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Introduction.

The Pine-Apple (*Ananas Sativa*) belongs to the natural order Bromeliaceae, the members of which are either tropical or subtropical and are generally of an epiphytic nature; that is they grow on other plants but do not derive nourishment from them.

The pine-apple plant is terrestrial but may be regarded as half epiphyte in that it will remain alive for months without being in contact with the soil and also in view of the fact that it only flourishes in a light well aerated soil where its roots have a plentiful air supply.

Description of Plant.

The pine-apple plant consists of a short stem covered with leaves arranged in whorls and supported by roots which are directly attached.

The root system is shallow and in certain soils is restricted to a somewhat narrow region around the plant.

The leaves are long and narrow and in most varieties bear spines along their margins. The leaf colour varies from red and red and white striped to dark green, the last being the predominating colour. A dark green colour is a sign of health in most varieties.

The flowers are purple in colour and are small but the flower bracts are bright red so that the flower head is rather conspicuous. The pine-apple is a multiple fruit: that is to say it is really an aggregate of a number of individual fruits which become fused together.

Each plant bears but one fruit and the new crop must be produced by a new set of plants.

Varieties.

Several varieties of pine-apple have been described, but few varieties are cultivated to any great extent. Two only are grown on the large scale for export—the Red Spanish and the Smooth Cayenne.

The Red Spanish bears a small or medium sized cone shaped reddish yellow fruit of fair quality. It ripens early is a vigorous plant and a prolific cropper. The fruit ships well and in Cuba, Florida and in Porto Rico this is regarded as the most profitable variety to grow.

The Smooth Cayenne bears a large orange yellow fruit of very good quality. This variety is grown extensively in Hawaii and in the Azores and shipped from the latter place it fetches the highest prices on the London market. In the West Indies it is generally regarded as somewhat difficult to grow and as a fancy pine reserved for a select trade. It should be noted, however, that this variety has done well in experimental trials in Antigua in 1900-1 and 1901-02 and that in 1904 specimens were successfully grown in Dominica and sold for 3/9 each on the London market.

The following other varieties are also worthy of description:— The Porto Rico, Cabezona or Bull Head bears a large orange yellow fruit of good quality which is excellent for canning but is not suitable for export. This variety does not grow as readily as the Red Spanish.

The Sugar Leaf bears a small yellow fruit of very good quality and is grown to some extent in Cuba for home consumption. This variety does not ship well.

The Antigua Black bears a small oblong bronze coloured fruit of the best quality, which, however does not ship well as a general rule.

The Antigua White bears a medium sized round yellow fruit of good quality, which like the Antigua Black is not a very good shipper.

Soils and Climate.

As stated in the introductory section the pine-apple is partly epiphytic in nature and requires a well aerated soil. A rich soil is not a necessity but a light well drained soil is essential. Pine-apples are frequently grown on gently sloping ground as on a slope the drainage is likely to be better than on the level.

While the physical properties of the soil are of more importance in pine-apple culture than are the chemical ones it should be noted that soils containing manganese are unsuitable as on such soils the plants are stunted and sickly in appearance and are liable to be attacked by pests and diseases. Alkaline soils and soils containing much calcium carbonate are also unsuitable.

The optimum temperature for pine-apple growing lies between 75 and 80° Fahrenheit and the plant is suited for a dry rather than a wet climate. A heavy rainfall during portion of its period of growth is not injurious, however, provided the soil is well drained enough to prevent the accumulation of water at the roots. Rather dry weather is required during the fruiting period more particularly when maturity is being approached.

Preparation of the Soil.

In the preparation of the soil for pine-apples great attention should be given to getting the soil into a condition of good tilth—a hard lumpy soil is likely to cause the disease known as tangle root: this will be discussed at greater length in a later section.

In the pine-apple district of Florida, where very light sandy soils are encountered the following method of preparation is practised:— The land is ploughed and cross ploughed and is then treated with a wheel or disc harrow to pulverise any lumps. Finally a harrow is used to smooth and level the land.

In Antigua it is not customary to pay much attention to the preparation of the land; it is generally forked but not banked. It is however better to plant in beds and this method is practised in some districts.

In pine apple cultivation unless a very porous soil is found, careful attention must be paid to the securing of efficient drainage. For this purpose contour drains are best used as they avoid the danger of the washing away of soil in wet weather.

