

Some Fruit-tree Diseases in Relation to Horticultural Practices and Mineral Deficiencies.*

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In combating plant diseases the most desirable and the least expensive means lie more in the line of prevention than in that of treatment. In fact, preventive methods are the only means effectively employed in certain diseases. Effectiveness of the method and the expense involved are the two criteria to be reckoned with when any of them are to be advocated either for prevention or for cure or when their suitability is to be assessed.

In the domain of horticulture it is a well recognised fact that healthy and productive orchards are mainly dependent upon the care and attention bestowed by the growers to each and every orchard or nursery practice with an eye not merely on the future growth and productivity but also on the freedom of trees from pests and diseases. The incidence of a host of diseases can be accentuated to as great a degree by an ill-devised or badly executed orchard practice as the insurance of the health of the orchard can be effectively done through proper cultural methods. Countless orchards have been ruined irreparably by a thoughtless orchard practice; and the tragedy in these is all the more acute because the growers have not usually any scope left to rejuvenate the damaged trees or make them regain their normal vitality. Loss of the entire crop in one season due to a severe pruning of root or shoot in an adverse season is but one of the instances to the point. Much loss from diseases and pests starts in the seed and nursery beds and continues to mount up as the orchards grow. Poor drainage, improper application of water, excessive shading, too great a humidity and over-crowding in seed beds are factors most congenial to the incidence of 'damping off' and other allied diseases. Sowing healthy and mature seed on raised beds of good soil texture with sufficient spacing is the simplest method of creating healthy and beneficial growth conditions for the seedlings and preventing them from susceptibility to such seed bed infestations. It is very gratifying to note that at least a few of our private nurserymen have realised the effectiveness of these methods instead of trying to combat the diseases at a later stage by resorting to curative treatments entailing unnecessary expenditure. Planting the seedlings too far apart to permit of animal power interculture, frequent interculture in nursery beds resulting in an injury to roots, heavy organic manuring and indiscriminate watering are some of the prevalent practices to be thoroughly discouraged, as each of them has the effect of rendering the nursery stock predisposed to fungal attack or nutritional disorder through root injury and through frequent inhibition of growth activity. As a good nursery is the foundation of the

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future orchard any precautions taken at this stage have undoubtedly a profound bearing on the future prosperity of the plantations.

Everything else being favourable, fruit trees adapt themselves to a wide range of soil types, but marked differences in their rate of growth and power of resistance to diseases and pests are easily perceptible. However, mango and citrus orchards raised on soils of poor fertility, or on ill-drained soil or sub-soil conditions and alkaline in reaction, or on those with a relatively high percentage of soluble salts are predisposed to diseases like 'wither tip', 'die-back' and various kinds of root and bark rots after a short period of apparently luxuriant vegetative growth. Opening up sub-soil drains and such other soil curative methods may alleviate the trouble to a certain extent, but it would be far better if the growers exercise more care in the selection of the site for the plantations than depend on the improvement of soil at a later stage. In and around Bezwada, acres of orchards planted to *Vadlapudi* and *Botavian* oranges have been ruined owing to the prevalence of various kinds of root and bark diseases which still continue to assume very serious and disquieting proportions. Prolonged water stagnation in these stiff soils partly as a result of the prevalent defective practices of irrigation and culture rendered the problem of combating the diseases more complicated. The obvious line of successful approach to the problem would seem to lie in propagation of these oranges on root-stocks resistant to these diseases under such conditions. Limes which are known to thrive exceptionally well even under such adverse conditions may provide very useful root-stock material.

Selection of economic varieties and of inherently high yielding trees form the very basis of remunerative orcharding. Therefore only those of outstanding performance and quality resistant to diseases and pests common to the tract should be propagated. The safest method would be to propagate buds or grafts from trees showing the least tendency for marked variations in fruit and leaf characters and also such of the strains within the varieties indicating marked disease resistant qualities. While no uniformity exists at present in the selection of suitable rootstocks, rough lemon (*Citrus jamberi*) for oranges has been the most popular rootstock in use, as it is believed to possess resistance to stem and root diseases besides a rapid rate of growth. A nurseryman eager to produce big sized plants to meet the fancy of the purchaser may prefer the indigenous *gojanimma*, which is of exceptionally quick growing habit; but the purchaser of oranges on this rootstock does not take long to find out the extreme susceptibility of this plant to *gummosis*, a disease so virulent that often it baffles the ingenuity of the pathologists to control. An elaborate trial of nine different rootstocks for oranges and three for limes to test the relative merits of each of these is in progress at the Fruit Research Station, Kodur, and may be expected to yield in due course very useful results from a practical standpoint, both in regard to selection of the most paying rootstocks as well as in the views of disease resistance. Such trials when conducted under the diverse conditions prevalent in this Presidency will furnish the requisite information

to the fruit growers in every tract, and thus enable them to avoid the pitfalls from the injudicious selection of rootstocks.

