, Green Gage, Pond (Hungarian), and Sugar, each gave better than ten per cent of a set or, in other words, set one fruit from every seven to ten flowers. Italian gave a set of eight and six-tenths per cent, or about one fruit from every twelve flowers. The latter result represents just one trial, under one set of conditions, so

that better results would not be at all surprising.

The difference between the percentages given in the tenth column and those given in the last column in Table VIII, represents the percentage of flowers pollinated which dropped after May 18th, and may be called the "June Drop." This so-called "June Drop" is not enough to make any appreciable difference in the size of the crop in most cases. In the cases of the Pond (Hungarian) and Golden Drop (Silver) crosses, the larger amount of drop should be attributed to Brown Rot rather than to the "June Drop", since these two varieties were badly affected with this disease and falling readily at the time of harvesting. Although from the table under consideration it is unfair to judge what Italian would do, it must be remembered that the work considered previously, indicated that many Italian fruits dropped during this period when improperly fertilized.

The relative value of these different cross-pollinations, as compared with the crop borne on the remainder of the tree and open to insect pollination, is more clearly brought out in Table IX.

TABLE IX

Showing per cent of a Full Crop Given by Different Kinds of Pollen when Used on Different Varieties.

Cross	Location	Per cent pollinated developing plums	Normal set for season	Estimated per cent of Full Crop Borne	Per cent of Estimated Full Crop Given by the Cross
Bavay x Italian	Corvallis	6.6	1.4	6	28
Giant x Italian	Corvallis	3.0	21.6	100	17
Golden Drop x Bavay	Riddle	7.8	2.8	70	195
Golden Drop x Pond	Riddle	8.3	2.8	70	207
Golden Drop x Italian	Riddle	13.3	2.8	70	332
Golden Drop x Petite (1)	Riddle	12.3	2.8	70	307
Imperial Epineuse x Italian	Corvallis	5.8	1.5	5	19
Imperial Epineuse x Petite (1)	Corvallis	0	1.5	5	0
Italian x Bavay	Riddle	0	2.0	20	0
Italian x Bradshaw	Riddle	0	2.0	20	0
Italian x Bulgarian	Corvallis	0	3.7	20	0
Italian x Clyman	Corvallis	0	3.7	20	0
Italian x Clyman	Riddle	1.7	2.0	20	17
Italian x Giant	Corvallis	0	3.7	20	0
Italian x Giant	Riddle	1.9	2.0	20	19
Italian x Golden	Corvallis	0	3.7	20	0
Italian x Green Gage	Corvallis	4.5	3.7	20	24
Italian x Green Gage	Riddle	2.0	2.0	20	20
Italian x Pond	Corvallis	1.1	3.7	20	6
Italian x Pond	Riddle	2.2	2.0	20	22
Italian x Imperial Epineuse	Corvallis	0	3.7	20	0
Italian x Petite	Corvallis	.4	3.7	20	2
Italian x Petite (1)	Corvallis	0	3.7	20	0
Italian x Petite (1)	Riddle	.4	2.0	20	4
Italian x Peach	Corvallis	.5	3.7	20	2
Italian x Peach	Riddle	1.0	2.0	20	10
Italian x Red Magnum Bonum	Corvallis	1.8	3.7	20	10
Italian x Red Magnum Bonum	Riddle	1.8	2.0	20	18
Italian x Roberts	Corvallis	.4	3.7	20	2
Italian x Golden Drop (1)	Corvallis	1.5	3.7	20	8
Italian x Golden Drop	Riddle	.5	2.0	20	5

Table IX cont'd.

Italian x Sugar	Corvallis	.5	3.7	20	2
Italian x Tennant	Corvallis	1.0	3.7	20	5
Italian x Tragedy	Corvallis	0	3.7	20	0
Italian x Tragedy	Riddle	0	2.0	20	0
Petite x Bavay	Riddle	3.9	12.9	100	31
Petite x Clyman	Riddle	8.4	12.9	100	65
Petite x Giant	Riddle	6.8	12.9	100	52
Petite x Green Gage	Riddle	10.7	12.9	100	83
Petite x Pond	Riddle	10.7	12.9	100	83
Petite x Imperial Epineuse	Corvallis	13.1	10.7	48	59
Petite x Italian	Riddle	8.6	12.9	100	66
Petite x Italian (1)	Riddle	5.4	12.9	100	42
Petite x Peach	Riddle	3.5	12.9	100	27
Petite x Red Magnum Bonum	Riddle	9.6	12.9	100	74
Petite x Roberts	Corvallis	14.1	10.7	48	63
Petite x Golden Drop	Riddle	4.9	12.9	100	38
Petite x Golden Drop (1)	Riddle	6.4	12.9	100	50
Petite x Sugar	Corvallis	10.2	10.7	48	45
Petite x Tragedy	Riddle	11.4	12.9	100	88
Pond x Giant	Corvallis	3.0	6.2	18	9
Pond x Italian	Riddle	18.8	1.3	15	210
Pond x Petite (1)	Riddle	14.6	1.3	15	169
Pond x Golden Drop	Riddle	8.6	1.3	15	99
Quackenboss x Italian	Corvallis	5.0	4.8	18	19
Quackenboss x Petite (1)	Corvallis	6.7	4.8	18	25
Red Magnum Bonum x Italian	Corvallis	16.0	2.2	17	123
Red Magnum Bonum x Golden Drop	Corvallis	5.2	2.2	17	40
Sugar x Italian	Corvallis	12.3	17.5	68	49
Sugar x Petite (1)	Corvallis	2.9	17.5	68	11
Sugar x Golden Drop	Corvallis	.5	17.5	68	2
Tennant x Italian	Corvallis	12.5	7.3	17	29
Tennant x Petite (1)	Corvallis	.8	7.3	17	2
Tennant x Golden Drop	Corvallis	0	7.3	17	0
Tragedy x Italian	Corvallis	17.2	1.8	18	172
Tragedy x Petite (1)	Corvallis	1.7	1.8	18	17

