

# BULLETIN

OF THE

## Agricultural and Mechanical College of Texas

(In co-operation with the United States Department of Agriculture)

Address

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College Station, Texas.

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MARCH, 1920

EXTENSION SERVICE

B-56

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# PECAN CULTURE IN TEXAS

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WILL PECAN GROWING PAY?

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So many letters are received by the Extension Service of the A. and M. College of Texas from all parts of the country asking whether or not it will pay to engage in growing improved varieties of pecans it is found advisable to prepare a short treatise bearing on the different phases of the subject in order to answer them.

Many of these letters state that the writers have read somewhere that great fortunes could be made in the pecan business, and they usually

embody the short request, "Tell us all about it." Now, a plant specialist sometimes writes a book of considerable size in treating of some particular tree, or class of trees, and still does not exhaust his subject. It is plain that such requests as the above cannot receive full answer in the space of an ordinary letter. Therefore, this effort is made to furnish the public the desired information. In making the effort great care has been exercised to make all estimates conservative, so they can be fully realized in those cases where pecan culture is engaged in under the conditions hereinafter set out, and correct cultural methods are followed.

### WILL PECAN CULTURE PAY?

The answer to this question depends in varying degree upon the definition of the word culture. What the average Texan means by the term is the kindness shown by him to nature in leaving a few native trees scattered around the edge of his field and on brushy banks when he cut down the other timber to plant field crops. The only attention the trees receive is incidental to cultivation of the crops—and that isn't much. In this sense, pecan culture pays the highest possible rate of profit just as raising razor back hogs in the piney woods pays. If the farmer has no investment in his hogs, and has no feed bill—if the hogs live on pine mast and acorns and finally come to be worth \$5.00 each—nothing divided into \$5.00 gives infinity as the rate of return. Still no one thinks it more profitable to raise razor back hogs under these conditions than to raise registered hogs on a properly equipped hog farm.

What is embraced in the term "pecan culture" in these pages is the growing of budded or grafted trees of the best varieties, in the best pecan soil, under the most favorable climatic conditions for the particular varieties, and always under proper cultural methods.

Each of these subjects will receive treatment in its proper place.

It would be easy to take a particular tree, or group of trees, on a favorable year and figure out fabulous returns on a pecan orchard, but the results would be misleading. It is, therefore, thought best to take two trees, a good one and a poor one, and draw a conclusion between the two.

There is growing on the grounds of the Denton Normal School a tree of the Kincaid variety, which is now in its seventh year after transplanting. It was set out on the location of an old cellar that had been filled with good soil, and has received due care and attention. It bore in 1919, which was a favorable year, thirty-two pounds of nuts, which could have been easily sold at 50c per pound. Twelve such trees to the acre would bring an income of \$192.00.

Not far from this tree is another of the same age and variety, but growing in poor clay soil, without proper care and attention. This tree produced about a hundred inferior nuts this year.

The conclusion based on these facts is inevitable that pecan culture will pay under favorable conditions, but that mere spasmodic attempts at pecan tree growing will not pay under any circumstances, particularly unfavorable ones.

However, it should not be expected that the tree on the Normal grounds will yield as well every year as in 1919, or that every tree on an acre would yield as well as this one, as there is some inherent difference of productive capacity.

The age at which pecan trees begin to produce has some relation to the question of profit. As will be shown under a separate heading, there is a marked difference between the Western or Texas varieties and the Eastern or Coastal ones. The Western kinds are both more precocious and prolific. As a rule they begin bearing the second season after transplanting, while the Eastern kinds begin the third or fourth season. Mr. W. T. Evers of Denton, Texas, has a Halbert tree, not larger than ones little finger, that was set out in February, 1919, and bore fifteen nuts the same year. A gentleman in Arlington owns a small Halbert tree, set out in March, 1918, which bore forty-three nuts in 1919. He expects it to bear two pounds in 1920. The annual increase is not definite, but by the time the trees are ten years old they ought to yield fifty pounds each, or six hundred pounds to the acre. At 25c per pound—a very low price—this would bring a gross income of \$150.00 per acre.

This estimate of production is not over large, and the price is low. It would, therefore, be a very conservative estimate to place the annual production of a ten year old grove at \$100.00 per acre, after making ample deductions for the ravages of known insect pests and unfavorable seasons. This production would continue to increase for many years.

The regularity of the crop, on the one hand, or the failure of it, on the other, bears a most important relation to the question of profit in pecan culture. If, as the general belief in Texas, pecan trees produce a good crop only once in three or four years, then the above estimate of \$100.00 per acre should be reduced in proportion. There is some foundation for this belief as applied to the trees growing wild in nature. In the majority of cases they grow in rather poor pecan soil and have to fight for existence against other trees, while striving at the same time to produce fruit. Furthermore, not one wild tree in a thousand is inherently a heavy bearer. Under the head of varieties it will be shown that the point of most value in selecting a variety for transplanting is regularity and heaviness of yield. Having this inherent quality in the transplanted trees, and taking it in connection with good soil and the assistance rendered by cultivation, the crop is just as sure as any other.

