THE POLLINATION STATUS OF PRUNUS SUBCORDATA

by

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L. A. H.

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INTRODUCTION

Prunus subcordata Bentham, the Pacific or Western plum, according to Hedrick (9, p.74-78), is an inhabitant of the region east of the Coast Range from southern Oregon to central California. It is so rarely found on the seacoast as to have escaped the attention of the earliest botanists and remained unknown until the middle of the nineteenth century, when Hartweg, working in the interior of California, brought the plant to notice.

The fruit of this wild plum was prized by the Indians and early settlers of southeastern Oregon and northern California, and this esteem has continued even to the present day. Most of the people of Lake and Klamath counties, and other areas where this plum grows wild, have their favorite plum thicket which they visit each fall.

Considerable attention was given to this plum species by the California hybridist, Luther Burbank. He made crosses of this plum with other species of cultivated plums and produced what he considered some of his most outstanding plum hybrids. Records of these crosses are vague and there is no way of knowing which of his hybrids include Prunus subcordata as one of its parents. A California bulletin (12, p.19-30) on Burbank's work, lists

three plums that had Prunus subcordata in their ancestry. These were 1. Nixie, described as a seedling of Prunus subcordata, fruit nearly globular, one and one-half inches in diameter, most brilliant scarlet and flesh of deep golden yellow which is firm, sweet and freestone; 2. Glow, which has a very complicated heredity of several species including Prunus subcordata; 3. Early Crimson containing the wild plum and European and Japanese mixtures.

Occasional orchards of the California type of Prunus subcordata were planted in the vicinity of Mt. Shasta at an early date and some are reported to be still in existence. One California type was known as the Sisson plum, and produced a yellow fruit as compared with the more common red types. The Sisson plum was so named for the man who selected and grew it as a cultivated plum near Shasta.

Most of the attention given to this plum in Oregon has come from settlers and ranchers in southern Oregon who early appreciated the value of the plum. Articles in the Biennial Reports of the Board of Horticulture of 1893 mention that seeds of this wild plum were brought to the Willamette Valley in 1848 and planted, but no record was made of their success.

The increasing interest on the part of people in eastern Oregon for fruits adapted to their rigorous

climate and the interest in planting cultivated orchards of this plum for commercial purposes has focused the attention of horticulturalists on some of the problems in this connection.

One of the research problems in connection with the improvement and development of this fruit commercially is the pollination requirements being presented in this paper. It is important that this information be available at this time for use by those making commercial plantings. Not only does pollination affect the layout of the orchard but may well determine the success or failure of the venture.

BOTANICAL DESCRIPTION

Before undertaking a study of any plant it is well to become acquainted with its forms and characteristics. After careful search, several good botanical descriptions were found of Prunus subcordata.

The original description was written in Latin by George Bentham in Plantae Hartwegianea, December 1848. It is from this original description that most others have been taken.

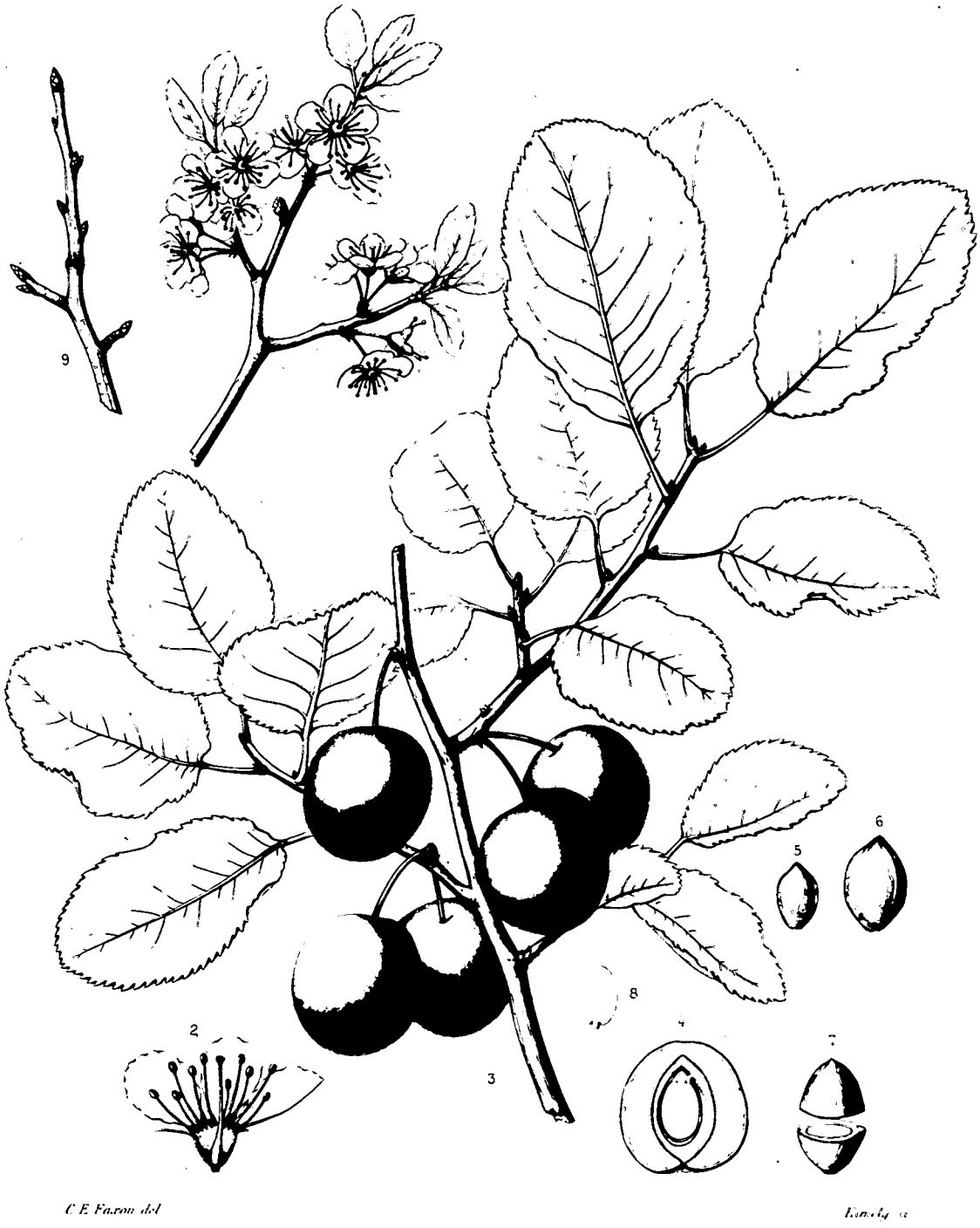
Perhaps the best and most accurate description is that given by Charles Sprague Sargent in Silva of North America (16, p.31-33). It is as follows:

"Calyx-lobes pubescent or puberlous. Stone flattened or turgid, pointed, at the two ends. Leaves broadly ovate to orbicular."

