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MODERN FRUIT PRODUCTION IN THE UNITED STATES OF AMERICA AS THIS
MAY BE RELATED TO THE PROBLEMS OF FRUIT PRODUCTION
IN YUGOSLAVIA

Fruit growing in Yugoslavia is in a state of transition. On the one hand are the older small farms where the growing of fruit is relatively primitive and without regard for recently obtained knowledge of fruit production. On the other, are the State farms and cooperatives where large commercial orchards are planted with a view to high productivity and mechanization and to furnishing high grade fruit for export and local consumption. It is on these latter farms that the transition is taking place, not as a gradual development, but as an abrupt change which leaves out all the intermediate steps.

The transition from Horticulture as an art in which the practices were learned by rote through apprenticeship, to the modern highly technical and scientific discipline of modern fruit production has taken more than a half century. It has been the result of the application of the scientific method of research by workers in England, the United States, and in some degree in France, Germany, Russia and elsewhere in Europe. To solve the problems of fruit growing, the techniques of the basic sciences have been brought to bear, more specifically. Plant Physiology, Soil Science, Genetics, Plant Pathology and applied Entomology. An example of an organization dedicated to this progress in Fruit growing is the American Society for Horticultural Science which succeeded and replaced in large part, the older American Pomological Society. The latter was mostly concerned with variety testing and nomenclature; the former with the application of science to its problems. Now, with about two thousand members, its proceedings from 1910 to the present, represent a chronicle of the progress of Horticulture from an art to a science. Other scientists and societies in other countries have, of course, made their comparable contributions to this progress.

This research and the orchard practices based on it, have already been summarized and interpreted in books written in English and in other languages. Yugoslavia is thus in a position to choose the best methods and practices which have been worked out elsewhere, as for example in Italy, Russia, England and America. The problem then is not to do further basic research but to determine which practices of those that have been worked out for different countries, are applicable to Yugoslavia conditions. This may not be an easy matter and requires a basic knowledge of the factors affecting plant growth, response to climate and soil and the like and conducting carefully planned, comparative trials of different practices or varieties to establish their value. In addition to these basic scientific and technical skills is the need for technical training at the operational level. In spraying, for example, it is not sufficient for the man in charge of pest and disease control to know the theory of such control; he must also know how the material is to be applied — when and how much, and be able to tell if application of material is being effectively done. Also, for effective work, the man who operates the spray machines must, in addition to understanding the machine and how it works, know what he is trying to control and how this can be done.

The point of view of the writer of this report is of necessity that of one familiar with Horticulture in America. The development of fruit growing from an art to a science has occurred during his lifetime. Familiarity with conditions in Yugoslavia has been gained by extensive travel through the country in 1960 and 1962 visiting Fruit Growing Institutes and State Farms in many places. In this report an attempt is made to describe practices and trends in fruit production as they have developed in America and in some instances to call attention to possible changes in present practice in Yugoslavia that might in his opinion lead to improvement and modernization in this country. No attempt is made to compare American practices

with those of other countries specifically. In the last analysis the Yugoslav horticulturists must determine the methods which they will use. This report may be useful only as may call attention to and analyse the factors operating in modern fruit production.

Yugoslavia has a great potential in growing temperate zone fruits because of the favourable climate and soil. The writer has been much impressed by the large amount of deep, well-drained soils that are available for orchard sites. The climate of the country shows a diversity found in few areas of comparable size and this gives opportunity for growing varieties of fruits adapted to different length of growing season and heat requirements. The United States has many comparable areas but much more widely scattered. It would be useful to work out the climatic analogs of Yugoslavia and the United States to facilitate determining regional variety adaptation. The same may be said of other temperate zone countries particularly France, Germany, Japan, and parts of Russia.

In modern fruit production the objective is to produce superior crops of fruit in the most efficient manner possible. In the research leading to any change of practice, in the beginning, costs may be largely ignored. However, before any practice will be adopted by practical growers or is justified in commercial production, it must be proven to be economical as well. Much is said about the desirability of obtaining high yields of fruit per hectare. This is important because high yields are usually closely associated with low production cost per quintal. However, this is not always the case and in choosing any procedure or practice as compared to an other, the essential factor for consideration is its cost all things considered, as related to increased yield, improved quality or in last analysis the profit to be gained by adopting that practice.

