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EFFECT OF BORON ON FLOWERING AND FRUITING OF TOMATO IN SOILS OF CHOUCHI AND GERIYO IRRIGATION SCHEME YOLA ADAMAWA STATE.

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Abstract

Two years pot experiments were conducted at the Modibbo Adama University of Technology screen house Yola during 2009 and 2010 dry session. The objective of the experiments was to evaluate the effect of Boron (B) on the number of flowers and fruits in tomato (Variety Roma VF) grown in soils of Geriyo and Chouchi. The experiment was laid out in a completely randomized design comprising of four levels of B and the control replicated three times (0, 2, 3,4 and 5mg/kg). Boron significantly enhanced the numbers of flowers and fruits in tomato. Result obtained on combined analysis indicates that Soil of Geriyo recorded significantly higher numbers of flowers and fruits in both years. However, 2mgB/kg resulted in maximum number of flower clusters and fruits per plant. Therefore base on the outcome of this experiment it is concluded that 2mgB/kg significantly affected flowering and fruiting of Roma VF tomato compared to other concentrations of boron treatment used. As such application of 2mgB/kg along with normal fertilizer in tomato could be recommended for screen house experiment.

Key Words: Tomato, Boron, Flowering, Fruiting.

Introduction

Tomato (*Lycorpersicon esculentum* Mill) belongs to the family Solanaceae and is one of the most popular, important and widely used vegetable crops in Nigeria. The yield potential and quality can be improved by maintaining proper fertilizer application. Among the micronutrients, boron plays an important role in improving the yield and quality of tomato in addition to checking various diseases and physiological disorders (Magalhaes *et al.*, 1980). Tomato crop requires heavy manure and sufficient amount of fertilizers for higher yield. For improving plant growth and development, use of organic and inorganic manure or fertilizers is essential. It is a well established fact that chemical fertilizers improve plant growth directly (Splittstoesser,1990).

As reported by Lombin (1985) soils of the savannah regions of West Africa are inherently deficient in boron, this observation is noticeable in soils of Geriyo and Chouchia according to the result of the soil analysis perform on the soils of the study area, however there is no any available literature work on the boron content of the study area. Like other nutrients, boron has a pronounced effect on the production and quality of tomato. In tomatoes, Boron assist in the translocation of sugars, pollination, proper seed set, increase in yield and fruit quality (Gupta, 1993). Symptoms of B deficiency include the breakdown of meristematic tissue and abnormalities of the reproductive organs. Plants low in B may produce deformed flowers, aborted seeds, thickened, brittle, puckered leaves, or dead growing points (Brady and Weils, 1999). Boron deficiency may limit leaf and root development and reduce plant growth (Blevins and Lukaszewski, 1998).On the other hand, excess concentrations are phytotoxic and may cause chlorotic and necrotic lesions on leaves.

Boron is needed by the crop plants for cell division, nucleic acid synthesis, and uptake of calcium and transport of carbohydrates (Bose and Tripathi, 1996). Boron also plays an important role in flowering and fruit formation (Nonnecke, 1989).Further, more the concentration and utilization of nutrients elements like phosphorus, potassium and nitrogen in plant is enhanced by boron (Ali *et al.*, 2015).The objective of this research was to study the influence of boron application on flowers and production of fruit in tomato plant variety Roma VF in soils of chouchi and geriyo under different boron concentrations.

