

## Mechanization in Fruit Culture

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ARTICLE ID: 055

### Introduction

Horticulture is one of the important sector in determining the economy of many countries but for most of the farmers the cost of different horticultural operation are probably considered as one of the major factors in determining whether there will be economically successful season or not. Different horticultural operations like soil and seed bed preparation digging, fertilization and irrigation, manure spreading, pruning and training, spraying and harvesting, accounts more than half of production cost. In many countries farmers mostly faces these problems which are likely to take more time and also increases the total production cost. So in order to minimize production cost and to saves time we have to take a step towards mechanization. Current mechanized horticulture includes use of trucks, tractors, harvesters. Modern orchards even sometimes use computers in conjunction with satellite imagery and GPS guidelines to increase yield. In fruit cultivation several machinery are available to increase production, mould board plough, disc plough and rotavator are being used in ploughing and seed bed preparation. Operations such as harvesting, spraying, weeding and irrigation use of trunk shaker, air blast sprayer, bush cutter, drip irrigation, respectively can be used to overcome production cost and to saves time compare to conventional method.

### Need of Mechanization

The followings are the points which arises the need of mechanization in fruit culture:

- To increase land labour productivity
- To reduce drudgery involved in the cultivation of the fruit crops
- To minimize cost of production
- To achieve timeliness of an operation

## Following are the Operations where Mechanization is Applied

### 1. Levelling and Seed Bed Preparation

Field preparation is the primarily step for planting of fruit plants. Presently, there are several machinery available for the preparation of soil for fruit plants viz. mould board plough, disc plough, rotavator and laser land leveller. Mould board plough is available for animals, power tiller and tractor operations and the main advantages of using mould plough are, suitable for effective covering of surface trash and weeds, it does not leave the soil in rough and cloddy condition and soil pulverization (Parvin, 2012). Disc plough is suitable for hard soil, it works well in sticky soils and it is more useful for deep ploughing (Jamshidi, 2014). Another important machinery available for the field preparation is rotavator which is derived from rotary cultivator. It is a tillage machine designed for preparing land suitable for sowing seeds, for eradicating weeds, mixing manure or fertilizer into soil, to breakup and renovates pastures for crushing clods etc. (Pradhan *et al.*, 2015). It saved 30-35 per cent of time and 20-25 per cent operation cost. Laser land leveller is widely used for the precision levelling and consists of three major components viz. laser transmitter, laser receiver and hydraulic control unit. It saves about 25-30 per cent of irrigation water and avoids water stagnation in field which results in good yield.

### 2. Digging

A process of using some implement such as claws, hands, or mechanized tools to remove material from a solid surface, usually soil or sand on the surface of the earth. In the process of digging, mechanical and hydraulic drive post hole diggers are used, holes of diameter 15 to 100 cm and depth of 9 to 100 cm can be made by using appropriate augers.

**Table 1: Efficiency of Different Digging Machinery**

Digging Method	Efficiency	Time Requirement
Manual labour	1-2 pits	1day
Tractor operated post hole digger - gear drive	250-300	1 Hour
Tractor operated Post hole digger - hydraulic drive	300-400	1Hour

### **3. Grafting and Budding**

Grafting and budding are the most common methods followed for asexual reproduction in fruits plants. Presently, it is done with the help of various modern tools like grafting and budding knives. The blade is beveled on only one side as well as grafting tape which is 5/8” wide and 328 feet long and clear. Grafting tools also include professional graft pliers for notch graft, omega graft and bud graft and top grafters for bark graft, bench grafter, field whip and tongue grafter, grafting machine for commercial nursery.

### **4. Pruning and Training**

Tree pruning and training is very important for canopy management as it maintains a balance between vegetative and reproductive growth in plants and ensures higher yield and fruit quality. Now's-a-day some modern equipments like pruning shear and folding pruning saw are being used for training and pruning in horticultural fruit crops. Pruning shear is easier to use, ideal for small farmers for pruning young trees. Its short blades facilitate closer cutting to the stem of the plant. The recommended crop capacity is 2 cm, length 18 cm and weight 200 g. Folding pruning saw cuts branches up to 4 inches in diameter and shape of the blade is thinner at the top and thicker at the bottom. The overall length of folding pruning shear is about 35 cm and 15 cm blade length.