The factors that must be considered should include such obvious items as cost of land, labor and equipment but also the availability of skilled labor that can put a practice into operation in an economical manner or the suitability of the available equipment for accomplishing the necessary work economically. In this report the writer is concerned with the horticultural aspects of modern fruit production rather than with processing and marketing.

The choice of Orchard Site

Obviously, in establishing an orchard the first matter of importance is the choice of the orchard site. The necessity of locating a new planting on deep, well-drained soil of good moisture-holding capacity and with good air-drainage to reduce the frost hazard is well understood and practiced in Yugoslavia. What is obvious and sometimes lost sight of, is that the choice of site may from the very start determine and fix planting plans and distances, cultural methods, pruning practice, irrigation possibilities, spraying procedures and the possibilities of mechanization. Thus, choosing a slope of erodable land immediately determines that the orchard should be planted on contour, that some system of sod culture should be used, that irrigation, if necessary, will be difficult, that heavy spray equipment cannot be used and the problems of spraying, harvesting and general maintenance must be carefully planned in advance. It is of greatest importance that the orchard, particularly a large one, be layed out in such a way that it can be sprayed effectively. This involves a convenient and adequate water supply, roads to allow easy access of nurse supply tanks to sprayers in action and adequate space for the spray machines to operate. On some slopes perhaps stationary spray systems are the only solution. All these matters and many more should be considered before planting is done. Once the trees are planted it is next to impossible to make changes economically.

In the preparation of the orchard site for planting, the question of deep plowing (70—100 cm) arises. In the experience of the writer this practice has little evidence to justify it. In orchards of the highest production of high grade fruit in America, deep plowing is not practiced and insofar as the writer is aware there is little carefully considered evidence to show its value as compared to plowing at a depth of 25 to 30 cm. At best, it may be considered as a special practice adapted to special conditions where there is a plowsole or hardpan and even here, it is pro-

bable that the same purpose could be accomplished much better by plowing at ordinary depth and breaking up the subsoil with a ripper or subsoiler. On a World-wide basis the burden of proof is upon the necessity of deep plowing as a general practice and carefully conducted experiments to compare deep plowing (70—100 cm) with shallow (25 cm) with all variables controlled are needed to justify this expensive practice.

The problem of planting plans for orchard fruits is similar to that of choosing the orchard site in that it is related to the practices to be followed later and is dependent upon such things as the size and vigor of the kind of fruit or even the clone, often determined by the stock, the pruning system to be used and the general pattern of mechanization. In the United States the trend of the past half century has been away from the intensive culture of some European countries. This has been because there was no shortage of land upon which orchards could be planted and also because there was the lack of skilled labor to prune and otherwise take care of trees planted on espalier or other systems requiring detailed pruning. The trend was toward extensive culture using standard trees widely spaced and adapted for mechanized culture. More recently, because of changes in insect and disease control and increased labor costs for pruning and harvesting, there has been a trend toward using semi-dwarfing stocks such as East Malling II and VII for apples and toward planting in hedge rows instead of on the square. Trees on E. M. II are planted 6 meters apart in the row and rows 10 meters apart, E. M. VII 5 meters by 10 m. and trees on seedling stocks $6,5 \times 13$ m. and when the trees crowd to thin then to 13×13 m. unless hedge rows are desired. At the present time there is much interest in mechanical harvesting. As practices become more stabilized the planting plan for orchards will be modified to meet the conditions of this form of mechanizations.

Young Orchards

Whatever the cultural practice in the mature orchard may be, in the newly established orchard the young trees must be freed from competitions with weeds or other vegetation. This may be done by clean cultivation during the growing season followed by cover crops in late summer and winter or be the use of mulches heavy enough to smother weed growths. The use of cover crops depends on the moisture available during the late summer months and unless irrigation is possible, cover crops should be used with caution as they compete directly with the young trees for water.