"A small tree, twenty to twenty-five feet in height, with a trunk sometimes a foot in diameter, dividing, six or eight feet from the ground, into almost horizontal branches; or often a shrub, with stout ascending stems ten or twelve feet tall, or a low scraggy much branched bush. The bark of the trunk is a quarter of an inch thick, gray-brown, deeply fissured, and divided into long thick plates, their surface broken into minute persistent scales. The young branchlets are glabrous or pubescent, and are covered with bright red bark marked by occassional

minute pale lenticels, and in their second year become darker red or purple, ultimately turning dark brown or ashy gray. The winter-buds are acute and an eighth of an inch long, and are covered with chestnut-brown scales with scariose margins, those of the inner rows accrescent with the young shoots and at maturity a quarter of an inch in length, oblong, acute, and generally bright red. The leaves are broadly ovate or orbicular, usually cordate, sometimes truncate, or rarely cuneate at the base, and are sharply and often doubly serrate; when they unfold they are puberulous on the upper, and pubescent on the lower surface, with broad midribs, grooved on the upper side, and conspicuous veins. The stipules are lanceolate, acute, glandular-serrate, and cauducous. In autumn at the north the leaves assume, before falling, brilliant scarlet and orange or red and yellow colors. The flowers, which appear before the leaves in March or April, are two-thirds of an inch across and are produced in sub-sessile two to four-flowered umbels on slender glabrous or pubescent pedicels which vary from a quarter of an inch to one half of an inch in length. The calyx is campanulate and glabrous or puberulous, with oblong-obovate lobes rounded at the apex, pubescent on the outer, and more or less covered with pale hairs on the inner surface, and half the length of the white petals which are obovate, rounded above and

Silva of North America



PRUNUS SUBCORDATA Benth

A Riocreux direx!

Imp R Lancon Cors

Figure 1

Figure 2

Typical plant. This is one of several thickets located on the northern slope of the hills overlooking Summer Lake.

contracted at the base into short claws, and in fading turn rose-color. The filaments and ovary are glabrous, and the slender style is funnel-shaped at the apex. The fruit, which ripens in August or September, is oblong and from half an inch to an inch and a quarter in length, and is born on a stout stem from half an inch to two thirds of an inch in length; the skin is dark red or rich purple or sometimes bright yellow; the flesh is more or less succulent, subacid, often of excellent flavor, and adherent to the flattened or turgid stone, which is acute at the two ends, narrowly wing-margined on the ventral edge, conspicuously grooved on the other, and from a third of an inch in length."

Sargent continues by stating that, "The wood of Prunus subcordata is heavy, hard, and close-grained, with a satiny surface susceptible of taking a good polish. It is a pale brown, with thin lighter colored sapwood composed of five or six layers of annual growth, and contains many inconspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.6412, a cubic foot weighing 40.01 pounds."

There are two varieties of Prunus subcordata that are of lesser importance and though the author has not knowingly seen them, they are briefly mentioned here.

Variety Kelloggii is described by Lemmon (14, p.67-68)

as probably being only a minor variant of the species. The fruit is supposed to be larger, sweeter and yellow in color. Many authors describe it as being found in the Mt. Shasta area in California. A. N. Roberts and the author on a trip into that area were unable to locate this yellow-fruited variety.

The other variety referred to by botanists in the literature is called Prunus subcordata oregana. Wight (20, p.31-33) describes it as, "Leavos oval or ovate, about 3 cm. long, pubescent even when mature, otherwise similar to the species." It was originally described from specimens collected on the Klamath Indian Reservation, in south-eastern Oregon, and since then has been collected near Klamath Falls and in the Sprague River Valley.

DELIMITATIONS

With the development of a new fruit such as Prunus subcordata, investigations are undertaken to learn as much as possible about the plant. One of the more important phases, that of pollination requirements, has been undertaken in this study. In connection with the Western or Pacific plum there are other phases that do not concern the immediate study, and due to the time involved did not lend themselves to investigation at this time.

It is desirable that studies be conducted as follows:

1. Variety selection and testing consisting of continued selection of the most desirable types. These selections to be put through a regular variety testing program.
2. Continued pollination studies to determine the pollination requirements of this species and to determine the degree of self-sterility and the incompatability within the selections made.
3. Rootstock studies to determine the most satisfactory understock on which to work this plum for orchard production and to determine the feasibility of other methods of propagation.
4. Study the botanical relationship of this species to others and obtain more accurate botanical de-

scriptions. Determine the origin of supposedly hybrid types found in the area inhabited by this plum which are not typically Prunus subcordata.

NEED OR TIMELINESS OF THE STUDY

In the development of a new fruit plant, it is important to have a fundamental knowledge of it; its pollination requirements, the best variety to grow, its most satisfactory rootstock, and other related information. Satisfactory crops of fruit are dependent on proper pollination and fruit set.

In recent years a great deal of interest and enthusiasm has developed for this native plum in southern Oregon, particularly, in Lake and Klamath counties where it is native.

Two enterprising individuals in Lake County have demonstrated that successful orchard culture is possible. Fortunately, both orchards consist of mixed seedling plantings and no pollination problem has been evident.

At this orchard planting stage it is necessary to know the pollination requirements of this native plum. If orchards were planted without provision for adequate cross-pollination, little or no fruit would be produced and possibly five or more years would be lost as well as a great deal of interest and enthusiasm. Such a setback might cause the death of such an industry in its infancy.

Specialty crops such as this diversify and stabilize Oregon horticulture and can mean added wealth and income to the counties involved. By starting the orchards with

the correct type of plantings, a step is made in the right direction.

DISTRIBUTION AND LOCATION

The distribution of the Pacific plum as shown in Figure 4 is indicated only as to general areas and is by no means complete. However, it is a representative picture as to the known range of the species at this time. Future work and investigation will undoubtedly make such a map more complete.