Materials and Methods

The study was conducted in the screen house of Modibbo Adama University of Technology Yola in 2009 and 2010. The area is located between latitudes 9ºN and longitude 12º E. The area falls within the Sudan vegetation agro ecological zone of Nigeria (Ojanuga, 2006).Soils samples were randomly collected at a depth of 0 – 30cm from Geriyo sites using bucket auger and shovel. Thereafter composite soil from Geriyo were, thoroughly, homogenized and treated as a single sample. The same procedure was done to Chouchi soils. A total of 210kg of soil samples were collected, from the two sites (Geriyo and Chouchi). The soils for routine analysis were thereafter dried in the sun, crushed using pestle and mortar and sieved through 2mm sieve. Tomato (Variety Roma VF)was used as a test crop. They were initially raised in nurseries before transplanting into prepared pots in the green house of Modibbo Adama University of Technology, Yola, teaching and research farm. At four weeks after planting the seedlings were transplanted to already prepared plastic containers (12mm in diameter) containing 5kg soil using hand trowel. Two seedlings were planted per pot and later thinned to one plant per pot when they became fully established. Watering was done with deionised water as at when due. About 500ml water was added during each watering. The treatments consisted of (0, 2, 3, 4, and 5mgB) per pot. The treatments were arranged in a completely randomized design and replicated three times.

Data collection on flowers started in week nine after transplanting. Number of flowers was recorded by counting the number of flowers on each plant.

Available Boron

Available B in the soils was determined using hot distilled water as the extractant and colorimetric analysis of the extracted boron. Boron in the extract was reacted with curcumin to form an orange colored complex. The concentration of boron was then determined calorimetrically (Jaiswal, 2003).The data obtained were statistically analyzed using analyses of variance (ANOVA). Means that were statistically different were separated using least significant different (LSD) as provided by Gomez (1984). The software that was used for statistical analysis is crop stat.7.2.

Results and Discussion

The result of the soil analysis is presented in (Table 1). Soil of Geriyo is clay loam in texture. Chouchi soils are sandy clay loam in texture, the soil reaction (pH) in water of Geriyo is moderately acidic. However soil reaction pH in Chouchi is slightly alkaline in nature. Shankara *et al.,* (2005) reported that Tomato plant thrive well under slightly to moderately acid soil by improving boron availability while alkaline soil favors boron deficiency in the soil. Soils of both Geriyo and Chouchi are non saline in nature. This concurred with the report of Usman (2005) who reported that soils of Geriyo are non-saline in nature.

Table 1: Physico – Chemical Properties of the Soils of Geriyo and Chouchi

Soil parameters	Geriyo	Chouchi	Mean
pH(H_20)	5.70	8.40	7.05
EC mmhos/cm	2.40	0.07	1.24
Organic carbon (g/kg)	14.00	9.00	11.5
Organic matter (g/kg)	24.13	15.51	0.71
Total N (g/kg)	0.88	0.53	6.58
Available p(mg/kg)	4.32	8.84	0.17
Available B(mg/kg)	0.22	0.12	4.10
Exch bases (cmol(+)/kg			
Ca (cmol /kg)	4.00	4.20	4.10
Mg(cmol /kg)	0.80	1.15	0.98
Na(cmol /kg)	0.25	0.37	0.31
K(cmol /kg)	0.29	0.23	0.26
TEB	5.44	5.95	5.71
CEC	9.89	9.00	9.45
%BS	55.00	66.00	60.5
Sand	32.00	38.00	35.0
Silt	31.00	30.00	30.5
Clay	37.00	31.20	34.1
Textural Class	Clay loam	Sand clay loam	

The organic carbon content of soils of Geriyo and Chouchi are moderate and low respectively as classified by Aduayi *et al.,* (2005). Similar result (2.0%) and (2.04%) was reported by (Usman 2005), Saddiq *et al.*,(2007). The low organic carbon content of the soil may be

attributed to high temperature in the study area which leads to rapid decomposition of organic residues as well as inadequate fallow period. Also the low organic matter may be attributed to erosion during the rainy season. The total nitrogen content of soils in both study areas was low. Usman (2005) obtained similar result. He reported that there is direct relationship between organic matter and total nitrogen in the soils. The low content of nitrogen in this area can also be attributed to sheet erosion during the rainy season which deplete the A horizon associated with organic matter that furnished the soil with nitrogen. (Brady and well, 2008). Available P concentration in Geriyo and Chouchi is low and moderate respectively based on the classification of Marschner (1998). The low available P content observed in Geriyo may be due to greater P sorption in Geriyo as a result of the clay content of the soil than Chouchi. Boron content of the soil is low as classified by Ewenzor *et al*., (1989). Cationex change capacity of the soils is also low. This concurred with the study of Ewenzor *et al*,. (1989). They reported that most savanna soils have low cation exchange capacity values.