### **5. Weeding**

Weed infestation is the main constraints in fruit yield and quality. It competes with the main crop for nutrients, water requirement and fertilizers. It is essential for the farmers to remove weeds from the orchard land. Earlier, weeds are removed either by hand or simple process of ploughing but both the processes are time consuming and required labour. Now, some equipment's like power weeder (self propeled machine and with 2-3 hp engine) bush cutter (light weight engine operated and suitable for cutting dry and fresh grass) are available for cutting of grasses from the orchard fields in less time.

### **6. Spraying**

Spraying is an another important operation during fruit the production, traditionally orchardist spray insecticides, pesticides and fungicides applications using foot sprayers or gun sprayers, that causes improper utilization and more than 50 per cent loss of insecticides, pesticides and fungicides. Now, air blast sprayer and electrostatic sprayers are used to

overcome these problems. Air blast sprayers operate by using a relatively low pressure pump to deliver the spray mixture into an air stream. Air stream is produced by a large fan that serves to carry the spray to the target. Electrostatic sprayers spray insecticides, pesticides and fungicides vertically. Spray delivered rapidly in the form of median drops (500 micron) vertically to entire volume of tree and automatic target-detecting orchard sprayer which is the combination of both air blast and electrostatic sprayer based on automatic sensor device. Sensor devices help to locate the target (tree). Its gives an efficiency of 50-70 per cent. This technique is more efficient than other mentioned techniques but it is still under experimental purpose and not commercialized yet.

## 7. Fertilizer Spreader

A method was devised to spread the fertilizer evenly over a follow field by dropping the fertilizer on the impeller disc. The system has three wheels, two forwards and one for the rear. These two wheels on the front are used for fertilizing. Two hoppers are used to store fertilizer; These hoppers are placed at some height from the wheel axle so that the fertilizer falls on the impeller. Hopper is provided with the flow control mechanism. In fertilization, flow management is required. Generally an adequate amount of fertilizer should be applied to each crop. This condition is satisfied by spring mechanism. Under normal conditions the spring is not in tension and the hopper is closed. As the operator applies tension to the spring, the rear of the control plate rises and the hopper opens. Below this system there is an impeller. It is mounted on output shaft. Hooper opens on impeller eccentrically and due to centrifugal action fertilizer spreads in the farm. This high value of centrifugal force is generated by the help of proper gear reduction ratio. The gears are coupled to the shaft of wheel (Narode *et al.*, 2015).

### Efficiency of Machine

- Percentage of reduction in time was observed to be 50 per cent and reduction in labour cost as compared to conventional method was 80 per cent.
- For one acre it requires half an hour to complete the process.

**Table 2: Cost Effectiveness of Machine**

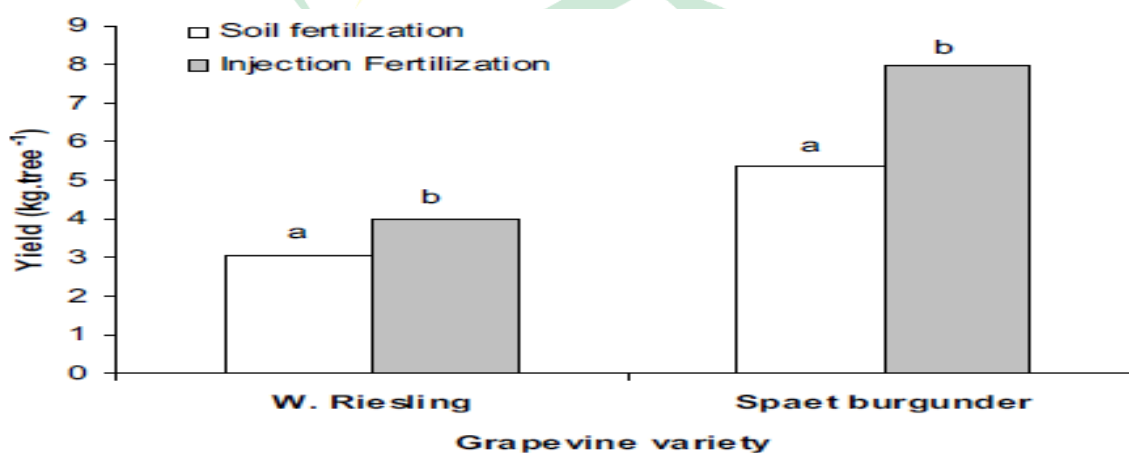
Parameter	Conventional Method Cost	Fertilizer Spreader Cost
Cost per acre	600 – 700/-	100 – 150/-
Time per acre	2 hour	1 hour
No. of labours	04	01

### 8. Irrigation and Fertigation

Irrigation and fertilization are one of the most important operations in better quality fruit production. Earlier, irrigation is generally done by flood system and fertilization through broad casting method, but presently it is done by using drip irrigation and sprinkler irrigation. Drip irrigation is localized, low-volume form of landscape irrigation. Its application rate is 1-12 litre/hour. It can save 90 per cent of the water (Bryla *et al.*, 2005). Sprinkler irrigation is a method of applying irrigation water equivalent to natural rainfall. Its application rate is 25 - 30 litres/hour.