To the writer's knowledge, Prunus subcordata, the Pacific or Western plum is found only in a limited area of Oregon and California. This area consists of the southern regions of Lake, Klamath, and to a limited extent, Jackson counties of Oregon. This species is also found in northern California in Modoc, Siskiyou, Lassen and Shasta counties. Early writers stated that this plum extended to Tulare and Santa Cruz counties in California, but there are no recent reports known to the author that they are today found that far south. Writers in the past have referred also to this plum as being found in Douglas County and the Umpqua Valley of Oregon, which sounds logical, but in recent years no mention has been made of it in these localities.

Other early writers mention this plum as being found from San Felipe and Sacramento, California, northward to Oregon. They, however, bear out the author's statement that they are most abundant in the northern part of the

state.

This wild plum does not seem to be too particular as to soil type for it is found on rocky hillsides, in open woods, though seldom in forests, and in heavy clay soils. The most productive plants are found in heavier soils along the bottoms of small creeks or washes or other locations where they will have adequate moisture at the times of their lives when water is needed.

From the viewpoint of the affect of location on pollination, there does not seem to be much that can be applied in this respect. Although plum thickets may be somewhat protected from frost and cold in some locations, in others the plums may be fully exposed to all the elements. No general statement can be made regarding the factor of location.

Figure 3

Typical Native Habitat of Prunus subcordata; a selection located on John Withers' Ranch, Paisley, Oregon.

WILD PLUM DISTRIBUTION

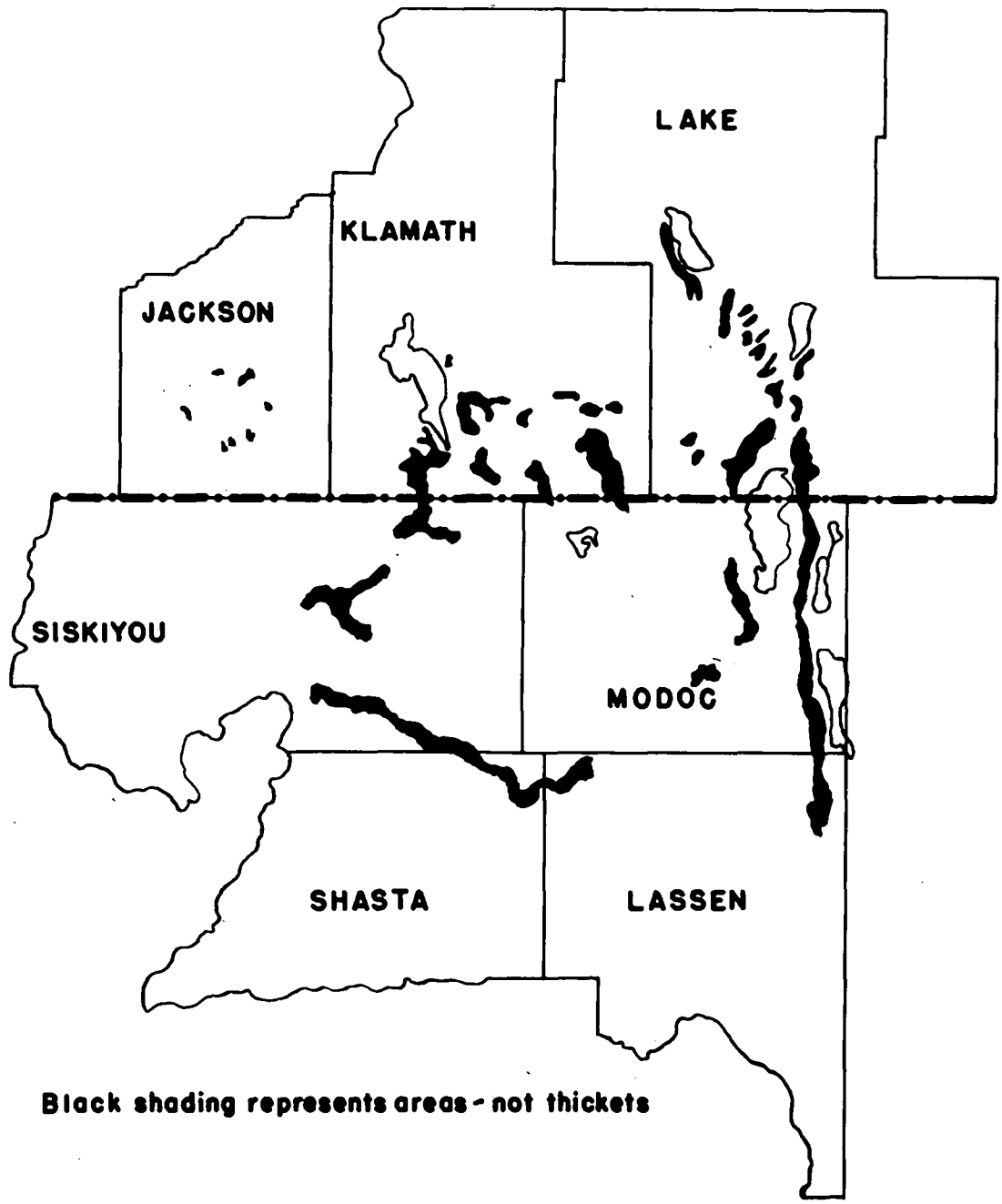


Figure 4

FRUIT SETTING

There can be no understanding of fruit setting unless one is familiar with the processes that take place within the flower. These will be briefly outlined here.

There are certain processes that occur within the anther and the ovule which result in the formation of pollen grains and the embryo sac. This is a complicated process and is quite too involved to discuss here other than to state that it involves nuclear divisions and distribution of the chromosomes that carry the genes which determine the character of the fruit. These genes may also be the kind that inhibit growth of the pollen tube. Briefly, pollen cannot function in the style of a plant carrying the same incompatible factor, or gene, as the pollen.

The second stage involved in the development of the fruit is the dehiscence of the anthers and transfer of the pollen to the stigma. Dehiscence usually occurs within a few hours after the unfolding of the petals. In most tree fruits the anthers will usually dehisce even though the pollen may be largely non-viable.

Germination and growth of the pollen tube follow pollination. If the stigma is not receptive the pollen will not germinate and grow, but in tree fruits the stigma usually becomes receptive when it is exposed by the unfolding

of the petals. Experiments have shown that the stigma may even be receptive as long as two or three days before the petals normally unfold. This indicates that the pollen on the stigma remains capable of germination until receptivity occurs.