The fifth column gives the estimated per cent of a full crop borne by the tree under ordinary conditions and the last column gives the per cent of a full crop produced by the cross.

Leaving Italian out of consideration, all but three varieties, Bavay, Petite and Sugar, indicated that they might produce larger crops if care was exercised in selecting a pollenizer. Numbers in this test are entirely too meager to make any definite recommendations. On the whole, Italian seems to be the best pollenizer, as it gave the highest set on seven varieties. Petite would rank second to Italian, both in number of varieties in which it gave the highest per cent of set and in most cases it gave almost as good results as Italian.

Petite gave a higher per cent of set when left open to insect pollination than when crossed with any one variety of pollen. It is probable that more or less mechanical injury was affected in pollinating. However, it is evident that such varieties as Clyman, Green Gage, Pond (Hungarian), Italian, Red Egg, Roberts, Tragedy and possibly other varieties will give satisfactory results as pollenizers for Petite.

Since Petite and Italian are each good pollenizers for most varieties, and since Petite sets fairly well

with any of the leading varieties, it seems that it is not necessary that one be particular as to what varieties are planted together. It is only necessary that more than one variety be planted and that they bloom at approximately the same time.

What Relation Exists Between Inter-Fruitfulness and Inter-Fertility of Plum Varieties?

The relation of self-fruitfulness to self-fertility has previously been discussed, and the results seemed to indicate that most self-fruitful varieties were also self-fertile. Since many of the varieties were self-barren, the number of varieties was far too small to warrant the drawing of conclusions. The following table (Table X) gives further consideration to the same question.

TABLE X

Showing Relation of Inter-Fruitfulness to Inter-Fertility of Plum Varieties, 1914.

Cross	Location	No. fruits maturing	No. normal seeds in mature fruits	Per cent set	Per cent normal seeds in mature fruits	Per cent normal seeds resulting from cross
Bavay x Italian	Corvallis	6	2	6.6	33.3	2.2
Giant x Italian	Corvallis	13	10	3.0	30.0	2.3
Green Gage x Italian	Corvallis	7	6	3.6	8.6	3.1
Green Gage x Petite	Corvallis	6	6	4.3	100.0	4.3
Imperial Epineuse x Italian	Corvallis	5	5	5.8	100.0	5.8
Italian x Clyman	Riddle	2	2	1.7	100.0	1.7
Italian x Giant	Riddle	2	2	1.9	100.0	1.9
Italian x Green Gage	Corvallis	5	5	4.5	100.0	4.5
Italian x Green Gage	Riddle	4	4	2.0	100.0	2.0
Italian x Pond	Riddle	4	4	2.2	100.0	2.2
Italian x Miracle	Riddle	1	1	1.7	100.0	1.7
Italian x Petite	Corvallis	1	1	.4	100.0	.4
Italian x Petite	Corvallis	1	1	.4	100.0	.4
Italian x Red Magnum Bonum	Corvallis	3	3	1.8	100.0	1.8
Italian x Red Magnum Bonum	Riddle	2	2	1.8	100.0	1.8
Italian x Silver	Corvallis	1	1	1.5	100.0	1.5
Italian x Golden Drop	Riddle	1	1	.5	100.0	.5
Italian x Tennant	Corvallis	2	2	1.0	100.0	1.0
Petite x Bavay	Riddle	4	4	3.9	100.0	3.9
Petite x Clyman	Riddle	16	16	8.4	100.0	8.4
Petite x Giant	Riddle	4	3	6.8	75.0	5.1
Petite x Green Gage	Riddle	8	8	10.7	100.0	10.7
Petite x Pond	Riddle	17	17	10.7	100.0	10.7
Petite x Imperial Epineuse	Corvallis	19	15	13.1	78.9	10.1
Petite x Italian (1)	Riddle	2	2	5.4	100.0	5.4
Petite x Italian	Riddle	4	4	8.6	100.0	8.6
Petite x Peach	Riddle	5	5	3.5	100.0	3.5
Petite x Red Magnum Bonum	Riddle	6	5	9.6	83.3	7.9
Petite x Roberts	Corvallis	11	10	14.1	90.9	12.3

Table X cont'd.

