emergent
Life Sciences Research

Research Article

Micronutrient status of pomegranate growing soils of Hosadurga Taluk in Karnataka, India

M. N. Shivakumara, C. T. Subbarayappa, D. Mamatha

Abstract

A study was conducted in 2015 to investigate the micronutrient status of pomegranate growing soils of Hosadurga Taluk in Chitradurga district of Karnataka. Total 100 soil samples were collected considering two categories as >2 years old pomegranate garden and <2 years old pomegranate gardens. The samples were analyzed for pH, electrical conductivity (EC), organic boron (OC), micronutrients like Zn, Fe, Mn, Cu, and hot water soluble boron. The results revealed that soil had slightly acidic to alkaline (6.28 to 9.80) pH, had low level of organic carbon (mean 0.40 %) and had lower soluble salt concentration. Micronutrients content viz; Fe, Zn and B were recorded lower in both <2 years old and >2 years old gardens; whereas other nutrients were sufficient. By using the longitude and latitude positions, soil fertility maps were prepared. Correlation study between soil micronutrient status and yield observation explained that soil nutrient content has direct relationship with yield variations.

Keywords fertility, micronutrient, nutrient content, pomegranate, variation

Received: 30 January 2019
Accepted: 8 May 2019
Online: 14 May 2019

Authors:
M. N. Shivakumara ✉, C. T. Subbarayappa, D. Mamatha
Department of Soil Science and Agricultural Chemistry, College of Agriculture, University of Agricultural Sciences, GKVK, Bangalore-560 065, India

✉ mnshivakumara@gmail.com

Emer Life Sci Res (2019) 5(1): 56-62

E-ISSN: 2395-6658
P-ISSN: 2395-664X

DOI: https://doi.org/10.31783/elsr.2019.515662

Introduction

Pomegranate (*Punicagranatum* L) is one of the fruit crops, grown in tropical and subtropical regions of the world. In India, Maharashtra is the leading producer of pomegranate followed by Karnataka. India is one of the leading countries in pomegranate production and more than 1.32 lakh hectare area is under cultivation; out of this, nearly 94,000 hectare area is covered in Maharashtra, which produces fruits of over 1 lakh metric tonnes worth about 4 billion rupees. Nutrient management in pomegranate is one of the crucial things which decide their yield level [1].

The nutrient elements which are required comparatively in small quantities are called as micro or minor nutrients or trace elements. Micronutrients are essentially as important as macronutrients to have better growth, yield and quality of pomegranate plants. The micronutrient requirement by the plants is partly met from the soil or through chemical fertilizer or through other sources. The major causes for micronutrient deficiencies are intensified agricultural practices, unbalanced fertilizer application including NPK, depletion of nutrients and no replenishment. Horticultural crops like pomegranate suffer widely by zinc deficiency followed by boron, manganese, copper, iron and Mo deficiencies. Cl, Cu, Fe and Mn are involved in various processes related to photosynthesis and Zn, Cu, Fe, and Mn are associated with various enzyme systems; Mo is specific for nitrate reductase only. B is not specifically associated with either photosynthesis or enzyme function, but it is associated with the carbohydrate chemistry and reproductive system of the plant. The soil micronutrient status of pomegranate growing soils of Hosadurga taluk was unknown; hence, this study was conducted to reveal the fertility status of the soil in order to help out the farming community by framing new packages according to the specific nutrient status in the soil.

Methodology

One hundred soil samples from more than two years old and less than two years old pomegranate gardens were collected. Soil samples were air dried under shade, powdered by using wooden pestle and mortar, passed through 2 mm sieve and stored in polyethylene bags. For organic carbon determination, 2 mm sieved samples were further subjected to grinding and passed through 0.2 mm sieve. Jackson [2].

Soil analysis

Soil pH

The pH of soils was determined in 1:2.5 soil water suspensions using a pH meter [2].

Electrical conductivity (EC)

Electrical conductivity was determined in the soil water supernatant solution (1:2.5) using a conductivity meter [2].

Organic carbon (OC)

Organic carbon was estimated by Walkley and Black's wet oxidation method as described by Jackson (1973) [4]. In this method, soil was oxidized using known excess of 1 N potassium dichromate in the presence of concentrated sulphuric acid making use of heat of dilution of H_2SO_4. Excess of $K_2Cr_2O_7$ not reduced by organic matter was determined by titration with standard ferrous ammonium sulphate in the presence of ferroin indicator.