The effect of B on Growth parameters.

Number of flowers

The effect of Boron on growth parameters per plant of tomato in the soils of Geriyo and Chouchi as presented in Figure 1 to4 shows a significant difference among the treatments at all sampling period in the two growing seasons. Application of boron significantly increased the number of flowers of tomato plant. Result clearly showed that the maximum number of flowers was recorded with 2 mg/kg B application for the two locations at the different time of sampling while control recorded the minimum number of flowers.

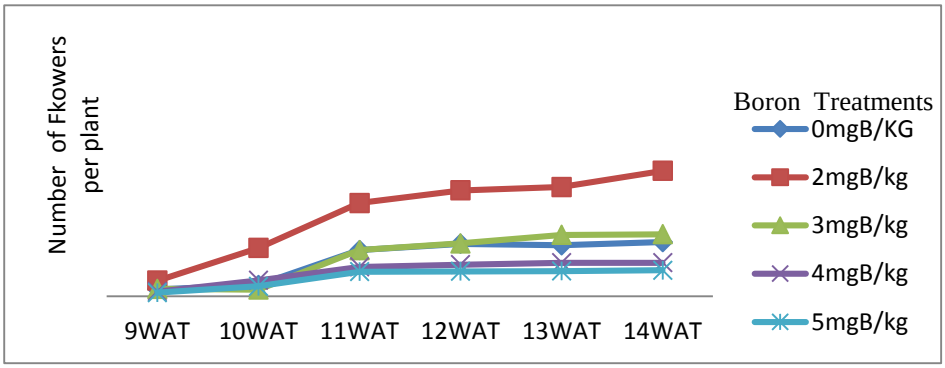