Petite xGolden Drop (1)	Riddle	7	7	6.4	100.0	6.4
Petite x Golden Drop	Riddle	9	8	4.9	88.8	4.3
Petite x Sugar	Corvallis	14	13	10.2	92.8	9.2
Petite x Tragedy	Riddle	2	2	11.4	100.0	11.4
Pond x Giant	Corvallis	3	2	3.0	66.6	2.0
Pond x Italian	Riddle	25	8	18.8	32.0	5.7
Pond x Petite	Riddle	8	4	14.6	50.0	7.3
Pond x Golden Drop	Riddle	4	2	8.6	50.0	4.3
Quackenboss x Italian	Corvallis	9	1	5.0	11.1	.5
Quackenboss x Petite	Corvallis	18	7	6.7	38.8	2.5
Red Magnum Bonum x Italian	Corvallis	23	13	16.0	56.5	8.9
Red Magnum Bonum x Golden Drop	Corvallis	9	4	5.2	44.4	2.2
Golden Drop x Bavay	Riddle	10	9	7.8	90.0	7.0
Golden Drop x Pond	Riddle	8	8	8.3	100.0	8.3
Golden Drop x Italian	Riddle	27	26	13.3	96.3	12.7
Golden Drop x Petite	Riddle	21	18	12.3	85.7	10.2
Sugar x Italian	Corvallis	25	25	12.3	100.0	12.3
Sugar x Petite	Corvallis	5	5	2.9	100.0	2.9
Sugar x Golden Drop	Corvallis	1	0	.5	0	0
Tennant x Italian	Corvallis	26	2	12.5	7.6	.8
Tennant x Petite	Corvallis	1	0	.8	0	0
Tragedy x Italian	Corvallis	24	15	17.2	62.5	10.5
Tragedy x Petite	Corvallis	2	1	1.7	50.0	.8

It has previously been stated that Italian prunes would not reach maturity unless the fruits contained seeds. This is very strongly emphasized in the above table. Every fruit which reached maturity contained an apparently normal seed.

The twelve varieties in this table may be divided into two rather widely separated groups; one, in which practically every fruit contains a normal seed or, in other words, is fertile to the same degree that it is fruitful, and another group in which only a part of the developing fruits contain seeds. Those varieties included in the first group must contain a viable seed in order to reach maturity. Apparently, just as soon as this seed dies or ceases further development, the fruit also ceases development and soon falls to the ground. This group includes such varieties as Italian, Petite, Sugar and Golden Drop. It is noticed that from seventy-five to one hundred per cent of the fruits contained apparently viable seed. Golden Drop did not give such striking results as did the other three varieties. At this writing, the seeds have not been germinated, so the percentages are based on outward appearances of the seed entirely. Whenever it was doubtful as to whether the seed possessed vitality enough to germinate, it was

classified as an aborted seed.

The second group includes the other eight varieties. In none of these did the degree of fertility run as high as the degree of fruitfulness. The highest percentage of apparently viable seeds found in any lot of stones included in this group was sixty-six and six-tenths per cent. In most varieties, the percentage of mature fruits containing viable seeds was about thirty to fifty. It is noted that the variety of pollen plays no part at all in determining the ratio of fertility to fruitfulness of a variety. The kind of pollen may give a high set or a low set, according to the predilections of the varieties, and it may likewise give a high degree of fertility or a low one, but the ratio between the number of fruits borne and the number of apparently viable seeds is practically the same, regardless of kind of pollen applied.

To What Degree Are Reciprocal Crosses Inter-Fruitful?

The number of reciprocal crosses available for this tabulation is very materially lessened when Italian is not used. As previously stated, it would be unfair to consider this variety, on account of weather conditions. Table XI presents the figures pertaining to the cross in the second, fourth and sixth columns, and those pertaining to the reciprocal cross in the third, fifth and seventh columns.

TABLE XI

Showing Results from Reciprocal Crosses, 1914.

Cross	Location	Location of Reciprocal	No. flowers pollinated	No. flowers of reciprocal pollinated	Per cent set	Per cent set of reciprocal cross
Petite x Green Gage	Riddle	Corvallis	139	140	10.7	4.3
Petite x Pond	Riddle	Riddle	214	109	10.7	14.6
Petite x Golden Drop	Riddle	Riddle	377	170	5.5	12.3
Petite x Sugar	Corvallis	Corvallis	157	201	10.2	2.9
Petite x Tragedy	Riddle	Corvallis	131	115	11.4	1.7
Petite x Imperial Epineuse	Corvallis	Corvallis	152	26	13.1	0
Pond, x Golden Drop	Riddle	Riddle	116	96	8.6	8.3

Although numbers here are far too small to serve as a basis from which to draw conclusions, it may be said that there is evidently no relation existing between the degree of fruitfulness of the cross and its reciprocal. These few reciprocal crosses indicate that a good set may result when a cross is made in one direction and that a failure may result when in the other direction. This is practically what happens in the Petite-Tragedy cross.

When Petite was pollinated with Tragedy, a fair set resulted, but when Tragedy was pollinated with Petite pollen, the result was a very low set. The Petite-Sugar combination gave similar results. In one instance, the Pond (Hungarian)-Golden Drop (Silver) combination, the results of the cross and its reciprocal are approximately the same.

To What Extent are Related Varieties Inter-Fruitful?

Table XII

Showing Results when Closely Related Varieties are Crossed.

