International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 6, 2019, pp.-8112-8114.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Review Article

ROLE OF INTEGRATED NUTRIENT MANAGEMENT ON VEGETATIVE GROWTH OF ROUGH LEMON (*CITRUS JAMBHIRI* L.)

JOSHI P.*, MAUHALKAR R. AND KADAM D.
College of Horticulture, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, 444104, Maharashtra, India
*Corresponding Author: Email - psjoshi175@gmail.com

Received: March 15, 2019; Revised: March 26, 2019; Accepted: March 27, 2019; Published: March 30, 2019

Abstract: Citrus is considered as most important fruit crops, with their wholesome nature, multifold nutritional and medicinal values have made them so important. Its attractive appearance, penetrating aroma of peel and excellent taste, hold a remarkable position among all sub-tropical fruit crops, value wise it on a better position.

Keywords: *Citrus, Nutritional and medicinal values, Root stock, INM*

Citation: Joshi P., *et al*., (2019) Role of Integrated Nutrient Management on Vegetative Growth of Rough Lemon (*Citrus jambhiri* L.). International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 6, pp.- 8112-8114.

Introduction

The most important commercial citrus cultivars in India are mandarin (*Citrus reticulata* Blanco), sweet orange (*Citrus sinensis* Osbeck), acid lime (*Citrus aurantifolia* Swingle) and lemons comprising of 45, 25, 15 and 10 percent area in respectively. Citrus fruits occupied 13.3 percent area out of the total area under fruit crops in India. It stands third position after banana and mango and about 10 per cent annual fruit production of the country [1]. The true citrus fruits are generally to be of old-world origin having involved in a region bound by Southern China, North Eastern India. Rootstocks in citrus have been a horticultural practice for over a century. The roots of plant are as active as leaves, interacting with the above ground system. The root of a plant plays an important role in growth, development and fruiting on plant. In citrus crop rootstock provide strong root system. It regulates uptake of moisture and nutrients and enhancing flowering, fruit set, control fruit drop. It also develops resistance to biotic and a biotic stress with improving fruit quality and yield. Rough lemon is one of the important rootstock in India. It was mostly cultivated for its fruits and seeds. The true home of the rough lemon is North-Western India. It is supposed to have been introduced in Southern Italy in 200 A.D. It has long been used in India, where it is commonly known as "Jambhiri". In Maharashtra, demands of Nagpur mandarin, sweet orange and acid lime plants are increasing day by day. A state agriculture department of Maharashtra initiated a lot of schemes / projects for the citrus growers, purposed of this initiative was to produce export oriented citrus fruit production in the region for their commercial benefit. At present, in Vidarbha region the citrus nurseries near Morshi and Warud talukas of Amravati district is supplying nearly about one crore plants of citrus crop to the growers of Maharashtra, adjoining areas of Madhya Pradesh and Chhattisgarh and roughly their estimated annual turnover is of Rs 5 crore. Citrus growers are not fully satisfied because they are not getting quality plant material or virus free plant material. It has been observed during the various surveys conducted by university scientists / NRCC scientists in the above said talukas and they concluded that the seed material obtained by nursery growers are from the Himachal Pradesh and adjoining areas. The collected seed material is very prone to Phytophthora root rot and other diseases and same seed material was used for budding of citrus plants. The resultant planting materials which are obtained were easily get infected by various fungus and bacterial diseases.