FIG.1 WFFWCT OF BORON ON NUMBER OF FLOWERS PER PLANT 2000 GERIYO

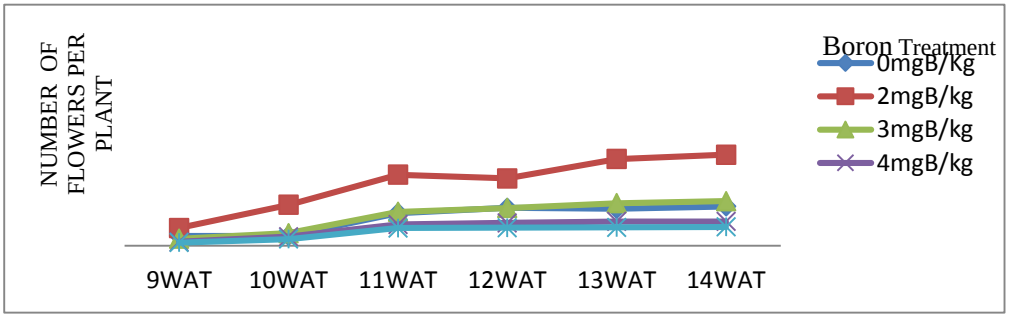

FIG 2 EFFECT OF BORON ON NUMBER OF FLOWERS PERPLANT 2010 GERIYO SOILS

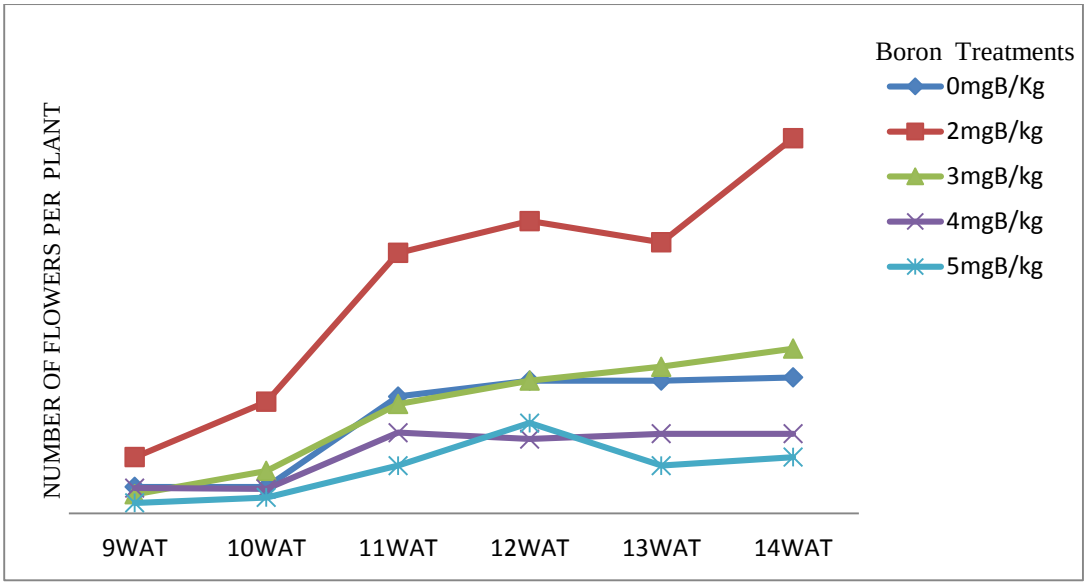

FIG 3 EFFECT OF BORON ON NUMBER OF FLOWERSPERPLANT 2009CHOUCHI SOILS

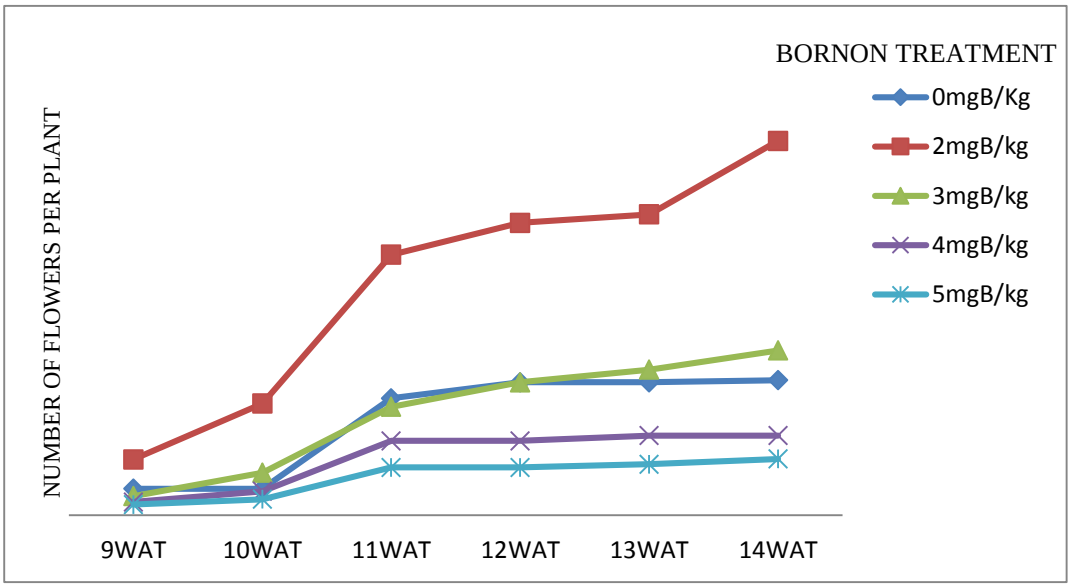

FIG 4 EFFECT OF BORON ON NUMBER OF FLOWERS PER PLANT 2010 CHOUCHI SOILS

The result of the combine analysis as indicated in figure 5 for soils of Geriyo and Chouchi indicated that highest numbers of flowers were recorded with application of 2mgB in both 2009 and 2010, while the least were recorded with 5mgB/kg.