Cross	Relationship	Location	No. pollinated	Per cent set
Green Gage & Bavay	Green Gage is parent	Corvallis	82	0
Pond x Giant	Pond is parent	Corvallis	100	3
Petite x Giant	Petite is parent	Riddle	102	68
Petite x Sugar	Petite is parent	Corvallis	157	10.2
Red Magnum Bonum x Golden Drop	Yellow Magnum Bonum is parent	Corvallis	174	5.2
Sugar x Petite	Petite is parent	Corvallis	201	2.9

The few varieties of known relationship which were used in the inter-fruitfulness test are listed in the above table, the relationship being indicated in the second column. All of these crosses gave slightly lower per cents of set than some other combinations. On the other hand, they are all inter-fruitful to a certain extent, with the possible exception of the Green Gage-Bavay cross. It may also be stated that the degree of fertility is about the same as in other crosses. Considering the question from the several viewpoints mentioned, it is very doubtful if lines of relationship play any appreciable part in determining the per cent of set in plums within a species. The writer does not know that this has been reported upon in any case other than with sweet cherries, by Gardner (1913). He found some varieties of cherries to be completely self-barren, but in concluding a discussion of the parts played by lines of relationship, says, "Inter-sterility among sweet cherry varieties studied is not correlated with closeness of relationship."

Inter Species Pollination.

In a great many plum orchards of the Pacific Coast States, especially in parts of California, both the European and Japanese plums are grown. The question arises as

to whether these two groups are inter-fruitful.

Waugh (1898) worked with a number of species of plums and says that although he did not work with the varieties of Prunus domestica, that there was reliable evidence to show that they could not be effectually pollinated with pollen of Japanese or native varieties. He found most other species inter-fertile.

Fletcher (1900) in discussing the mutual affinity of varieties and groups says, "there seems to be no doubt but that varieties of native, Japanese and domestic plums will fertilize each other. Orchard experience in many places indicates this; as when Satsuma is used to pollinate Coe Golden Drop in Californian prune orchards."

In reviewing the literature previous to any of the pollination work, the writer noticed that few hybrids contained blood of P. domestica. A careful search was then made for such hybrids and their parentage. The following list is taken from the numerous hybrid varieties included in the Plums of New York (Hedrick, 1911).

1. Alhambra--(P. triflora x P. cerasifera x P. domestica) x (P. Simonii x P. triflora) x (P. americana x P. nigra).
2. Burbank No.7--P. triflora x P. domestica.
3. Burbank No.11--P. triflora x P. domestica.
4. Miracle--P. insititia x P. domestica.

5. Pennock--P. besseyi x P. domestica.
6. Red Glass--P. hortulana mineri x P. domestica.
7. Red GlassJunior-- (P. hortulana x P. domestica) x (P. domestica)
8. Reine des Mirabelles--P. insititia x P. domestica.
9. Victor Sand Cherry--(P. besseyi x P. munsonia) x (P. domestica).

Of these hybrid varieties none are grown commercially. Since such a very few of the many plum hybrids contain domestica blood, it seems probable that this species does not cross with other species at all readily. It is probable that none of the seeds producing the above hybrids were borne on trees of this species, as the mother of the hybrid is usually given first when giving the parentage of a cross.

The following table (Table XIII) gives a few inter-species combinations and the results obtained.

Table XIII

Showing Inter-Species sterility in Plums.

Variety Cross	Species Crossed	Location	No. pollinated	Per cent set
Wickson x Golden Drop	(triflora x simonii) x domestica	Corvallis	20	0
Satsuma x Italian	triflora x domestica	Corvallis	25	0
Sultana x Italian	triflora x domestica	Corvallis	139	0
Simon x Golden Drop	simonii x domestica	Corvallis	13	0
Italian x Miracle	domestica x (insitia x domestica)	Riddle	112	1.7
Italian x Miracle	domestica x (insitia x domestica)	Corvallis	124	0
Italian x Burbank	domestica x triflora	Corvallis	48	0
Italian x Burbank	domestica x triflora	Riddle	100	0
Italian x (?)	domestica x passardii	Riddle	55	0
Italian x Satsuma	domestica x triflora	Corvallis	50	0
Italian x Sultana	domestica x triflora	Riddle	56	0
Petite x Simon	domestica x simonii	Riddle	25	0
Petite x Satsuma	domestica x triflora	Riddle	203-	0
Petite x Wickson	domestica x (triflora x simonii)	Riddle	125	0

The second column indicates the species to which the respective varieties belong. It is noticed that only two fruits matured from the 1095 individual pollinations. Furthermore, these two fruits resulted from parentage, one of which is pure domestica and the other probably half domestica blood. The Golden Drop-Satsuma cross, referred to by Fletcher (1900) was not tried, and it is not known that it would be unsuccessful. However, it would seem, judging from the fact that there are few hybrids and the results as presented in the table, that it would be quite exceptional if one should make a combination which should prove fertile. The possibility of a combination which may have been fruitful but not fertile should not be overlooked. It does not seem probable, judging from the tabulations in Table XIII, but again numbers are not sufficient to warrant the drawing of decisive conclusions. However, in view of these results, it would not be advisable to plant a variety of P. triflora and one of P. domestica and expect them to fertilize each other.