So, there is a need to address these problems and a right solution for farmer of our region in order to establish their own mother block plantation. So that, they can get genetically pure material, the efforts have been made to give financial aids to beneficiary who want to take mother block nursery of rough lemon and rangpur lime. By taking advantages of these schemes many growers have initiated to established mother block nursery of root stock in Amravati, Nagpur and Wardha districts but there is need to enhance these numbers in future to fulfil the requirement of growers in these regions. From above, it is equally important to undertake nursery production of root stocks as well as mother block development of root stocks with advance management practices. Experiment conducted by AICRP and other research stations have clearly indicated that, sustaining the productivity at higher level without impairing the soil environment is beyond the capacity of single type of nutrient source. Hence, an integrated approach of using chemical, organic and biological sources and their combinations with efficient management has shown not only in sustaining productivity but also soil health. Biofertilizers and vermicompost are not able to supply the entire nutrient required for plant growth, however use of biofertilizers, bioagents and vermicompost along with inorganic fertilizer in a proper proportion not only increase the yield but also act as a stored house of nutrients besides improving the soil physical properties. Conventional, chemical based farming is not sustainable because of many problems such as loss of soil productivity from excessive erosion and associated plant nutrient loss, surface and ground water pollution from fertilizer and sediment, impeding shortage of non renewable resources and low farm income high production cost. In view of this, there is an increasing awareness worldwide about alternative agriculture systems known as integrated plant nutrient management, which maintain soil fertility and plant nutrients supply an optimum level of sustaining desired crop productivity through optimize benefits from all possible sources of plant nutrient in an integrated manner [2].

Effect of integrated nutrient management on growth parameter of rough lemon

Plant height (M)

The data regarding plant height as influenced by integrated nutrient management was recorded and indicated that, there was significant difference amongst the treatment in respect of plant height.

The maximum plant height (4.96 m) was recorded in treatment 75% RDF (450 N + 225 P_2O_5 + 225 K_2O / plant) + 500 g AM / plant + 100 g *Azotobacter* / plant + 100 g PSB / plant + 15 kg vermicompost / plant). Application of vermicompost, *Azotobacter*, PSB, AM may be lead to higher availability of NPK to the plant and different microorganism produce growth promoting antibiotics and enzymes which ultimately results into improvement of soil [3]. Nakhlla *et al*. (1998) revealed that application of organic nitrogen 75 per cent and inorganic nitrogen 25 per cent was most effective concentration as compared to other treatments in orange [4]. Singh *et al*. (2000) found that the treatment consisting of ¾ P + VAM + N recorded the maximum height as compared to other treatments resulting in increase of 68.49 percent over control in sweet orange [5]. Goramnagar *et al*. (2000) noted that an application of 15 kg FYM + 360 g N + 180 g P_2O_5 per plant resulted in more plant height of Nagpur orange under Nagpur condition [6]. Ingle *et al*. (2001) conducted an experiment of integrated nutrient management in acid lime at All India Coordinated Research Project Akola (M.S.) and found that, the plant height was not influenced significantly by application of organic and inorganic nutrients sources. However, maximum plant height (3.95m) was recorded from the trees which received 600 g N, 300 g P_2O_5 and 300 g K_2O + 15 kg neem cake per plant per year [7]. Khan and Hameed (2007) conducted field experiment on acid lime for two consecutive years and revealed that, application of organic manures, inorganic fertilizers and biofertilizers had the significant influence on plant height. The maximum plant height (3.20 m) and (4.02 m) observed respectively in first and second year by the application of individual higher dose of FYM @ 50 kg / plant very closely followed by the combined treatment *i.e*. FYM 25 kg + press mud (PM) 2kg + iron pyrite 200 g / plant under Andhra Pradesh conditions [8]. Ram *et al*. (2007) carried out an experiment on seven years old plant of guava and revealed that maximum increase in vegetative growth in respect of plant height (0.45m) with an application of 250:100:250 g NPK and 10 kg FYM inoculated with 250 g *Azotobacter* per plant under Lucknow conditions. Dutta *et al*. (2009) recorded the maximum increase in plant height of guava which received 565 g N + 1000 g P_2O_5 + 30 g *Azospirillium* / plant under West Bengal conditions [9]. Khan *et al*. (2009) reported that the significant effect of plant height by the application of individual manure (FYM and press mud) and by inorganic iron pyrites (IP) by the combined effect of FYM + IP, PM + IP, FYM + PM + IP. Among at the various treatment's application of FYM 25 kg + IP 200 g / plant, FYM 25 kg + PM 2 kg + IP 200 g / plant and FYM 50 kg / plant had recorded the maximum plant height and percent increase over initial height as compared to other treatments given to acid lime trees in calcarious soil of Andhra Pradesh [10]. Munde *et al*. (2012) conducted an experiment on eight years old plants and reported that, the maximum plant height in the plants which received FYM + 100% NPK + Azotobactor+ PSB / plant under Faizabad conditions [11]. Musmade *et al*. (2009) conducted an experiment on integrated nutrient management in acid lime at MPKV, Rahuri and revealed that, plant height of acid lime was significantly increased due to combined application of neem cake and FYM along with inorganic fertilizers. The significantly maximum height (4.41m) was recorded in the plant which received 600:300:600 g NPK + 15 kg FYM and neem cake per plant per year [12]. Patel *et al*. (2009) reported that microbial and inorganic fertilizers influenced different growth parameters in sweet orange significantly the plant received ¾ of recommended dose of NPK +Azospirillum + AM along with micronutrient had the maximum plant height while, minimum plant height was recorded in control under New Delhi conditions [13]. Hiwale *et al*. (2010) revealed that significant increase in plant height obtained with an application of 500:250:250 g NPK with 50 kg FYM per tree in 10 years old sapota plantation cv. kalipatti under Gujarat conditions [14]. Pawar (2011) conducted an experiment on integrated nutrient management in acid lime and revealed that, the maximum plant height was associated with application of (450:225:225 g NPK + 40 kg Vermicompost + 500 gAM / Plant + 100 g PSB / Plant / year). Garhwal *et al*. (2012) conducted an experiment in kinnow mandarin and reported that, the combined application of 80 kg FYM and 750 g nitrogen per plant gave significantly maximum increase in plant height (15.20%) over the initial plant height [15]. Sadafale *et al*. (2012) conducted an experiment of integrated nutrient management on Nagpur Mandarin at AICRP, Akola and revealed that, significantly maximum plant height was found with application of 100% RDF + 500 g AM + 100 g PSB + 50 g *Azospirillium* + 100 g *Trichoderma harzianum* / plant under Akola conditions [16]. Ghosh *et al*. (2013) conducted an experiment of integrated nutrient management in pomegranate by and noticed that, the plant height was significantly influenced by application of organic and inorganic nutrients sources. However, the maximum plant height was obtained from the trees received 400 g N, 100 g P and 300 g K + 20 kg FYM per plant per year [17].