"Well", says the inquiring mind, "Are there no drawbacks to pecan growing, and if so, what are they? If there are none, everybody will go into the business and ruin it by over-production."

No, everybody will not go into it. Most people do not look ten years ahead. Then, too, there are some drawbacks in the way of fungous diseases and insect pests. Texas is little troubled by the former, except in the regions of great rainfall; but one insect, the pecan nut case bearer, is a serious pest. It would be beyond the province of a short general discussion of pecan culture to attempt to give the life history of this insect,

and the proposed measures for its control. Prof. S. W. Bilsing of the Texas A. and M. College, has been working on it for some time, as have, also, other entomologists of the United States Department of Agriculture, and it is hoped that reasonable measures of control are in prospect.

It is not intended to convey the impression that the destruction wrought by this insect is of such a serious nature as to endanger the growing of pecans as an industry. It would be just as sensible to stop producing cotton because of the boll weevil, or corn because of the corn ear worm. It is no more serious in connection with its particular host than are some other insects in connection with theirs.

The attention of the public is called to the insect through the desire to place all facts fairly before it, so that all who engage in the business of pecan culture may fully realize the expectations with which they start.

### SOIL AND CLIMATE.

Soil and climate are treated under the same head because of the intimate relationship between the two, particularly in the point of moisture content, the necessary depth of loose surface soil increasing as the average annual rainfall decreases.

The ideal condition for pecan production is to have the roots of the tree in perpetual, moderate moisture and the top in constant sunshine. This condition is most nearly approximated in the deep filled valleys between the hills of the semi-arid portions of the southwest. It is well to dispose at once of the idea that pecan trees require excessive moisture and that the tap roots should extend down to water. As a matter of fact the trees thrive best and produce the most fruit under conditions of moderate but constant moisture. Most of the water, together with the mineral plant food materials in solution that are taken up by the hair roots, is taken from within four or five feet of the surface of the ground.

Trees take in water through the white tips of the hair roots, and there are very few of these roots far down under the ground. Free water under the soil will doubtless be beneficial in those cases where it is near enough to the surface to reach the hair roots in the shape of soil moisture through capillary attraction. But the idea that a pecan tree can take all the moisture it may need immediately its tap root reaches water is a fallacy. Upon this theory one might quench his thirst by sticking his great toe into the river. At Fort Worth a pecan tree stands on a high bank of the Clear Fork. A dam has been constructed just above the tree, and the flood waters pouring over the dam have cut under the bank and exposed the tap root, so that it can be seen extending into the water. Still, the nuts on this tree failed to mature for lack of moisture during a dry year.

Many a tree by the creek that is thought to bear well because of the water in the creek, bears well rather because the land in which it grows is deep and rich and loose and well drained—"Pecan trees abhor wet feet" or soggy land.

Good pecan land should, first of all, be fertile and should consist of deep loose surface soil, containing some sand, and should be underlaid by a porous clay subsoil. This surface soil will allow the easy development of the lateral root system and will take in easily and quickly the

rain that falls upon it. The clay subsoil will check and hold the sinking water and will aid in conserving a reservoir of soil moisture sufficient to carry the tree through a drought. The necessary depth of this surface soil varies with the annual rainfall. In no case should it be less than two feet, so as to allow the development of the lateral root system. In areas of limited rainfall it should be much deeper. Shallow soils that are underlain by unfavorable subsoils, such as joint clays, may produce a big crop occasionally during a favorable year, which crop might be used by visionary enthusiasts as a basis for calculating fabulous returns from the grove, if the average for a number of years be left out of the consideration; but such soils cannot be relied upon to produce regular crops. Neither will tight-natured land do so, nor black waxy land that cracks during a drought, although it may grow very large trees. Tight land prevents the growth of an extended root system, and black waxy land is too uneven in its moisture content.

The wood growing period of a pecan tree extends from the opening of spring to about June 15th—that is, the new growth continues to increase in size until about that time. The remainder of the season is required to properly mature the new growth. The bloom that produces the next crop of nuts is contained in the terminal bud of this new growth. In the black land, subject to extremes in regard to moisture, the trees put on an abundant growth under the influence of the spring rains and rich soil. July and August are likely to be dry and the ground to crack badly and to dry out to considerable depth. Under these conditions the tree cannot fully develop its new growth, and weak and under developed buds are likely to be on weak and under developed branches, and the crop the following year may range from a light one to a total failure. Trees that grow in ideal locations do not suffer so much in this respect. The depth of the soil with its underlying clay insures a reservoir of soil moisture, and its loose texture insures the maximum development of the roots through which the tree is enabled to take the moisture from a large area. This difference between a deep loose soil and a big root system on the one hand, and a shallow tight soil and a limited root system on the other, may prove, and probably will prove, to be the difference between success and failure in the crop, save on exceptional years.