When the pollen has been deposited on the stigma, germinated and grown down the style, fertilization takes place. This consists of the union of one sperm nucleus with the egg nucleus to form the zygote while another sperm nucleus unites with the polar nuclei to form the primary endosperm nucleus. Fertilization is dependent on the chromosome constitution of the nuclei involved.

Development of the embryo and endosperm follows fertilization. The growth rate of the embryo and endosperm depends on the available food supply. This growth continues and the fruit and its seeds are formed if all conditions are favorable.

Gourley and Howlett (8, p.293) state that, "The principal factors that affect fruit setting are: 1. nutrients and water; 2. ecological factors, including temperature, rainfall, wind and humidity; 3. pollination and fertilization; 4. pollinating insects; 5. chromosome constitution of the variety; 6. injury by spray materials; and 7. insect, fungal and bacterial injuries."

The main nutrient is nitrogen. A deficiency of water may limit fruit setting. Perhaps one of the reasons that

the wild plum under study is such a heavy bearer is that it is located in areas where there is sufficient water and probably maintains a good carbon-nitrogen balance. These factors, together with high altitude and consequent clear atmosphere, make this plum a very heavy bearer.

In addition to the fact that unfavorable temperature may kill the organs of the flower or seeds of the fruit, temperature, wind, humidity and rainfall may also affect fruit set by their influence on insect activity, dehiscence of the anthers and receptivity of the stigma as well as pollen germination and the subsequent pollen tube growth.

Temperatures below 40 degrees Fahrenheit hinder or prevent pollen germination as well as bee activity. According to MacDaniels and Heincke (15, p.367), "Germination is very satisfactory at 60 degrees Fahrenheit to 70 degrees Fahrenheit."

Wind will desiccate the flower parts and whip the flowers so as to destroy their capacity to function.

Humidity, if excessive, may prevent dehiscence of the anthers, thereby rendering the pollen unavailable for transfer by insects. Too low a humidity will dry the style and stigma, reduce pollen germination and the rate of pollen tube growth.

Pollination is the transfer of pollen from the anthers to the stigma. Self-pollination is the transfer of pollen from one variety to the stigma of the same variety. Cross-

pollination is the transfer of pollen from one variety to the stigma of a different variety. Gourley and Howlett (8, p.298) define the applicable terms used as, "The terms self-unfruitful and self-fruitful have now replaced self-sterile and self-fertile in indicating the amount of fruit produced in response to self-pollination. Self-unfruitful, as commonly used, refers to the production of insufficient fruits following self-pollination for a full commercial crop, while self-fruitful indicates the equivalent of at least a full commercial crop."

It has been shown quite conclusively that pollen of the various fruit trees is carried by insects rather than air currents. The honey bee is the most important carrier, but wild bees, including bumble bees and solitary bees, are very important. The latter two are probably the ones that are important in the pollination of the wild plum. No observations were made as to what insects worked the wild plum of southern Oregon.

Chromosome constitution is a very important factor affecting the set of fruit. Briefly, those varieties which possess an even-numbered multiple of the basic number of chromosomes have viable pollen and egg cells, with the exception of some hybrids. The varieties with odd-numbered multiples of the basic number tend to be sterile.

Injury by insects and diseases may result in the loss

of flowers and fruit by the early formation of an abscission layer and premature dropping. Injury by spray materials has a similar effect.

REVIEW OF LITERATURE

No attempt is made here to give a complete history of plum pollination problems, but a brief review of some of the work more closely connected with this problem is presented.

It is impossible to say who first advanced the idea that cross-pollination in plants is necessary. We do know that Sprengel, in 1793, observed cross-pollination in some plants and that insects played an important part in it. Even though he observed this, he did not realize the importance of his discovery. Later Andrew Knight (13, p.202) 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.

Generally, Darwin is given credit for being the first to realize the benefits of cross-pollination when he emphasized its importance in his Origin of Species in 1859. (6)

In 1862 when Darwin published his work on Various Contrivances by Which British and Foreign Orchids are Fertilized by Insects (5) and later publications, Darwin pointed out that, "Nature abhors perpetual self-fertilization" and 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".

Waite, working with tree fruits, might be given credit for beginning pollination work in 1894. About the same time Beach and Gage were working independently of each other on grapes.

Heideman (10, p.189-195) 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.

Protandrous, 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.

Heideman (10, p.189-195) says that, "Self-sterility of Prunus americana in the heterostyled and bisexual forms is caused by great differentation of the sexual elements."

Waugh (18, p.47) says of Heideman's classification, "It is probable that each of these six forms occassionally appears in plum blossoms, particularly in varieties of the American group; but aside from bearing imperfect pistils, I am inclined to believe these diversities have little immediate significance."

Waugh (18, p.283) suggests that June Drop is largely due to failures in pollination, and raises the question as to whether there may not be degrees of fecundation in the plum. He also found that the amount of pollen transported by wind was far too small for effective pollination.

Fletcher (7, p.363) says that in the case of the self-sterile Wild Goose plum, "the pollen grain actually germinates and the pollen tube passes down to the ovule. Why the sexes are unable to unite after having gotten this far, the embryologist has not yet told us."

Backhouse (3, p.299) in his first report on pollination studies of European plums in 1911, stated that nine of twenty-one varieties tested were self-fertile. He

further states, "It seems probable 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."

Hooper (11, p.238) suggested that although Green Gage plums blossom well, their shy bearing habit may be due to some peculiarity in pollination. He further states that Backhouse's studies at the John Innes Horticultural Institute showed forty per cent of the plum varieties to be self-sterile. Some of the common self-sterile varieties are Coe, Green Gage, Pond, French Prune and Washington.

Waugh, in his book, Plums and Plum Culture (19, p.283), states, "When the native plums first began to be cultivated in this country, their general self-sterility was a drawback which in many cases proved fatal to their success. The settlers in the prairie states found many good plums growing along the river banks and of these they gathered freely." He further states that when a tree was moved to the garden of the homestead it failed to fruit. Waugh explains this saying, "it was doubtless due to the fact that the tree had been growing with many others and had been well cross-pollinated in its old home on the river bank but when isolated in the garden, its flowers were not fertilized."

Speaking of self-sterility Waugh says, "This condition of self-sterility is very common among plums. It is well-nigh universal with the native species, and the Japanese plums seem to have the same character."

Waugh (21, p.45), in writing of the amount of pollen produced, states, "Wild Goose bears abundant pollen under most circumstances, although it is one of the most notably self-sterile varieties in general cultivation."