Intercrops in the young orchard, either grain, cultivated row crops, such as corn or beans or trees of another kind such as peaches or cherries with apples offer special problems. In any case, if the orchard trees are considered the most important part of the enterprise the inter-crops must be allowed to compete with the trees. This appears to be a simple matter but in practice does not prove to be so. With grain or row crops there is always the tendency to crowd the trees so that there is competition and almost invariably there is considerable damage to the trees from the careless use of machines and implements used in caring for the intercrop. Also, the practices used in growing the intercrop are usually not those that are best for orchard. Cultivation of the intercrop may be continued much later than is desirable for the trees and leave them in poor condition to withstand the winter. Probably growing strawberries or raspberries between rows of apple or other trees fruits is as satisfactory as any combination provided there is a market for product and pickers to handle the crop.

Planting other fruit trees as an intercrop is sometimes done but to the detriment of the orchard. For example, peaches as fillers in an apple orchard might appear to be ideal. However, peaches require a longer period of cultivation than do apples, the spray schedules of the two fruits are quite different and as the trees begin to crowd any pattern of mechanization that may be of advantage to the apple trees is prevented. Also, there is always the tendency on the part of the owner to leave the peach trees in the orchard too long, to the permanent damage of the apple trees, or at least an appreciable set back for them.

Another factors, perhaps not fully appreciated, is that in a mixed orchard apples and peaches, the number of times that heavy machines must go through the

orchard is doubled. This packs the surface soil in a way that under some conditions is highly undesirable. The trend in orchard management is to keep heavy machines off the orchard soil as much as possible.

Whether or not intercrops are to be planted depends upon many important factors among which is the economic necessity of getting some return from the land in the early years of the orchard. Such returns are possible but there is always the danger that management will favor the intercrop to the detriment of the orchard and that careless labor in taking care of the intercrop will injure the trees. In general it may be said that in the United States the trend is away from intercrops except as these may aid in building up the soil for the orchard trees.

Pruning

In the matter of pruning the writer's experiences has been mainly in the New York State where in the last half century there have been many changes. It was evident almost from the start of fruit growing there that the detailed systems practiced in England and Europe were not adapted to the extensive culture of the country. In the older orchards the trees were pruned to high heads to allow cultivation with horse-drawn implements. Securing such high heads required heavy pruning of the growing trees. During the years 1912—1916 Dr. W. H. Chandler working in New York, showed that any pruning of the growing tree, that reduced its leaf surface reduced the size of the tree and delayed bearing. The little pruned trees of 10—12 years of age in the experimental planting yielded more fruit in one year than heavily pruned trees in the Western New York fruit belt produced in three years even though these trees were in the 15—18 years bracket. Practice then shifted toward very light pruning of the tree until bearing age. This resulted in early bearing but many trees had poor scaffold structure and required heavy corrective pruning. From this situation developed the practice of pruning the young tree only as much as was necessary to build a strong framework of scaffold limbs that would resist breakage of the mature tree. This resulted in the general adoption of the so-called modified leader tree in which the following principles were recognized: (1) that the leader should be larger than any side branch (2) that side branches should make a wide angle with the trunk, 45° or more on upper angle, (3) that not more than two side branches should originate from the leader at the same level and probably only one and (4) that side branches should be spaced vertically on the leader at intervals of least 25 cm. and preferably more. Other than this apple trees were pruned little until they came into bearing and some wood became weak and shaded or the trees became too tall and required additional pruning to remove shaded wood and reduce their height.

More recently somewhat more severe thinning out in the center of the trees has been necessary to allow spray material from the air-blast speed-sprayer to cover all parts of the tree thoroughly. Trees are kept low to facilitate ease of spraying and harvesting and semi-dwarfing stocks are also used to prevent the trees from growing too tall.

The mechanics of pruning apples and other fruit trees is undergoing change in mechanization. One development is a compressed air or hydraulic pruner. In using this the worker stands in a cage on a tractor lift which is adjustable at the desired height. Improved types of saws and shears are also used. The prunings are chopped up with a «chopper» and left as a mulch. In peach orchards hedge type pruning is being tried out in which knives or saws shear the tops of the trees to the level desired and trim back the sides vertically along the row. At the present time pruning practices are being worked out to aid mechanical harvesting but this whole matter is in a state of flux except with walnuts, filberts and prunes which are now harvested mechanically. Some progress is being made with peaches, apricots and cherries for processing. The trend is to regard an orchard as expandable and to adopt procedures that are profitable even though the trees may be short lived as a result.