In Jamaica, drains 14 inches deep and 14 inches wide placed 12 feet apart are recommended, all the soil taken from the trenches being thrown equally on both sides to build up the beds. Such a system could of course be modified to suit the conditions existing in any given locality.

Propagation.

The propagation of pine-apples may be effected by means of either suckers, ratoons, slips, crowns or seeds.

Suckers are offshoots, which grow out from among the leaves of the parent plant.

Ratoons are suckers which are thrown off below the level of the soil.

Slips are offshoots which appear at the base of the fruit; unless required for propagation these should be removed as soon as formed as otherwise they interfere with the full development of the fruit. They require about a year longer than suckers to produce a crop.

Crowns are the tufts of leaves on the top of the fruit.

Seeds are seldom found and are not used for propagation except for the production of new varieties.

Suckers are most frequently used for propagation as their growth is more rapid than is the case with slips or crowns and is as rapid as that of ratoons except in such cases as the latter are left to function as true ratoons (to take the place of the parent plant during the next year) or are removed from the parent plant with a ball of earth which keeps the roots alive.

Suckers selected for use in propagation should be borne on strong healthy plants, which have already fruited or are fruiting, and must themselves be well grown and free from disease. Suckers 12-18 inches long are suitable; such mature suckers can endure exposure to wind, sun and moisture far better than is the case with younger ones, which rapidly dry up or rot under similar conditions.

In districts near canneries large well matured crowns can be obtained very easily and these are frequently used in such districts for propagation ; small crowns are not used as they are likely to rot in wet weather.

Before planting, especially in dry soils it is advisable to trim the leaves from the bases of the young plants ; this allows the roots to expend and lessens the danger of "tangle root."

The young plants should be planted with a trowel to a depth of $\frac{1}{2}$ the length of the plant.

In some districts it is customary to tie up the leaves of the young plant to prevent dust blowing into the heart or being carried in by ants and thus causing rotting. It is stated that a pinch of powdered tobacco placed in the heart is equally efficacious.

The distances apart at which the plants are set vary greatly in different districts and with different varieties but as a general rule the more fertile the soil the greater the space required per plant.

In Antigua the two varieties Antigua Black and Antigua White are planted 4-5 feet apart. In Cuba the Red Spanish is planted in some districts as close as 12 inches between plants. Many other spacings are advocated, two feet being a favourite in some places.

Various systems of planting are met in practice. In some plantations pines are grown in single rows four or six feet apart. This system of planting facilitates cultivation and reaping but affords the plants insufficient support so that in many cases especially in varieties bearing heavy fruit the plant falls over and exposes one surface of the fruit to the sun's rays resulting in a condition known as "sun scald."

Planting in double rows is a system suitable for use in almost any kind of soil. Like the one row system this system allows of ready cultivation and reaping while the danger of the plant and fruit falling over is considerably reduced.

In other system three to six or more rows of plants are set in each bed. Such systems are successful where the physical condition of the soil is suited to pine-apples and where the soil is not weedy. The greater the number of rows per bed and consequently the closer the individual plants the less the danger of sun scald to the fruit.

Cultivation and Manuring.

The young plants should be left undisturbed for five or six weeks after setting out to allow them to root well, unless the weeds become so vigorous as to render weeding a necessity. A vigorous growth of weeds may administer a check to the growth of the young plants from which they seldom recover.

The workers engaged in weeding pine-apples must be careful to avoid injury to the shallow root system and should stand in the trenches between the beds so as not to trample the soil. Care should also be taken to avoid breaking the leaves; these are covered with a thick epidermis which controls the loss of moisture and on breaking this there is likely to be considerable evaporation from the broken surface resulting in serious damage to the plant.

To reduce the water loss from the soil a system of mulching is desirable; a vegetable mulch also slowly increases the humus in the soil.

Cultivation from the time of planting to the time of fruiting then consists in keeping the ground free from weeds and in a condition which will facilitate aeration and at the same time prevent too rapid a loss of moisture.

After fruiting the treatment accorded the field depends on the system of planting. In the one row system it is not always profitable to ratoon as the suckers frequently fall over when in the fruiting stage unless supported by other plants; ratoons or the lowest placed suckers may however be left.

In other systems it is customary to ratoon for as many years as a satisfactory yield is maintained, except, however, in the case of varieties such as the smooth Cayenne which

bears fruits weighing 10-15 lbs and is almost sure to fall over if grown from side shoots.

