

ADVANCEMENT IN CITRUS RESEARCH WORLD OVER

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Citrus production was merely one million ton in the world by the beginning of 20th century which has rose to 92 million tons by now. This huge increase is unprecedented. The world citrus production is thus higher than all deciduous fruits produced in the world. The tremendous increase in production is mainly due to the awareness about its importance for health and particularly the much expanded citrus juice industry in the world. Its presence in the world market as fresh fruit is well over 10 million tons annually which is again the highest than any other fruit. Moreover, citrus juice and other products as well as the fresh fruit mark well over a total international business of more than \$ 4 billion annually.

The present increase in production is due to extensive research studies conducted all over the world. The particular aspects of production which are well improved over the time and shall be briefly discussed in the present paper are; improved nursery practices, density orchard production and canopy management, improved irrigation and nutrition, thorough information about flowering, fruit setting and crop Production, improvement in harvesting and post harvesting knowledge for reducing the losses and comprehensive studies about disease and insect pest management.

The implementation of the improved practices has increased the production anifold per unit area. It is common to harvest 60-100 tons per hectare in many citrus producing countries. The average however, of many countries remains

within 10-40 tons/ha. The low land and mid land tropical regions generally produce less while in Semi-tropical regions heavy yields are produced. It is deemed fit to mention that our region is considered quite suitable for citrus production but the attitude of bypassing the recommendations has placed us among the lowest average producing country in the world. Similarly in the international market where fresh citrus fruits are sold between 2\$400- 700 per ton our citrus fruit are sold @ \$ 95-104 per ton. It is also quite embarrassing that over the years, there is little increase in average production (from 8 (Tons to 10 tons/ha) while the enhanced total production is only due to increased acreage which was only 15600 hectares in 1948 and now is 200 thousands hectares in Pakistan. Some countries particularly Spain and USA has proved as model countries regarding improvement in citriculture and thus enhanced yield and quality of their crop. Some salient points of advancements are discussed as below:

Nursery and bud wood certification

Preparation of new plants for further propagation is of basic importance. Many Citrus growing countries have rightly studied this aspect to produce healthy plants of true to type. This research covers selection of suitable rootstocks for the respective areas and for the respective citrus cultivars. Rootstocks besides providing healthy root system also affect the Vigor, Longevity, resistance against diseases and weather Vagaries, improved

production and quality of the fruit. Thus rootstocks are selected which have resistance against phytophthora rots, tristiza, salinity, nematodes and low temperature. Some hybrid rootstocks like Swingle Citrumello and Carizo citrange have achieved popularity in the major citrus growing countries while these are under trial in Pakistan too.

Bud wood certification programmed has widely been adopted in many countries to ward off graft transmissible virus diseases of citrus. This programmed has boosted healthy citrus production and thus has enhanced the average age of the trees and the productivity per acre. We in Pakistan are quite behind in this important field although it has already been initiated. It is hoped that we may succeed to establish a progeny block free of viruses to distribute bud wood to the growers shortly.

Planting density

Citrus trees are larger in size which is affected besides from the rootstock, the management practice and the climatic conditions. Since it is the plant surface which produce crop therefore the research was initiated to cover more surface at the earliest.

The number of trees per acre was increased from traditional 81 trees per acre to 300 and in some exceptional cases even more than 800. A modest and effectively tractable density is between 200-300 plants per acre. This plantation starts giving higher 3" production during the early age of the trees. At an age of five year the production may be harvested as if at the age of 10 years of a traditional plantation. The farmer starts getting more income earlier and thus the problem of intercropping is minimized as the farmers do not feel as if the space

is lying empty. The trees are managed for canopy by standardizing irrigation, nutrition and the pruning practices. The practice is being followed in several Mediterranean countries and Americas to boost production. The same has already been initiated at the research stations and by some farmers too in Pakistan.

Irrigation and Nutrition

There could be hardly any place in the world where irrigation is not recommended for commercial citrus orchard. Additional irrigation is required for the commercial citrus grooves. Over as well as less irrigation are harmful. Even quite early in the history citrus plantation used to be irrigated. Flood irrigation to high density orchard with precisely leveled floor is practiced. The clean cultivated and the intercropped or sod cultured orchards have different water requirements. Today citrus is perhaps considered the most advanced crop in use of irrigation technology and Physiological principles of water use. In recent years the water requirements of individual trees under different sets of climates are precisely calculated. Thus the economic use of water is practically applied to citrus orchards though drip irrigation and low profile sprinklers. The frequency and the quantity of irrigation water are rightly found out to affect the yield and quality of the fruit. Use oftensimeters for determining water use is in wide practice in the world. The water quality is another important consideration as the brackish water is potentially fatal to citrus orchards.

Nutrition is an important aspect which is thoroughly studied in case of citrus fruits. For harvest of optimum yield different leaf standards are determined under different climatic and

adaphic conditions. A modest standard of leaf analysis under subtropical conditions and of an orchard on sandy loam soil for different elements is N.2.5%, P.O.13%, K.1.3%, Ca.3.5%, Mg.0.25%, 8.0.4%, B 60 ppm, Cu 3 ppm, Fe 100 ppm, Zn 50 ppm, Mn 50 ppm and Mo 5 ppm.

This level of nutrients if maintained through regular soil and foliar applications may give good response to general health of trees and good production of high quality of fruits. Foliar applications are recommended for elements like Zn, Mn, Fe, Cu and B while urea can also be sprayed as a supplement for nitrogen if facing deficiency. Mostly the major elements like NPK are applied through soil according to the recommendations. In sweet orange and sweet lime orchards, fertilizer application during August and early September has increased yield to a significant level.

