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## **Simplified Orange (*Citrus spp.*) Production Guide for Small-scale Farmers**

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### **Author's contribution**

*The sole author designed, analysed, interpreted and prepared the manuscript.*

### **Article Information**

DOI: 10.9734/AJAHR/2020/v5i130040

#### Editor(s):

(1) Dr. T. Selvamuthukumar, Assistant Professor, Department of Entomology, Faculty of Agriculture, Annamalai University, Tamil Nadu, India.

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(2) Dirk Janssen, Centro IFAPA de La Mojonera, Spain.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/51135>

**Short Communications**

**Received 20 June 2019**

**Accepted 26 August 2019**

**Published 11 January 2020**

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### **ABSTRACT**

Orange production provides both nutritional and financial benefits to farmers across Africa. However, these farmers do not realize the full benefits due to low yields caused by poor agronomic practices currently applied in the region. This guide, therefore, highlights key practices that farmers need to adopt for better yields. Farmers should always follow the best practices right from the selection of a variety to harvesting practices for high yield and better quality fruits to be achieved. Proper land preparation helps in early weed control and improves water infiltration and growth of roots. Weeds should always be kept below economic thresholds to ensure efficiencies in the use of water and nutrient. Like other plants, oranges require proper nutrition for growth and development of big fruits. Both manure and inorganic fertilizers should be applied depending on the availability and cost. Soil analysis helps in determining the rates of application. During production, farmers should scout for pests such as aphids, false codling moth, whiteflies, leaf miners, thrips, fruit fly and common spiral nematode and diseases like *Pseudocercospora* leaf and fruit spot, *Phytophthora spp.* and orange fruit scab which are common in the area. These pests cause significant yield losses if not timely controlled. When ready, harvesting of fruits should be careful and gentle without causing injuries.

**Keywords:** *Orange harvesting practices; soil fertility management; orange pests and diseases management; orange production; weed control in oranges.*

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## 1. INTRODUCTION

Orange is one of the most important fruits in the horticulture industry providing both financial and nutrition benefits to farmers. Currently, the crop is grown within the tropic and sub-tropic environments with USA, Brazil, Spain, Italy, India, South Africa and Egypt leading in production [1]. Common varieties include Valencia, Blood oranges and Washington navel [8]. The growing temperatures range from 13 to 38°C with an annual rainfall of up to 1500 mm [2]. The crop does well in deep, well-drained soil with a pH range of 6-7.

## 2. LAND PREPARATION

Proper land preparation is required for better weed control and soil water infiltration. Depending on the scale of production, farmers may decide to use herbicides or tractor/ oxen-drawn implements to clear the fields. The use of herbicide is applicable when oranges are planted in pure-stand compared to when planted together with other annual crops. Under intercropping systems, farmers should carry out 2-3 harrowing to create suitable tilth for planting and growth of such crops. Planting holes should measure 0.5 x 0.5 x 0.5 m each though it can vary from 0.4 m x 0.4 m x 0.4 m up to 0.6 m x 0.6 m x 0.6 m depending on growth statuses. When making planting holes, farmers should ensure that all big rocks and tree stumps are removed to facilitate movement when carrying out farm activities.

## 3. PLANTING

Depending on the orange variety grown (dwarf versus non-dwarf), prevailing climatic condition, the farming system adopted (rain-fed versus irrigated system) and level of mechanization, an inter-row spacing of 3-8 m and intra-row spacing of 3-6 m is commonly used for production. Wider row spacing is applicable when considering intercropping (with other food crops, animal feed or agroforestry fruit trees) and mechanization. Planting should be done at the onset of the rains under rain-fed system or any time under irrigated system. The planting process involves;

- Removal of the polythene bag that was covering the roots then putting the seedling in the hole.
- The hole is then filled with topsoil mixed with 10-20 kg (or 1/2-1 bucket) manure/hole.
- When filling back the hole, ensure that the seedling stems are not covered with soil

past the level it was while in the nursery/polythene bags.