After harvesting all diseased plants are destroyed and their places are filled with vigorous and healthy young plants. Slips are remove together with surplus suckers, each plant being left with two or three ratoons or well placed suckers to produce fruit in the coming season.

If there has been much washing away or working away of the soil between the plants it is desirable to throw some of the soil from the paths into the beds to a depth of 3-4 inches.

Experiments have indicated that the proper use of fertilizers invariably exerts a beneficial influence; this is of course more markedly so on the poorer soils.

The root system of the pine-apple is shallow and extends only a few inches away from the stem so that the soil in this small space must be rich in plant food in order to produce a large plant and marketable fruit. It has been found in Porto Rico that one of the best ways for the plant to take up nourishment was to absorb it from a solution trickling down the stem from the leaf bases. Consequently manures may be applied by dropping a small quantity into the heart of each plant.

The first application to young plants may be a small quantity of dried blood mixed with tobacco dust dropped into the heart of each plant almost immediately after setting.

Subsequent applications of fertilizers are best made at intervals of three to six weeks up to about two months before blooming expected.

Fertilization of the ratoon crop should take place immediately after reaping of the fruit.

On account of the method of application no fertilizers must be applied, which are likely to injure the plant by direct contact. Nitrogen is best applied as dried blood or as cotton seed meal although in some districts it is claimed that

the latter causes the production of fruit which do not ship well. Phosphoric Acid is best applied as steamed bone, basic slag and especially acid phosphates should be avoided. Potash is best applied as Potassium sulphate, this salt may, however, be injurious if applied to very young plants.

It should be noted that a plentiful supply of Nitrogen in the soil especially when there is a shortage of potash is likely to result in the formation of soft fruit which do not keep well.

Fruiting and Yields.

The time which elapses between planting and the reaping of the first crop varies in different localities and depends on whether suckers or the slower growing slips have been used for propagation. In Antigua the first crop is borne in from 7-8 months after planting on poor lands to 18 months after planting on rich lands. Well cultivated fields always bear earlier than neglected ones. A ratoon crop generally ripens twelve months of the previous crop.

Generally speaking in the case of the Antigua varieties most of the plants bear at the first crop. In the case of the Red Spanish in well cared fields 95% of the plants can be relied upon to fruit. Other varieties are not so prolific. In the second year the number of plants has doubled or trebled from the growth of the two or three suckers or ratoons left on each plant of the previous year so that the yield of fruit is considerably increased. As a rule the maximum crop is borne in the 4th or 5th year when from 1000-2000 pine-apples may be obtained from one acre.

The fruit reaped in the first crop is usually larger and softer than that reaped in subsequent years, which is sweeter and is better suited for shipping.

Reaping.

It is of importance to know the correct stage at which to reap the fruit. This varies, depending on whether the pine is to be used for home consumption or is to be exported. In both cases the fruit must be full sized before it is picked

as pines picked when not properly mature decay before they ripen. Moreover the nearer ripe the pine when picked the better its quality when ripe.

As a rule fruit for export will ripen and colour satisfactorily if the eye margins are well rounded, the spaces between show a light greenish yellow and the leaflets are wilted or withered.

Two systems of picking are practised:—Snapping the fruit off the stem and cutting with an inch or two of stem attached. The former method may be used with varieties such as the Red Spanish in which the stem breaks off clean and close to the base, but the second must be used with varieties such as the Cabezena in which the fruit stalk is large and extends into the fruit, leaving a cavity when broken.

Some authorities advocate always cutting with two or three inches of stem and hanging from this stem to dry for some hours before packing.

Fruit pickers should wear long sleeved heavy canvas gloves to protect their hands. The fruit should be collected in baskets, carried either by the picker or by an assistant. They should be placed carefully in the baskets, never thrown in.

In the operation of picking and in transport to the packing shed as well as in all subsequent operations it is of the utmost importance that all care be taken to prevent the fruit from being bruised or injured in any way—apparently slight bruises may afford ingress for organisms which destroy the fruit while in shipment.

Packing.

All packing sheds must be cool, dry and clean and must not contain diseased fruit, as these are sources of danger to all other fruits in the shed.

Fruit picked in dry weather must be cooled before packing, exposure over night in a cool dry place should be adequate for this purpose. Fruit picked in damp or wet

weather must be dried and cooled before packing. This is generally effected by standing for 3—4 days on their crowns, based upwards, in a cool, dry, airy situation.