F. A. Waugh, in an article, The Pollination of Plums, in The Plum of Kansas (21, p.43), says that plums are very uncertain in setting fruit and part of this uncertainty seems to be due to a lack of cross-pollination. He says of the American Group, "The Western wild plum, very hardy, fruit good but inferior to European; good stocks; very delicate sexually, usually requires cross-pollination." It is not certain that Waugh is refering to Prunus subcordata or another type of western wild plum.

Waugh (18, p.88) further writes, "Bailey asserts that our native plums do not fertilize themselves; and the experiments of Heideman with varieties of Prunus americana indicate not only frequent self-sterility but also a remarkably capricious selective affinity among certain varieties."

Tomlison (17, p.309), writing about the Beach plum says, "While the beach plum was mentioned in the records

of early explorers dating back to 1524 and was a topic of considerable interest to botanists and plant breeders as far back as 1785, comparatively little positive information is available even now concerning its culture. It is still the wild, native fruit it was when first discovered over four centuries ago."

He goes on to say, "Perhaps the greatest single obstacle to the development of the beach plum as a commercial crop is the fact that the yield is extremely uncertain. Heavy crops of plums may be three or more years apart and up to the present time no one has a satisfactory explanation for this situation."

J. H. Clark (4, p.6) has to say of the wild beach plum, "In a preliminary test to see what possibilities there might be in beach plum breeding, a little over forty open-pollinated seedlings have been grown to fruiting age. The range in fruit size, flavor, and plant characters indicate that a definite breeding project is worth while and one has been outlined."

John S. Bailey (2, p.9) has the following to say on the pollination of the beach plum, "It is a commonly expressed opinion among beach plum growers that the failure of crops is due to unfavorable weather at blooming time. It is true that weather at blossoming time has a marked effect on the set of any fruit. The effect may be direct

by influencing the growth of the flowers or indirect by influencing the activity of pollinating insects and disease. A frost may destroy the blossoms. Cold, wet weather may prevent the shedding of pollen or, even though pollination has taken place, it may so retard the growth of pollen tubes down the style that the ovule degenerates before fertilization takes place. On the other hand, pollination may be poor because pollinating insects either do not fly at all or are much less active during cold, rainy or windy weather. Also rainy weather increases certain fungous diseases, particularly the blossom form of brown rot, which interferes with set. Nevertheless, such an obvious factor as the weather should not be blamed for every crop failure without just cause.

To study the relation of insects to crop success or failure, observations of the insects working beach plums were made at several places on the Cape during the blooming seasons of 1942, 1943, and 1944. Wild bees were found to be the most common pollinators, followed by bumblebees.... At one place bumblebees were working apple blossoms in preference to beach plums although the beach plums were all around the apple tree and were in almost full bloom."

Leonard H. Day, Associate pomologist at the University of California, states in a personal letter dated February 2, 1949, that a man in Humbolt County, California, did

some hybridizing work with Prunus subcordata and Coe's Golden Drop plum about fifty years ago. He later introduced into these crosses a wild plum from Kansas. Mr. Day states that he worked with two of the original crosses which had hybrid vigor. This seems to bear out an earlier reference to Luther Burbank's work in using Prunus subcordata in a breeding program resulting in promising plums. The importance of these two men's work with this plum seems to be that they have shown that this wild plum has a definite place in a breeding program, and that Prunus subcordata is compatible with the European plums.

SELECTION AND LOCATION OF STUDIES

The original plan for this problem called for part of pollination work to be done on wild plum trees at the Horticulture Farm, Corvallis, Oregon, but due to the effect of brown rot, blossom blight, Sclerotinia spp., on the flowers, it was necessary to conduct all of the pollination work with cooperators in Lake County.

An attempt was made to work with trees that had been observed by people in Lake County as to their fruiting and other characteristics. Representative areas were chosen as well as representative thickets within those areas.

The first trip to Lake County was made April 16, 1948, for the purpose of selecting and tagging plum trees to be used in the pollination study. Three rather widely separated locations were decided on; thickets on the John Withers' Ranch, about eight miles north of Paisley, Oregon; a thicket of plums on the Reid Ranch at New Pine Creek, Oregon; plum trees on the Rugg Ranch, about ten miles south of Lakeview, Oregon. Those selected were marked with metal tags designating the location and tree number, and were marked with red cloth to fascilitate quick identification on return trips and later work.

The three thickets on the Withers Ranch were located on the slopes of Fremont Mountain at an estimated elevation

of 4000 feet. One group of plums selected was growing next to a mountain stream in the mouth of Miners Canyon. The second thicket of plums was at an old mill site, about three miles northeast of Miners Canyon. There was an outbreak of water just below the thicket forming a small marsh and terminating in a stream that flows by the third plum thicket about three hundred yards down the slope. The second thicket referred to above was designated as the "Old Mill Area" and the one below it as "Below the Old Mill Area". The plums growing on the Reid Ranch were on the bank of a small stream in a flat pasture. This thicket is at a lower elevation being just above the Goose Lake flats. Considerable "witches broom", Taphrina Pruni-subcordatae, was observed in this thicket.

Plums on the Rugg Ranch consisted of two and one-half acres of orchard planted selections made by Mr. Rugg from wild thickets. These plums had been grown on peach root-stocks. This orchard was on a gentle slope and faced west to Goose Lake.

METHODS AND PROCEDURE

A second trip was made to Lake County for the purpose of bagging the selections to prevent contamination of the flowers by bees after visiting blossoms of other thickets or adjoining plum trees. This process consisted of covering the flower buds on a branch with a brown Kraft paper