- In case of too much wind during transplanting, one should use sticks to support the seedlings.
- In the case of grafted seedlings, the bud union should be left above the ground.
- Once planted the seedlings should be watered. Adequate soil moisture is very important at planting to reduce any early water stress.

## 4. INTERCROPPING PRACTICES

Being a perennial crop with at least 2 years to the first production, intercropping oranges with other annual crops such as maize, beans, soybean, groundnut, banana, and pawpaw, is applicable and encouraged. Intercropping ensures that the weeds are controlled consistently during production. Also, it ensures that land is utilized fully during the early periods when trees have not reached the maturity stage- no land is left idle. For better yields, farmers should plant agroforestry trees such as grevillea as edge plants to act as windbreaks, minimize the spread of fungal diseases and to provide shade.

## 5. WEED CONTROL

Weeds have a great impact on orange production through their influence on farm management operations such as pruning, pesticide application, fertilizer application, harvesting, etc. Weeds increase insect populations and disease infestation in the plantation by acting as alternate hosts. Presence of weeds creates a favorable environment for pathogens that infect orange trunks and roots leading to yield losses. Also, they compete with oranges for growth factors- e.g. applied fertilizers, water and available space. For better yields, farmers should ensure that fields are weed-free by hand mowing, cutting/slashing or spraying them with herbicides. Shallow ring hand weeding on the areas around the trees may also be necessary. When carrying out the shallow ring hand weeding, care must be taken to avoid damage to the roots that could increase fungal infections. This practice is optional especially when farmers have maintained good mulch cover around the trees. Cover crops could also be used to reduce weed pressure.

## 6. PRUNING

Pruning is the proper and cautious removal of plant parts such as shoots, branches or pinching

away of terminal parts to correct and maintain plant structure and increase its usefulness. There are three common types of pruning in orange production;

- **Early pruning:** This is done on young and growing trees for proper establishment. It involves maintaining a single stem up to a height of 0.6-1 m then nipping the main shoot to allow for side branching. The side branches are allowed to grow and develop then pruned, allowing 3-4 main branches for production. Any extra side branches including those growing inwards should be removed.
- **Maintenance pruning:** This type of pruning is done throughout the season mainly to control diseases and pests. Any infested branch is cut, taken out the field and burned. The burning must be controlled to avoid damage to other farms.
- **Annual pruning:** This is done yearly to open up and maintain the canopy thereby reducing overbearing and incidences of pests and diseases. The best time to carry out annual pruning is at the end of the harvest season or at the beginning of the rainy season before flushing.

## 7. MULCHING

This is the practice of adding a layer of either organic (e.g. plant materials) or synthetic materials on to the soil surface. When properly done, it controls weeds and reduces water losses through evapotranspiration [3]. With organic mulches, farmers would benefit from increased soil fertility after the decomposition and mineralization of the materials leading to better yields [4]. When adding mulches, care should be taken to ensure they are not in contact with the graft union region and orange stems to avoid infections. Mulches coming into contact with the stem create damp conditions leading to stem rot incidences and sometimes ant and termite attacks. Under normal circumstances, mulches should be about 30 cm away from the stem and spread to at least 1 m in diameter around the tree, though the wider the area covered the better. The depth of the mulch could vary depending on the availability of mulches and the type of mulch used, usually, 5 to 10 cm thick of organic materials is better.

## 8. SOIL FERTILITY MANAGEMENT

Like other crops, oranges require proper nutrition for better growth and yield. Depending on

availability and cost, farmers may decide to use manure or fertilizer, or both for production. Use of inorganic fertilizer is challenging due to the high cost while the use of manure is faced with quality and quantity issues. These challenges affect more the resource-constrained smallholder farmers compared to large scale commercial farmers. The quality issues with locally produced manures are mainly due to poor storage and decomposition process. A farmer may decide to go for;

### • **Option 1: Use of organic manure**

This practice involves the use of manure. At planting, farmers should use a half bucket (10 kg) of manure per hole. In subsequent years, one should supply 1 bucket (20 kg) of well-decomposed manure per tree yearly during the rainy season [5]. Once the trees have reached the reproductive stage, the same quantity of manure should be applied 2-4 weeks before flowering every year. Use of compost encourages fruit formation and development as nutrients are supplied when demanded by the trees.