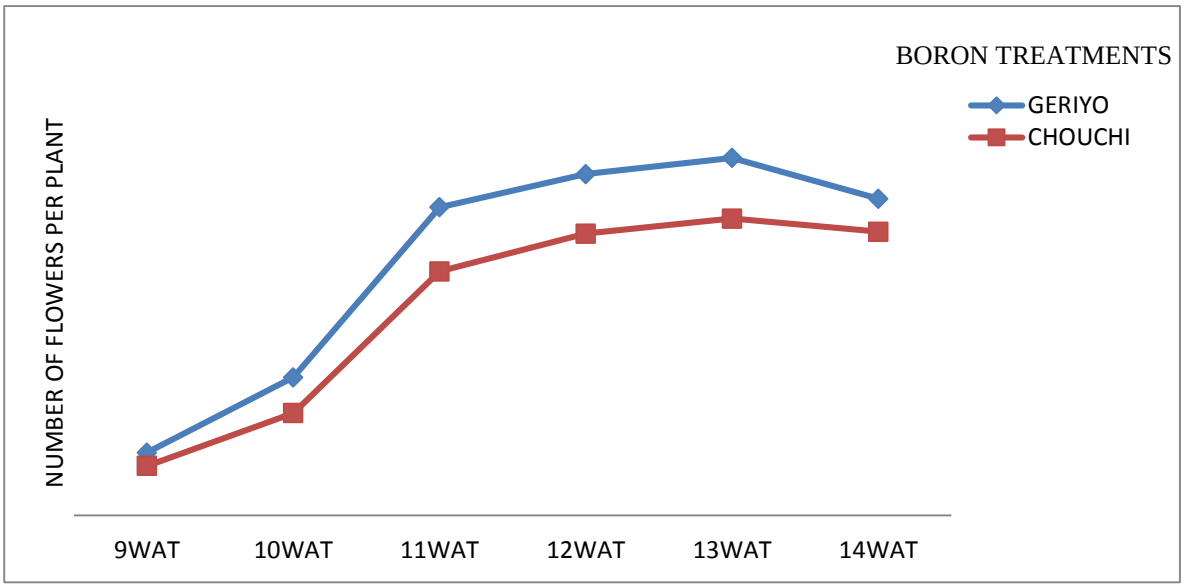

FIG 5 COMBINES ANALYSIS OF EFFECT OF B ON NUMBER OF FLOWERS AT GERIYO AND CHOUCHI

The highest number of flowers recorded by 2 mg/kg B application may be due to the optimum supply of Boron. Day (2000) reported that the optimum supply of Boron stimulated the uptake of phosphorus by plant roots and may have promoted more flower cluster formation as phosphorus directly promote flowering. Similar result was obtained by many researchers (Blevins and Lukaszewski, 1988; Goldbach and Wimmer, 2007) who reported that boron application to plant exert many Pysico-logical role such as flower production. They also attributed the increased in perfection of flowers (buds that produce flowers), number of flowers and fruit set to the application of various levels of Boron. It was evident that Geriyo soils recorded higher number of flowers per plant (Fig 5). This may be due to the favorable Physico-chemical properties of the soil. The soil reaction (5.70) is moderately acidic and favors the availability of apply boron so also the amount of organic matter in soils of Geriyo is higher than chouchi. There is high affinity of B with organic matter which is gradually released in to solution and taken by the plants. The presence of organic matter in soil can increase the concentration of boron in the soil solution and the plant, (John *et al*. 1999). The percent content of clay in Geriyo (37%) is higher than that of Chouchi (31%), as such this will make the texture of the soil finer than Chouchi and therefore applied boron will not be easily leached away from the soil, will be held up by the clay and subsequently absorbed by the plant. Geriyo soils are inundated by seasonal flooding as such there is seasonal deposition of alluvial and colluvial deposit. This will result to variation in physical and chemical, properties, as well as nutrient accumulation Brubaker, et.al (1993) .Rainer *et al.*, (2006) reported that the supply of soil B to plants depends upon different forms and equilibrium among them as influenced by environmental conditions, soil management and Physico-chemical properties of the soil.