DTPA extractable Zn, Fe, Mn, and Cu

The DTPA extracting solution consists of 0.005 M diethylene triamine penta acetic acid + 0.01 M $CaCl_2$ $2H_2O$ + 0.1 N triethanolamine buffered at pH 7.3 [3]. Ten gram of soil sample was shaken with 20 ml extracting solution for 2 hours. The soil was filtered through Whatman No.42 filter paper. Zinc, Fe, Mn and Cu in the extract were determined by using atomic absorption spectrophotometer (Perkin's Elmer, Analyst 400) fitted with appropriate hollow cathode lamps under specific measuring conditions.

Available boron (B)

Available boron in soils was determined by hot water soluble (HWS-B) method developed by Berger and Troug [4].

Results and Discussion

The soils under pomegranate cultivation are dynamic in nature and vary in their properties due to wide range of geographical and climatic conditions, parent material, and cultivation practices adopted by the pomegranate farmers of Hosadurga taluk. The range and mean values of pH, EC, OC, and micronutrients like Zn, Fe, Mn, Cu, and hot water soluble boron were presented in Table 1. The mean pH of soils was 8.40 in case of less than 2 years old and 8.44 in more than 2 years old garden. The soil pH varied from acidic to alkaline and from 6.28 to 9.80 in less than 2 years old garden (Figure 1a) and 6.26 to 9.76 in more than 2 years old garden (Figure1b). This may be due to the presence of granitic and basaltic parent material and the soils formed by this parent material will be acidic and alkaline in nature. The present observations are in conformity with the findings of Raghupathi and Bhargava [5]. Soluble salt content (Figure 2a, 2b) in pomegranate soils were below the threshold values of EC < 4 dS m-1; hence there was no problem of salt injury for the crop [6].

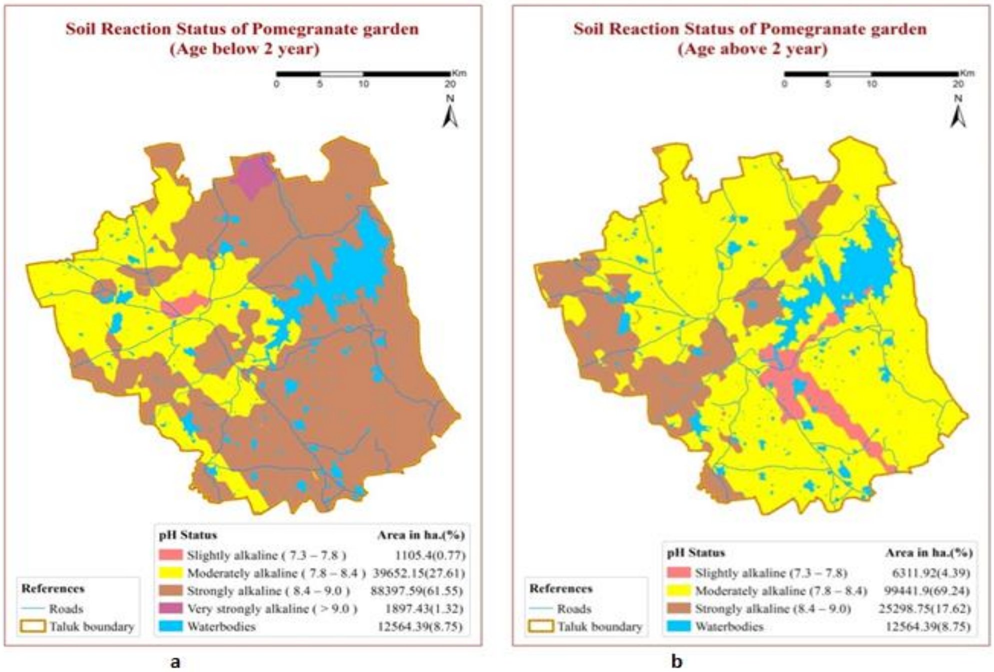


Figure 1. (a) Soil pH status of less than 2 years old pomegranate garden
(b) Soil pH status of more than 2 years old pomegranate garden