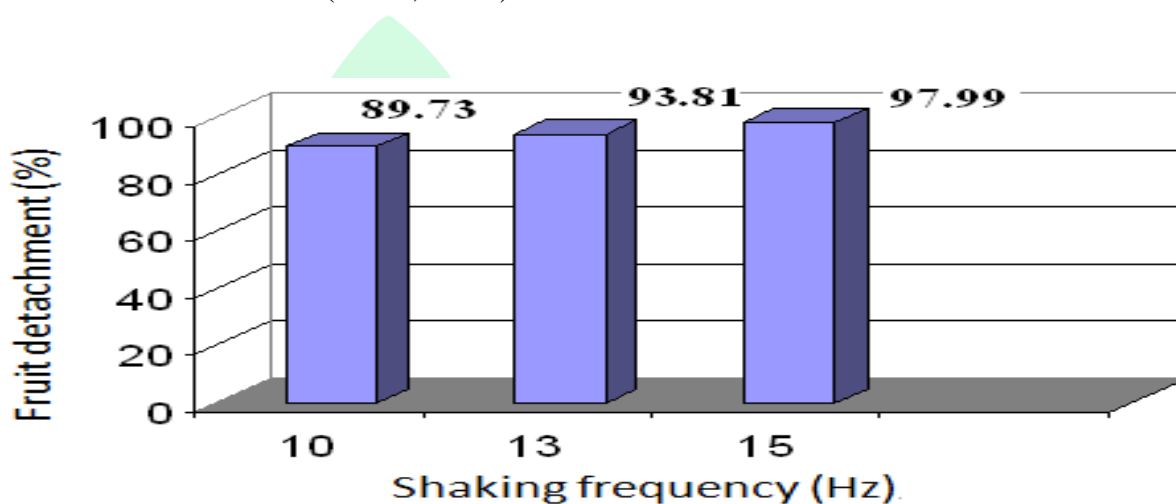
#### Injection Fertilization

Injection fertilization is effectively used in mango and grape plants. Fertilizers are injected by 2-4 cm deep and 0-1.6 cm wide pore in the tank using electric machine (21J-13 china). Then removing bark piece of about 2-3 cm length and 0.5-1.5 cm in diameter for injection. (Shaaban, 2009).