Budding and grafting when extremely dry or wet weather prevails, or on crooked and old rootstocks making too wide or deep incisions on the rootstocks and propagating with buds from wood of disproportionate size rendering the region of the joint very vulnerable to the retention of moisture for unduly long periods, consequently providing a good nidus for the development of parasitic and saprophytic fungi are a few of the numerous undesirable practices in our nurseries which require to be discontinued. Incompatibility in the rates of growth of scion and stock results in either a smothering of the scion sprout or a too rapid growth of the stock and defective union, leading ultimately to a disturbance in the essential balance, rendering such plants easily susceptible to parasitic and non-parasitic influences. Early lopping of the stock or propagating on very old rootstocks merely to cope with the growing demand for big-sized plants, or again, lifting trees for immediate despatch in an active growing condition without preliminary hardening are all measures which tend to raise the percentage of mortality. Unskilled grafting and budding resulting in unsightly constructions at the joints, or forcing growth inordinately under artificial shade and pot-house conditions just to satisfy the consumers' demands are yet other prevalent nursery practices to be thoroughly discountenanced.

Under orchard conditions also there are a host of practices which are of prime importance in determining the future health of the plantations. Planting out trees during seasons of extreme heat or humidity, planting them too close as to hamper free root spread and preventing sunlight from ever reaching the lower branches of trees after they have grown up resulting in a dislocation of their photosynthetic activity, or planting them too low as to permit irrigation water coming in direct contact with the trunk and the bud or graft-joint all have harmful repercussions on the future health and vitality of young plants, and therefore are to be avoided. Undue and unnecessary mechanical injury to the root and trunk portions during planting or exposing them too long to the sun and drying winds prior to planting also tend to increase the chances of fungal infection and are therefore undesirable.

Irrigation to plants, young and old, are given generally at predetermined or spasmodic intervals. Flood irrigation wherein water is inevitably allowed to get into direct contact with the trunk and remain as such for long periods, mounding up earth round tree trunks or making miniature basins too narrow to serve any useful purpose or surface wetting at too frequent intervals are some of the most injurious practices now prevailing. Thorough and soaking irrigations given at long intervals after determining the extent of soil moisture by rough tests, and widening tree basins so as to encompass the entire root-zone of absorption with a gentle slope towards the extremities would prove very effective in preventing the occurrence of root and collar rots.

Applications of disproportionate quantities of artificial fertilisers to the complete exclusion or a meagre dose of bulky organic manures tend to encourage plethoric activity in plants to the detriment of flowering and fruiting, besides bringing about various nutritional and physiological disorders. Manuring young plants too heavily or at the time of planting are also attended with disappointing results.

It would apparently seem incredible, but is yet a verifiable fact that in some of the orchards, in an anxiety to ensure some quick returns, alleys of fruit trees have been used for raising crops like paddy and cholam or fruit crops like bananas. Besides proving very serious competitors to the main trees for plant foods, any cultural treatments given to these intercrops are bound to influence adversely the health and vigour of the main plantation. Instead, growing and ploughing in green manure crops would enhance the fertility of the soil.

Pruning is so much more of a science than mere art that most growers with whom it merely consists in drastic stubbing back of trees during periods of active growth and exposing the wounds have reaped too often only disastrous results. Severe and repeated root pruning at all stages of growth and in all seasons indiscriminately to force off-season crops tones down the trees rendering them susceptible to pathological infestations. Pruning trees to shape and training them to fruit in the lower branches facilitating easy harvest and preventing sun burn of fruits is no doubt a commendable practice if resorted to with a full sense of discrimination.

Harvests should be done with a great deal of care for the reason that, carelessness will result in bruises and abrasions of the skin which admit the germs of decay. Picking fruits with the stalks intact but cut back to the level of the skin, would ensure a reasonable measure of safety against inroads by fungi. Dumping fruits after harvest in odd ill-ventilated corners would also mean inviting various kinds of storage and fruit rots.

From the foregoing, the conclusion would seem indisputable that at every stage of orchard management, ignorance or indifference brings into operation a series of factors most congenial to the incidence and multiplication of various pathological disorders. It would seem very appropriate therefore to expect that a detailed and sustained study of the relationship that undoubtedly exists between horticultural practices and the incidence and severity of diseases and pests would open up new vistas of very useful and fruitful research. As Kodur is the natural centre of investigation on the cultural aspects of tropical and sub-tropical fruits, situated as it is in the heart of an important fruit producing region, and capable of providing a wealth of material for research, a wing in plant pathology opened in collaboration with the pathologists at Coimbatore would satisfy the most pressing need and render it most up-to-date and eminently modern from all points of view.