Plant spread(M)

Integrated nutrient managements positive effect on mean plant spread showed significant effect. Maximum plant spread (4.98 m) was recorded in treatment 75% RDF (450 N + 225 P_2O_5 + 225 K_2O / plant) + 500 g AM / plant + 100 g *Azotobacter* / plant + 100 g PSB / plant + 15 kg vermicompost / plant) Different treatments of biofertilizers and inorganic fertilizers significantly increased the plant height and spread in guava by application of *Azospirillium* + VAM inoculation along with 100% N + 100% P_2O_5 showed maximum plant and spread while control recorded minimum Dutta *et al*. (2009). Goramnagar *et al*. (2000) reported that maximum plant spread in Nagpur orange due to application of 360 g N + 180 g P_2O_5 + 15 kg FYM / tree under Nagpur conditions. Ingle *et al*. (2001) conducted an experiment of integrated nutrient management in acid lime and noticed that the plant spread was not influenced significantly by organic and inorganic nutrients sources. However, maximum plant spread was recorded in the tree which received 600 g N, 300 g P_2O_5 and 300 g K_2O + 15 kg neem cake per plant per year. Ram *et al*. (2007) carried out an experiment on seven years old plant of guava and observed that maximum increase in vegetative growth in respect of plant spread was an application of 250:100:250 g NPK and 10 kg FYM inoculated with 250 g *Azotobactor* / plant under Lucknow conditions. Patel*et al*. (2009) reported that microbial and inorganic fertilizers influenced different growth parameters in sweet orange significantly. The plant received ¾ recommended dose of NPK + *Azospirillium* + AM along with micronutrient had the maximum plant spread while, minimum plant spread was recorded in control under New Delhi conditions. Hiwale *et al*. (2010) recorded the maximum increase in plant spread in sapota plants which received 500:250:250 g NPK + 50 kg FYM / tree under Gujarat conditions. Pawar (2011) conducted an experiment of integrated nutrient management in acid lime and revealed that, the plant spread was influenced significantly by application of organic, inorganic nutrients and biofertilizers. The maximum plant spread was recorded in the tree which received (450:225:225 g NPK) + 40 kg Vermicompost + 500 gAM / plant + 100 g PSB / plant) under Akola conditions. Garhwal*et al*. (2012) conducted an experiment in kinnow mandarin and revealed that, the combined application 80 kg FYM and 750 g Nitrogen per plant significantly increase in plant spread. Sadafale*et al*. (2012) conducted an experiment on integrated nutrient management in Nagpur mandarin and noted that maximum plant spread with an application of (100% RDF + 500 g AM + 100 g PSB + 50 g *Azospirillium* + 100 g *Trichoderma harzianum*) under Akola conditions. Atom (2013) studied the effect of inorganic and bio-fertilizers on growth, yield and quality of Sardar guava at College of Agriculture, Latur during 2012-13. The maximum increase in shoot length (28.90 cm), the maximum number of leaves per shoot (19), increase in tree height (41.55 cm), increase in stem girth (5.90 cm) and tree spread (37.55 cm East-West and 50.80 cm North- South) were recorded in the treatment of 100% RDF + FYM + *Azotobacter* + PSB. Ghosh *et al*. (2013) reported that the plant spread was significantly influenced by organic and inorganic nutrient sources. The maximum plant spread was recorded from the trees received 400 g N, 100 g, P_2O_5 and 300 g K_2O + 20 kg FYM / plant / year in pomegranate. Godage *et al*. (2013) studied the influences of chemical and biofertilizers on growth characteristics of guava (cv. Sardar) at B.A. College of Agriculture, Anand Agricultural University, Anand. The treatment of 75% N + 75% P_2O_5 + 100% K_2O + *Azotobacter* 5 ml / tree + PSB 5 ml / tree resulted significantly maximum tree height (3.80 m), East-West tree spread (5.20 m), North-South tree spread (5.13 m) at harvesting stage [18].

