

NOTES ON THE PLANTING AND CULTURE OF AVOCADO TREES

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1. THE GROWING OF NURSERY STOCK

T. U. BARBER

Selection of Seed.

The thin skinned Mexican fruits contain the most desirable seed from which to produce root stock and are generally used in California. This type is more resistant to both frost and heat, produces an extremely vigorous root system and has the strongest class of wood to be found in the different types of avocado trees. Seed should be obtained from strong, healthy trees producing fair sized seed.

Planting.

The thin skinned Mexican fruits mature during the fall months, therefore it is best to plant the seed in special beds which can be protected with glass or canvas covers during the cold winter nights and heavy rain storms. The most satisfactory soil for the seed bed is a mixture of half sand and half leafmold or rich loam soil. Plant the seed two inches apart, with the pointed end up, cover the tops with a light, clean sand to keep the bed from baking.

Irrigating Seedbed.

The seed should be kept moist but will not require heavy watering until the warm days of spring, when the small seedlings are well leafed out. Seeds planted during October, November and December should be three to six inches high in April or May, when they are ready to transplant.

Transplanting Seedlings.

It is best to transplant the seedlings from the seed bed to the nursery rows before they grow too large and have developed a heavy root system. Plants up to six inches can be handled with bare root without much setback. They should be carefully shaken out of the seedbed soil, cutting off all injured roots, and placed at once in small boxes which will hold about fifty packed with wet moss around each one and the box covered over with wet burlap. Take the trees out in small lots so that each tree is planted in the nursery within one hour from the time it is removed from the seed bed.

The nursery soil should be moist and easily workable so the roots may be spread out in the trench, made by a small walking plow, and loose soft dirt carefully rolled in around them. Water must follow the planting within a few minutes to settle the soil and freshen the small trees.

Irrigating Nursery.

Water should be supplied very close to the newly planted trees every few days until they are well established.

Shades.

Each tree must be shaded from the direct sun, shingles being generally used for this work.

Do not use pots or boxes in raising avocado trees. They produce root curl and spoil the future growth of the orchard trees.

Budding.

Stock planted in the field during April should be ready to bud the following August or September. The seedlings should be from three-eighths to three quarters of an inch in diameter before budding.

Budwood of the different varieties is not alike. In some kinds a bud which is slightly broken open can be used, while in others this advanced bud is sure to be unsuccessful; therefore it is necessary to become familiar with the wood to be used and learn which buds grow best in each variety. In general, it is desirable to select a plump, mature bud which seems ready to start into growth. Early in the spring this wood is obtained from the last growth of the previous year, and later in the season from the new branches. This new growth must become fairly mature, which usually requires six to ten weeks. Very little success is obtained from using soft tips.

Cut a shield bud three-quarters of an inch or more in length allowing an equal amount of wood above and below the bud. Do not remove the hard wood from the shield. It is best to leave a short piece of the leaf stem to push on while inserting the buds, this also protects the bud from the wrapping. The common T shaped cut is made, being careful not to break the bark in placing the bud. The sap must be flowing freely so that the bark separates readily.

Waxed tape or heavy soft cotton string is used for wrapping with equal success. The bud must be tied extremely tight as close to the eye as possible without covering it. Secure the wrap by slipping the end under the last loop and pulling down tight. Many buds are lost through spreading of the bark. Unless the wrap seriously cuts the bark do not remove it for at least four weeks. If the stock is growing very fast the trees should be gone over very often, starting the end of the second week and re-tie any that show a serious cutting by the wrap.

The seedling tops are cut back gradually to start the bud into growth, always allowing a few leaves to remain to aid in keeping up the flow of sap above the bud. The avocado will not stand the complete topping, so often practiced in citrus work. The bud should be at least six inches high and contain some mature wood before the entire stubbing can be made. This is most satisfactory if practiced through the cool months of spring.

