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Demonstration on orchard rejuvenation in citrus (Khasi mandarin)

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Abstract

Citrus decline is one of the reasons that citrus productivity in the NEH region is not increasing at the same speed as that of the region. Citrus decline is a symptom of numerous plant illnesses rather than a single disease. The symptoms of this condition vary depending on the causes and components involved and are triggered by both biotic and abiotic factors. A total of 10 nos. farmer's orchard were selected with 40 nos. of tree for each farmer and followed the rejuvenation calendar operation in Mizoram's Aizawl district during 2017 and 2019. The study revealed that the rejuvenation calendar-adopted orchard was found to be beneficial for producing more fruit—260 nos., 108 g per fruit, 4.97 cm in length, 4.96 cm in diameter, and 91.33 ml per fruit—than non-rejuvenated trees, which was produced 126 nos., 83.67 g per fruit, 4.52 cm in length, 4.56 cm in diameter, and 67.03 ml per fruit, respectively. The rejuvenated orchard produced a net return of Rs. 42500.00 and a cost-benefit ratio of (2.8), compared to a net return of Rs. 18700.00 and a cost-benefit ratio of (2.4), which demonstrated the viability of the rejuvenation technology demonstration.

Keywords: Orchard rejuvenation, citrus, Khasi mandarin

Introduction

The Khasi mandarin (the Latin *Citrus reticulata*, or Serthlum in Mizo) is a little bigger than a tennis ball in size and bright orange in colour. Oranges are among the most loved, and widely accepted, fruits in the world and the Khasi mandarin are the king of them (<https://www.zizira.com/blogs/plants/king-oranges-khasi-mandarin#:>). King mandarin was introduced from Cochin China to California in 1882 (<http://ecoursesonline.iasri.res.in>). Among the citrus crops available in Northeastern Region, Khasi mandarin is the most economically important one and plays a vital role in the socio-economic development of the people in this region. Khasi mandarin is well known for its quality, fruit colour, unique sugar acid blend and shelf life which make it the most popular citrus cultivar in Northeastern region of the country. It covers the largest area in the region due to its commercial value. In the State of Mizoram, Khasi Mandarin ranked 1st in terms of area having a total of 13508 ha with recorded total production of 4043 mt. It is worth taking note that the average productivity of mandarin orange in the state is 2.99 mt/ha only, which is less than third time of the national average production of 10.4 mt/ha (NHB Data Base 2019) [8]. Though Mizoram being blessed with good climatic conditions for horticultural crops yet its productivity is very low due to non availability of critical inputs, know-how, intervention, decline of old orchard etc. among them orchard decline is one of the most limiting factor. Citrus decline or dieback is not a specific disease but a disease syndrome expressing many disorders in the plant leading to decline in productivity, reduced productive life and poor fruit quality. Viewing to these booming issues that needed to address at the earliest, KVK scientist thoroughly scrutinize and selected decline orchards for rejuvenation in the villages namely Nausel, Muthi and Sairang of Aizawl district, Mizoram since 2016-17 and 2017-18. A total of 10 nos. farmer's orchard was selected with 40 nos. of tree for each farmer and followed the rejuvenation calendar operation developed and released by ICAR-RC Basar A.P. for NEH region (Technical Bulletin 2011-12). The following points has been considered while, adopting rejuvenation programme (De, L. C., and Patel R.K. 2019) [2].

1. Preparation of half moon terrace and cleaning of tree basin and mulching with straw, dry leaves.
2. Pruning of old declined Khasi mandarin and acid lime at primary branches and 1.5 m produced fruits ranging from 100-220 and 185-237 respectively, after two years. In Khasi mandarin, pruned plants produced fruits with higher quality.
3. Periodical removal of water shoots, dry and diseased twigs, lichen, mosses and phanerogamic parasites.
4. FYM @ 30 kg in the month of March-April along with 1.3 kg urea + 3 kg SSP and 1.2 kg MOP/ tree/year in three split doses i.e. March-April, June-July and Sept-Oct.
5. Dolomite lime @ 3 kg/tree once in three year in the month of February is applied.
6. Multiplex a mixture of micronutrients @ 2.5 ml/litre of water or mixture of 0.5% zinc sulphate, 0.4% copper sulphate and 0.5% magnesium sulphate is sprayed when new flush comes.
7. Trunk borer (damage 20-30%): Collection and destruction of trunk borer adults by shaking the branches 2-3 times at 10 days interval in the month of May. Injection of 3 to 5 ml of petrol or monocrotophos in to the bored hole through syringe and plugging the hole with wet soil. Apply *Beauveria bassiana* (10^{20} spores/ml of water on the trunk).
8. Gummosis or foot rot: Proper drainage to avoid water stagnation around the plants. Scraping of affected portions and pasting of Bordeaux paste.
9. Root rot: Removing of soil around the trunk and

drenching the root with 1% potassium permanganate solution followed by 1% Bordeaux mixture.