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SUMMARY

1. Pollen of the varieties of Prunus domestica seems to germinate best in a solution of five per cent cane sugar and two per cent gelatin.

2. If one flower in every twenty matures into a fruit, the result may be a full crop in some cases, while in some others one in every two or three should set to mature a full crop. Generally speaking, one flower in five should set.

3. Nine of the nineteen varieties of plums tested are evidently self-barren. Blue Damson is decidedly self-fruitful. Italian and Petite are partially self-fruitful. The other varieties should be considered virtually (commercially) self-barren.

4. Most varieties are self-fertile to the same degree they are self-fruitful.

5. The varieties of Prunus domestica may be considered as inter-fruitful, but in varying degrees. Inter variety sterility was not found in this group.

6. Italian and Petite are each good pollenizers for practically all varieties of Prunus domestica tested.

7. It is not necessary that one be particular as to which of the varieties of Prunus domestica commonly grown in the Pacific Northwest are planted together. There should

be more than one variety and they should bloom at approximatel y the same time. Some varieties are actually commercially profitable where no pollenizers are used.

8. In such varieties as Italian, Petite, Sugar, and Golden Drop (Silver), the pericarp ceases development just as soon as the seed dies and the fruit soon falls.

9. In such varieties as Bavay, Blue Damson, Giant, Green Gage, Pond (Hungarian), Quackenboss, Red Magnum Bonum (Red Egg), Tennant, and Tragedy, the fruit may mature regardless of seed development.

10. For the varieties tested, there is no direct relation between the variety of pollen used and the ratio which exists between plump seeds and mature fruits. This ratio is fairly constant for the variety regardless of the kind of pollen applied.

11. There is evidently no relation existing between the degree of fruitfulness of reciprocal crosses.

12. The data available would indicate that the results are the same whether the varieties of a given species are closely related or non-related.

13. The species of Prunus domestica and P. triflora may be considered inter-sterile for all practical purposes.

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Supplement to

STUDY IN PLUM POLLINATION

The plum pollination work was continued in the spring of 1915, the object being to check on the results of 1914, especially to repeat the tests with Italian which were greatly interfered with by the cold rains in the spring of 1914, and to test out a number of crosses not made the past season. The work was done in the College Orchard and in the orchard of Mr. Geo. Tinker, west of Corvallis. The methods used were identical with those of 1914.

The pollination season was very favorable except for three or four days beginning about March 29th, which days were characterized by warm rains. While these latter conditions were not the best for insect pollination, it would seem that they were not unfavorable to fruit setting conditions when pollen was applied by hand. As a matter of fact, the largest sets of Italian prunes were obtahed from crosses made during one of these rains. Table XIV shows weather conditions during the plum pollination season of 1915.

TABLE XIV, Showing Weather Conditions: March 15 to April 8, 1915.

DATE	Temperature		Precipitation	Character of day.
	Maximum	Minimum		
15	64	47	.11	Partly cloudy
16	66	40	--	Clear
17	64	43	T	Cloudy
18	59	35	T	Clear
19	62	35	--	"
20	76	38	--	"
21	75	40	--	"
22	75	42	--	"
23	73	47	--	"
24	52	36	--	Partly cloudy
25	60	35	--	Cloudy
26	59	39	T	"
27	60	38	T	"
28	62	40	.01	"
29	61	45	.44	"
30	60	43	.36	"
31	62	41	.12	"
1	67	52	.05	"
2	64	53	.31	Partly cloudy
3	62	47	.08	Cloudy
4	58	38	--	Partly cloudy
5	64	37	--	Clear
6	57	38	--	Cloudy
7	59	36	.23	"
8	60	36	--	Partly cloudy

Conditions following the pollination season were quite favorable for plum development until May 1st, when the temperature dropped to 28° F. May 3rd the plums were examined and it was found that practically all varieties had been injured to such an extent that many of the fruits had blackened and shriveled. It was then necessary to

to check as closely as possible upon the apparent set at that time. Plums which were noticeably smaller than the largest fruits of the tree, even though they had a rich green color, were not counted as set. No doubt a number of the fruits counted as set would drop before maturity. However, it was mentioned earlier in this report that in the case of most varieties tested, Italian excepted (as it has a late drop), one could check very closely upon the crop two months after pollination. See tables V and VIII. The results of this season, then, should be regarded as indicative of the final count and are well worth consideration.

Table XV. Germinability of the Pollen Used. 1915.

Variety	3-13 5% c.sugar 2% gelatine	3-16 5% c.sugar 2% gelatine	3-20 5% c.sugar 2% gelatine	3-29 6% c.sugar 3% gelatine	3-31 6% c.sugar 3% gelatine	4-2 3% c.sugar 2% gelatine	maximum germination	average germination
Bavay				46			46	46
Bradshaw					0		0	0
Burbank	0	0	0	0			0	0
Chalco	6	40	20	30			40	28
Clyman				44			44	44
German					38		38	38
Giant					38		38	38
Golden Drop		75	Good	51			75	59
Green Gage				64			64	64
Imperial Epineuse					38		38	38
Italian		84	47	42			84	56
Miracle				18			18	18
Petite				19			19	19
Pond				18			18	18
Pottawattamie						31	31	31
Quackenboss				34			34	34

Table XV cont'd.