After the bud is started, it should be tied with raffia every few weeks in order to make a straight trunk. The seedling top can be used to good advantage in this work until the bud is large enough to require staking.

The suckers and heavy branches[^] should be kept off until the tree reaches a height of 24 to 30 inches, when it will generally form a perfect head of four or more branches.

Stock grown in this manner soon shades itself and makes a beautiful, well shaped tree.

The only way to carefully transplant budded avocado nursery stock is by balling. Careful handling of the balls, hardening off in a lath house and great care in shipping are extremely important to obtain the best results.

2. TOP WORKING BY BUDDING

T. U. BARBER

In budding over old or large trees the first operation is to cut back the trees half to two thirds, leaving several large limbs and some foliage. It is best to place the buds in the main trunk wherever possible, allowing the new head to be formed from one bud, thus making it possible to form a more perfect structure from a mechanical standpoint. It is well to place two or three buds in a ring around the trunk to be bound in by the same cord. After these have grown the most suitable one may be selected for the new head.

Budwood sticks for topworking large trees should be of large caliper and the eyes plump, large and well formed. Cut the buds longer and with more hard wood than in those generally used in nursery work. The top of the bud shield should be cut off square and fitted closely to the cross cut on the incision. For wrapping sixteen ply white cotton string should be used, being careful to pull it absolutely tight, completely covering the incision and wrapping very close to the bud without covering it. Too great care can not be used in wrapping, as this is one of the most important features of top budding.

Never remove the strings until they show serious cutting of the bark; leave them on for at least two months or more if possible as seventy-five per cent of the buds placed in heavy bark are lost through spreading after premature removal of the wrap.

After the buds have been in from four to six weeks sucker growth should be removed to force the bud growth. It will be necessary to tie up the new buds in a careful way as they make a very soft, vigorous growth.

The old trunk and heavy limbs must be protected from sunburn by either a loose wrapping of burlap or heavy whitewashing, burlap being the most practical.

Pruning in order to shape and stock up the bud and relieve it of overweight to prevent breakage is necessary.

The complete stubbing off should be left until the following year, when the bud contains a considerable amount of hard wood.

Trees being top worked must be kept in the most vigorous condition to insure the success of the work.

Where the buds have failed to take and the tree has been severely cut back and kept so during an entire season it will be necessary to allow the tree to fully recover before being budded again or the life of such tree will be seriously endangered.

3. TRANSPLANTING YOUNG AVOCADO TREES FROM THE NURSERY INTO THE ORCHARD OR BACK YARDS

WM. HERTRICH

By far the best time to transplant young avocado trees from the nursery is in the Spring, as soon as the ground is warm enough to encourage root action, regardless of whether the stock has been previously established in cans, boxes or taken from the nursery row. Established plants, which have been kept in the open for some time before planting, will require no special protection, but plants taken from a lath-house or other shaded places ought to be protected for the first few months from the strong rays of the sun; if no shade is provided and a few warm days should follow the planting, the tender foliage as well as some of the soft shoots will become sunburned and cause a severe check to the young tree in establishing itself in its new place.

The holes for the trees should be dug large enough to provide plenty of loose soil for the young roots for the first couple of years. In ordinary soil a hole three feet square by three feet deep should be ample; if any layers of hard-pan are present within this distance or below the three foot level they should be broken up, which can be done easily by the use of powder.

When planting the trees the holes should be back-filled from the surrounding rich top soil, if such is present; the poorer soil from the bottom of the hole can be utilized in making the rim of the basin. If a hole three feet deep is used, the required back-fill should be firmed down well, otherwise the settling of the ground would result in having the tree too low and in most cases out of plumb.

The string with which the sack is held above the ball should be cut and the flaps of the sack laid down so that they will decay in a short time. Immediately after planting, a good irrigation is necessary. At all times be positive that the ball of the tree, before it is placed in the hole, is not in a dry condition, especially so, when the earth of the same is of a heavy clay soil, which gets hard when dry and does not take in water as freely as it should.