Cultural practice, mature orchard

It is generally agreed that in the young orchard, for best growth, the trees must be protected from competition from other vegetation either by cultivation and cover crops or mulch over the tree roots. In the bearing orchard the established practice

is mulch, sod mulch, or trash cultivation and cover crops. In the past half century there has been a definite change from clean cultivation and cover crops to some form of sod or mulch. This is due to the realization based on experience and experimentation that clean cultivation on almost all soils is an untenable practice in a permanent agriculture, leading to loss of organic matter, unfavorable soil tilth and general soil exhaustion. Cover crops planted in July may delay such soil depletion but are not sufficient to adequately replenish the organic matter except possibly in regions where the cover crop grows most of the winter. Other factors leading to the use of sod culture are the understanding of adequate fertilizer application, reduction of mud in orchard operations when soil is wet, lessening of puddling the soil and soil compaction and the ability to keep the grass sod out short with a large rotary-type mower. On slopes, erosion may also be important. Maintaining a mulch may be extensive if mulching material is hauled in and introduces the hazards of mice and fire. In the sod mulch system the grass is kept short by cutting it several times during the season letting it lie where it falls. Fire is not a hazard in sod mulch culture but mice must be controlled. By trash cultivation is meant a system in which course vegetation like sweet clover (*Melilotus*), rye or weed are allowed to grow, but during the spring - April to June - the cover crop is run over with a disk harrow or other implement leaving a trash mulch on the soil surface. This treatment does not destroy the cover but gives it a set back that prevents excessive competition of the cover with the trees and at the same reduces water loss and erosion. The above described systems apply to apples, pears and cherries and less to peaches which respond to more intensive cultivation.

Fertilizers

The fertilizer requirements of the bearing orchard in sod culture are mainly for nitrogen with lesser amount of potassium and magnesium and only rarely for phosphorus. Some soils may be deficient in boron. In modern production the fertilizer requirement of the trees is determined by foliar analysis and such analysis service has been provided for growers in the States where fruit is an important crop.

The amount applied varies widely in different soils and under different conditions the pH and the texture of the soil being important factors. Foliar application of Magnesium and Boron has proved effective at least to supplement soil application. In nitrogen application, Sodium Nitrate may cause poor soil structure if applied continuously and is being replaced by Ammonium Nitrate. The rate of application depends on many factors and must be related to vigor of growth and the color of fruit. Too much nitrogen causes poor color, poor keeping quality and under some conditions susceptibility to winter injury. Phosphorus is usually not deficient in American orchards and is either omitted or applied to improve cover growth.

Water supply

To secure maximum fruit production a continuing and adequate water supply is essential. This is particularly necessary during the summer months while the fruit is developing. Studies have shown that on orchard soils the rate of growth of apple fruit is slowed down when the soil moisture falls below 25% of field capacity. As size is directly related to yield and often determines the marketability of the fruit, this is an important matter and should receive major consideration at the time the orchard is laid out. The method of irrigation is not so important except as it is related to the topography of the land and the porosity of the soil.

Thinning

In modern fruit production of tree fruit except for cherries adequate thinning of the crop is one of the most important practices. Not only is early and adequate thinning necessary for securing satisfactory size of the harvested fruit but with apples particularly, such thinning is the key to annual bearing. Until comparatively recently, hand thinning after the June drop was practiced and this was fairly satisfactory in giving size to the fruit. However, this was too late in the season to affect bud formation for the following year. With the advent of blossom

and post blossom thinning the problem of alternate bearing in well cared for orchards has been largely solved. Naphtalene acetic acid and Naphtalacetamide are both effective materials for post blossom thinning, the latter is the one cleared for use by Federal regulations. Dinitro sprays are also effective in thinning heavy setting varieties.