Red Magnum Bonum			40		40	40
Satsuma	74	47	12		74	45
Simon	31	25	32		32	29
Sultana	40	21	0		40	20
Tennant			43		43	43
Tragedy			55		55	55
Wickson	47	48	23		48	40
Wyant				30	30	30
Yellow Egg			0		0	0

The pollen was germinated as described for the season of 1914. Table XV gives the results of individual tests, the maximum germination and the average germination percentages. The relative number of pollen grains which germinated is, on the whole, much better than in 1914. Three varieties, Bradshaw, Burbank and Yellow Egg gave no germination. Burbank was tried repeatedly after reaching various stages of development on the tree and using germination media of different concentrations, but germinated pollen grains were not found. The germination of the pollen of other varieties showed them to be sufficiently viable to insure fertilization of the ovules, provided all other factors were favorable.

Table XVI shows the percentages of set on the various varieties under natural conditions of insect pollination. It is noticed that as a whole they are very low. It is not possible to estimate the per centage of a full crop borne in each case, at this time with any degree of accur-

acy. A comparison of Tables VI and XVI shows that the set during the year 1914 was invariably heavier than in 1915.

Table XVI. Normal Set of Fruit Among Plum Varieties, 1915.

Variety	Flowers counted	Plums apparently SET May 3d	Per cent apparently Set May 3d
Bavay	135	2	1.4
Blue Damson	126	50	39.7
Burbank	430	10	2.3
Clyman	184	8	4.3
German	220	23	10.4
Giant	175	48	27.4
Golden Drop	600	15	2.5
Green Gage	90	1	1.1
Imperial Epineuse	370	2	.5
Italian	2800	256	9.1
Miracle	300	12	4.0
Petite	100	10	10.0
Pond	140	8	5.7
Red Magnum Bonum	162	4	2.4
Satsuma	700	26	3.7
Sergeant	325	0	0
Sugar	200	12	6.0
Sultana	700	2	.3
Tennant	170	3	1.7
Wickson	400	0	0

Table XVII. Results of Self-Pollination, 1915.

Variety	No. sacks	Date sacked	No. flowers sacked	Plums apparently set May 3	Per cent apparently set May 3
Bavay	14	3-22	150	2	1.3
Blue Damson		3-20	67	24	35.8
Burbank	9	3-16	365	1	.3
Clyman	14	3-21	204	0	0
German	11	3-27	210	32	15.2
Giant	14	3-26	206	7	3.4
Golden Drop	18	3-24	612	0	0
Green Gage	13	3-22	74	0	0
Imperial Epineuse	14	3-26	204	1	.5
Italian	3#	3-25	2005	145	7.2

Table XVII cont'd.

Miracle	6	3-21	231	11	4.7
Myrobalan	16	3-16	122	0	0
Peach	17	3-25	183	0	0
Petite	15	3-27	166	9	5.4
Pond	18	3-25	174	0	0
Red Magnum Bonum	7	3-23	126	0	0
Satsuma	8	3-17	612	0	0
Sergeant	8	3-16	196	0	0
Simon	7	3-16	236	12	5.0
Sultana	7	3-18	566	0	0
Tennant	10	3-23	53	0	0
Tragedy	14	3-22	84	2	2.4
Wickson	7	3-21	245	0	0

Note #--Muslin bags

The results from the self-pollinations are much the same as last year and indicate that most varieties are practically self-barren. Varieties which were classified as being self-barren last year have given similar results this year. Blue Damson is again decidedly self-fruitful. Grant, Italian, Petite and Simon have each set a comparitively small percentage of fruits, as they did last year. German and Miracle are varieties which were not used in 1914, but the results of 1915 would warrant classifying them with those varieties which are partially self-fruitful or self-fruitful in degree.

Table XVIII.

Results of Cross-Pollination of Varieties of *Prunus domestica*, 1915.

Cross	No. sacks	Date emasculated	Date pollinated	No. flowers pollinated	Plums apparently set May 3d.	Per cent apparently set May 3d.
Bavay x Italian	10	3-22	3-22	154	21	13.6
Bradshaw x Italian	4	3-27	3-27	108	64	59.2
German x Italian	12	3-26	3-26	164	54	32.9
Giant x Italian	16	3-26	3-26	193	106	54.9
Golden Drop x Italian	12	3-24	3-27	238	123	51.7
Golden Drop x Petite	13	3-24	3-27	235	137	58.2
Golden Drop x Tragedy	8	3-24	3-27	137	63	46.0
Imperial Epineuse x Italian	13	3-26	3-26	210	9	4.2
Italian x Bavay	11	3-24	4-1	211	37	18.2
Italian x Bradshaw	7	3-25	4-1	211	2	.9
Italian x Clyman	8	3-24	3-31	205	22	10.7
Italian x German	5	3-25	4-1	208	1	.5
Italian x Giant	5	3-25	4-1	200	1	.5
Italian x Golden Drop	6	3-25	4-1	218	12	5.5
Italian x Green Gage	9	3-25	4-1	203	15	7.4
Italian x Imperial Epineuse	9	3-25	4-1	228	5	2.2
Italian x Petite	10	3-24	3-31	292	18	6.2
Italian x Pond	7	3-25	4-1	219	1	.4
Italian x Quackenboss	6	3-25	4-1	211	4	1.9
Italian x Red Magnum Bonum	6	3-25	4-1	209	10	4.8
Italian x Tennant	12	3-24	4-1	205	29	14.2
Italian x Tragedy	9	3-24	3-31	213	41	19.2
Italian x Yellow Egg	1	3-25	4-1	50	0	0
Peach x Italian	12	3-25	3-25	155	18	11.6
Petite x Italian	20	3-27	3-27	171	58	34.0
Pond x Golden Drop	14	3-25	3-25	173	76	43.9
Pond x Italian	18	3-25	3-25	216	65	30.1
Red Magnum Bonum x Golden Drop	6	3-23	3-24	49	20	40.8
Red Magnum Bonum x Italian	8	3-23	3-24	78	21	26.9
Sergeant# x Italian	5	3-16	3-19	177	0	0
Tennant x Golden Drop	7	3-24	3-24	33	4	12.1
Tennant x Italian	14	3-22	3-24	132	11	8.3
Tragedy x Italian	5	3-22	3-22	51	11	21.6