Flowering and fruit setting

Flowering for obtaining optimum fruit setting remained a main concern of the horticulturist since ages. A healthy tree should bloom well to set a good crop. Some varieties bloom heavily and set low crop; to get better yield the bloom is reduced by spray of GA, 3-4 weeks before blooming, low flowering trees are girdled to enhance bloom fruit set and yield. In case the crop is heavy which may result limb breakage, the trees are treated with NAA for thinning of fruit to improve the size of the fruit to enhance marketable fruit.

Harvesting and post harvesting cares

Citrus fruits unlike all other fruits do not develop abscission on ripening i.e. the fruit do not drop automatically on ripening if it is healthy. The fruit when

not mature maintains a pull force of about 19 lbs but near ripening it reduces to 3 lbs. It is enough to keep the fruit intact with the tree and if pulled it may cause plugging of fruit, a source of infection and rendering the fruit unmarketable. That is why harvesting of citrus fruits is cared much and should be clipped with a sharp clipper at the shoulder level of the fruit and not with a longer stems which may puncture the other fruits. The fruit should not be allowed to drop on the ground rather should be picked individually and bagged. It is particularly important for kinnow as it is a loose skinned variety and can easily be bruised that is sometimes, not even visible but promotes rot if stored or shipped for export. Heaping of kinnow is not advisable and its transport in bulk on trollies is not at all good particularly if the fruit is to be prepared for export in the packing and processing house.

As regards post harvest handling the fruits is degreased if color development is not good at ripening. Then after grading and washing, the fruit is properly waxed to minimize the respiration. This is an important point where a lot of research studies are conducted to put a suitable wax coating which should not stop respiration and develop an alcoholic taste of the fruit. The fruit after waxing is packed and stored at temperature between 3-5°C in case of mandarin (Kinnow) and sweet orange. The grape fruit lemons and limes are not stored at less than 10°C.

Weeds, insect pest and diseases

Weed, insect pest, nematodes and diseases are major constraints to citrus production in all areas of the world. Some problems have severe economic losses. Among them in recent years are

witches' broom that has ruined citrus plantation in Amman and in the past citrus Tristiza virus almost completely ruined citrus plantation in Brazil and Spain. Phytophthora collar rot gave a major blow to citrus seedling orchards in Italy and Florida. The management of these problems hence requires accurate information, proper strategies and production practice inputs in order to maintain economic yields.

Weeds

Impact of weeds is not yet well realized in our country. In fact frequent Intercropping has masked their effect in several orchards. Infestation of weeds However has been observed to harbor the insects as an alternate host besides competing trees for water and nutrients. Some climbing vines cover entire canopy Thereby, reducing photosynthesis of trees. Weed control in clean cultivated orchards must be taken up promptly. Use of Round up @ 1500 ml/100 L has proved effective to control summer weeds. Repeated cultivation as is practiced in our country is no more a recommended practice in countries with higher citrus production averages. However, mowing is common to keep the weeds under control.

Insect pests

Mites, insects and nematodes that attack citrus trees and fruit number in hundreds. Many of them are only occasional. However, there are pests that feed on roots, trunk, leaves, flower, flower buds, and fruit and injure the tree enough to cause economic loss. In Pakistan, citrus leaf miner, citrus psylla, lemon butterfly, citrus leaf looper (folder), white and black flies attack citrus leaves during spring and summer months. Thrips to younger fruit and fruit

fly at maturity during August and September attack citrus fruits. These insects cause economic losses in the orchards hence their control is commonly accomplished chemically.

Diseases

World wide the most serious limitations to profitable production of citrus in other wise suitable environments are diseases caused by bacteria, fungi and viruses. In addition to a number of diseases that cause death or seriously limit production, there are many more problems that require costly control programmers to sustain economic production. Diseases cause fruit drop, blemishes and rot in storage are many. Some important diseases of citrus prevalent in Pakistan are:

Citrus canker

It is a serious problem and is widespread. Its favorite host in Kaghzi lime and lemons while it may attack grapefruits and kinnow too. It attacks both on tree organs and fruit. Attacked fruit bring low price. Control of the problem is difficult, but copper based fungicides if sprayed just prior to spring and rainy season when new growth begins to grow, the infestation can be kept minimum and practice if repeated every year regularly, the canker may be controlled.

Greening

It is another problem identified recently in our orchards. The bacteria causes yellowing of foliage hinder the fruit to change to yellow color; the fruit hence remains green, small sized, mis-shaped, seeds are frequently aborted. To control this problem it is advisable not to take bud wood from such trees for further propagation.

Fungal diseases:

There are several fungal diseases of citrus. Few of the important that because economic loss to our orchards are; citrus wither tip, collar rot and root rot. In general chemical control is practiced. Two sprays of broad spectrum fungicides per year should keep these diseases under control.

to improve fruit size. Annual Report; College of Agri. & Life Science, University of Arizona.

Viral diseases:

There are many serious viral diseases of citrus. These are mostly graft transmissible and can only be curtailed if bud wood certification programmed is implemented in letter and spirit. We are fortunate that because of high temperature the viruses do not become a threat and particularly citrus tristiza virus is not serious in our country. The vector as well as the susceptible rootstock is not common in this region. It is however, immensely important to at least implement ethics of nursery growing in the country to minimize the threat to citrus industry in Pakistan.

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