Adequate chemical thinning, if the set is still too heavy is usually followed by hand thinning to properly space the fruits on the branches and reduce the number of fruits to the desired fruit-leaf ratio. If water and nutrient supply is adequate the size of the fruit is determined largely by the number of healthy leaves on the tree as related to the number of fruits.

Pollination is a problem in areas with cool spring weather, particularly where the nearness to bodies of water contributes to low spring temperatures. This is solved in the first place by having an abundant supply of good pollinizers planted in the orchard and of bees in the orchard at blossoming time. The orchardist usually rents the bees from a beekeeper who takes full responsibility for bringing in the bees at the proper time and removing them after petal fall. If for some reason, such as frost or continued cool weather, it appears that blossoms will not be pollinated, hand pollination may be resorted to. On the West Coast orchards of Washington and Oregon in America many thousands of ounces (1 ounce = 28 gr) of pollen are sold and used each year. Through the planting of pollinizers, the use of bees and hand pollination the progressive fruitgrower makes sure that he has a set of fruit and by chemical thinning if necessary, he controls the size and quality of the crop and prevents the overbearing that causes alternation of crops.

Stop drop sprays

In recent years stop-drop sprays have been used to prevent the fruit from falling off the trees before picking particularly with varieties like McIntosh that fall early before coloring. Naphtalene acetic and 2, 4, 5-trichlorophenoxy-propionic acid are used for the purpose. However, these materials hasten the ripening of the fruit and shorten storage life and the present trend is to plant red sports of such varieties as Delicious which will color early and may be harvested at the proper stage of color and maturity for maximum storage life without stop-drop sprays.

Herbicides

The research on the use for herbicides for weed control and to replace cultivation in orchards has in general gone far ahead of usage and some materials that are effective in destroying vegetation have been cleared by Federal Agencies controlling the use of materials that might be harmful to consumers of fruit. Also, the whole subject is so new that anyone using the materials cannot be sure that injury to trees and crop will not result under some conditions and by repeated use. The tolerances of application are narrow and careful calibration of application equipment is essential. The most frequent use of weed killers in orchard is to kill the grass about the trunks of the trees in mouse control. However, some experimental work indicates that Simazine or a mixture of it with Doupon may be applied over a wider area to control weeds in apples, peaches and cherries. The next few years will, in all probability, witness a far wider use of herbicides to control weeds and replace cultivation in orchards even as the practice has grown and is used in raising corn and other row crops.

Insect and disease control

Perhaps the greatest advances in raising quality fruit during the last two decades have been in the area of insect and disease control. This has resulted from a number of causes including (1) a much better understanding of the life histories of insects and pathogens on the part of entomologists and pathologists, (2) in the discovery and use of far more effective materials that control insects and diseases without seriously damaging the plants, (3) more efficient spray machinery, and (4) the organization of agencies that advise growers as to just when and with what to spray. In Western New York State where losses from pests and diseases once were as much as 20—30% they are now reduced to as little as 1% by good growers.

The key to successful control of insects and diseases is in correct timing and use of the right materials in the right amount. To achieve this, a complex organization of highly trained persons is necessary. An example of such an organization is found in New York State which, in 1961, was first in apple production in the United States. Here, competent pathologists and entomologists know exactly the stage of development of the important pests and diseases in the orchards at any given time during the season when spraying is done. Thus, with apple scab, which is an important disease, it is known in the spring when the overwintering spores will be shed or the proportion of spores that have been shed or if all have been shed. They know the number of hours and temperatures that are necessary for infection to take place if the foliage is wet and the effect that any available materials will have in either preventing or eradicating infestation. The same informations is available for other diseases and the stage of development and abundance of the insect pests is also known.

With this information in hand the country agents in the fruit growing countries have a 15 minute radio program each day at 6:00 A. M. Prior to going on the air these agents have a telephone look up with the Weather Bureau at 5:30 A. M. in which they are briefed on the Weather for the next 24 hours. After this the agents talk among themselves on the telephone network and decide just what to recommend to the growers for the day sprays program as to materials and timing of sprays. There is a wide range of sprays available. Some act only as prevention, others will eradicate scab 6-24 hours after infection has taken place. With all this information recommendations can be very accurate.