### • **Option 2: Use of inorganic fertilizer**

Here, farmers purely use fertilizer for production. After transplanting, fertilizers are applied in 3 splits during the rainy season- at the onset, midseason, and end-season of rainy periods. A more general recommendation is as below;

- 1st year: Supply 0.120 kg urea/tree/year
- 2nd year: Supply 0.665 kg NPK-17/tree/year
- 3rd year: Supply 1.335 kg NPK-17/tree/year
- 4th+ year: Supply 2 kg NPK-17/tree/year

Both manure and fertilizer could be used together depending on the availability and cost. When applying both manure and fertilizers every year, the rates of fertilizer should be reduced depending on the quality of manure.

## 9. PEST AND DISEASE MANAGEMENT

The prevailing tropical and subtropical climate conditions encourage the survival of several pests and diseases that cause yield high losses if not timely controlled. The commonly found important pests include aphids, false codling moth, whiteflies, leaf miners, thrips, fruit fly and common spiral nematode [6,9]. Also, farmers should expect diseases such as *Pseudocercospora* leaf and fruit spot,

*Phytophthora* spp and orange fruit scab, to attack oranges in the season [6]. These pests and diseases cause yield losses depending on the tolerance level of the variety, weather and crop management practices such as nutrition, pruning and weed control. For sustainable management of these pests, proper implementation of integrated pest management (IPM) is required. The IPM is a broad-based approach that integrates practices for economic control of pests in the most promising and environmentally safe option. The broader approach to pest management involves;

- Regular monitoring of the outbreak of pests and diseases and reporting to area specialists for immediate help in terms of control.
- Use of disease/pest-free planting materials-farmers should only use seedlings sourced from a certified producer.
- Maintenance of general hygiene in the farm-keep orange fields weed-free and prune infested branches regularly.
- Maintenance of pest repellent plants within the farm to help in the management of moths, aphids and other leaf miners.
- Ensuring proper water supply and nutrition of the trees to improve their tolerance levels.
- Encouraging the establishment of natural enemies to these pests through planting nectar-producing edge plants (e.g. common vetch, *Daucus carota*, coreopsis (*Coreopsis* spp.) and eliminating the use of broad-spectrum pesticides.
- Judicious use of selective pesticides at all time. The use of any chemicals should be within the recommended rates and time. This information is provided on the product labels. In the case of illiteracy, farmers should seek guidance from area-based entomologist and pathologist. One should always avoid using toxic products with acute oral LD<sub>50</sub> < 2000 mg/kg when there are acceptable alternatives. All pesticides banned for use on oranges and other food crops by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) should be avoided. When making the application, farmers should always put on personal protective equipment (waterproof apron, rubber gloves, gumboots and breathing masks). Proper disposal of chemical remnants and used containers should be guaranteed by following the guidelines outlined on the product labels and summarized by Otieno [7].

## 10. HARVESTING

The maturity period of oranges varies largely depending on the variety and method of propagation (whether the crops are grafted or raised using seeds). The grafted oranges, e.g. Washington Navel orange, start bearing fruit after about 3 years from planting. Maturity of fruits is indicated by the color change from green to slightly-yellowish. When ready, fruits should be carefully harvested without causing injuries. Avoid shaking of trees to let fruits fall as this causes bruises leading to disease infection at storage and transportation. Under smallholder systems, mature fruits are always hand-picked mainly by women and children who form the majority of the farm labor force in Africa.

## 11. CONCLUSION

Orange production provides both nutritional and financial benefits to the farmers across Africa. Therefore, improving yields is very important. To do this, agronomic management practice like timely weed management, balanced nutrient application, adequate water supply, proper and timely pruning, and integrated pest management should be properly practiced. When harvesting the fruits, care must be taken to avoid causing injuries that may lead to attack and spread of disease.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<http://www.sdiarticle4.com/review-history/51135>