10. Scab: Spraying of Bavistin (0.05%) or Blitox (0.25%) in April, June and September.

Material and Methods

A total of 10 nos. farmer's orchard was selected with 40 nos. of tree for each farmer and followed the rejuvenation calendar operation developed and released by ICAR-RC Basar A.P. for NEH region. The investigation was undertaken on uniform 30 years old plants of orange (Khasi Mandarin). Frontline demonstration by personal interview with the help of well-structured interview schedule. The interview schedule was developed through discussion with experts, scientist and extension officers of horticulture department in the district. Before initiating the demonstration, the beneficiary farmers were given with skill training on various technological interventions especially half moon terrace, training and pruning, bordeaux mixture and paste preparation to be followed in rejuvenation of citrus orchard. In adopting the Rejuvenation approach, half moon terraces in circular beds of 1-1.5m diameter was cut into half moon on the hilly slope and bushy grasses which are locally available were planted on the bunds as to check soil erosion due to runoff (Fig.1). The processed then was followed by judicious selection and pruning of primary branches and tree up to a height of 1.5-2 m from the ground level which also includes pruning of water suckers. Regular removal of lichen and mosses was also monitored in time.



Fig 1: Preparation of half moon terrace and training pruning

Since, balance used of nutrients both in the soil and plants are essential for attaining proper growth and development and arrest/ mitigate the citrus decline, fertilizers doses 1300 g urea + 3000 g SSP and 1200 g MOP coupled with 30 kg FYM were applied in three split three splits doses in the month of April, July and November in-order to ensure profitable fruit bearing. Thereafter as to enhance the soil reaction, Ca and Mg content in soil, dolomite lime @ 3 kg/plant was applied in once a year for consecutive three years. In doing so, if the supplied macronutrients are in relatively higher proportion when compared to micronutrients it may lead to extreme depletion of micronutrient and can result to marked top growth and micronutrient deficiencies. Hence, to ensure a balance between macronutrients & micronutrients, two foliar sprays of micronutrient consisting of 0.2% Zn, 0.05% B and

0.05% Mo are applied; first spray @ 2.5 ml/litre of water during flush period in the month of March-April and second spray during September- October. Citrus trees are prone to many different diseases which affect all parts of the tree including the root and collar region, trunk, branches, leaves and fruit. Further, the cut ends created during pruning were sealed and protected using suitable fungicide pastes. Thereafter Bordeaux mixture of 100 litre of 1 percent was prepared in mixture of copper sulphate (1 kg) & quick lime (1 kg) in 100 litre water bucket. The Bordeaux paste in same ingredients mixed in ratio 1:1:10 (1 kg copper sulphate in 5 litre of water + 1 kg lime in 5 litre of water are stirred and mixed thoroughly). During April Month, the Bordeaux paste was applied up to a height of 60 cm from ground level and Bordeaux mixture was sprayed in the month of July (Fig:2).



Fig 2: Preparation & application of Bordeaux paste and mixture

Trunk borer, Leaf miner, citrus psylla, red scale, mealy bugs and aphids were recorded as major pests of Khasi mandarin oranges in the region. Among the major problems trunk borer and bark eating caterpillar were the most eminent. In order to check and control the foresaid, Integrated Management of trunk borer and bark eating caterpillar, Prophylactic smearing of 50 ml Dimethoate + 1 kg lime in 10 liters of water along with gum were applied at the trunk up to a 1 meter height above the ground level during the month of March-April. Further, Cleaning of infected holes and insertion of cotton soaked in Petrol followed by mud plastering was done where and when the trunk borer attack was noticed. During the rainy season, May-June, branches shaking of 2-3 time at 10 days interval were done as to catch the trunk borer adults (Fig:3). In the efforts, other cultural operations including mulching were adopted as to rejuvenate the decline orchards. The harvesting was done in the month of November-December.