Effect of Boron on number of fruits

Percent fruit set was significantly influenced by boron application in Geriyo and Chouchi (Fig 6 to 9). There was progressive increased in percent fruit set with boron application until a certain point was reached when an increase in boron application resulted in a corresponding decrease in the percent fruit set. The highest percent fruit set of (69.2 and 65.2%,) in Geriyo was recorded by 2 mg/kg B application in both growing seasons while the lowest values of 13.1 and 12.1% for the two growing seasons were recorded by 5 mg/kg B application . In 2009, the soils of Chouchi recorded its highest percent fruit set of 48.7% by 3 mg/kg B application while in 2010, the highest percent fruit set of 37.3% was recorded by 2 mg/kg B application. Lowest value of percent fruit set 19.2 and 14.1%) were recorded by control pots. This indicates that Boron plays significant role in the fruit set of tomato plant. Naz *et al.*, (2012); Nonnecke (1989) also obtained similar result. They reported that due to optimum boron application as Boron plays a vital role in maintaining cell integrity, improving respiration enhancing metabolic activities and uptake of nutrient**s.**

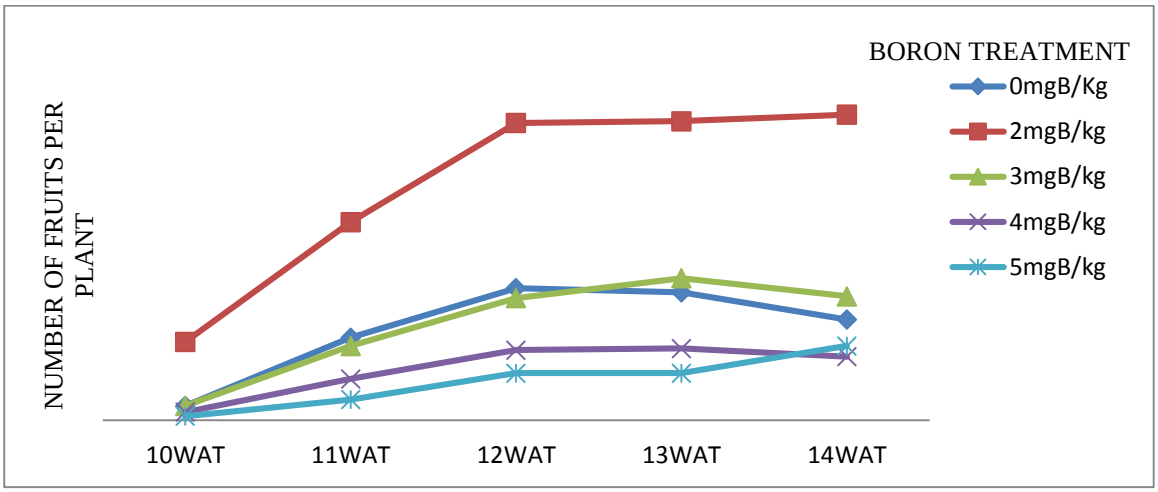

FIG 6 EFFECT OF B ON NUMBER OF FRUITS IN GERIYO SOILS 2009

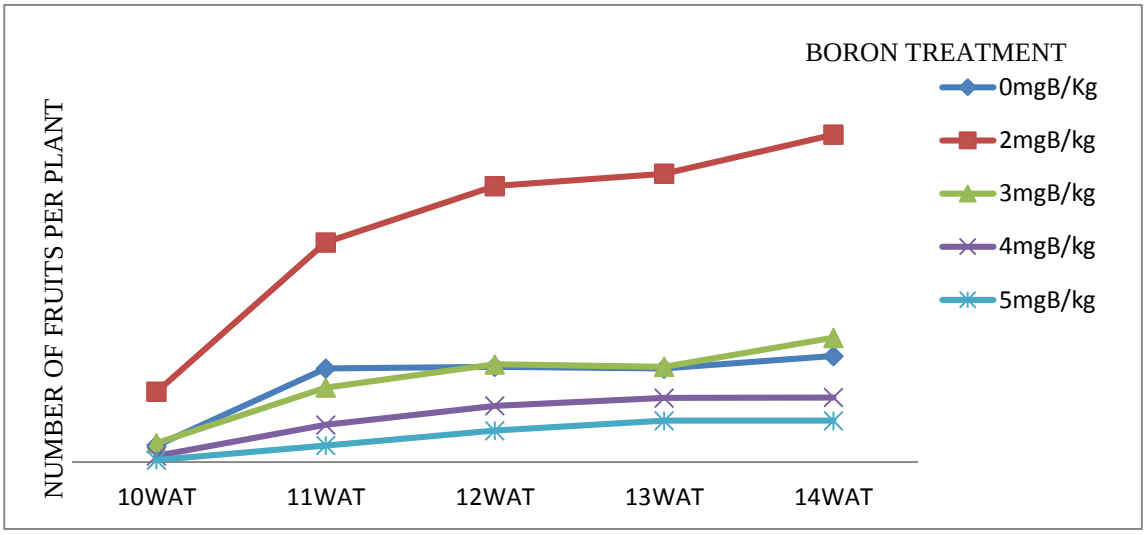

FIG 7 EFFECT OF B ON NUMBER OF FRUITS IN GERIYO SOILS 2010

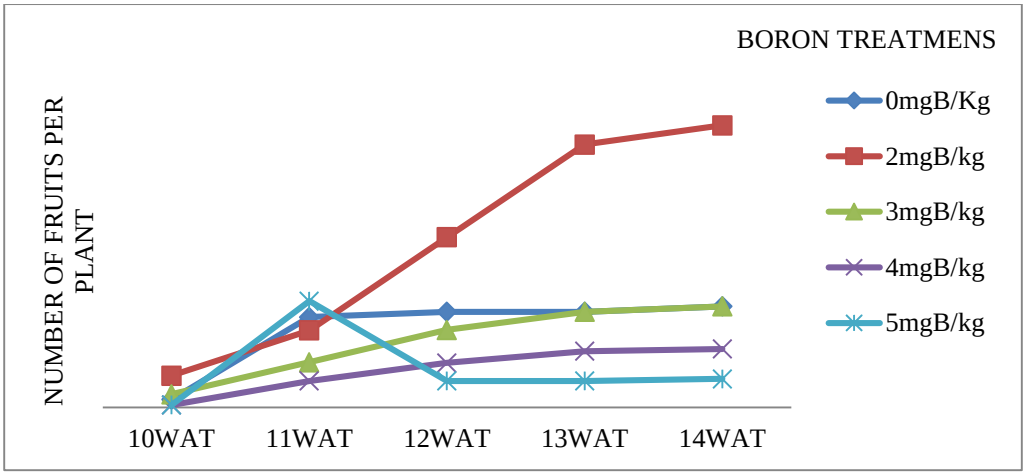

FIG 8 EFFECT OF B ON NUMBER OF FRUITS IN CHOUCHI SOILS 2009

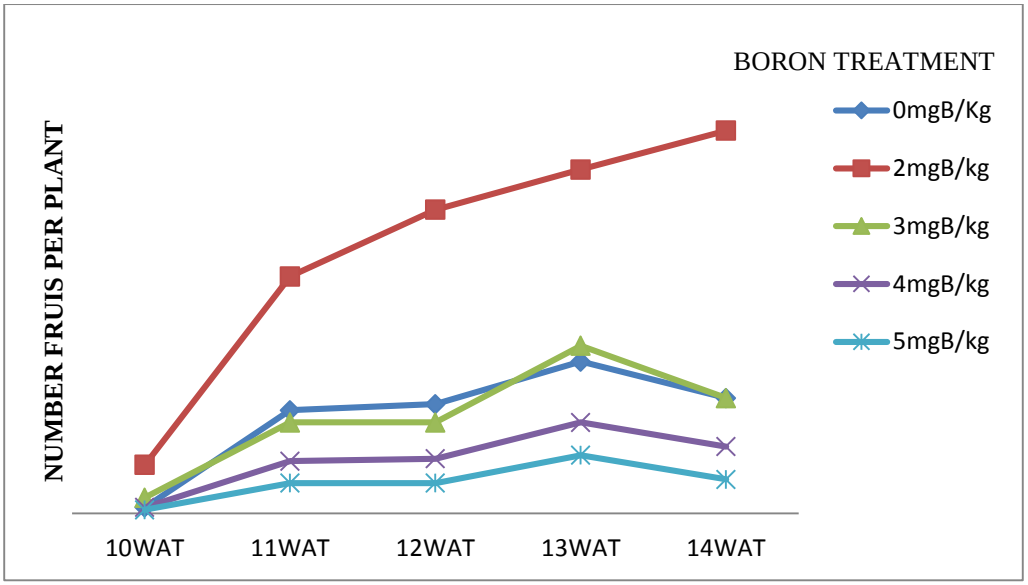

FIG 9 EFFECT OF B ON NUMBER OF FRUITS IN CHOUCHI SOILS 2010

Average Mean Effect of Boron in Soil of the study area

The highest average mean effect of boron was recorded in soils of Lake Geriyo in both 2009 and 2010 study period (Fig 10).
These reasons could be attributed to the nature of the soil properties of the area, that is texture, soil reaction and organic matter content, which favors the