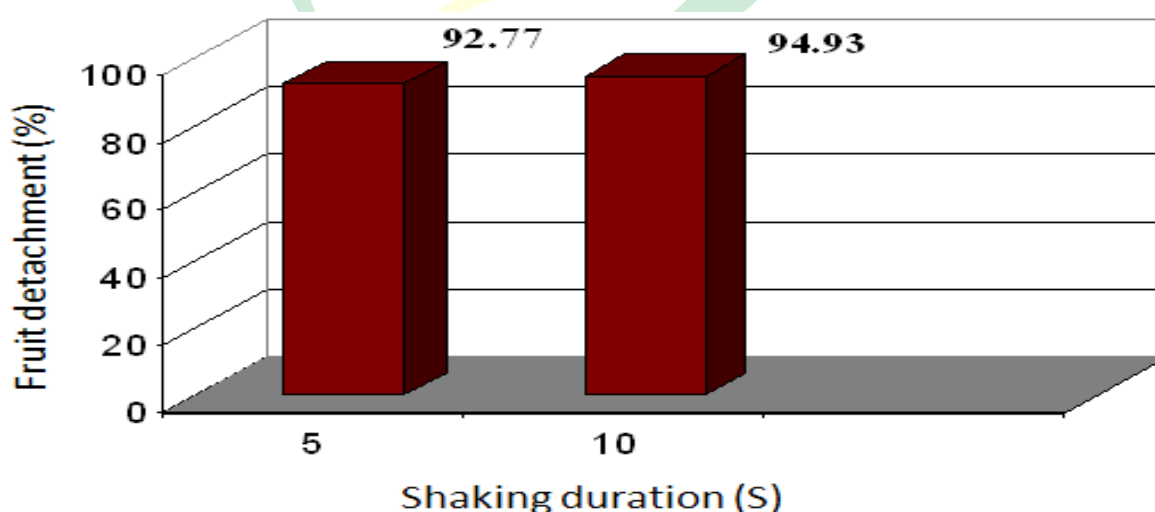
**Figure 1: Yield Efficiency Graph**

## 9. Harvesting

Fruits are mainly harvested by conventional methods like hand picking after climbing on trees or by using ladders. In such type of harvesting operations, labour productivity is very low with high drudgery along with lesser safety during harvesting. It is the process of detachment, collection, and handling of the fruit (Coppock and Jutras, 1960). Now's-a-day harvesting is done with the help of modernized shaking machines *viz.* trunk shakers, branch shakers and limb shakers (Kolhe, 2009 ).



**Figure 2.** Comparison of mean values of fruit detachment (%) at different levels of shaking frequencies.



**Figure 3:** Comparison of mean values of fruit detachment (%) at different levels of shaking duration.

**Photographs of Different Horticultural Machinery**



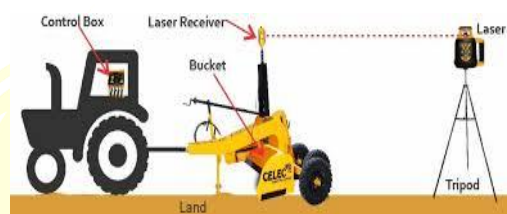
**Mould Board Plough**



**Disc Plough**



**Rotavator**



**Laser Land Leveller**



**Gear Drive Digger**



**Hydraulic Drive Digger**



**Dibber**



**Grafting Knife**



**Budding Knife**



**Pruning Shear**



**Folding Pruning Shear**



**Air Blast Sprayer**



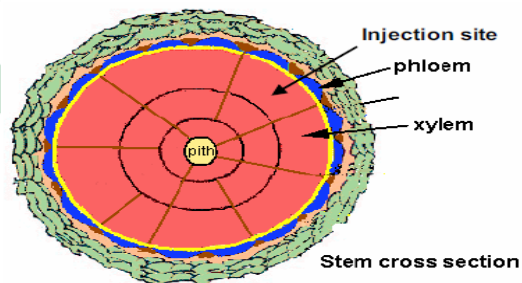
**Electrostatic Sprayer**



**Manually Operated Fertilizer Sprayer**

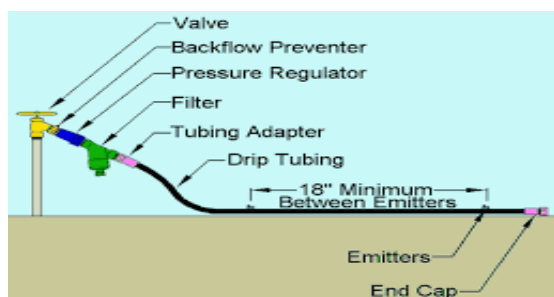
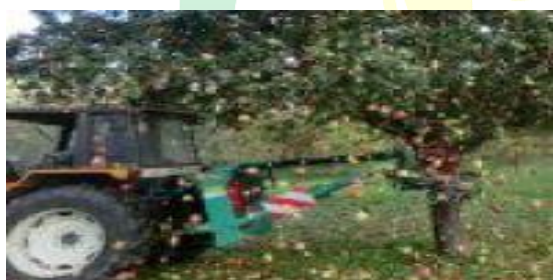


**Tractor Operated Fertilizer Sprayer**



**Injection Technique**



**Drip Irrigation****Sprinkler Irrigation****Bush Cutter****Trunk Hydraulic Shaker****Mechanical Trunk Shakers****Conclusion**

We can say there is little scope of horticulture without mechanization because majority of our farmers suffering from complications such as soil and seed bed preparation cost, harvesting cost, levelling cost and training and pruning cost which requires higher labour cost, needs time, requires lots of human efforts & minimizes land labour productivity that ultimately increases the cost of production that further resulted in lower benefits to the farmers. So mechanization is important because of following - to increase land labour productivity, reduces human efforts, minimizes production cost and saves time and gives higher efficiency in all aspects compare to conventional method.

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