The grower, on his part, has a clock radio by his bedside set to wake him up just before the broadcast and learns what spraying, if any, should be done each day. With a speed sprayer and nurse tank it is possible to cover 40 ha. of orchard in about 6 hours.

During the winter's experience there has been the development from the horse-drawn, low pressure sprayers to larger machines tractor drawn, with high-pressure and large capacity to the present low-volume speed-sprayers with air-blast equipment. At the present time the machines are predominantly large-volume capacity but the trend is toward the low-volume, concentrate sprayers of the air-blast type. This trend is an attempt to correct the damage from compacted soils caused by hauling heavy loads through the orchard. Soil compaction is becoming an increasing problem in orchard particularly where large-volume sprayers and bulk harvesting are used. At one time stationary spray equipment was extensively used in which the pump and tank were near the water supply and spray materials were delivered under pressure through pipes to all parts of the orchard. The difficulty with this equipment was the hard work and time required to drag the spray hoses from the pipeline outlets to the trees.

The development of effective insect and disease control has developed over approximately a half century. During this time the knowledge and skill of the growers has developed along with the better understanding of the pathologists and entomologists. This is very important at the operational level where it is only by experience that effective operation can be secured. The problem of doing an effective job of spraying is quite different from driving an automobile. The latter is engineered to operate with a minimum of knowledge on the part of the operator and when it stops it is taken to the service station. Operating the modern spray machine is different in that the operator must be familiar with the mechanism and its proper operation and know what to do when something goes wrong, as it almost invariably does. These adjustments must be made on the spot for to take the machine to a repair shop would delay the time of spray coverage which is essential to control. It is very doubtful if this knowledge and skill can be learned except by actual experience in a situation where effective insect and disease control is actually being done.

In connection with the problem of spraying it is emphasized that the newer insecticides, especially the organic phosphates, are intensely poisonous and require much more elaborate and careful precautions to protect the operators from severe injury, or even death, than the older poisons such as lead, arsenic and nicotine

sulfate. There is a real question as to whether or not these extremely toxic materials should be recommended for general use by inexperienced persons.

Mechanization

In mechanized fruit growing in America, although there are some large operations, the trend has been towards an operation that can be handled by two men except at harvest time, usually the owner and one helper, with a mechanized system in which all the machines fit into one overall pattern. Thus, an orchard unit of about 40 hectares maximum will require one large speed-sprayer for adequate and timely coverage. This needs to be supported by two tractors one to pull the sprayer and the other to haul the nurse tank to service the sprayer. To other tools and implements must be adapted to these tractors and would include orchard disks or other cultivating implements, rotary mowers if the orchard are in sod, hoists or lifts to handle the pruning platforms or cages and to lift the bulk fruit containers at harvest if the bulk system is used and suitable wagons for hauling bulk containers from the orchard. A truck is also desirable to do hauling on the road and elsewhere where tractor-drawn wagons are not suitable. If irrigation is practiced then the pumps, or pipes for distribution of water must be fitted into the system also. The point is that in an efficient mechanized system there should be no operations of any importance that can be mechanized that still have to be done with hand labor. It is emphasized here that plowing the orchard after the roots of the trees have occupied the land may cause serious injury to the trees. In the established orchard the plow is not essential as a cultivating implement, for disk harrows and other specialized tools will do the necessary work much faster and better without the danger of injury to the trees. Mechanization can of course, be supplemented by the use of chemical thinning, the use of herbicides or any other labor saving practices. If areas are larger than about 30—40 ha, such development should be made in terms of units which may be duplicated with additional mechanization systems. Inasmuch as effective spraying is the key to marketable crops the size of the unit is determined by the amount of orchard that can be covered by the sprayers that are to be used. In the United States about 40 hectares is about the maximum that can be covered effectively with one sprayer and a nurse tank of the best type now available. In the Western United States the acreage covered by a single sprayer is about 30 ha. or less.