The physicochemical analysis was done on 10 randomly selected fruits from each direction. The data on yield attributes like number of fruits per tree, fruit weight, fruit length and diameter measured by vernier calipers, fruit volume by water displacement method and cost of economic. The farmers were taught about the importance of rejuvenating the decline orange orchard through top working (Dehorning) the Exhausted trees, pruning of primary branches and trees upto a height of 1.5 to 2 meters from the ground level, Pruning of water suckers. They were also taught about the preparation of Bordeaux paste and Bordeaux mixture. The programme was later followed by the practical demonstration in the orange orchard by pruning of branches, top working, Ring application of manures, Mulching, application of Bordeaux mixture and Bordeaux Paste in the Pruned orange trees and spraying of organic pesticides.



Fig 3: Hand collection of insect and intercultural operation

The yield and economic performance of frontline demonstrations, the data on output were collected from after rejuvenation as well as before rejuvenation and finally the fruit yield, cost of cultivation, net returns with the benefit cost ratio was worked out. Data collected on demonstrated plot yield was obtained using the data from frontline demonstrations conducted in the farmer's field under the close supervision of scientists from Krishi Vigyan Kendra, Aizawl in different locations of the district. Further, information on actual yield obtained before rejuvenation management practices was collected. The gathered data were processed, tabulated, classified and analyzed in terms of yield and yield attributing parameters in the light of objectives of the study

Result and Discussion

The data pertaining to the yield parameter of Khasi Mandarin are presented in table (1) in term of fruit weight (108g), fruit length (4.97 cm), fruit diameter (4.96 cm) and fruit volume

(91.33 ml) were considerably recorded higher than before rejuvenated trees which was fruit weight (83.67 g), fruit length (4.52 cm), fruit diameter (4.56 cm) and fruit volume (67.03 ml). this may be attributed due to standardize a technology for restoring the production potential of existing plantations by a technique called Rejuvenation and also helps in increasing fruit volume, diameter and weight ultimately the fruit yield per tree was obtain maximum. This finding is in corroboration with the findings of Singh, Akath *et al.* (2015)^[9] and A. K. Sahoo *et al.* (2020)^[11]. Average production no of fruit per tree was recorded 260 nos. in rejuvenated orchard while for the before rejuvenation period was recorded only 126 nos. of fruit with misshapen and poor-quality fruits infested with fruit fly. This may be attributed due to the rejuvenation practices which helps in restoring the production potential of old unproductive and diseased orchards in shortest possible duration than any other technique (A review by Jahangeer A, 2011)^[7].

Table 1: Effect of rejuvenation on yield and yield parameter of Khasi Mandarin.

Particular	No. of fruits per plant	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (ml)
After rejuvenation	260	108.00	4.97	4.96	91.33
Before rejuvenation	126	83.67	4.52	4.56	67.03

The acceptance of any agricultural recommendation will mainly depend upon its benefit cost ratio and recommendation pertaining to specific crop management will not be adopted by any farmers unless treatments are not economically viable. The economics of the rejuvenation orchard production

affected by different rejuvenation calendar operation have been presented in Table 2. The net return (Rs. 42500.00) and cost: benefit ratio (2.8) was recorded with rejuvenated orchard while net return (Rs. 18700.00) and cost: benefit ratio (2.4) before rejuvenated orchard.

Table 2: Economic of rejuvenation of Khasi Mandarin.

Particular	Gross Cost (Rs./ unit)	Gross Return (Rs./ unit)	Net Return (Rs./ Unit)	B:C Ratio (GR/GC)
After rejuvenation	22,500	65000	42500	2.8
Before rejuvenation	12800	31500	18700	2.4

**Fig 4:** Bumper harvest of mandarin

Conclusion

It is obvious from the finding that rejuvenation technique not only increases the total yield but significantly improved the actual marketable yield. In the light of the results obtained from this investigation, it can be concluded that the rejuvenation calendar adopted orchard was found beneficial for getting higher in term of no. of fruit (260 nos.), fruit weight (108 g), fruit length (4.97 cm), fruit diameter (4.96 cm) and fruit volume (91.33 ml) than before rejuvenated trees which was 126 nos. of fruit, fruit weight (83.67 g), fruit length (4.52 cm), fruit diameter (4.56 cm) and fruit volume (67.03 ml) respectively. Since the orchard establishment is a long term process and cannot be done in days but once the yield is reduced to such an extent that orcharding becomes non-economical, rejuvenation is said to sustaining the life of farmer without affecting his economy to a great extent.

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