However it is not intended to suggest that a measured degree of success can be obtained only under the most ideal condition. The writer once owned a home on the top of a hill where the black waxy soil, two feet deep, rested on a stratum of limestone, under which was yellow clay. By digging large holes, really wells, and filling with soil, he succeeded in growing a half dozen good trees that now furnish an ample supply of pecans for the present owner's family. Under more favorable conditions, and still not perfect ones, the same result could have been accomplished with less expense and trouble.

There are thousands of farms in Texas that are crossed by creeks and branches, the banks of which are lined by under brush, briars, dead logs, and other debris, all of which furnish homes to injurious insects. The soil along these banks is fertile, is usually loose and deep, and is always well drained. If such places were cleaned up and a double row of pecan trees were set along either bank, it would not only add to the at-

tractiveness of the place, but the waste land would become the most profitable of the farm.

But it is not necessary to have a creek bank in order to grow pecans. There are many sandy flats, not crossed by any stream at all, that will grow them well. The soil of these flats is usually accumulated wash from the surrounding hills, and the soil and position of these hills play an important part in the moisture content of the flat. When rain falls upon sand it sinks more rapidly than the clay subsoil can absorb it. Accordingly an under drainage occurs at the meeting of sand and clay that may last for some time after a rain. This drainage may be sufficient in a wet climate to render the flat soggy and unfit for pecan trees, but in a dry climate it may be the means of maturing a heavy crop. It explains the fact that trees near the base of a hill, or just on its edge, often bear better than those further out in the valley. Such, however, is the case only where this under drainage is present.

There is some good pecan soil, if not perfectly ideal, on most of the farms in Texas, and it can be located by the exercise of a little judgment.

Thus far the only element of climate that has been mentioned in connection with pecan culture is that of moisture. It is probable that the wind is also a factor. It is thought the violent winds, particularly during a dry spring, not only interfere with the lodgment of the pollen grains on the stigmatic surfaces of the pistillate blooms, but that they, also, dry out those surfaces and thus prevent the sprouting of those grains that do lodge. This, of course, will prevent the setting of the crop. For these reasons, it may be better in Central and West Texas to have trees north of a range of hills in order to protect them from the south winds. This arrangement, however, is not of sufficient importance to deter one from growing pecan trees in an otherwise location.

#### PLANTING PECANS AND TRANSPLANTING PECAN TREES.

This question is often asked: "Would it be better for me to set out nursery trees, or to plant pecans where I want the trees to grow with the object of ultimate budding?"

No doubt time can be saved by setting out nursery trees as they will bear at least two years sooner than the trees from seed, and probably three years sooner; but it would cost more to establish the grove than by the other method. If a period of ten years be taken into consideration, the crops of the ninth and tenth years ought to much more than pay the additional cost of the plan. On the other hand, a regular stand of trees is more likely to result from planted seed, though considerable time and attention will be necessary to budding and the after care of the buds.

If the owner of good pecan land has not available the necessary money for transplanting the grove, he should, by all means, plant pecans and afterwards bud the young trees when they have attained sufficient size.

Pecans should either be planted in the fall where they are intended to grow, or should be stratified in boxes of sand and kept moderately moist during the winter. In the latter case they should be taken up just before germinating time and planted just as a single hill of corn or beans should be planted.

The young pecan tree is very little and tender and will die of sunscald the first year if it does not receive attention. If the ground around it is allowed to bake and become smooth, a black spot will appear on the southwest side of the trunk, just where the reflected rays of the sun and the direct rays converge. This spot is the result of an actual burn that killed the cells of the cambium layer. It can be prevented by stirring the ground frequently, or by placing a straw mulch around the tree, or by driving two short pieces of board into the ground, one on the south and the other on the west side of the tree.

Pecan trees in solid orchard formation should be at least sixty feet apart. The holes in which to set them should be three feet deep, and it is better to have them two feet wide and five feet long than to have them three feet square, as the former arrangement will permit free use of the shovel handle in the lower portion of the hole. The trees should be taken to the field in the original package and only one tree should be taken out at a time, as needed, care being exercised to keep the roots of the others covered with wet sacks to prevent drying out of the roots. One man should get in the hole with the tree while another shovels in the dirt, using only good top soil. The man in the hole should press the soil around the roots of the tree with his hands, being careful to see that the lateral roots are straightened out horizontally, and not pressed down around the tap root. Continue in this manner until all lateral roots are covered, when two or three buckets of water should be poured in to settle the soil to the roots. The hole should then be completely filled, and the soil packed down. All the top of the tree should then be cut off, leaving only five or six buds of the budded portion, and a cone shaped pile of dirt should be heaped up around the tree, nearly or quite to the top. Frequent stirring of the surface of this dirt will be necessary. Either a straw mulch or two boards will serve as indicated with young seedlings.