retention of applied boron in the soils. Goldberg *et al*., (1995) reported that soil factors affecting the availability of B to plant are organic matter, clay mineralogy, soil reaction (pH), Texture, moisture and Temperature. The amount of organic matter (24.13%) and the soil reaction (5.70) in Geriyo soils favors the absorption of boron than Chouchi.

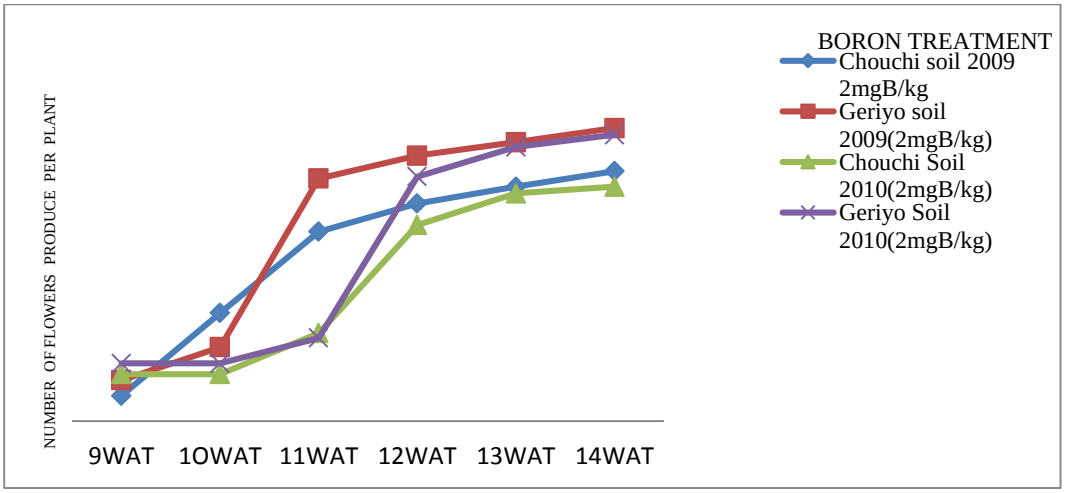

FIG 10 AVERAGE MEANS PERFORMANCE OF BORON IN GERIYO AND CHOUCHI SOIL

Conclusion and Recommendations

On the basis of results recorded from this experiment following recommendations can be generalized; among the various levels of treatments used, 2mgB/kg showed better results regarding flower production under screen house condition and that soils of geriyo irrigation scheme can adequately support the cultivation of tomato. It is advisable therefore to conduct the trials on the main field where the sample were collected.

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