Note #--Young tree

Table XVIII shows the results of the cross-pollination. It is noticed that all but three or four crosses gave comparatively good sets of fruits. Germination tests proved that Bradshaw and Yellow Egg pollen was not viable. It was also noted at the time of pollination of the Italian flowers that pollen of German, Giant, and Quackenboss was practically exhausted and that it was difficult to get much of it on the camel's hair brush. In spite of this, it does not seem that the stigmas did not receive enough pollen to insure fertilization, provided other factors were favorable. Italian again proves to be the best pollenizer of all the varieties tested. Bavay, Clyman, Tennant and Tragedy are the only varieties which gave higher sets on Italian than did self-pollination.

The inter-species crosses present somewhat different results at this time than last year. Whether all fruits indicated as set in Table XIX would reach maturity is not at all certain. Referring to the table, it is noticed that no fruits set where Italian was crossed with varieties of other species. On the other hand, varieties of Japanese plums, when pollinated with Italian, gave fully as good results as when pollinated with other varieties of Japanese plums. This would indicate that the European plums may be inter-barren with Japanese

plum pollen while the reciprocal is inter-fruitful. The only cases of barrenness indicated in the table, excepting those cases in which the pollen was not good and in which the trees refused to set, are where Italian was used as the female of the cross. While the other crosses do not give large sets, they seem to be inter-fruitful in moderate degree. It is also noted that varieties bearing P. insititia blood are quite inter-fertile with P. domestica varieties.

Table XIX

Results of Cross-Pollination with Plum Varieties of Other Species, 1915.

Variety Cross	Species Cross	No. sacks	Date emasculated	Date pollinated	No. flowers pollinated.	Plums apparently set May 3d	Per cent apparently set May 3d
Burbank x Italian	triflora x domestica	10	3-16	3-19	194	5	2.5
Burbank x Satsuma	triflora x triflora	4	3-16	3-19	132	7	5.3
Burbank x Wickson	triflora x triflora	3	3-16	3-19	113	2	1.7
Blue Damson x Imperial Epineuse	insititia x domestica		3-20	3-20	84	51	60.7
Golden Drop x Miracle	x(insititia x domestica) x domestica	8	3-24	3-27	157	46	29.3
Italian x Blue Damson	domestica x insititia	3	3-25	4-4	80	0	0
Italian x Chalco	domestica x triflora	4	3-25	4-1	125	0	0
Italian x Miracle	domestica x (insititia x domestica)	5	3-25	4-1	195	0	0
Italian x Pottawattamie	domestica x munsoniana	4	3-25	4-4	67	0	0
Italian x Satsuma	domestica x triflora	8	3-25	4-1	164	0	0
Italian x Simon	domestica x simonii	2	3-25	4-1	130	0	0
Italian x Sultana	domestica x triflora	3	3-25	4-1	128	0	0
Italian x Wickson	domestica x (triflora x simonii)	3	3-25	4-1	117	0	0
Italian x Wyant	domestica x americana	6	3-25	4-4	87	0	0
Miracle x Golden Drop	(insititia x domestica) x domestica	9	3-22	3-22	204	14	6.8
Miracle x Italian	(insititia x domestica) x domestica	5	3-20	3-20	201	27	13.4

Table XIX cont'd.

Myrobalan x Italian	cerasifera x domestica	14	3-16	3-19	78	0	0
Satsuma x Italian	triflora x domestica	5	3-17	3-21	216	13	6.0
Satsuma x Simon	triflora x simonii	4	3-17	3-21	135	6	4.4
Satsuma x Sultana	triflora x triflora	4	3-17	3-21	142	11	7.6
Satsuma x Wickson	triflora x (triflora x simonii)	3	3-17	3-21	144	0	0
Simon x Italian	simonii x domestica	4	3-16	3-19	103	10	9.8
Sultana x Golden Drop	triflora x domestica	4	3-18	3-21	167	4	2.4
Sultana x Italian	triflora x domestica	4	3-18	3-21	223	10	4.5
Sultana x Satsuma	triflora x triflora	5	3-18	3-21	214	5	2.3
Sultana x Wickson	triflora x (triflora x simonii)	2	3-18	3-21	83	4	4.8
Wickson x Satsuma	(triflora x simonii) x triflora	6-	3-18	3-21	175	0	0

EXPLANATION OF PLATES

Plate I.