In light open soil with plenty of drainage there is no danger of over-watering young trees, but in heavy clay or when hard-pan is present it is necessary to be cautious as over irrigating would cause sour soil, which would prevent the young roots from establishing themselves, as well as be injurious to the old roots, causing a sickly yellow looking tree which in the end would probably die.

In making basins for irrigating, it is a mistake to form the funnel or crater-like affair with its deepest point around the trunk of the tree. It is far better to make a circular ditch around the tree, leaving six inches of high ground next to the trunk. All basins should have some kind of a mulch covering to keep the moisture from evaporating as well as to keep the soil from baking hard.

All young trees should have a stick for the first couple of years placed to the south or south-west side to act as part shade for the trunk. A lean-to shade made out of burlap about 5 feet square and fastened to 5 or 6 foot stakes can be used as means of shade for the first few months after planting.

4. IRRIGATION

S. W. JAMIESON AND WM. HERTRICH

The irrigation of the Avocado, like every other subject in connection therewith, occasions wide diversity of opinion. The planter must study his soil and other conditions, and adopt a system that will meet his requirements and limitations. At one time it was considered impossible to over-irrigate, but it has been found that too much water is as bad as too little, and for this reason the drop system has been practically discarded.

There are three systems of irrigation in general use; furrow, basin, and overhead. In the first, furrows are made between the tree rows, usually with a team and cultivator; water is then turned into the furrows or rills, cutting down the flow when it has reached the end of the furrow and allowing it to run until sufficient water has been applied. The drawback to this system is that it requires the use of a horse or team at exactly the right time, which is not always possible on a place not large enough to warrant owning such equipment.

To use this system of irrigation it is very important to have the distance of the pipe lines correctly spaced. In light open sandy or gravelly soil the irrigating lines ought not to be more than two hundred feet apart; if the soil is of the light silty type the distance can be increased to about three hundred and fifty feet, while in heavy soil as much as four hundred and fifty feet between irrigating lines has been found to be satisfactory.

The length of time the water should run in the furrows is governed by the type of soil as well as the lay of the land. In a light open soil, with a one to two per cent grade, less time is necessary to accomplish the required results than would be in a heavy soil under the same grade conditions. However, to keep the water in the furrows from twelve to forty-eight hours, according to the conditions, should give satisfactory results.

The basin system consists in making a more or less permanent basin around each tree, which is filled with water at stated intervals. This basin is sometimes cultivated and sometimes kept filled with a mulch. Opponents of this system claim that it brings all the roots to the surface with ultimate injury to the trees.

The overhead system involves the piping of the entire orchard with water under pressure, together with sprinklers, either portable or permanently placed. The largest type of these sprinklers consists of an upright pipe of any height up to sixteen feet, with a revolving cross arm at the top, each end of which has a nozzle. It can be arranged that one end throws the water in a wider circle than the other, thus giving an even distribution over a circle of about sixty feet diameter. Where tall uprights are used as portables, they must be guyed to the four corners of a wooden platform. If sufficient sprinklers are used, the entire orchard can be irrigated at once, which would be of benefit in case of frost or excessive heat. The washing the trees receive, has some value in removing dust and keeping down pests. This system requires less labor than any other but is quite expensive to install; portable standards sixteen feet high cost about sixteen dollars each in addition to the cost of piping the orchard and the necessary hose connections.

In any system, the proper amount of water for the best results is dependent upon several conditions, one of which is the geographical location. Certain parts of San Diego, Orange, Los Angeles, Ventura and Santa Barbara Counties bordering on the

shores of the ocean obtain a great deal of moisture from the heavy fogs; furthermore, the average temperature in these sections is considerably lower than in some of the interior valleys, such as San Bernardino and Riverside Counties. Using the same method of cultivation for both the interior and coast regions, it is natural that less actual irrigation is required along the coast than further inland.