The next stage is the grading of the fruit. It is probably not advisable to ship more than the highest grade fruit. Such fruit should be free from sun scald or other injury, of the proper degree of maturity and of good shape; pine-apples with large well shaped crowns frequently fetch better prices than superior fruit which are not so attractive in appearance.

Fruit of other grades are best treated at a cannery if one is in the neighbourhood. Should it be decided to ship of a lower grade such fruit should never be mixed with first grade fruit but should be shipped in separate packages.

After grading, the fruit is sized. The standard sizes* used in Florida for Red Spanish are as follows :

Size.	Diameter of fruit in inches.
18	$5\frac{1}{2}$
24	$4\frac{3}{4}$ — $4\frac{1}{4}$
30	$4\frac{1}{2}$ — $4\frac{1}{8}$
36	$3\frac{1}{2}$ — $4\frac{1}{8}$
42	$3\frac{1}{4}$ — $3\frac{3}{4}$
48	$3\frac{1}{8}$ — $3\frac{1}{2}$

Much higher prices are paid for large fruit than for small as will be seen from the following prices paid for Porto Rico pine-apples in New York Market in October 1922. Size 24, 30 cents each. Size 30, 19.6 cents each. Size 36, 12.8 cents each. Size 42, 5.7 cents each. Size 48, 4 cents each.

* The sizes refer to the number of pine-apples packed in a standard crate.

Sizing is frequently done by the eye alone, it is however advisable to use a sizer. One of the simplest is a V shape with the different sizes marked on the sides. The fruit is placed in the sizer till it just touches each side, when the side lines indicate the size. In using this appliance care must be taken to see that the greatest diameter of the fruit is used.

Pine-apples should be packed for shipment in crates: barrels should never be used.

In Florida a standard box is used for the Red Spanish 36" x 13" x 10½" with a partition in the middle, the ends being either solid or paneled 5/8, 1 or 1½ inches thick.

The sizes refer to the number of pine-apples packed in a standard crate.

In other districts other sizes are used but it is advisable that in packing pines for any given market a package be used similar in appearance and size to others which find ready sale on that market.

Whatever crate is used the packer should see that the woodwork is bright and clean—a dirty mildewed box injures the appearance of a pack and affects the price adversely.

In packing each fruit should be wrapped in clean paper and then in dry straw. The wrapped fruit are then placed in the case so that crowns and butts alternate if packed in a single layer. If a double layer box is used in one layer the butts all face one way and in the other layer they face in the opposite direction the fruit being in the spaces between the crowns of the first layer.

Pine-apples should be packed firmly so as to prevent falling about and consequent injury in transit. On the other hand they must not be jammed in so tightly as to be bruised or crushed.

It is advisable to place a 1 inch layer of straw in the case before putting in any fruit. The well wrapped fruit are then placed on this layer and above is placed a second

layer of straw pressed down so as to fill the *case* quite tightly.

After packing and nailing up the crate it should be marked with the brand of the shipper, the name of the fruit its size and grade, the name of the consignee and any necessary shipping directions. An attractive label indicating the brand of fruit will enhance the appearance of the pack.

In general it may be stated that in packing every precaution should be taken that the fruit suffer no injury in handling or transit and that the whole exterior of the package be clean and attractive in appearance. The exterior is the first part of the pack seen and uniformity and neatness will do much to bring the best class of buyers and secure the highest prices.

Pests and Diseases.

Insect Pests. The Insect pests which cause damage to pine-apples are comparatively few in number, ants, mealy bugs, scale insects and red spider being the most important.

Of these mealy bugs cause the most damage which may become serious if neglected resulting in a stunting of both plant and fruit and assisting in the spread of fungoid diseases.

Methods of control include the planting of only such suckers as are free from the pest and dusting the hearts of of plants with powdered tobacco. A treatment at planting time and subsequent treatments at intervals of ten days as long as these insects are present should suffice. A healthy condition of the suckers is ensured by dipping their bases into a decoction of 1 lb. tobacco stems in two gallons of water or better still by fumigating with hydrocyanic acid gas.

Ants are attracted by the sweetish substance secreted by the mealy bugs and may injure the plant by carrying particles of dust into the hearts. Such methods as are used for the control of the mealy bugs also serve to control the attacks of the ants.

The red spider and scale insects are seldom serious. The former may be controlled by dropping a little tobacco

dust in the bud of the plant, the latter by spraying with whale oil soap.