More hazardous but obviously less realised by orchardists are the effects of nutritional disorders on the prosperity of fruit trees. While the prevention of these depends also to a considerable extent on the proper

selection of varieties, rootstocks, soils and environmental conditions and to a certain extent also on the orchard cultural practices, these disorders are more difficult to be understood and diagnosed by the average growers.

In the numerous literature on the deficiency disease of various kinds of fruits that has steadily accumulated during the past quarter of this century, the symptoms of diseases caused by each and every important element in the soil has been described with a wealth of detail in respect of most of the commercial fruits in different parts of the world. The preventive and control measures have also been indicated for each malady, and among the several devices employed, tree injections, sprays and soil applications with elements or compounds diagnosed as deficient in the tree or soil, insertions of the same within the bark and painting the pruning wounds are the most noteworthy.

By far the most baffling disease very commonly met with in almost all citrus orchards is a condition of partial chlorosis known as 'mottle-leaf' or 'frenching'. Though the disease gets its name from its effect on the leaves, in severe cases, the tree and fruit size are adversely affected. The leaves show chlorotic areas, irregular in outline between the veins of the leaves. Each yellow area arises as a spot which widens and turns deep yellow, the tissues over the mid-rib and veins retaining their chlorophyll even in advanced stages in most cases. This green tissue gradually fades into the yellow interveinous patches. In severe cases leaves do not attain their full size but are narrow, rosetting at the apex of the twigs, the trees stunting and branching densely as the twigs die back. The disease occurs on a variety of soil types including light, sandy and heavy loams. The relationship between soil type and incidence of mottle-leaf has been found very complex to determine. It may, however, be safely stated with the existing knowledge that deficiency of zinc is one of the immediate and primary causes of mottling in citrus though qualified by several others mainly contributory in effect. In the case of many fruit trees the incidence of several kinds of mottling has also been traced to elements other than zinc such as iron, boron, manganese, barium, strontium, vanadium, lithium, and such other minor elements and in some cases to the absence of important manurial elements like nitrogen, potassium, phosphorus and lime.

Control of mottle leaf in citrus has been sought as in other deficiency diseases by the use of a large number of compounds. At the Fruit Research Station, Kodur, trials of an observational nature to test the efficacy of compounds like sulphates of copper, iron, zinc and manganese, and boric acid in the control of mottle-leaf through soil application have been underway since an year. The necessity for these investigations arose by the fact that spraying the mottled trees with zinc sulphate and lime which for sometime held the field in the Kodur orange area as the most efficacious curative treatment did not always result in regaining the normal health of affected trees. Even in some cases where the recovery was almost immediate and spectacular the beneficial effects were found to be transitory and inconsistent. Small amounts of several compounds, well powdered, varying in

doses from two to eight oz. by weight were therefore deposited in crowbar holes made all round the trees about two feet away from the trunk and covered up before irrigation. Of the trees applied with 4 to 8 oz. doses of zinc sulphate nearly 80% have responded very well within periods varying from a month to three months of application. Majority of these trees had previously failed to respond to zinc sulphate spray. Boric acid and ferrous sulphate have also shown a high percentage of response but the population on which these were tried is too small as yet to justify any rapid conclusions being drawn as to their relative merits in the control of mottle-leaf, but nevertheless indicate very useful means of approach to the problem. Copper sulphate, manganese sulphate and lime failed to show any beneficial response even on the small population tried, and may possibly be ruled out after a further period of trial as ineffective. In no case has any toxic effect of the compounds applied been traced upto this period.

Data collected to correlate the incidence of the disease with the rootstocks on which orange varieties have been propagated at this station seem to indicate the easy susceptibility of *kichili* and *gajanimma* rootstocks, the extent of incidence ranging from 12 to 17 per cent. of the total number of trees affected by mottle-leaf. Pomelo and sour orange appeared more resistant with only 2 to 6 per cent. infection. Details as to varietal susceptibility and factors affecting the severity of the disease are also being gathered, but it would seem justifiable to indicate at this stage that while lemons and limes of all varieties are practically free from the disease, *santras* and to a much lesser extent sweet oranges show a predisposition to this disorder.

It would, therefore, seem reasonable to conclude from these observations that application of zinc sulphate to soil, preferably in the earlier stages, is full of promise as an effective control measure of mottle leaf under Kodur orchard conditions. Its cheapness, simplicity of procedure and effectiveness should make an appeal to every fruit grower of this tract and elsewhere as one of the safest and simplest of means available for controlling this baffling disease. It is not, however, reasonable to expect spectacular results at very advanced stages of the disease. And one need not be too often reminded of the wisdom in the age-old adage that 'prevention is better than cure'.

From a consideration of the facts presented in this paper it must be very evident that co-ordinated research on all aspects of fruit culture and the pathological problems associated with them made available to the fruit growers would be of immense practical value.

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