The second, and perhaps the most important factor to be taken into consideration, is the local condition; as to the lay of the land, and as to the texture of the soil; whether heavy, medium or sandy. An orchard with the soil in good physical condition and correctly cultivated can be properly maintained with much less water than would be required in the same orchard when cultivated poorly or not at all. Poor physical condition of the soil can be improved a great deal by planting a good cover crop to be turned under, or by applying stable manure or other fertilizer containing a large amount of humus. Sometimes a heavy soil requires but one of these methods whereas a light sandy soil may require both cover crop and manure.

Taking into consideration the geographical location, local conditions and physical properties of the soil, as well as weather conditions, the irrigations during the season should be three to five weeks apart. In the more exposed sections, the young growth may be seriously damaged by early frost, if the trees are over irrigated in the fall months.

Deep cultivation is the best means of preserving the moisture in the ground between irrigations. Cultivate as soon after irrigating as possible, before the soil gets too hard; repeat if possible once more before the next irrigation, discing or cultivating to a depth of six inches.

For the back yard trees it is practical to make a large basin, leaving twelve to eighteen inches of soil around the base of the trunk to prevent the collection of most of the water at this place. The ditch should be about four feet wide all the way around the tree with a six inch excavation, placing the soil around the outside of the basin so as to increase its capacity. The deepest part of the basin should be around the outside in order to spread the seepage out as far as possible, as the roots have a tendency to follow the moisture. The excavated portion of the basin should be filled with strawy manure; all kinds of old leaves can be used as well as peat or any other compost material which does not get hard after the water recedes. During the irrigating season the basin should be filled about every two weeks; however, if hardpan is present as a subsoil, care must be taken not to over water, as sour soil will be the result. On the other hand, light sandy or gravel soil cannot be over watered, unless underlaid by a heavier soil such as clay or hardpan. It is advisable for any grower to have a soil auger by means of which the moisture contents of the soil can be learned and the necessity for application of water be gauged.

5. CULTIVATION

WM. HERTRICH

It is a well known fact that the Avocado tree is inclined to make a great number of surface or near surface roots, if permitted to do so. which is against proper methods of establishing an orchard of any kind in a country where summer irrigation has to be

applied as the only source of moisture available. Intelligent tilling of the soil will avert the condition mentioned above and will encourage the roots to seek deeper levels, which is manifold in its benefits.

First, a four to six inch mulch can be maintained which aids to hold the moisture and permits air to work into the soil, both of which are very essential. Second, the root system, which is forced to seek lower levels, is better for anchoring a tree and holding it in an upright position. Third, in case the main supply of water, for some reason or other, breaks down in mid-summer, just at the time when your turn for irrigation comes; if your soil is in good physical condition, with a six inch mulch on top, your trees will withstand the water shortage much better than a non-cultivated orchard with most of its fibrous feeding roots near the surface.

Two methods of tilling the soil are practiced, one of which is plowing and cultivating, and the other is just cultivating mostly by means of discing. Either of these methods is satisfactory, if intelligently done, but the first is preferable to the second. Plowing ought to be done about once a year with either a disc or mold-board plow not less than eight inches deep and should be followed immediately with a disc or tooth harrow as required by prevailing conditions. If cover crop has been plowed in, discing will have to follow plowing, but in case of no cover crop either one of the tools mentioned will do satisfactory work.

The proper time to plow an Avocado orchard is a hard question to decide as not enough experiments have been made along this line to form definite conclusions. If no cover crop has been planted and deep cultivation has been practiced it won't matter materially whether the plowing is done in the winter or early spring months as only a small percentage of the roots will be cut; on the other hand, it takes six months to mature a cover crop, during which time no cultivation has been done and perhaps a little more water has been applied with the result that a large number of feeding roots have crept near the surface. All of these accumulated feeders, as well as a few more below will be cut during plowing, consequently it is not advisable to perform this work during blooming time as a certain amount of check will follow and very likely would affect the setting of the fruit. This method, however, is only practical when the orchard is planted with one or a few varieties which bloom at the same time, but as the blooming season of the various Avocados ranges from early fall to late spring it is very difficult to specify the proper time to do the work, especially so when several varieties are interset, which method of planting is frequently practiced.