#### CULTIVATION AND CARE OF THE GROVE.

The cow is the deadly enemy of the pecan tree. She will leave the surrounding woods and walk a long distance into the open to wool her head on a nice young pecan tree. It is one of the mysteries of nature how she can select with such unfailing accuracy, but the public is challenged to find a single young tree in the cow pasture, standing in an open space, that has not been twisted and broken by the horns of the cows., Just as well get rid of the idea that pecans can be grown successfully in the pasture and, also, that wealth will flow from a few pecan trees top-worked in the woods. Doubtless transplanted trees, if they happen to survive, will bear a few more pecans and a little better ones than the native trees under like conditions, but regular and heavy crops cannot be raised without care and cultivation. One does not expect a crop of fine peaches from a chance seedling growing in the woods. The same principle applies to the pecan tree, though perhaps in a lesser degree, because the pecan is a larger and stronger tree than the peach, and is more able to fight for its living with the other trees of the forest. Still, competition is present in the struggle for existence—competition for light and air above, and competition for moisture below—and no tree responds more readily and generously to care and cultivation than does the pecan.

An alliance exists between man and his plants. Under the terms of the contract it is man's duty to destroy the enemies of his plants, to cultivate the soil, to conserve the moisture, and to create in every possible way favorable conditions for the plants, so they can devote their entire energies to fruit production. In turn it is the function of the plants to produce fruit—and they are always faithful to their part of the contract. If man falls down on his part of the job he should not expect the plants to come up with full measure.

Cultivation that is good for other crops is also good for pecans. When an orchard has been set out the land should be planted to other small crops and cultivated as usual for a number of years, being sure to leave the pecan rows wide enough to obviate skinning the trees with the single-tree in plowing the other crops. Hired help is wonderfully proficient in hitting the trees, which are easily skinned while full of sap during spring and early summer.

Not much reduction in the farm crop will be sustained by the space left for the pecan rows, as the adjacent rows on either side will yield more abundantly than the others, being relieved of competition on one side.

By the time the trees are eight to ten years old they should be producing in commercial quantities, and thereafter other crops on the land should be considered only incidentally. The open space between the trees should then be planted to peanuts, peas, or other legumes, which should be hogged off, not harvested. The remains of these crops should be turned under in the fall and rye or other grain sowed for a cover crop and winter pasture—the trees now being large enough to permit of pasturage. This cover crop likewise should be turned under in the spring.

It is sometimes asserted that cultivation injures pecan trees, and to support this theory assertion is made that trees which formerly bore fair crops while in the woods, now either fail to bear altogether, or produce only light crops since the other trees were cut down and the land placed in cultivation. Doubtless there is some truth in the statement, and explanation can be found in the fact that in the wild state the trees had filled the soil near the surface with hair roots in competition against weeds and shallow rooted trees and that these roots were cut by the plow in breaking the land, with consequent temporary injury to the trees. Doubtless new systems of hair roots will eventually develop below the plow in such cases, and the trees will regain their former vigor, with increased production. Had they been cultivated from the beginning there would have been no roots so near the surface.

Pecan trees require little pruning except the first two or three years after transplanting. The early pruning has in view the formation of the head of the tree, with special reference to height above the ground and arrangement of branches. Some four or five feet above ground is the best height to head a tree. It is high enough to permit of plowing under the tree and yet not high enough to make the harvesting of the nuts difficult. Two or more limbs should never be allowed to grow from the tree at the same height above ground, as they would form a crotch and might split off later.

Young pecan trees are likely to put out a number of branches near the ground the first season after transplanting. All these branches should



be removed the following winter except the best one, so as to force the growth into it. If this branch should in turn put out other branches too near the ground, they should also be removed, and so on till the proper height is reached. If a young tree should fail to put out branches near enough the ground it can be made to do so by cutting off the top. However, it is rarely the case, if ever, that one fails to branch when grown in the open.

### HARVESTING, CURING, AND MARKETING THE CROP.

Inquiry is often made as to whether or not it injures pecan trees to thresh the nuts in the fall. Beyond doubt it does. The terminal bud contains the pistillate bloom, which in turn contains the embryonic nuts of the next season. Manifestly the destruction of one of these buds may mean the prevention of the development of a whole cluster of nuts the next season. It is also manifest that the terminal buds are particularly subject to destruction by flailing on account of their prominent position on the limbs. But aside from any loss to the following crop, it cannot be otherwise than that the bruising, breaking and skinning of the limbs is injurious to the trees.