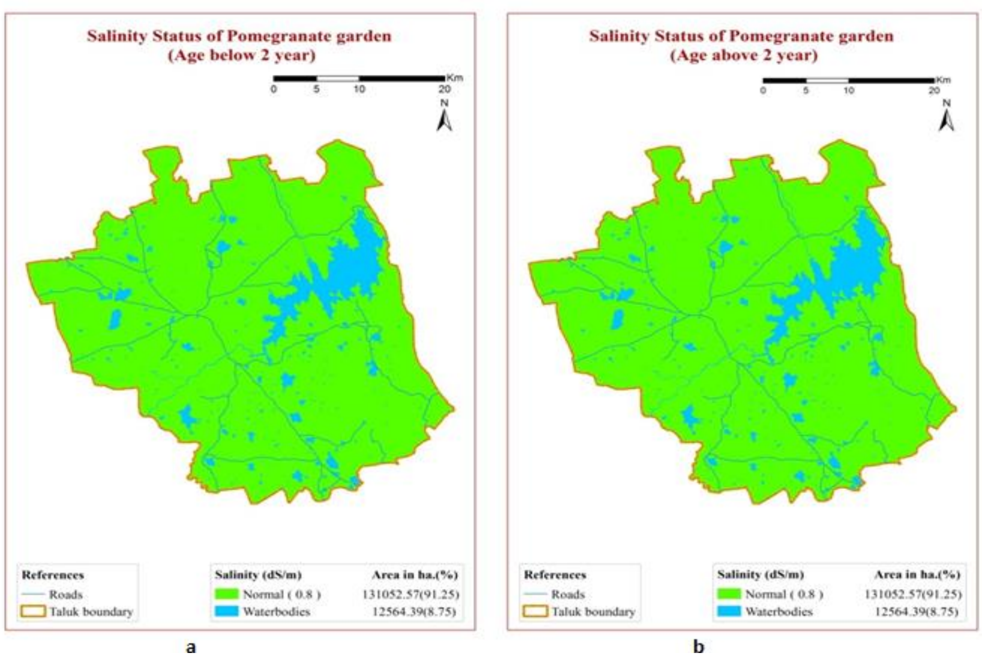


Figure 2. (a) Soil salinity status of less than 2 years old pomegranate garden
(b) Soil salinity status of more than 2 years old pomegranate garden

Organic carbon content ranged from 0.10 to 1.05 with a mean value of 0.40 percent in less than 2 years old gardens (Figure 3a) and 0.11 to 0.82 with a mean value of 0.37 percent in more than 2 years old pomegranate garden (Figure 3b). The low organic carbon may be because farmers only applied the chemical

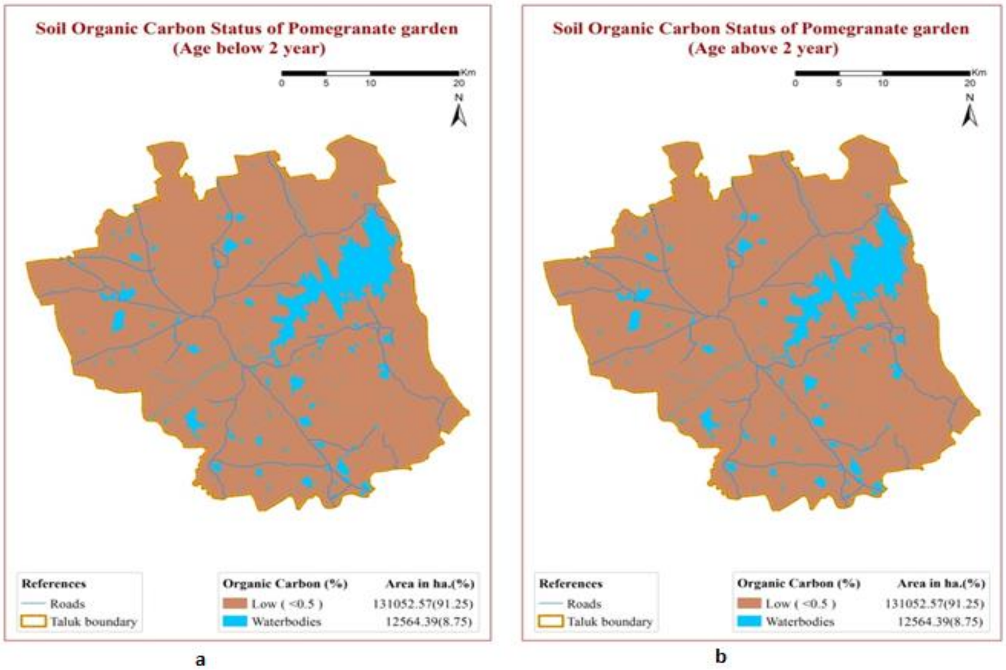


Figure 3. (a) Soil organic carbon status of less than 2 years old pomegranate garden
(b) Soil organic carbon status of more than 2 years old pomegranate garden