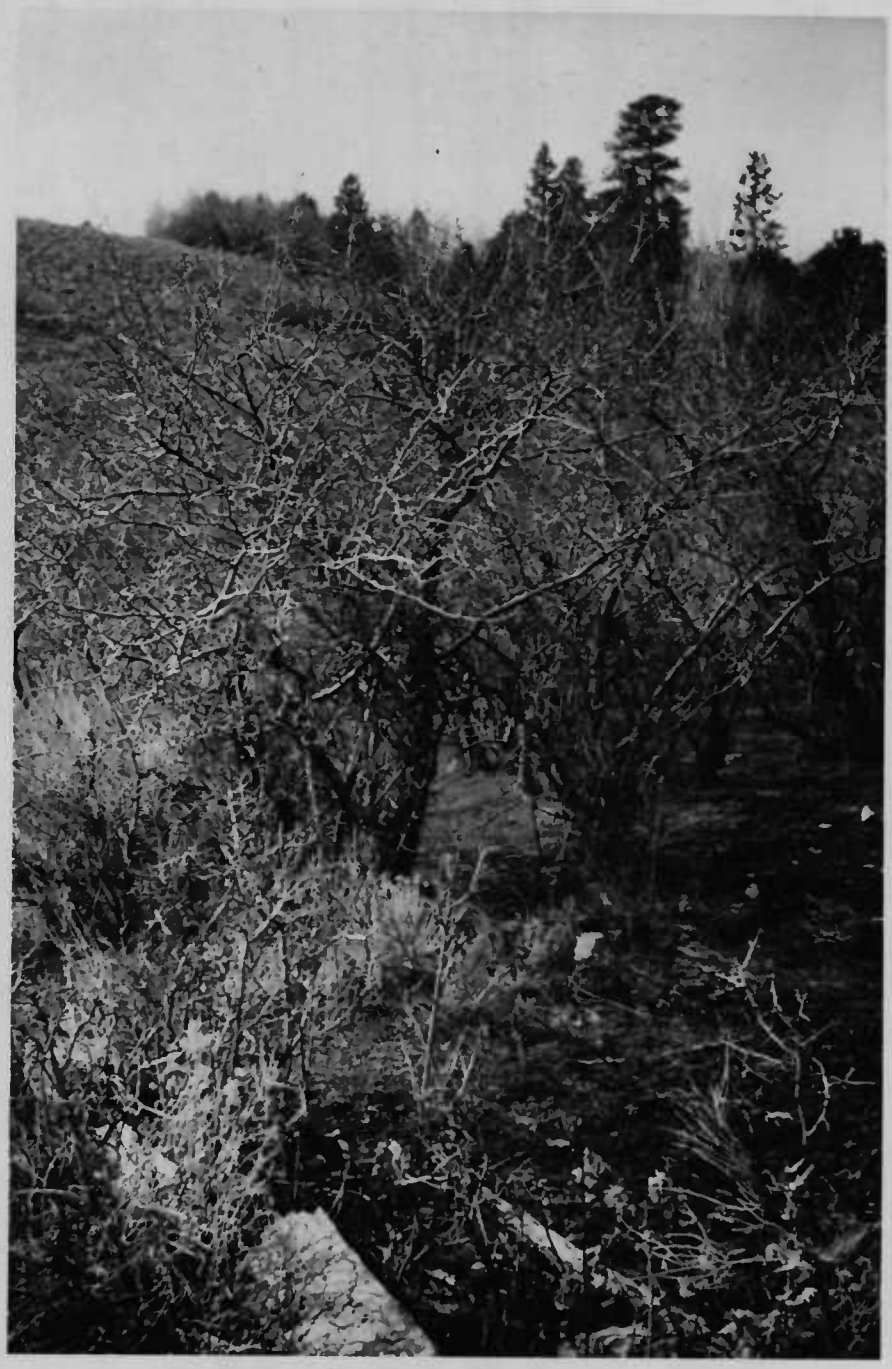


Figure 5

Prunus subcordata, The Old Mill Plum, dormant, showing the twiggy and dense growth of the plum.

bag. It was slipped up over the branch and tied closed with a string. Each bag was perforated with small holes of such a size so as to allow some air circulation but not being of large enough diameter to allow the entrance of insects. At the time of bagging, the flower buds were swollen but not open so there was no danger of contamination previous to bagging.

EMASCULATION AND POLLINATION

The third trip to Lake County was made May 26, 1948, for the purpose of emasculating and pollinating the plum flowers.

SELFING

The selfing was done first at the Withers' and Reid ranches. This consisted of brushing the open flowers with a camelshair brush. There was an ample amount of pollen which was a bright yellow color and could be seen on the stigmatic surface of the pistil when the selfing process was finished. Many of the petals fell off when the flower was brushed but the bags were replaced over the treated blossoms and retied. These bags were removed at a later date when all of the petals had fallen and it was felt that the pollen had sufficient time to germinate and begin its growth down the style. The exact dates that the bags were removed varied at the different locations and the

