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Frequency of nutrient application on growth and yield of tomato (*Lycopersicon esculentum Mill)*

[*]Shobo, B.A.[1], Bodunde, J.G.[2], Akinboye, O.E.[1], Ayo-Bello, T.A.[1], Afodu, O.J.[1], Ndubusi-Ogbonna, L.C.[1] and Chioma, G.O.[1]

1. Department of Agriculture and Industrial Technology, Babcock University, Ilishan-Remo, Ogun State, Nigeria.

2. Department of Horticulture, Federal University of Agriculture, Abeokuta, Nigeria.

*Corresponding author < teetoade@yahoo.com >

Abstract

Megagreen® is an activated calcite of a worldwide granularity. It is an ecological foil fertilizer with a strong impact on plant resistance, it improves the fertility and health of plants resulting in an improvement of yield and plant quality. The experiment was carried out to examine the growth and yield performance of indeterminate (Ibadan Local) and determinate (UC 82-B) tomato varieties as influenced by the number of application of a nutrient supplement (Megagreen®) applied as foliar spray at the recommended rate of 3.0kg/ha. The experiment was laid out in a split plot design with three replications. Variety was allotted to main plot and number of times of application (2, 3, 4 times and control) to sub plots. Plant growth and yield variables were observed and data collected were subjected to Analysis of Variance (ANOVA). Mean separation was done using Least Significant Difference (LSD). Results showed that the two varieties were significantly different in growth and yield parameters except for leaf area at 8WAT and unit fruit weight. There was a significant difference in the effect of number of times of application of Megagreen® on plant height (at 2WAT), number of leaves at 6 and 8WAT, number of branches (except at 6WAT), leaf area, days to flower, days to maturity, number of flowers (except at 6 and 8WAT), and fruit yield. Three times application of Megagreen® at the rate of 3.0 kg/ha is recommended for fruit yield enhancement in tomato.

Keywords: Megagreen®; Tomato (*Lycopersicon esculentum* Mill); foliar application; indeterminate; determinate; nutrient supplements.

Introduction

Tomato (*Lycopersicon esculentum* Mill) belongs to the family *solanaceae*. It is one of the most important commercial vegetables grown in the tropics and could be grown in green houses and outdoor fields. It is also considered the most widely grown vegetable crop in the world because of its economic impact on the growers and its nutritional quality by way of its richness in vitamins (A and C) and minerals (Villareal, 1980).

One of the reasons for the increased production worldwide is the fact that the knowledge of improved management, and an ever increasing economic importance of the crop, has resulted in tomato cultivation now being extended to places and seasons that are ordinarily unsuitable for its productivity (Bodunde et. al. 1993).

In West Africa, tomato is used as a condiment for stew, which is a regular feature of African meal. It is an essential vegetable staple in Nigeria both for fresh fruit market and processed food industries (Rick, 1956; Grubben *et al*, 1977; Akinsanya, 2002).

The tomato is classified as a functional food, for having good levels of vitamins, minerals, and especially lycopene, a carotenoid pigment that provides red color and has antioxidant qualities (Alvarenga, M.A.R. 2004). The quality of the tomato is affected by genetic foundation, developing conditions, used inputs, and aging during postharvest storage. The quality of a vegetable can be characterized by features such as appearance, texture, safety, flavour and nutritional value. The appearance is the main characteristic because it defines the product commercialization value (Rocha *et al.,* 2013).

To maximize its productivity, tomato seedlings require a light, well-drained, fertile and organic matter rich soil that may be sandy or loamy with a pH range of 5-7, moderate temperature (15-19^{o}C) are ideal for optimum growth and yield (Rick, 1956; Villareal, 1980).

The demand of crop for potassium, phosphorus and nitrogen are high and fertilizers containing these nutrients should be applied to the soil before planting, the amount of nitrogen being somewhat less than that of either phosphorous or potassium (Tindall, 1983). Use of fertilizer is reported to be responsible for over 50% yield increase in crops (Ayodele, 1993). In the savanna zone, Nitrogen is the most limiting nutrients while in the forest zone, phosphorous is the limiting nutrient (Sobulo et al., 1975; Simon and Sobulo 1975). Specifically iron, zinc and boron deficiencies in soils affect tomato crop. Adequate nitrogen is required by tomato for growth and high yield, but supra-optimal nitrogen application leads to excessive vegetative growth and a delayed maturity (Wilcox, 1962 and Adams et al. 1973).

Recent research has revealed that a low calcium level in the root is rarely a limiting factor for the vegetative growth of tomato (del Amor and Marcelis 2006). Nevertheless, the calcium nutrition of tomato demands special attention because this nutrients is intimately involved in the occurrence of the physiological disorder, bottom and end rot (BER), which may considerably reduce fruit quality and market acceptability (Ho et al. 1993; Grattan and Grieve 1999). BER is caused by a local deficiency of Ca in the distal part of the fruit, which results in a disruption of tissue structure in that area (Adams 2002).