Tangle Root. The leaves of affected plants turn yellow, beginning at the tips and gradually extending over the whole plant which finally wilts and dies. On examination the roots are found to be wound round and round the body under the leaves in a tangled mass causing strangulation as the butt expands.

The cause of this disease is generally either too heavy a soil or poor preparation of the land. In impervious soils or in soils containing hard lumps the roots do not spread out readily and moreover unless the soil is in a moist condition the moisture which collects in and runs down from the leaf bases renders that portion of the soil immediately around the plant moister than that a few inches away so that the roots are encouraged to remain within that narrow region.

Methods of control consist in a thorough preparation of the soil and the trimming away of the lower leaves before planting so as to encourage the spreading of the roots.

Sanding. In dry windy weather especially on light soils sand is frequently blown into the hearts of young plants upon which it seems to have a smothering effect. If the plants are set a little too deep sand is sometimes washed into the heart and forms the same kind of a plug.

To prevent sanding it is as well to fill the bud with a mixture of cotton seed meal and tobacco dust (Three parts tobacco dust to one part cotton seed meal.)

Blight or Will. The symptoms of this disease are those of a slowly progressive wilting and drooping of the leaves, ending with complete drying up of the plant. Examination of the affected plants shows that this condition is caused by root decay. It has not been shown as being due to any particular parasite, although various fungi have been found associated with affected plants. This disease like root disease of sugar cane seems to be due primarily to unfavourable environmental conditions; it is most common in badly drained soils or in soils which have been cropped for a number of years.

In addition to adopting measures to improve general soil conditions methods of control include the planting of healthy slips only and the eradication and burning of all infected plants. After burning a plant the soil from which it is has been removed should be treated with lime and exposed to the sun for some weeks before another plant is set in it.

Spike or Long Leaf. The leaves of affected plants become long and slender and as the disease progresses the plants become more and more like bundles of rod like leaves. In the final stages the central leaves do not unfold but form a spike whence the name of the disease. Affected plants seldom produce fruit.

Spike is generally caused by the improper use of fertilizers, the use of acid phosphate being one of the commonest causes, although the use of nitrogen as sodium nitrate or as ammonium sulphate may also be responsible.

Methods of control include the planting of healthy slips and the application of nitrogen and phosphate as dried blood and bone meal or other organic forms.

Sun Scald. This is caused by the bending over of the plant so that one side of the fruit is exposed to the sun's direct rays. This is likely to produce a premature ripening and scalding at the exposed portion and there may also be a development of rot.

Sun scald can be prevented to a great extent by placing small handfuls of dried grass on every fruit that has fallen over.

Black Heart or Core Rot. This is one of the most serious diseases affecting pine-apples in the West Indies; it is more prevalent in wet than in dry seasons. It is very similar if not identical with Brown Rot which has caused some damage in Hawaii.

Infected fruit show little external indications of the disease; they, however, ripen unevenly, certain portions remaining pale green while the rest of the fruit appears ripe.

On cutting, black patches are formed opposite the pale green portions extending from a short distance from the outside towards the centre.

In the later stages of the disease the fruit may present brown patches externally and deep fissures may arise amid the sections—a green mould appearing in these fissures.

In the West Indies a species of *Penicillium* is the fungus found in all infected fruits: in Hawaii a *Fusarium* is generally found.

It is believed that the fungus enters the fruit through the small punctures made by the bites of mealy bugs and mites.

The following methods of control should be noted:

(1) Root out and destroy all diseased plants and replace by suckers from healthy plants.

(2) Before planting dip all suckers in Bordeaux Mixture.

(3) Spray plants with a contact insecticide such as resin compound or lime and sulphur wash.

(4) Spray with Bordeaux Mixture.

Fruit Rot. This disease attacks ripe pine-apples in the field to some extent but is most destructive in crated fruit during shipment.

In the field infection generally occurs at the base of the fruit at a point where a moist chamber is formed between the bracts which occur on the stem, although infection will also occur wherever there is a wounded surface. In crated fruit the presence of wounds however small favours the entrance of the disease.

Fruit rot has been ascribed by different workers in different parts of the world to two fungi—*Trichosphaeria sacchari* and *Thielaviopsis ethacetica*. In both cases the method of control is as follows:—

(1) Avoid packing any bruised pines—the fungus enters at the bruised surface and one unsound pine may communicate the disease to nearly all the fruit in the package.

(2) Ship the pines well dried in dry, well ventilated cases: wrap and pack in such a way as to avoid shaking bruising in transit.

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