Fig.1--A Golden Drop (Silver) prune picked from the tree about August 1st, 1914. Two seeds started but finally one ceased development. One half of the prune is of normal size and color, the other half being only about two-thirds normal size and yellowish green in color.

Fig.2--Golden Drop prunes taken August 1st, 1914, showing a typical "June Drop" prune and a normal one.

Fig.3--Typical "June Drops" of the Giant prune. Note the shriveled seed in one corner of the seed case of each of the small prunes. The middle one is a normal one picked from the tree August 1st, 1914.

Plate II.

Fig.4--Typical Italian "June Drops" picked from the ground beneath a self-pollinated part of an Italian prune tree in August.

Fig.5--Aborted seeds taken from the Italian "June Drops" shown in figure 4.

Fig.6--Seeds from mature self-pollinated Italian prunes. Practically every fruit which reached maturity contained an apparently viable seed.

Plate III.

Fig.7--Seeds from the mature fruits of the Tennant x Italian cross. Only two of the twenty-six fruits which reached maturity contained apparently viable seeds.

Fig.8--Seeds from the Tragedy x Italian cross. Over sixty per cent of the mature fruits contained apparently normal seeds.

Fig.9--Seeds from the fruits of the Quackenboss x Petite cross. About forty per cent of these fruits contained well developed seeds.

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PLATE I.

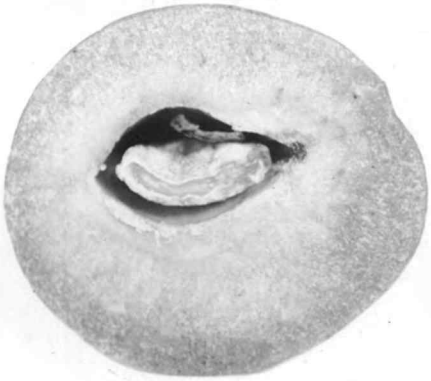

Fig. 1.

Fig. 2.

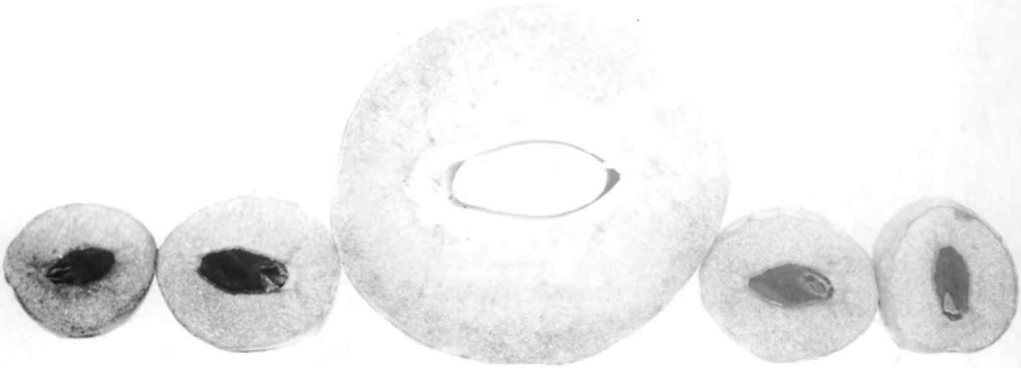

Fig. 3.

PLATE II.

Fig. 4.

Fig. 5.

Fig. 6.

PLATE III.

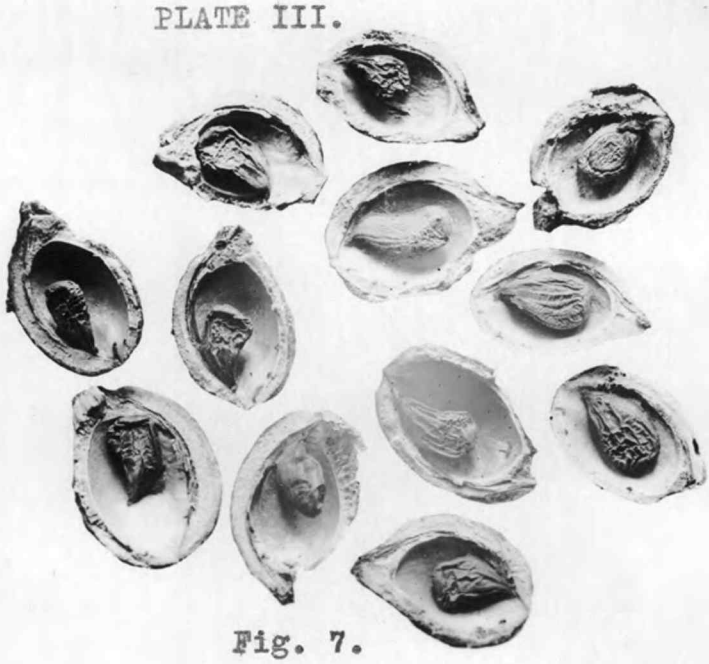

Fig. 7.

Fig. 8.

Fig. 9.