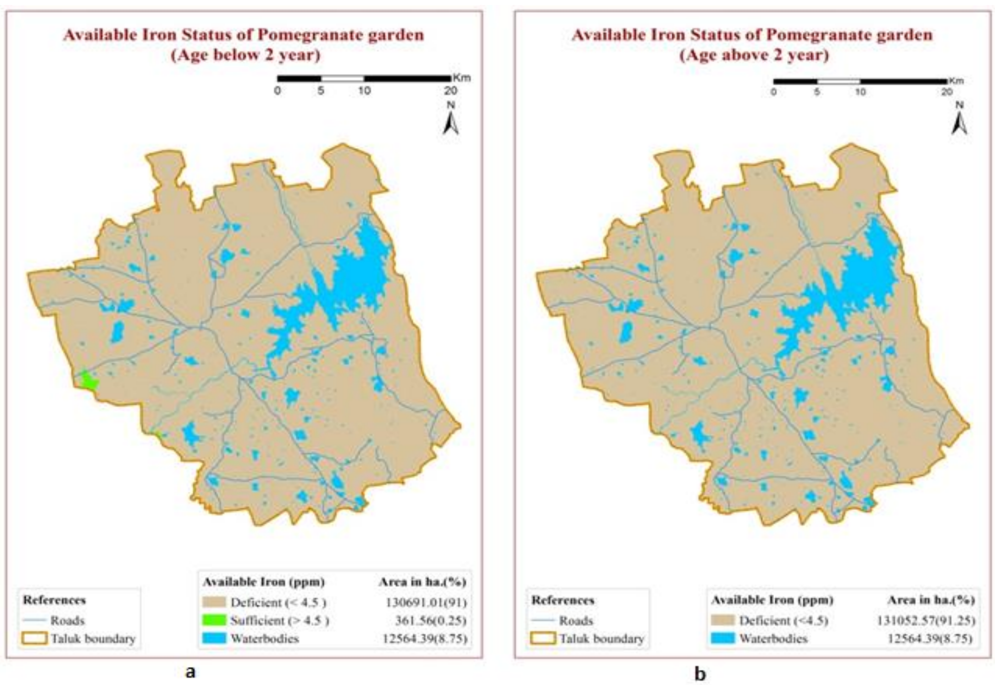
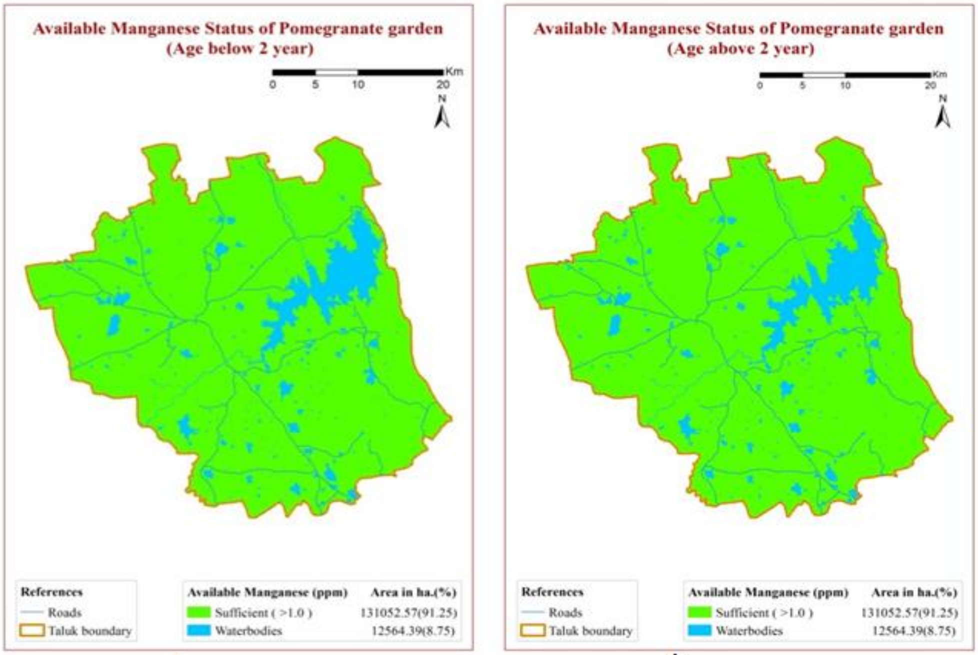