Canopy volume (m^3)

The data clearly indicated that, significantly maximum plant volume canopy volume (45.00 m^3) was recorded in treatment T8 (75% RDF (450 N + 225 P_2O_5 + 225 K_2O / plant) + 500 g AM / plant+100 g *Azotobacter* / plant+100 g PSB / plant +

15 kg vermicompost / plant) which was at par with T7 (44.70m^3) and T6 (43.97m^3) and minimum canopy volume of a plant (34m^3) recorded in treatment T1. The positive effect of integrated nutrient management on growth performance in respect of plant height, plant spread and plant volume could be attributed due to beneficial effect of microbe present in rhizosphere leading to higher mobilization of solute to the roots. Shukla *et al*. (2010) conducted an experiment at Industrial Farm of Department of Horticulture by on 8 years old guava plants which revealed that 500:200:500 g NPK along with 50 kg FYM and 250 g *Azotobacter* showed superior response with respect to canopy volume under Rajasthan conditions [19].

Conclusion

The response of inorganic and organic sources of nutrient along with biofertilizers applications on the plant growth in terms of plant height (m), plant spread (m) and plant volume (m^3) was showed significant variations.75% RDF (450 N + 225 P_2O_5 + 225 K_2O / plant) + 500 g AM / plant + 100 g *Azotobacter* / plant + 100 g PSB / plant + 15 kg vermicompost / plant). Regarding soil nutrient status showed significant variations under different treatments. The maximum soil nutrients content was found in treatment T8 (75% RDF (450 N + 225 P_2O_5 + 225 K_2O/ plant) + 500 g AM / plant + 100 g *Azotobacter* / plant + 100 g PSB / plant + 15 kg vermicompost / plant.

Application of review: Study is useful in root stock studies of citrus propagation. Citrus is third largest crop in India after Mango and Banana.

Research Category: Citrus propagation

Acknowledgement / Funding: Authors are thankful to College of Horticulture, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, 444104, Maharashtra

***Principal Investigator or Chairperson of research: Dr Prashant Joshi**
University: Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, 444104
Research project name or number: Review Study

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Amravati, Nagpur and Wardha districts

Cultivar / Variety name: Rough lemon - *Citrus jambhiri* Lush

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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