Instead of threshing limbs, they should be shaken by the use of a long slender cane pole with a hook attached to the end. This hook should be wrapped with cloth or sheepskin to prevent injury to the limbs. Any limb that can be flailed by such a pole can be shaken by it, and the nuts will fall by shaking if they are ripe enough to harvest.

Mr. H. A. Halbert of Coleman, Texas, has made a most ingenious contrivance to aid in harvesting his pecans. It consists of two wheels and an axle of an old buggy, with two horizontal bars attached to the axle, legs being at the other end of the bars, after the manner of a pushcart. A platform is on the bars, and on the platform is a high step ladder. On one side of the machine are long slender arms, supporting screen wire that slopes to a point. A man standing on the top of the ladder can reach a height of twenty feet, and by the aid of a twenty-foot pole can shake off all nuts within forty feet of the ground. Most of the nuts fall on the wire screen and roll into a barrel. The machine can be easily pushed from place to place, to suit the convenience of the harvester.

Pecans should not be gathered until the hulls are well open and pretty well dried out. The nuts are then cured, and keep better. It is sometimes necessary, however, to gather them early in order to get ahead of pecan thieves in the shape of bird, beast and man. They should never be gathered early, however, except when absolutely necessary to save the crop, as the kernels are not so plump and heavy and the corky filler is likely to adhere to the meat. If the pecans be taken from the hulls and examined just as the hulls begin to part, the kernels will be found to contain much water. If gathered and stored in this condition in barrels, boxes, or other close containers they are sure to mildew and spoil—in fact they should never be stored in barrels and boxes, but in bags. If they are dry before harvesting and the weather is dry at the time, they can be kept very well in porous bags, as some air can get in between them; but if not perfectly dry at harvesting, or if the weather is damp at the time, they should be spread out on the floor, or in special racks along the wall,

in layers not more than six inches deep, and should be kept there for several days before sacking.

In order to make the grading of pecans easy the nuts from each wild tree should be kept separate from those of every other tree, as no two wild trees produce exactly alike. It is the worst possible plan to mix large and small ones, long and round ones, light and dark ones, and thin and thick shell ones, all in a conglomerate mass, and place them on the market in that condition. The lot will hardly bring the price of the lowest grade among them. They cannot be sold to the fancy trade, and the big cracking plants will have to go to the expense of separating and grading them before the power cracking machines can handle them to advantage. In assembling the smaller nuts, usually consumed by the confectionery trade, particular attention should be paid to shape, size and color.

The handling of the crop from a grove of improved trees is quite an easy matter, as it is only necessary to separate the nuts according to variety.

Nothing has yet been done in Texas in an organized way toward grading and marketing the pecan crop, though some effort to do so is now in contemplation. At the present time all the fancy nuts of the State are readily taken by our local people at satisfactory prices. The mail order business offers an unlimited means of selling the good medium varieties. An old couple at San Saba cleared enough money in this way through a single twenty dollar advertisement in a northern magazine to buy a fine automobile. But to take full advantage of the mail order business it is necessary for one to provide himself with fancy five and ten pound box containers, and to put up his packages in an attractive way. Finally, it will not do to fill the containers with a conglomerate lot of inferior pecans and thus "kill the goose that laid the golden egg."

### VARIETIES OF PECANS.

The question is frequently asked: "What is the best all round variety of pecan?" The answer is: "There is no such thing." A variety that does well in one part of the country may not do so in another, and what one man might consider the value of certain points in a percentage scale of grading might differ from another man's judgment. In fact this lack of unanimity in judgment accounts for the fact that there is yet no universally adopted scale of grading.

The following system may be of service in attempting to establish the value of particular varieties for transplanting:

	Points
(1) Heaviness and regularity of bearing of tree.....	50
(2) Size of nuts .....	5
(3) Appearance of nuts; (Shape 5), (Color 5).....	10
(4) Cracking and separating quality .....	15
(5) Proportion of meat to shell and corky filler.....	15
(6) Richness and flavor .....	5
	100

This table is intended to be used in establishing the value of varieties of trees for growing, and not to grade nuts for purchase or sale, without regard to the bearing habit of the tree from which they came. However it is good for that purpose also, only the scale is based on fifty points instead of a hundred.

It will be observed that this scale assigns fifty points of the hundred to the bearing habit of the tree. This is done on the ground that no variety is worthy of introduction that does not score high on this point.

Entirely too much value has been placed upon the size and appearance of pecans without consideration of the other and more important characteristics. As a matter of fact the very large nuts are nearly always inferior to the ones of good medium size. There appears to be a law of nature running through all plant and animal life to the effect that extreme size is gained at the cost of excellence.