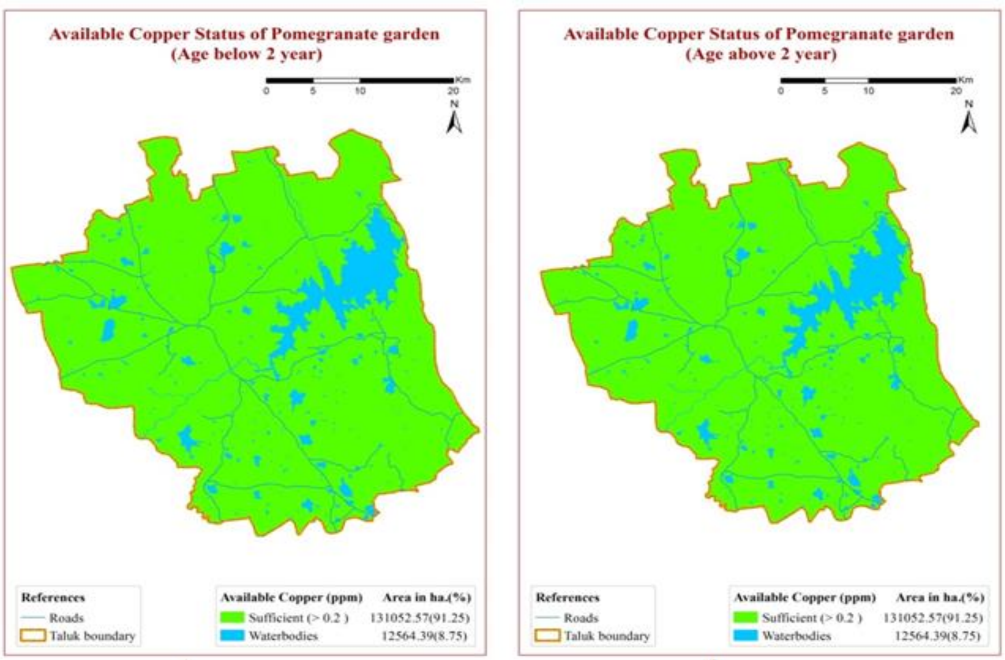
Figure 4. (a) Available iron status of soils of less than 2 years old pomegranate garden
(b) Available iron status of soils of more than 2 years old pomegranate garden

fertilizers, and not organic manures. High temperature in this area might have resulted in decomposition of organic matter to compounds like carbon dioxide [6].



a b

Figure 5. (a) Available manganese status of soils of less than 2 years old pomegranate garden
(b) Available manganese status of soils of more than 2 years old pomegranate garden



a b

Figure 6. (a) Available copper status of soils of less than 2 years old pomegranate garden
(b) Available copper status of soils of more than 2 years old pomegranate garden

The micronutrient content like Fe, Mn and Cu in less than 2 years gardens ranged from 0.99 to 8.83, 0.89 to 9.54 and 0.47 to 5.54 with mean of 3.12, 3.22 and 1.96 mg kg-1, respectively (Figure 4a, 5a and 6a). The Zn and B contents (Figure 7a and 8a) varied from 0.23 to 2.66 and 0.08 to 0.91with mean of

0.92 and 0.36 mg kg-1, respectively. The micronutrient content like Fe, Mn and Cu in more than 2 years old gardens