What this means in terms of modern fruit growing in Yugoslavia is that the large areas planted to fruits probably should be broken down into units that can be sprayed effectively in one day the necessary sprayers and other equipment for each unit provided. Spraying one part of a bearing orchard one day and another the next is not good enough. Of course while the trees are small a larger acreage can be covered by a single machine. The above discussion applies to the bearing orchard only. The development of an effective spray program for modern large-scale fruit production is not going to be easy because there is no large group of persons who have »grown up« with sprayers and spraying and are ready to assume the responsibility of doing effective spraying with modern machines on a large scale operation. The training of such a force will take some time.

Harvesting

During the writer's experience harvesting methods with apples began with picking the fruit in a grain sack from tall trees with a ladder and packing it in barrels in the orchard. Through the years the trend has been toward greater care to prevent bruising of fruit and greater efficiency in picking from the trees. To achieve the former, more convenient, more rigid and better padded picking containers have been devised, the number of times the fruit is handled reduced and in general, greater care used in handling the fruit. The latest development is to use large containers which are handled with a tractor lift. These are taken into the orchard and receive the fruit from the pickers from padded buckets with canvas aprons. The containers of fruit are taken to the packing house and the fruit floated out of the large containers in water. The fruits are then carried to the sizers on rubber conveyor belts where they are weight sized, and graded as to color and quality.

Efficiency in harvesting apples has been improved by the organization of picking crews in which one crew picks from the ground, another from stepladders and another picks the top of the trees. The trees are pruned to keep them low or semi-dwarfing stocks are used. In some orchard the trees are pruned to facilitate the placing of ladders. A promising development is the use of a tractor-elevated cage in which the picker stands and lets the fruit fall into a canvas shoot which lowers it into the bulk container without bruising.

Mechanized harvesting is now practiced with nut crops, prunes for drying and peaches and apricots for canning. Promising developments are under way with cherries for processing and grapes for juice. Experiments are also in progress for picking citrus fruit for processing. With the development of mechanized harvesting it will be necessary to work out methods of training and spacing the trees to facilitate the use of the machines.

As the writer sees the problems of modern fruit production in Yugoslavia they are primarily related to the growing of fruit of good size and quality and this appears to be related to adequate disease and insect control more than to any other one factor. There are many refinements of cultural practice and procedure that are important in producing maximum yields of fruit of good size and quality and these may need attention, but until the problem of insects and disease control is solved, other cultural improvements are of little value. The immediate problem is training personnel at the operational level who will understand insect and disease control and can keep machines operating at high efficiency. How this is to be decided. Perhaps the control program can be organized around the sprayers that are being made at the factory at Maribor. Engineers from this factory could organize schools for trainees who would operate the machines. Perhaps this is already being done. This, however, is not enough and the need is for men who have had spraying experience in the field. Such experience can be gained only in orchards where effective and efficient spraying is being done.

As stated earlier in this report, the climate and soil of Yugoslavia are very favorable for the production of temperate zone fruits. The potential for the development of modern fruit production is thus very great. The basic research and the practices based on this research have for the most part been worked out in areas with similar climate and soil. The overall problem is to adapt this research and these methods to Yugoslav conditions. To do this effectively will require many more technically trained persons. Many of these may be trained at the technical level but perhaps the greatest need is to have a considerable number trained at the Doctors level in which a thorough knowledge of the basic sciences is secured. There are now some trained horticulturists in the country but not enough to man all the positions of high responsibility, and important decision may be made by some who are not qualified by training and experience to make them. This, of course, is the inevitable result of trying to expand quickly in fruit production or any other field.

Another factor standing in the way of expanding modern fruit production is the difficulty of bridging the gap between those who are well versed in the theoretical aspects of fruit growing and those concerned with the operational level. It is quite possible to learn from books the description of a given practice and perhaps understand the theoretical factors involved and yet be quite unable to actually put these ideas into practice. This situation is probably related to a system of education which does not require actual experience before or during the technical study. Abstracts study and research undoubtedly has its place but when it comes to solving the basic problems of fruit production the trained person must be able to do what is necessary to accomplish the desired results even though it may not be appropriate for him to do it for social reasons.