While there is no one best pecan for all locations, either in the excellence of the nuts or the bearing of the trees, there are certain differences between the Eastern or Coast varieties and the Western or Texas ones that will admit of some discussion.

The Eastern varieties are, on the whole, somewhat larger than the Western ones, though some of the latter are equal in size to the largest Eastern kinds, except perhaps the Nelson—and it is repeated that extremes in size are not the best nuts.

The Western nuts are richer in oil than the Eastern ones by fully ten per cent, and in an average of the introduced varieties from both sections, the Western ones will show bigger proportion of meat to shell and corky filler.

In cracking and separating qualities the two kinds are fairly even. The Schley and Russell, both Eastern kinds, are remarkable in this respect, while others, like the Stuart, are poor. Certain nut men—from the East—have criticised the Western pecans on the ground that they fill their shells so full of meat as to prevent cracking without bruising the kernels. This should rather be regarded as a compliment than otherwise, as it is the kernel the purchaser is after and not the waste matter. Other things being equal, nuts that are full to the ends necessarily show a higher proportion of meat to waste matter than those that are not full to the ends. It may be very nice to have a little vacant space at each end of a pecan when you come to crack it, but it is not economical for the tree to devote energy and material to the production of shell for so insignificant a purpose. Given a full rich pecan, the public will eat the kernels even though the end of one should be slightly bruised now and then. Furthermore, it may be that mechanical genius has not yet exhausted the possibility of inventing a machine that will crack a full nut without bruising the kernel; and it would appear the part of wisdom to strive to adapt cracking machines to full pecans rather than try to shape the pecan industry to fit the present imperfectly developed machines.

In regard to richness and flavor, no one disputes the fact that the Western nuts surpass the Eastern ones.

Wide as may be the difference between the nuts of the two divisions, there is an equal difference between the trees. The limbs of the young trees of the Eastern kinds are large, long and shanky, with few side

branches. The limbs of the young trees of the Western kinds are smaller and shorter and have many minor branches. This difference in form continues indefinitely, and when it is considered that the terminal buds of the branches contain the pistellate blooms, it is apparent that the number of these buds measures the potential crop capacity of the tree—another factor might enter, namely, the number of nuts to the cluster—and in this respect the Western varieties surpass the Eastern.

It might be argued that any pecan tree will eventually grow enough terminal buds to produce as many pecans as the tree can mature. It is granted that this conclusion would be correct if no other elements entered, but certain injurious factors sometimes cause the destruction of a large part of the crop and, under this condition, one tree might have a good crop left, while another would have a poor one.

If the foregoing comparison leads to the conclusion that the writer is partial to West Texas as a pecan growing section, he confesses to the belief that the best pecan land to be found lies between the hills of West Texas, and that the best nuts in the world are found there. There is now in possession of the Extension Service of the A. and M. College of Texas samples of varieties not yet introduced that are thought to equal, or surpass, any that have been grown anywhere—and the end is not yet. No systematic search has been conducted, and the best nuts are always consumed by local people. Those that reach the Eastern markets are never better than the common run.

Still there is no prejudice against East Texas as a pecan growing section, or against Georgia, or against any other gulf coast state. Each section has its peculiar varieties and advantages—one of which, in the East, is dependability of rainfall. Certainly no preference for the West could be stretched to warrant the conclusion that pecan growing in the East will not prove profitable. But Western varieties should be grown in the East in only a limited way, just as Eastern varieties should be grown in the West in only a limited way. The Western kinds have suffered very little from fungous diseases because of the dry climate, and in the process of evolution they have not developed resistance to that character of disease. Accordingly they suffer greatly when moved to a wet climate, which fact probably gives rise to the familiar expression, "Pecans hate to be moved East." However it is by no means certain that all the Western varieties are destined to failure in the East. The finest specimen of the San Saba variety that the writer has ever seen were grown at Huntsville, Texas, in 1919.

Eastern varieties do well in West Texas on wet years and under irrigation. The very finest samples the writer has seen came from West Texas, but this should not be taken as a universal result. On dry years and not under irrigation, trees of the same varieties produced nuts barely larger than the common run of wild ones.

There is no clear line of demarkation between the sections adapted to the two kinds, but a line from Denison to Houston would nowhere be far out of place. Along this line there is a belt some fifty miles wide in which either kind flourishes to some extent, one kind enjoying the ascendancy one year and the other kind another year, owing to varying climatic conditions, particularly rainfall. All territory East of the belt, to-

gether with a strip one hundred miles wide along the coast, extending as far West as Victoria, is better adapted to the Eastern varieties. All other territory in Texas is better adapted to Western varieties.