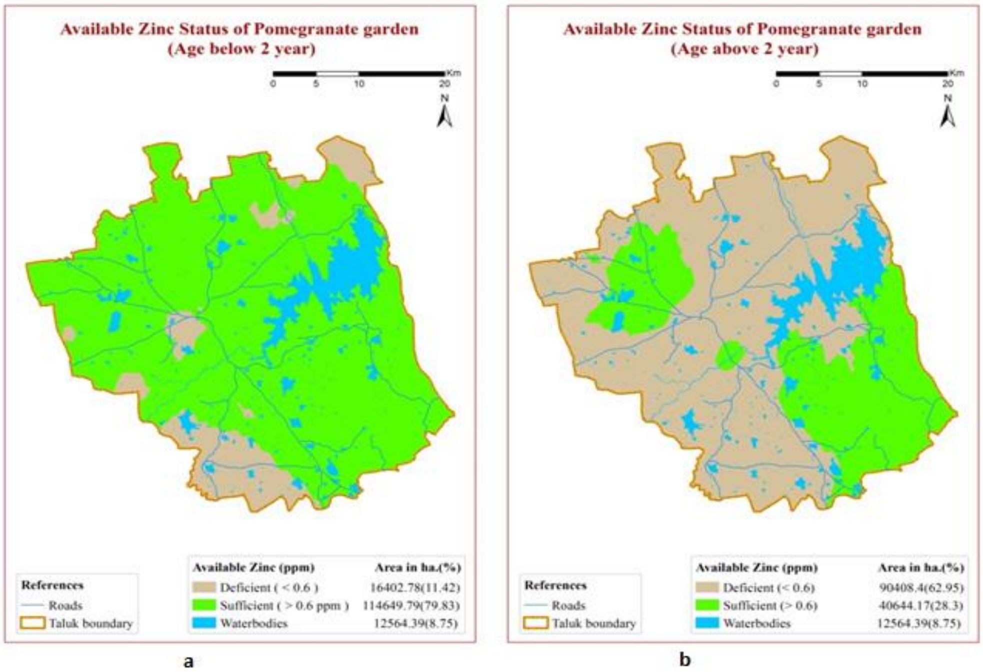


Figure 7. (a) Available zinc status of soils of less than 2 years old pomegranate garden
(b) Available zinc status of soils of more than 2 years old pomegranate garden

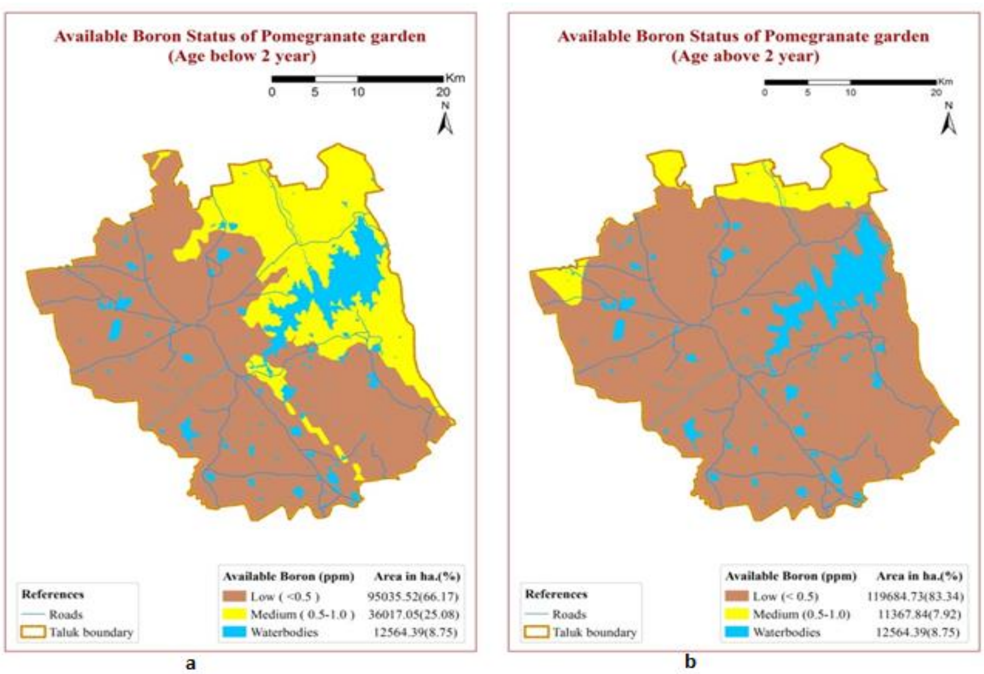


Figure 8. (a) Available Boron status of soils of less than 2 years old pomegranate garden
(b) Available Boron status of soils of more than 2 years old pomegranate garden

varied from 0.95 to 8.04, 0.87 to 8.27 and 0.09 to 3.62 with mean of 2.84, 3.04 and 1.15 mg kg-1 respectively (Figure 4b, 5b and 6b). The Zn and B Content (Figure 7b and 8b) varied from 0.14 to 3.51 and

0.05 to 0.92 with mean of 0.49 and 0.30 mg kg-1, respectively. The micronutrient deficiencies were 76 % for Fe, 58 % for boron, 50 % for Zn and 34 % for Mn in less than 2 years old gardens.