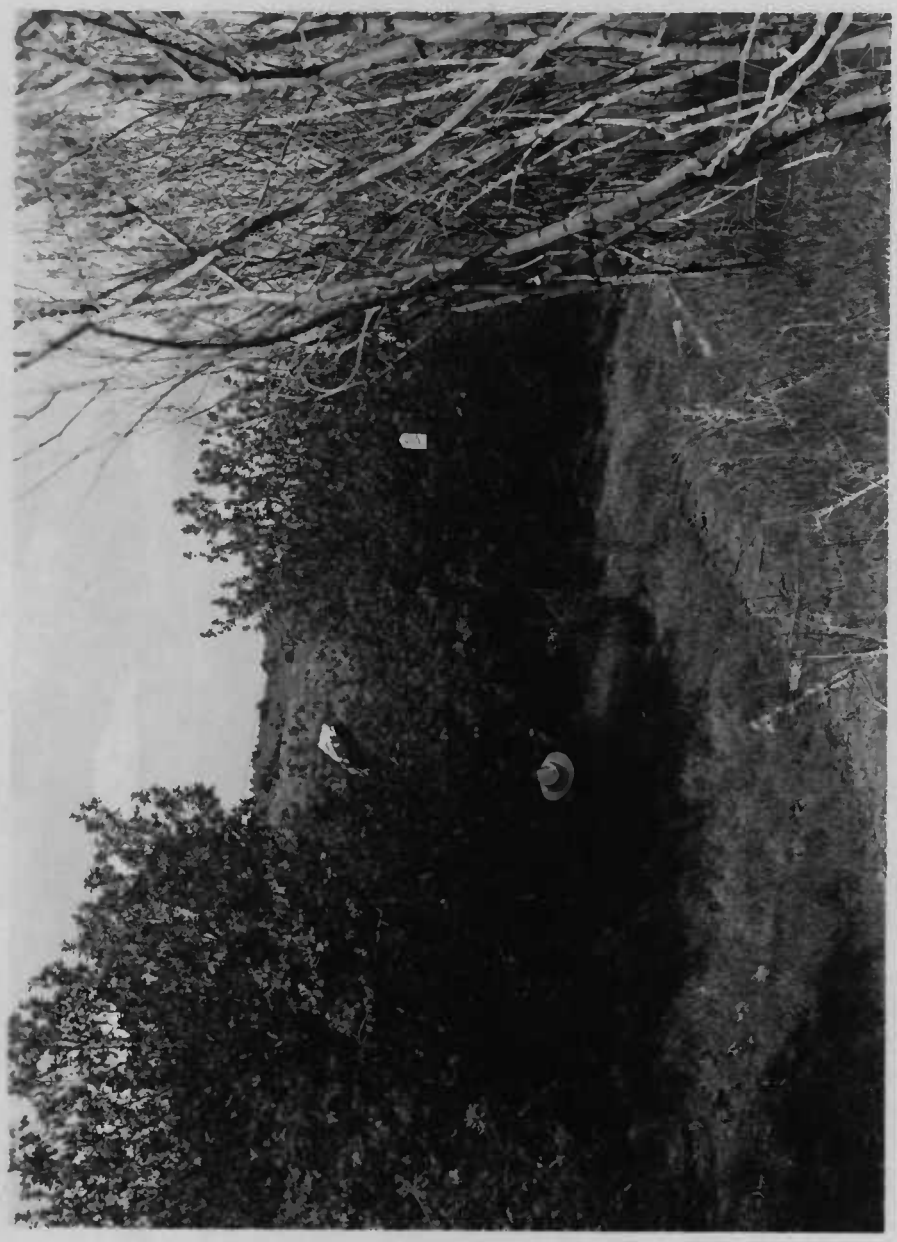


Figure 6

The plum brush shown in this picture is located on the John Withers' Ranch, Paisley, Oregon. This is the plum referred to as Below The Old Mill Area.

time varied from two to nine days. The dates are shown in Tables 1, 2, 3 following this discussion.

CROSSING

Although the main purpose of this problem was to determine if Prunus subcordata was self-fruitful, some blossoms were crossed in the event that this wild plum proved to be self-unfruitful, there would be some indication as to its compatability within the species.

All crosses were made on plum trees at the Rugg Ranch south of Lakeview. The buds were emasculated just before the buds opened. It was impossible to have all the flowers under a bag in this condition so it was necessary to remove the opened flowers. The flower bud is very small and quite tender and sensitive to handling. Two methods of emasculating were used and both were quite successful. One consisted of removing the anthers, petals and sepals with a set of tweezers. Great care was necessary as a slight injury of the style or ovary by the tweezers would cause it to wither and die. A second technique was considerably faster and was quite simple. It has been used rather extensively in other fruit tree pollination work. The stem of the flower is held in the left hand and then bringing the nails of the thumb and middle finger of the right hand together so as to cut across the receptacle on

either side, just below the intersection of the stamens, lift up the upper portion which has been severed and all the floral parts are removed except the pistil. Again great care is necessary as the slightest injury to the pistil causes it to wither and drop.

Four hours was allowed from the time the flowers were emasculated until the pollen was applied. Two trees were used as the female parent and pollen from four sources was used. Branches were removed from the trees selected as pollen parents and the method of applying the pollen was simply by brushing the emasculated flower with the entire flower of the pollen parent. There was an abundance of pollen and it would be seen on the pistil following this procedure.

There was such a large supply of pollen and it seemed so light that branches on two trees were bagged and given no treatment other than to slightly shake the branch. The thought was to see if the movement of the limb in the wind might cause the flowers to pollinate themselves. They were designated as "check self" but on later examination there was no fruit set of the blossoms treated in this way.

This plum seems to produce a very large amount of pollen and an unusual number of blossoms. There was such a profusion of blossoms that in almost all cases it was

Figure 7

A closeup of Prunus subcordata showing the profusion of bloom typical of the species. Rugg Orchard, Lakeview, Oregon

necessary to thin about half of the blossoms off a branch so that accurate counts could be taken.

Arrangements were made with the county agent to check the bagged flowers and remove the bags when all petals had fallen and there was evidence present that germination had taken place.

The weather was very unfavorable at the time all of the pollination work was being done. It was cool and damp with threatening rain alternating with periods of warmth when the sun shone. Table 6.

RESULTS

The last trip made to Lake County was for the purpose of determining the amount of fruit set from those blossoms treated, with the following results. In the Old Mill Area, where the blossoms had been selfed, there was no fruit set. See Table 2. The selfed blossoms were dried and brown. An estimated five per cent had started to set and form fruit but were small and red whereas the normal fruit was large and green. The rest of the thicket had set a heavy crop of fruit. In the thicket below the Old Mill Area, the same was true of the selfed blossoms although none could be found that had started to set. There was not as good a crop of fruit in the rest of the thicket as found in the Old Mill Area. In Miners Canyon, four of the

Figure 8

Prunus subcordata, Miners Canyon, Withers' Ranch, Paisley, Oregon. This thicket has a very distinctive type of growth as may be noted in the picture. There is a great deal of variation in this wild plum as to type of growth.

Figure 9

Prunus subcordata, located in Miners Canyon, John Withers' Ranch, Paisley, Oregon. The Kraft paper bags used in the pollination are shown in the picture. The profusion of bloom is typical of the species.

Figure 10

Prunus subcordata, Rugg Orchard, Lakeview, Oregon. These plum trees have been propagated on peach roots and this picture shows what the plum looks like in commercial planting.

Table 1

Percentage of Fruit Set In
Plums Selfed At Rugg Orchard, Lakeview, Oregon.*

Selection		# Selfed	% Set	Remarks
B I 1 branch	1	225**	0	
	2	303	0	
	3	178	0	
	4	213**	0	
B I 2 branch	1	174	0	
	2	216**	0	
	3	116	0	
	4	222**	0	
B II 1 branch	1	157**	0	
	2	268	0	
	3	166	0	
	4	306	0	
B II 2 branch	1	138	0	
	2	158**	0	
	3	151**	0	
	4	140	0	
B III 1 branch	1	207**	0	
	2	132**	0	
	3	158	0	
	4	157	0	
B III 2 branch	1	107**	0	
	2	208	0	
	3	240	0	
	4	214**	0	

* Bagged 5/20/48; pollinated 5/27/48; bags removed 6/6/48.