No detailed description of the different varieties can be undertaken in an article of this length. For the Eastern division and Coastal belt the Schley, Moneymaker, Fortscher, Success, Bradley, and others are recommended. In the Western section the Halbert, Burkett, Texas Prolific, San Saba Improved, and other varieties now being introduced, but as yet available in only limited numbers, should be used.

### REQUISITE POINTS OF GOOD NURSERY STOCK.

There are three very important points in connection with the purchase of pecan trees from the nursery, namely, constitutional vigor, a good lateral root system, and adaption to the environment where the trees are to be grown.

The meaning of constitutional vigor is pretty well conveyed by the definition of the term. Examination of any row of nursery seedlings will show some large trees and some small ones, all of the same age. One tree two years old may be as large as one's thumb and three feet high, while on either side of it may be another tree not half so large or half so high. It has heretofore been the custom of some nurserymen to bud the larger trees as soon as they attain sufficient size and to leave the smaller trees till they, also, are large enough to bud at a more advanced age. Now the man who gets the first trees gets a good bargain, even though they cost him \$5.00 a piece, and the man who gets the last trees gets a bad bargain, no matter how little the price.

The part played by the stock in case of budded trees is in some respects a mooted question, but there can be no doubt that the stock is to a great extent analagous to the soil in which a seed is planted. Corn, for instance, growing in rich land will, with sufficient moisture, produce an abundant yield. Likewise, a pecan bud, growing on a vigorous stock, will, with the abundant sap supplied, produce a greater growth and heavier crop.

All small, weak trees should be destroyed in the nursery row, leaving only the strong vigorous ones to be budded. Since the weak trees are probably in the majority, the question of the price of budded pecan trees is naturally brought into consideration. It requires three years at the shortest to get one of these trees ready for the market, and the public should not complain at reasonably high prices. It is advised rather to pay the price and in return to insist on high quality. There are few other possible purchases as well worth the price as a good pecan tree.

It has been stated elsewhere that a pecan tree takes the greater portion of its moisture from comparatively near the surface of the ground. In order to get this moisture in sufficient amount it is necessary for the tree to have an elaborate and extended system of lateral roots. Young trees that are deficient in this respect may continue the characteristic after transplanting, if they live, but the death rate among them is sure to be high. Purchasers are advised to write across their orders that they reserve the right to reject all trees deficient in this respect—and this again emphasizes the necessity for a fair price for trees.

The development of a good root system to nursery trees depends upon two factors, namely, the inherent properties of the seed and the nature of the nursery soil. Trees grown from the seed of one tree produce better root systems than trees grown from the seed of another tree under the same conditions. The fact that good seed can be determined only by test opens a great field for experiment—a field that has thus far been but little explored.

Important, however, as the seed may be, the nature of the nursery soil is of even greater importance. No young tree can develop a big root system in tight soil, nor is one likely to do so in deep bottom land. In the latter case the tendency is to establish a large and long tap root during the early stages of the tree's growth, leaving the development of the lateral roots to the later period.

The best pecan nursery lands are those with a loose sandy top soil, two feet or a little more in depth, underlaid by a rather stiff subsoil. This subsoil tends to check the growth of the tap root and to induce the growth of the lateral ones. It also serves as a convenient place to cut the tap roots when digging the young trees for transplanting.

Something has been said elsewhere on the subject of varieties. In connection with nursery trees it need only be added that no argument should be allowed to induce the purchase of varieties that have not been proved to do well where the purchaser wants the trees to grow, except in a very limited way for the purpose of trial.

It has been reported that certain individuals or concerns, far away from Texas, have bought up large numbers of culled trees at low prices and sold them through salesmen working on a commission basis—the commission being all above a certain amount. Now the first thing one of these salesmen does is to buy two or three Nelson pecans to be used as bait. (The Nelson is the largest of all varieties, but not the best). He approaches his prospective victim and, pulling his bait from his pocket, says: "See what we raise! Florida paper shells! A limited number of trees at \$2.50! Better order before they are all gone!" No connection can be established between the nuts shown and the trees sold. And, if the trees should prove eventually to produce nuts like the samples, the customers would be cheated.

Those who buy from the itinerant tree peddler, representing an unknown concern, will eventually learn their lesson through the Benjamin Franklin rule—but it is a long time to wait ten years on pecan trees and then reap disappointment.

The public is advised to buy from reputable concerns of the state, with which tangible connection can be established and maintained—to pay good prices and to exact high requirements.

### CAUSES OF CROP FAILURE.

Quite a number of letters come to the Extension Service of the A. and M. College, saying the writer owns pecan trees some ten or fifteen years old that have not as yet borne fruit asking why they have not borne. Specific answer cannot be given to such questions without previous observation. In some cases the failure is due to the poor inherent bearing quality of the tree, and in others it is due to observable causes. Of the latter class there are four, in addition to the one discussed under the head of soil and climate. They are: (1) Variation

in the blooming habit of the trees; (2) the weather; (3) plant diseases; and (4) insect pests.