In heavy or near heavy soil plowing or discing practiced for some time often causes a hard crust below the depth or reach of the tool used. This formation called plow sole finally gets hard enough to resist water penetration; to avoid this condition, plowing two different depths at different times is advisable, also, use of subsoil plow once or twice through the center of the rows both lengthwise and crosswise from twelve to sixteen inches deep according to the requirements, but not when the trees are in full bloom. If subsoiling is practiced during the summer months it should be followed immediately by irrigation. Cultivating and irrigating should be used in conjunction and must be practiced intelligently; to cultivate too soon after irrigating is detrimental to the soil, especially so when of the heavy type, as the soil does not pulverize well and stays too open, consequently the moisture evaporates too freely; to wait too long with the cultivating

after irrigating is just as bad, if not worse, as the soil will not break up and make a fine mulch but will remain in a dry and baked condition. But generally speaking from three to five days should elapse between irrigating and cultivating, depending upon type of soil and other conditions.

The non-cultivation of the Avocado orchard is not to be recommended, as the root system of the trees will be formed too near the surface and the crop of weeds, which will grow as the result of irrigating and no cultivating, will take away a great deal of moisture from the tree. On the other hand, if the weeds are plowed under once a year, it will add to the physical condition of the soil.

When trees come into bearing, fertilizer applied to the best advantage should be plowed under in case of barn-yard manure and if of the commercial type should be either plowed or drilled in.

To sum it up—intelligent plowing and cultivating at the proper time is advisable in preference to no cultivation.

6. FERTILIZATION

WM. HERTRICH

It is the general opinion of most Avocado growers that a liberal application of fertilizer of some kind or other is necessary, when trees begin to bear heavy crops. To this date barn-yard manure has been used in most cases, but experiments are in progress as to the value of commercial fertilizer; tankage, bone meal and fish meal having been used, the results of which should be available within the next year or so.

Different kinds of cover crops have been used (in some of the larger orchards) of the leguminous types, which improve the physical condition of the soil as well as add humus and nitrogen. The most common legumes in use at the present time are the *Melilotus indica* and Purple Vetch.

The Avocado tree is very similar to the citrus tree so far as its growth is concerned, the fruit, however, differs considerably in its analysis, and bearing trees will probably require somewhat different proportion of fertilizing elements to produce satisfactory results.

7. AVOCADO PRUNING

CARTER BARRETT

The pruning of any tree is prolific of more argument than any other phase of horticulture, perhaps, and the avocado is no exception to the rule. Many growers have left their trees severely alone in this regard, arguing that the avocado is naturally a drooping type of tree, and should be allowed to spread all over the ground. Very few deny that this has been a mistake, now that the young orchards are reaching the bearing point.

Based on an experience covering large acreages, and consisting of many varieties, in different localities and ranging over a period of years, the writer has developed certain well defined general methods, which, of course, have varied in details to meet the

individual problem of each tree. A budded avocado, being an artificially produced tree, must receive help outside the ordinary course of nature in order to form the sturdy framework requisite to the successful carrying of the heavy loads of fruit the grower expects of it.

The pruning of the avocado may be divided into two phases, the first consists of the formation of the tree during the first three or four years or up to the time it begins bearing; the second consists of the treatment bearing trees should have.