Table 1. Soil chemical properties and nutrient status of soils of less than 2 years and more than 2 years old pomegranate gardens

SN.	Soil nutrients	Range	Mean	Range	Mean
		Less than 2 years old gardens		More than 2 years old gardens	
1	pH	6.28 - 9.80	8.40	6.26-9.76	8.44
2	EC (dSm-1)	0.03 - 0.41	0.11	0.03-0.88	0.13
3	OC (%)	0.10 - 1.056	0.40	0.11-0.82	0.37
4	Zn (mg kg-1)	0.23-2.57	0.92	0.14-3.51	0.49
6	Fe (mg kg-1)	0.99 - 8.03	3.12	0.95-8.04	2.84
7	Mn (mg kg-1)	0.89 - 9.54	3.22	0.87-8.27	3.04
8	Cu (mg kg-1)	0.47 – 5.54	1.96	0.09-3.62	1.15
9	B (ppm)	0.08 - 0.91	0.36	0.05-0.92	0.30

In more than 2 years old garden 80 % for Fe, 78 % for Zn, 40 % for boron and 34 % for Mn was found deficient. This may be due to alkaline soil reaction which does not encourage the availability of micronutrients and deficient of organic carbon content in soils, which is the source of micronutrients in soil. Lower content of boron was due to variation in dissolution of boron containing minerals. The results are inconformity with the findings of Anitha, Jayaprakash et al., Shetty et al., [7-10]. The fertility maps were prepared by using the nutrient status of soil.

Conclusion

The differences between the nutrient statuses of two categorized pomegranate soils was less. In other words, no proper trend was observed in nutrient status with respect to the age of the gardens. In case of micronutrients, combined soil and foliar application has to be tried.

References

[1]Annonymous**(2015)**.
http://agriexchange.apeda.gov.in/Market%20Profile/MOA/Product/Pomegranate.pdf.

[2] M. L. Jackson **(1973)**. Soil Chemical analysis. Prentice Hall of India (pvt.) Ltd., New Delhi.

[3] W. L. Lindsay, and W. A. Norvell **(1978)**. Development of DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. Am. J., **42:** 421-428.

[4] K. C. Berger and E. Troug **(1939)**. Boron determination in soils and plants. Ind. Eng. Chem. Anal., **11:** 540-545.

[5] H. B. Raghupathi and B. S. Bhargava **(1998)**. Leaf and soil nutrient diagnostic norms for pomegranate (*Punicagranatum* L.). J. Indian Society of Soil Science, **46:** 412-416.

[6] Y. Pawar, S. Kadam and P. H. Vaidya **(2014)**. Characterization and classification of pomegranate growing soils of Osmanabad district, Maharashtra. Int. J. Innovative Res. Development, **3:** 187-188.

[7] M. S. Anitha **(2011)**. Distribution of boron in some identified soils and land use systems of Karnataka (Doctoral dissertation, University of Agricultural Sciences GKVK, Bangalore).

[8] R. Jayaprakash, S. Vishwanath and B. C. Punitha **(2012)**. Vertical distribution of chemical properties and macro nutrient status in non-traditional areca growing soil profiles of Karnataka. Ind. J. Fundam. Appl. Life Sci., **2:** 72-77.

[9] Y. V. Shetty, C. Narayanaswamy, B. C. Dhananjaya and K. S. Shesagiri **(2009)**. Available micronutrient status in the traditional arecanut growing soils of Karnataka. Mysore J. Agric. Sci., **43:** 579-582.

[10] Y. V. Shetty, M. S. Nagamma, M. D. Kumar and S. M. Jayaprakash **(2008)**. Fertility status in arecanut garden soils of Karnataka. Karnataka J. Agric. Sci., **21:** 503-506.