It is the writer's opinion that the problems of modern fruit production in Yugoslavia on the State and Cooperative farms very closely resemble those of similar acreage in the United States. Just what the situation may be in Russia is not known to him but in England, France and Italy, although there are some large tracks planted to fruit, extensive culture similar to that in the United States is the exception rather than the rule. It would be logical to believe therefore that the methods that have been developed in the United States would be well adapted to the larger plan-

tings in Yugoslavia. These methods have produced and are producing very large quantities of high grade fruit for both domestic and export use. It is also logical to believe that the educational system which has trained the scientists and workers who are concerned with this modern fruit production has considerable merit in its insistence on broad basic training and the requirement of practice and experience as a prerequisite to such training.

However, as pointed out earlier in this report, in the last analysis it is the Yugoslav horticulturists who must evaluate the practices in vogue in other countries as they may be applicable to conditions in their country. If this report has explained the practices used in modern fruit production in the United States so that it will be helpful in making any such evaluation, it will have served its purpose.

MODERNA VOĆARSKA PROIZVODNJA U SJEDINJENIM DRŽAVAMA AMERIKE I U KOJEM JE ONA ODNOSU PREMA PROBLEMIMA VOĆARSKE PROIZVODNJE U JUGOSLAVIJI

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Voćarstvo u Jugoslaviji nalazi se na prekretnici od sitne seljačke proizvodnje na krupnu modernu proizvodnju na socijalističkim gospodarstvima. Cilj je moderne proizvodnje proizvesti kvalitetno voće na najuspješniji način.

U svom referatu autor prikazuje hortikulturene faktore koji uvjetuju proizvodnju voća:

IZBOR I PRIPREMA STANIŠTA

Kod pripreme staništa po njegovom mišljenju koje se bazira na iskustvu u USA, da duboko rigolanje 70—100 cm nije svrshodna mjera kod pripreme tla, za sadnju. On smatra, da je u tu svrhu dovoljno oranje na dubinu od 25—30 cm, a ako postoji nepropusni sloj ispod te dubine potrebno ga je probiti.

Međukulture u mladim voćnjacima — žitarice i okopavine predstavljaju problem, koji nije lako riješiti. U USA postoji tendencija protiv međukultura izuzev onih koje mogu popraviti tlo.

Princip je uzgoja voćaka svoditi rez na najmanju mjeru.

Kod održavanja tla u voćnjacima je praksa molčiranja, dok je čista obrada tla potpuno napuštena, osim kod uzgoja bresaka.

Gnojđba voćaka provodi se prema potrebama utvrđenim folijarnom dijagnozom.

Voda je jedan od najvažnijih činilaca, koja uvjetuje podizanje voćnjaka i rentabilitet voćarske proizvodnje.

Prorjeđivanje plodova je važna agrotehnička mjera za redovitu rodnost voća, koja se u USA provodi hormonskim preparatima.

Oprašivanje voćaka vrši se pomoću pčela, pa zato voćari plaćaju pčelarima rad na oprašivanju.

Modernim mašinama i sredstvima za zaštitu voćaka protiv bolesti i štetnika, štete u voćarstvu svedene su na svega oko 1%. Mehanizacija radova provedena je do te mjere, da jedan čovjek uz jednog pomoćnika i uz pomoć mašina može obavljati sve radove na površini od 40 ha osim berbe. Mehanizacija radova na berbi provedena je do sada kod jezgrastog voća, šljiva za sušenje i kajsija za preradu.

S obzirom na podizanje voćarstva u Jugoslaviji, autor misli da u Jugoslaviji postoje dobri prirodni uvjeti za proizvodnju kvalitetnog voća i postizavanje visokih prinosa. U svrhu takve proizvodnje voća treba riješiti u prvom redu problem stručnog kadra i to kako onog sa višom stručnom spremom, tako i radnika specijalista voćara.

Fundamentalna naučna istraživanja u voćarstvu u USA i u svijetu do sada su riješila najveći dio problema iz savremene proizvodnje voća ali ipak unapređenje proizvodnje voća u Jugoslaviji moraju rješavati jugoslavenski stručnjaci primjenom tih saznanja na konkretne uslove proizvodnje.