Due to the extreme brittleness of avocado wood and the tendency of the trees to form dangerous types of crotches, the wisest and most successful type of structural framework to build up is based on a modified leader plan. In other words, the main limbs should radiate from the central trunk up to a height at which it seems desirable to stop direct upward growth, which will vary with type and variety of tree. In order to achieve this result, it will be necessary to carefully stake all young trees as they are set out and to follow this staking up consistently until the tree is at least twelve or fourteen feet in height. The best way to do this is to use one stake placed immediately against the trunk of the tree and up which the trunk should be carefully trained. This stake should be placed against the wind. After the first year, two by two redwood in eight foot lengths will be found best for the purpose. If these are creosoted they will last indefinitely. If necessary, one by two pine can be spliced with baling wire to lengthen these. In young trees, a judicious amount of heading of the limbs will be necessary in most cases, in order to stock up the trunk and primary branches, and to correct a too droopy tendency. No limbs should be allowed to attain any permanent size or maturity closer to the ground than two and a half feet. If any one limb seems determined to take the growth of the tree, the only safe thing for the future of the tree is to remove it entirely. Sunburn and water starvation must be zealously avoided as they will defeat all the skill of the most experienced pruner.

In the first few months after setting the young tree out when the growths it makes during the re-establishment periods are very short, as little cutting should be done as is consistent with the correction of structural faults carried over from the nursery.

If, during the first months, the tree makes little growth, the bark of the trunk may become tight and constricted, preventing proper development when the tree does become established, it is advisable to slit this bark lengthwise, giving the trunk a chance to expand. This will heal very rapidly and aid the tree greatly.

It is vitally important in handling young budded avocado trees that no stubs be left and all cuts be carefully painted. A cut should be made either close to a bud or flush with a small twig. Any ragged cuts should be carefully trimmed with a knife. A saw cut of any size should always be trimmed with a knife on an avocado of any size. The danger of die-back in young trees establishing themselves, when these details are not properly observed, is much greater. If it is necessary to cut the terminal of the leader of a young tree, great care should be exercised. If cut to a plump bud in the internode, the result will be that the growth will be temporarily checked, stocking up the tree, but allowing the leader to eventually continue upward. If cut to a small twig, limb or bud of poor development, the result will be that the tree is more or less permanently flattened out at this point. Further upward growth will follow several leaders in this case. The split-type

of crotches should be removed as fast as they appear, as they are a great menace.

Now as to the second phase or the treatment of trees from the time they begin production onwards. If the methods outlined above are carefully followed, there will be no necessity for any severe cutting (particularly stubbing or heading of limbs) in the matured or maturing trees. This is a very desirable state of affairs, as the writer feels assured that this is very detrimental to the fruiting tendency of the tree; not so much from the bearing surface removed, but due to the inhibitory action of the growing tips being removed from the older portion of the limbs, and allowing them to rush into rank growth instead of fruiting naturally. This growth then has to harden up and regain a normal tendency before fruiting, many months thus being lost. A bearing tree, which has been properly developed, should only require the removal of limbs crossing out of their place in the tree, the removal of dead wood and the lifting of the skirts sufficiently to just clear the ground. This is advisable as fruit resting on the ground will either blanch or bruise, rendering it of poor grade for the market.

If it is necessary to prune an orchard of large trees which have never had any care, the best time will be immediately after all danger of heavy frost is over, as in many places they will be thrown open to the sun, and this will give them time to cover themselves before intensely hot weather sets in. In handling trees in this condition do not be afraid to remove all misplaced branches, but avoid heading in so far as possible. Keep all dead wood removed. Keep all rank sucker types of growth removed.

The ideal tree of bearing age should have a well formed and symmetrically developed structural framework. The foliage should be like an umbrella, the center being hollow, admitting light and air for the proper development of fruit. While the limbs will droop to the ground, it should be out and down from above and not the limbs coming from the trunk close to the ground.

The proper time for any minor pruning is at the time one sees the need of it; for heavy and thorough treatment, either late in the Fall or early in the Spring.

In conclusion, it should be borne in mind that most varieties of avocados are destined to make large trees; trees more closely approximating a walnut in size than a citrus tree. The course pursued should be governed by this fact.