Megagreen®

Megagreen® is an activated Calcite of a worldwide unique granularity. It is an ecological foil fertilizer with a strong impact on plant resistance. Megagreen®

improves the fertility and health of plants resulting in an improvement of yield and plant quality.

Megagreen® is a purely mineral, non-toxic and non-polluting agent. It consists of activated calcite micro particles ranging from 0.1 to 0.2um in size allowing them to permeate directly into the leaf. Due to the continuous process of disintegration of calcite, the atmosphere inside the leaf is enriched with carbon dioxide replicating the conditions of a CO2 enriched greenhouse. Furthermore, an improved resistance against fungal diseases and certain varmints was observed. Due to the increased calcium level, better organoleptic qualities of fruits and vegetables as well as prolonged storage periods were noted. Megagreen® is often applied in solution (as a foliar application). The principal constituents of Megagreen® are given as shown in table 1.

Table 1: Elemental composition of megagreen®

CONSTITUENT	*QUANTITY*
$CaCO_3$ (Calcium carbonate)	95%
SiO_2 (Siliceous dioxide)	2%
MgO (Magnesium oxide)	1.5%
Fe (Iron)	8783 mg/kg
Mn (Manganese)	156 mg/kg
Selenium	0.24 mg/kg

Source: Gmbh(2004). www. Megamin-gmbh.de, e-mail: info@megamin-gmbh.de.

Materials and methods

The experiment was carried out at the Research and Teaching Farm of the Federal University of Agriculture, Abeokuta, Ogun state, Nigeria (Longitude $30^0$25'E, Latitude $70^0$25' N). Two varieties of tomato, one indeterminate (Ibadan local) and the other determinate (UC 82-B) were used. The two tomato varieties were raised in the screen house of the department of Horticulture, University of Agriculture, Abeokuta, Ogun State, Nigeria for the period of four weeks. The land was cleared, ploughed and harrowed. Beds for planting were manually

prepared on the field. The experiment was laid out in a with split plot design and treatments were replicated three times, tomato varieties: Ibadan Local, and UC 82-B was allotted to the main plot while number of times of application of Megagreen®: 2, 3 and 4 times application and control were the sub plot treatments. Transplanting was done to the field when seedlings were four weeks old, at a spacing of 0.5m by 0.5m intra and inter row, plot size was 2.0m by 3.0m. Foliar spraying of Megagreen® solution commenced two weeks after transplanting at the recommended rate of 3.0 kg/ha (Shobo *et al*, 2016) using a Knapsack sprayer after calibration.

Calibration procedure

- Determine the quantity of water the knapsack will discharge in one minute.
- Assume that each plant will use that quantity of water
- Measure the plant swort i.e. the plant canopy width
- Calculate the quantity of water that will be required for 1 hectare ($10000m^2$)
- Determine the quantity of water required by a plot and multiply by the number of plots for each rate.

Basal fertilizer application was done using NPK 15-15-15 at the rate of 150 kg/ha at one week after transplanting. Top-dressing followed using NPK 15-15-15 at the rate of 150kg/ha at four weeks after transplanting to the field. Weeding was done manually as the need arose. Five out of the total of 12 plants per plot were tagged for observations in each plot. Data collection started two weeks after transplanting. Stand count per plot was taken at the commencement of harvest to aid in estimating the yield per plant.

Soil sample was taken from the experimental site before planting for laboratory analysis and the result is as shown on table 2.

Table 2: Pre-planting soil analysis of the experimental site.

Parameters	*Value*
K	4.62mg/kg
Na	5.21mg/kg
P^H	5.58
Total Phosphate	4.3ppm
Total Nitrogen	3.64mg/kg
Organic matter	10.43%
Organic Carbon	5.99%
Exchangeable anion	0.2mg/kg
Sand	90%
Clay	7%

Silt	3%

Results and discussion

Application of Megagreen® could increase tomato plant height although not significantly, the two tomato varieties responded differently to Megagreen® application which can be attributed to the genetic differences of the two varieties. The number of times of Megagreen® application appears to have influenced the plant height as reflected in taller plants in three times application of Megagreen®, this suggests that Megagreen® application at up to three times will influence the height of tomato plants for both determinate and indeterminate varieties. The positive effect of Megagreen® on tomato plant height suggests that Megagreen® has constituents that can affect this parameters. It is evident from results obtained that application of Megagreen® will significantly increase the number of leaves of tomato plant. Just as in plant height, the two tomato varieties responded differently in the production of leaves and this is equally attributable to inherent differences in the varieties. With the observation that the number of times of Megagreen® application influenced leaf production in tomato, higher number of leaves were produced where Megagreen® was applied four times and where it was applied at the rate of 3.0kg/ha. This suggests that Megagreen® application up to four times at the rate of 3.0kg/ha will influence the number of leaves on tomato plants for both determinate and indeterminate varieties. Thus, Megagreen® application at an appropriate rate may result in a more efficient and higher photosynthesis for dry matter production in tomato.