The pecan belongs to the monocious class of plants—that is, both blooms occur on the same tree, but in different places. The pistillate blooms can be seen in the ends of the new shoots in the spring. They are small green spongy masses, bearing no resemblance to flowers in the ordinary meaning of the term. When they reach the receptive stage they are swollen and take on a slight yellow tinge to the green.

The staminate blooms push out from the base of the buds that put out the new shoots. They are in the form of catkins and are composed of a great many anthers, or little pods like short pea pods. The anthers burst when they are mature and the pollen grains are scattered abroad. If a grain falls on the **surface** of a pistillate bloom and germinate, the bloom will set a nut. If no grain falls on the surface of the bloom, the little nut will dry up and fall off.

The receptive period of the pistillate bloom lasts, as a rule, about ten days, while the pollen shedding period of the staminate bloom is somewhat shorter. Now there is considerable variation in the blooming time of different trees, as there may also be between the time of maturity of the two blooms on the same tree. In some cases the receptive period of the pistillate bloom passes away before any pollen of the same tree is shed. In other cases all the pollen is shed before the pistillate bloom becomes receptive. In still other cases the two periods may be partly concurrent. But it is rarely the case that the two periods are wholly concurrent on the same tree.

If, in the beginning, there had been a tree of wholly concurrent blooming and perfect self-pollination, its offspring would, in a large measure have inherited the character; and, having become weak through generations of inbreeding, would eventually be crowded out by cross-bred trees.

Eventually data on the blooming of the different trees will be assembled and made available to the public. All that can be done at the present time is to advise the use of more than one variety in a grove, running the rows east and west, across the direction of the prevailing winds.

The part played by the weather in the failure of pecan crops has to do directly with the blooms of the tree, except in so far as wet weather favors the development of fungus diseases. Violent winds are thought to prevent the lodgment of pollen grains on the stigmatic surfaces of the pistillate blooms, and possibly, also, to prevent the germination of some grains that do lodge there.

Pecan blooms are neither sweet nor possess bright colors to attract insects, and are entirely dependent upon the wind as a carrier. Rainy weather may wash out the pollen, and continued wet soggy spells may so waterlog it as to prevent its easy carriage by the wind. This emphasizes the necessity for a range of varieties to extend the pollen production beyond the duration of such a spell of weather.

Frost rarely, if ever, injures a pecan tree in Texas. Late freezes sometimes kill the young shoots and, incidentally, the embryonic blooms they contain; but the trees put out new shoots from other buds and these new shoots appear to be quite fruitful of blooms.

Certain fungus diseases attack leaves, twigs, and nuts in damp climates and even in West Texas during wet years. The standard treatment of these diseases is spraying with Bordeaux mixture.

Some insects attack pecans to some extent, but only two do serious damage. These are the twig girdler and the pecan nut case bearer. The twig girdler, in the adult form, is a beetle resembling the lightning bug in shape, but much larger, and of a very dark grayish brown color. In September it punctures the bark of the small limbs of certain trees near the buds, notably the pecan, persimmon and elm, and deposits an egg in each puncture. It then girdles the limb in order to kill it and protect its offspring, which does not emerge till the following summer. Most of the girdled limbs drop to the ground, and all of them should be gathered up and burned. This is the only method of controlling the insect. Sometimes the burning of one twig destroys a dozen girdlers.

The twig girdler is not a far traveler and a grove can be kept reasonably free from them by carefully destroying the branches that are cut off.

The most serious drawback to pecan growing is the pecan case bearer. In the adult stage it is a small moth. It winters in the larval stage in the limb of a tree, under the bark, through which it has eaten its way. It tunnels its way out in the early spring and frequently enters a new green shoot, forming a tunnel in it. Here it pupates and emerges a moth about the time the little nuts are the size of blackeyed peas, and immediately begins to lay eggs on them, usually on the stigmatic end. Soon these eggs hatch and each little worm crawls down amid the clusters of the nuts, weaves a little web to protect it, and eats its way in one of the nuts. If this nut does not feed the worm till it is grown, it comes out and enters another, and so on. Finally it pupates in the last nut entered and comes forth a moth, to take up the habits of its predecessors. There are three generations during a season, and sometimes four near the coast.

Much study has been devoted to this insect by Prof. S. W. Bilsing of the A. and M. College of Texas, and also by certain entomologists in the employ of the United States Department of Agriculture, and it is hoped that a reasonable measure of control may soon be announced. This insect has a number of parasitic enemies that tend to limit its numbers. Otherwise there would be no pecan crop.