** "Check self".

Percentage of Fruit Set In
Plums Selfed at John Withers Ranch, Paisley, Oregon.*

Selection		# Selfed	% Set	Remarks
OLD MILL AREA				
A II 1 branch	1	75	0	
	2	102	0	
	3	172	0	
	4	219	0	
A II 2 branch	1	190	0	
	2	99	0	
	3	159	0	
	4	198	0	
A II 3 branch	1	189	0	
	2	182	0	
	3	119	0	
	4	129	0	Tag torn off
A II 4 branch	1	253	0	
	2	201	0	
	3	98	0	
	4	254	0	
BELOW OLD MILL				
A III 1 branch	1	86	0	
	2	140	0	
	3	43	0	
	4	-	-	Bag broken
A III 2 branch	1	83	0	Not rebagged
	2	289	0	
	3	200	0	
	4	111	0	
A III 3 branch	1	96	0	Not rebagged
	2	145	0	Not rebagged
	3	89	0	Not rebagged
	4	90	0	
A III 4 branch	1	106	0	
	2	138	0	Not rebagged
	3	96	0	
	4	51	0	
MINERS CANYON				
A I 1 branch	1	214	1	Ready to drop, small
	2	233	3	Ready to drop, small
	3	185	0	
	4	212	0	
	5	87	0	*Bagged 5/19/48;
	6	135	0	pollinated 5/26/48;
A I 3 branch	1	140	0	bags removed 5/28/48
	2	320	0	
	3	129	0	

Table 3

Percentage of Fruit Set In
Plums Selfed at Reid Ranch, New Pine Creek, Oregon.*

Selection		# Selfed	% Set	Remarks
D I 3 branch	1	48	0	
	2	136	0	
	3	221	0	
	4	-	-	Bag broken
D I 1 branch	1	160	0	
	2	170	0	
	3	78	0	
	4	-	-	Bag broken
D I 2 branch	1	90	0	
	2	75	0	
	3	135	0	
	4	84	0	
D I 4 branch	1	102	0	
	2	131	-	Branch dead
	3	142	0	
	4	118	0	

* Bagged 5/20/48; pollinated 5/27/48; bags removed 6/3/48.

Table 4

Fruit Set In
Plums Crossed at Withers Ranch, Paisley, Oregon.*

Parents ♀	♂	# Crossed	# Set	Remarks
A I x	A II	100	0	
A I x	A III	78	0	

* Bagged 5/19/48; crossed 5/26/48; bags removed 5/28/48.

Table 5

Fruit Set In
Plums Crossed at Rugg Ranch, Lakeview, Oregon.*

Parents ♀	♂	# Crossed	# Set	Remarks
R.F.P.1** x	A II 1	105	4	
R.F.P.1 x	A I 3	148	6	
R.F.P.1 x	A III 3	103	39	
R.F.P.1 x	B I	166	-	Tag lost
R.F.P.2 x	A II	132	16	

* Bagged 5/20/48; crossed 5/26/48; bags removed 6/6/48.
**Rugg Female Parent

Table 6

Weather Report for Lakeview
from 1948 Weather Readings
During Approximate Pollination Period

Date	Temperature Maximum	Temperature Minimum	Precipitation	Character of Day
May 16	71	47	.25	cloudy
May 17	39	39	.25	cloudy
May 18	35	35	.20	cloudy
May 19	47	32	.07	cloudy
May 20	52	32	.44	partly cloudy
May 21	50	38	.04	partly cloudy
May 22	64	36	.44	partly cloudy
May 24	42	42	.25	partly cloudy
May 25	80	45	.03	clear
May 26	78	44	.20	partly cloudy
May 27	64	43	.01	cloudy
May 28	51	35	.08	cloudy
May 29	56	35	.06	cloudy
May 30	50	36	.05	cloudy

Maximum mean temperature for the month of May 59.7

Minimum mean temperature for the month of May 35.6

treated blossoms had started to set but were small and red in the stage that usually occurs before dropping. Other than these there was no set whatever in the remainder of the thicket. The blossoms were dried and brown as though they had been blighted by frost or some other agent. There was no fruit set on the selfed blossoms at the Reid Ranch. See Table 3. The crop set in the remainder of the thicket was very light. At the Rugg orchard there was no set on the selfed flowers. Some had started to set but were about the size of a pea and some of this kind had dropped to the ground. In the remainder of the trees there was an unusually heavy fruit crop. This might be explained by the fact that there is a mixed planting of plums in this orchard and that a great deal of natural cross-pollination takes place. For the selfed flowers see Table 1.

Of a total of 832 blossoms crossed, 65 large, nice normal fruit had set. This might have been even higher but one of the tags of the branches treated was lost or removed so that the results of 166 crossed blossoms could not be determined and used. See Table 5.

INTERPRETATION OF DATA

From the data accumulated in this study and tabulated in the foregoing tables the following interpretations might be made.

Of 9099 blossoms selfed, only four showed evidence of starting to set and these four fruits were about the size of a pea, turning red and about to drop. The normal fruit of other thickets at this time were about fully developed as to size and were still green. It is the belief of the author that the four above mentioned fruits were parthenocarpic and that fertilization had not occured.

Part of the selfed blossoms consisted of 1795 blossoms treated as "check selfs", explained in previous pages. No fruit was set by this method. With the evidence now available by the other selfing conducted this can be explained by the cross-pollination requirement of this species.

Of 832 blossoms crossed, 65 set fruit. The fruit were of good size and compared favorably with fruit resulting from open-pollination.

From the above cited evidence, it would appear that the selections worked with require cross-pollination to set fruit. No attempt was made to determine the cause of this self-sterility.

The heaviest bloom and subsequent fruit set was

observed in the orchard on the Rugg Ranch and it is the belief of the author that this is so because of the great variety of wild plum selections present giving an ideal situation for many combinations of inter-crossing.

Although the weather was not ideal for pollination work, it is believed by the author that the large number of blossoms selfed, and the distance between selections worked with, gave a true picture of this problem.

SUMMARY AND CONCLUSIONS

The pollination study undertaken in this problem has shown the probable need of cross-pollination of the native American species, Prunus subcordata. This conclusion seems to bear out similar studies on other native American plum species showing them to be self-sterile.

Further pollination studies need to be undertaken for this work has by no means concluded the investigations needed as far as pollination work is concerned. This splendid native plum should be tested for its intercompatibility and it has only been briefly used in breeding work with European plums.

It has much to contribute in a breeding program for it has a very distinctive flavor, firm flesh, good color and offers much as a preserve for eating with meats.

Justification of this pollination study can be seen and obtained by the amount of time, effort and money that might be saved by applying the material presented at the time when interest and enthusiasm has brought this wild plum to the orchard planting stage.

With the information now available it would seem wise to plant orchards of two or more different selections of the species. Observations made of a similar planting on the Rugg Ranch tends to bear this out.

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