Just like the other two vegetative parameters, the two tomato varieties responded differently in their number of branches as influenced by Megagreen® application. This confirms the inherent differences between the two varieties in vegetative growth.

The observed higher leaf area of the indeterminate variety shows that it could be more efficient in photosynthesis. Response of leaf area to Megagreen® application at the peak of the vegetative growth (8WAT) indicates that three times application, would be enough for a high leaf area value.

Almost following the superiority observed in the vegetative traits of the indeterminate variety, it also attained first and 50% flowering as well as maturity earlier than the determinate variety. The results obtained in this study indicate that Megagreen® could induce earliness to flower in tomato. For this purpose it however has to be applied more than once as only Megagreen® applied three times was able to induce earliness to first and 50% flowering.

Megagreen® influence on number of flowers made it to be important in the overall yield production. Ibadan Local had a high fruit yield, this is probably due to the earliness in flowering and maturity observed in Ibadan Local. Megagreen® application could also have a negative effect when applied beyond three times as Megagreen® applied four times could cause a delay in flowering and maturity, consequently reduce the total fruit yield but application made three times would favor higher fruit yield. Megagreen® applied three times at the rate of 3.0kg/ha would be required for enhanced fruit yield.

Conclusion

Application of Megagreen® affected the two tomato varieties differently in terms of vegetative characters, yield and yield characters. For all the vegetative parameters, Ibadan Local responded better than UC 82-B except for the number of branches at 2WAT and the leaf area at 8WAT. Ibadan Local responded better to Megagreen® application than UC 82-B in terms of total fruit yield, Ibadan Local attained days to first flowering, days to maturity and Days to 50% flowering earlier than UC 82-B and therefore had a higher fruit yield. For Both varieties, fruit yield was highest when Megagreen® was applied at the rate of 3.0kg/ha and when it was applied 3 times. For high fruit yield, megagreen® applied 3 times at the rate of 3.0kg/ha is recommended.

Table 3: Plant Height of tomato at 2 – 8 weeks after transplanting as influenced by variety, number and rates of Megagreen application.

Table 3: Plant Height of tomato at 2 – 8 weeks after transplanting as influenced by variety, number and rates of Megagreen application.

	2 WAT	**4 WAT**	**6 WAT**	**8 WAT**
Variety				
Ibadan Local	16.4	24.76	51.37	74.67
UC82B	13.39	19.67	34.63	52.96
LSD (0.05)	1.87	3.24	7.15	7.27
Number of Application				
2 times	14.52	21.08	42.94	64.16
3 times	14.30	21.23	44.04	64.42
4 times	16.35	23 62	42.01	62.88
LSD (0.05)	1.47	NS	NS	NS

Table 4: Number of leaves of tomato at 2 – 8 weeks after transplanting as influenced by variety, number and rates of Megagreen application.

	2 WAT	**4 WAT**	**6 WAT**	**8 WAT**
Variety				
Ibadan Local	4.20	9.59	34.65	62.56
UC82B	3.39	5.23	10.68	27.56
LSD (0.05)	0.50	2.01	6.25	8.79
Number of Application				
2 times	3.86	7.53	21.62	45.96
3 times	3.54	5.98	21.83	45.67
4 times	3.98	8.72	24.50	43.54
LSD (0.05)	0.39	1.75	NS	NS

Table 5: Number of branches of tomato at 2 – 8 weeks after transplanting as influenced by variety, number and rates of Megagreen application.

	2 WAT	4 WAT	6 WAT	8 WAT
Variety				
Ibadan Local	0.42	2.49	6.07	8.33
UC82B	0.23	0.47	2.08	3.83
LSD (0.05)	0.20	0.76	1.11	1.17
Number of Application				
2 times	0.31	1.70	3.70	5.65
3 times	0.04	0.95	3.77	5.79
4 times	0.31	1.80	4.75	6.81
LSD (0.05)	0.19	0.71	NS	NS

Table 6: Number of days to first and 50% flowering, maturity and fruit (t/ha) as influenced by variety and number of Megagreen application.

	Days to 1st flower	Days to 50% flower	Days to Maturity	Fruit Yield (t/ha)
Variety				
Ibadan Local	38.39	42.17	63.36	17.39
UC82B	42.00	46.06	80.81	5.28
LSD (0.05)	2.60	2.23	5.58	4.34
Number of Application				
2 times	41.04	43.83	68.50	11.69
3 times	39.08	42.79	69.88	13.84
4 times	40.46	45.71	77.88	8.44
LSD (0.05)	NS	1.93	5.54	4.42

Table 7: effect of Variety x number of application on number of days to 50% flowering and maturity in two tomato varieties

Variety	Number of Application	Days to 50% flowering	Days to Maturity
Ibadan Local	2 times	43.25	62.00
	3 times	41.08	64.33
	4 times	42.17	63.75
	Control	43.89	71.00
UC 82-B	2 times	44.42	75.00
	3 times	44.50	75.00
	4 times	49.25	92.00
	Control	48.22	93.00
LSD (0.05)		2.40	2.40

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